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10 CFR 50.12
10 CFR 50.54(w)(1)

TM-19-113

November 25, 2019

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket Nos. 50-289

Subject: Request for Exemption from 10 CFR 50.54(w)(1), Concerning On-Site Property Damage Insurance

Reference:
1) Letter from J. Bradley Fewell (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, *"Certification of Permanent Cessation of Power Operations for Three Mile Island Nuclear Station, Unit 1,"* dated June 20, 2017 (Accession No. ML17171A151)

2) Letter from Michael P. Gallagher (Exelon Generation Company, LLC), *"Certification of Permanent Removal of Fuel from the Reactor Vessel for Three Mile Island Nuclear Station, Unit 1,"* dated September 26, 2019 (Accession No. ML19269E480)

Pursuant to 10 CFR 50.12, "Specific exemptions," Exelon Generation Company, LLC (Exelon) requests a permanent exemption from 10 CFR 50.54(w)(1) for Three Mile Island Nuclear Station, Unit 1 (TMI-1). 10 CFR 50.54(w)(1) requires individual power reactor licensees to obtain insurance coverage from private sources to provide protection covering the licensee's obligation, in the unlikely event of an accident, to stabilize and decontaminate the reactor and the reactor site. Specifically, licensees must obtain insurance having a minimum coverage limit for each reactor station site of either $1.06 billion or whatever amount of insurance is generally available from private sources, whichever is less. This insurance coverage is referred to as "onsite coverage" or "onsite insurance coverage."

Exelon is requesting an exemption to 10 CFR 50.54(w)(1) to reduce the minimum coverage limit of 10 CFR 50.54(w)(1) to $50 million for TMI-1. The exemption request is provided in the attachment to this letter.

In Reference 1, Exelon provided formal notification in accordance with 10 CFR 50.82(a)(1)(i) to the NRC, that Exelon had determined to permanently cease operations at TMI-1 on or about

about September 30, 2019. On September 20, 2019 the TMI-1 reactor was permanently shut down and as of September 26, 2019, all fuel has been permanently removed from the reactor vessel and placed in the spent fuel pool (SFP). In Reference 2, Exelon provided formal notification in accordance with 10 CFR 50.82(a)(1)(ii) certifying all fuel has been permanently removed from the TMI-1 reactor vessel and placed in the SFP. As stated in 10 CFR 50.82(a)(2), upon docketing the certifications for permanent cessation of operations and permanent removal of fuel from the reactor vessel, the 10 CFR Part 50 license for TMI-1 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.

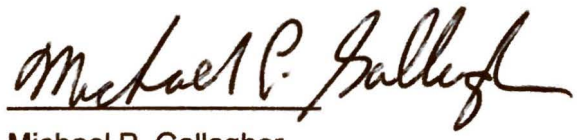
The underlying purpose of 10 CFR 50.54(w)(1) is to require property damage insurance to ensure adequate funding of onsite post-accident recovery, stabilization and decontamination costs following an accident at an operating nuclear power plant. However, the regulation does not take into consideration the reduced potential for, and consequences of, such nuclear incidents at permanently shutdown facilities. The proposed exemption would allow a reduction in the level of onsite insurance coverage for TMI-1 to a level that is commensurate with the permanently defueled status of the facility and the underlying purpose of the rule.

As discussed in the attachment to this letter, Exelon has determined that at the end of the zirconium fire period, which for TMI-1 is currently evaluated to occur at 488 days after shutdown, there will be sufficient decay of the spent fuel stored in the SFP such that there is a significant reduction in risk from SFP draining events. This reduction in risk supports the basis for the 10 CFR 50.12 "Specific exemptions." Based on the permanent shutdown date, the end of the zirconium fire period will occur January 20, 2021. Therefore, Exelon is requesting approval of this exemption request by November 30, 2020, with an effective date of January 20, 2021 and an implementation date no later than March 31, 2021. The approval date of November 30, 2020 would permit sufficient time to arrange for the reduced onsite liability insurance coverage allowed by the exemption.

This letter contains no new regulatory commitments.

If you have any questions concerning this submittal, please contact Leslie Holden at (630) 657-2524.

Respectfully,



Michael P. Gallagher
Vice President, License Renewal & Decommissioning
Exelon Generation Company, LLC

Attachment: Request for Exemption from 10 CFR 50.54(w)(1), Concerning On-Site Property Damage Insurance

cc: w/Attachments

Regional Administrator – NRC Region I
NRC Project Manager, NRR – Three Mile Island, Unit 1
NRC Project Manager, NMSS/DUWP/RDB – Three Mile Island, Unit 2
Director, Bureau of Radiation Protection – PA Department of Environmental Resources

Attachment

Request for Exemption from 10 CFR 50.54(w)(1)

Concerning Onsite Property Insurance

1.0 SPECIFIC EXEMPTION REQUEST

Pursuant to 10 CFR 50.12, "Specific exemptions," Exelon Generation Company, LLC (Exelon) requests a permanent exemption from 10 CFR 50.54(w)(1) for Three Mile Island Nuclear Station, Unit 1 (TMI-1). 10 CFR 50.54(w)(1) requires individual power reactor licensees to obtain insurance coverage from private sources to provide protection covering the licensee's obligation, in the unlikely event of an accident, to stabilize and decontaminate the reactor and the reactor site. Specifically, licensees must obtain insurance having a minimum coverage limit for each reactor station site of either $1.06 billion or whatever amount of insurance is generally available from private sources, whichever is less. This insurance coverage is referred to as "onsite coverage" or "onsite insurance coverage."

10 CFR 50.54(w)(1) reads as follows:

> *"(w) Each power reactor licensee under this part for a production or utilization facility of the type described in §§ 50.21(b) or 50.22 shall take reasonable steps to obtain insurance available at reasonable costs and on reasonable terms from private sources or to demonstrate to the satisfaction of the NRC that it possesses an equivalent amount of protection covering the licensee's obligation, in the event of an accident at the licensee's reactor, to stabilize and decontaminate the reactor and the reactor station site at which the reactor experiencing the accident is located, provided that:*
>
> > *(1) The insurance required by paragraph (w) of this section must have a minimum coverage limit for each reactor station site of either $1.06 billion or whatever amount of insurance is generally available from private sources, whichever is less. The required insurance must clearly state that, as and to the extent provided in paragraph (w)(4) of this section, any proceeds must be payable first for stabilization of the reactor and next for decontamination of the reactor and the reactor station site. If a licensee's coverage falls below the required minimum, the licensee shall within 60 days take all reasonable steps to restore its coverage to the required minimum. The required insurance may, at the option of the licensee, be included within policies that also provide coverage for other risks, including, but not limited to, the risk of direct physical damage."*

Exemption from 10 CFR 50.54(w)(1) is requested in order to allow reduced onsite liability minimum insurance coverage to $50 million for TMI-1 which is commensurate with the significantly reduced risks associated with the permanently defueled condition.

2.0 BACKGROUND

TMI Station is located in an area of low population density about 12 miles southeast of Harrisburg, Pennsylvania. The area is in Londonderry Township, Dauphin County, about 2.5 miles from the southern tip of Dauphin County, where the county is coterminous with York and Lancaster Counties. The TMI site is part of an 814-acre tract consisting of TMI and several adjacent islands, which were purchased by a predecessor. The island, which is situated about 900 feet from the east bank and approximately one mile from the west bank of the Susquehanna River, is elongated parallel to the flow of the river with its longest axis oriented approximately due north and south. The north and south ends of the island have access bridges, which connect the island to State Highway Route 441. The north access bridge is used daily. Route 441 is a two-lane highway, which runs parallel to TMI on the east bank of the Susquehanna River and is more than 2,000 feet from the TMI reactors at the closest point.

In Reference 9.1, Exelon provided formal notification in accordance with 10 CFR 50.82(a)(1)(i) to the NRC, that Exelon had determined to permanently cease operations at TMI-1 on or about September 30, 2019. On September 20, 2019 TMI was permanently shutdown and in Reference 9.2, Exelon provided formal notification in accordance with 10 CFR 50.82(a)(1)(ii), and certified that as of September 26, 2019, all fuel had been permanently removed from the TMI-1 reactor vessel and placed in the spent fuel pool (SFP). As stated in 10 CFR 50.82(a)(2), upon docketing the certifications for permanent cessation of operations and permanent removal of fuel from the reactor vessel, the 10 CFR Part 50 license for TMI-1 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.

3.0 BASIS FOR EXEMPTION REQUEST

The underlying purpose of 10 CFR 50.54(w)(1) is to require sufficient property damage insurance to ensure adequate funding of onsite post-accident recovery, stabilization and decontamination costs following an accident at an operating nuclear power plant. The requirements of 10 CFR 50.54(w)(1) were developed taking into consideration the risks associated with an operating nuclear power reactor, including the potential consequences of a release of radioactive material from the reactor. The onsite insurance coverage must be either $1.06 billion or whatever amount of insurance is generally available from private sources (whichever is less).

This regulation does not take into consideration the reduced potential for, and consequences of, such nuclear incidents at permanently shutdown facilities. The proposed exemption would allow a reduction in the level of onsite liability insurance coverage to a level that is commensurate with the permanently shutdown and defueled status of TMI-1 and the underlying purpose of the rule.

Although the likelihood of an accident at an operating reactor is small, the consequences can be large, in part due to the high temperatures and pressures of the reactor coolant system as well as the inventory of radionuclides. For a permanently shutdown and defueled reactor, nuclear accidents involving the reactor and its associated systems, structures and components are no longer possible. Furthermore, reductions in the probability and consequences of non-operating reactor nuclear incidents are substantially reduced because: 1) the decay heat from the spent fuel decreases over time, which reduces the amount of cooling required to prevent the spent fuel from heating up to a temperature that could compromise the ability of the fuel cladding to retain fission products, and; 2) the relatively short-lived radionuclides contained in the spent fuel, particularly volatile components like iodine and noble gasses, decay away, thus reducing the inventory of radioactive materials available for release.

Although the potential for, and consequences of, nuclear accidents decline substantially after a plant permanently defuels its reactor, they are not completely eliminated. There are potential onsite and offsite radiological consequences that could be associated with the onsite storage of the spent fuel in the SFP. In addition, a site with a permanently shutdown and defueled reactor may contain an inventory of radioactive liquids, activated reactor components, and contaminated materials. For purposes of modifying the amount of onsite liability insurance coverage maintained by a permanently shutdown and defueled reactor licensee, the potential radiological consequences of these non-operating reactor nuclear incidents are appropriate to consider, despite their very low probability of occurrence.

In SECY-96-256, "Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors, 10 CFR 50.54(w)(1) and 10 CFR 140.11" (Reference 9.3), the NRC staff generically evaluated the legal, technical, and policy issues regarding the financial protection requirements for large nuclear power plants that have been permanently shut down and

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. The NRC Commission approved the NRC staff's recommended course of action in Staff Requirements Memorandum to SECY-96-256, "Re: SECY-96-256, Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors" (Reference 9.4).

In SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning" (Reference 9.5) and SECY-01-0100, "Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools" (Reference 9.6), the NRC staff discussed additional information concerning SFP zirconium fire risks at decommissioning reactors and associated implications for onsite property damage insurance. Analyzing when the spent fuel stored in the SFP is capable of adequate air-cooling is one measure that demonstrates when the probability of a zirconium fire would be exceedingly low. The NRC discussed in SECY-00-0145 that "full insurance coverage must be maintained for 5 years or until a licensee can show by analysis that its SFP is no longer vulnerable to such [a zirconium] fire."

4.0 TECHNICAL EVALUATION

The most severe postulated accidents for nuclear power plants involve damage to the nuclear reactor core and the release of large quantities of fission products to the reactor coolant system. Many of the accident scenarios postulated during operation involve failures or malfunctions of systems which could affect the reactor core. However, based on the notifications of permanent cessation of power operations and permanent removal of fuel for TMI-1 (References 9.1 and 9.2, respectively), TMI-1 is no longer authorized to operate the reactor or to place or retain fuel in the reactor vessel in accordance with 10 CFR 50.82(a)(2), most of the Design Bases Accident (DBA) scenarios postulated during operation are no longer possible. The irradiated fuel will be stored in the SFP and/or the Independent Spent Fuel Storage Installation (ISFSI), when constructed, until it is shipped off site in accordance with the schedules provided in the Post Shutdown Decommissioning Activities Report (PSDAR) (Reference 9.7) and the Spent Fuel Management Plan (Reference 9.8).

With the reactor defueled, the reactor vessel assembly and supporting structures and systems are no longer in operation and have no function related to the safe storage and management of irradiated fuel. Additionally, the SFP and its supporting systems are dedicated solely to spent fuel storage. Fuel pool cooling and makeup capabilities function to remove decay heat from spent fuel stored in the fuel pool and to maintain a specified water temperature and level.

4.1 Accident Analysis Overview

Following the termination of reactor operations at TMI-1 and the permanent removal of the fuel from the reactor vessel, the postulated accidents involving failure or malfunction of the reactor and supporting structures, systems and components are no longer applicable.

TMI-1 "Request for Exemptions from Portions of 10 CFR 50.47 and 10 CFR Part 50, Appendix E," (Reference 9.9) provides information on the disposition of accidents and other incidents of concern.

A summary of the postulated radiological accidents analyzed for the permanently shutdown and defueled condition of TMI-1 is presented below.

4.1.1 Consequences of Design Basis Events

The postulated design basis accident that will remain applicable to TMI-1 in its permanently shut down and defueled condition is the Fuel Handling Accident (FHA) in the Fuel Handling Building where the SFP is located. A Post Permanent Shutdown FHA analysis (Reference 9.10) was performed. This new analysis did not credit the function of any structure, system, or component (SSC) or active mitigation measures. The analysis credits the decontamination of the 23 feet of water over the fuel assemblies in the SFP (i.e., 99.5% (or a Decontamination Factor (DF) of 200) of the iodine released from the fuel assembly is assumed to remain in the water).

The analysis shows that the dose at the EAB 365 days after shutdown (with no credit for containment) is 1.78×10^{-4} rem TEDE and 9.95×10^{-13} rem Thyroid, which are less than the Environmental Protection Agency (EPA) Protective Action Guides (PAGs) of 1 rem Total Effective Dose Equivalent (TEDE) and 5 rem Thyroid thresholds for recommended evacuation (Reference 9.11). Due to the amount of decay assumed (365 days), the results of this analysis may be applied after September 20, 2020, based on the September 20, 2019 shutdown of TMI-1.

4.1.2 Consequences of Beyond Design Basis Events (BDBE)

Hottest Fuel Assembly Adiabatic Heatup

The “DECOM Spent Fuel Pool Thermohydraulic Analysis” analysis (Reference 9.12), provided with Reference 9.9, compares the conditions for the hottest fuel assembly stored in the TMI-1 fuel pools to the criteria proposed in SECY-99-168 "Improving Decommissioning Regulations for Nuclear Power Plants" (Reference 9.13), 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 (°C) to 900°C adiabatically. If the heat up time is greater than 10 hours, then offsite emergency preplanning involving the plant is not necessary. This is generally referred to as the end of the zirconium fire period.

Based on the limiting fuel assembly for decay heat and adiabatic heatup analysis (Reference 9.12), the end of the zirconium fire period for TMI-1 will occur at 488 days after permanent cessation of power operations (488 days of decay). At that point 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" (Reference 9.14), 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 availability of 10 hours to evacuate) if fuel and cladding oxidation occurs in air.

Because of the length of time it would take for the adiabatic heatup to occur, there is ample time to respond (≥10 hours) to any drain down event that might cause such an occurrence by restoring cooling or makeup, or providing spray. As a result, the likelihood that such a scenario would progress to a zirconium fire is not deemed credible.

Air Cooling Analysis

As discussed above, the NRC has generically evaluated the legal, technical, and policy issues regarding the financial protection requirements for large nuclear power plants in SECY-96-0256 (Reference 9.3), SECY-00-0145 (Reference 9.5), and SECY-01-0100 (Reference 9.6), and the Commission has supported and approved a policy that authorized, through the exemption process, a reduction in onsite insurance coverage to $50 million, when a licensee is able to

demonstrate that the spent fuel could be air-cooled if the SFP was drained of water. The staff has used this technical criterion of air coolability to grant similar exemptions to other decommissioning reactors (see Section 6.0 of this attachment).

NUREG/CR-6451 (Reference 9.15) presents the results of spent fuel heat-up analyses for representative pressurized water reactor (PWR) and boiling water reactor (BWR) plants. The NUREG provides justification for receiving an exemption based on the representative plants. Exelon performed an evaluation to disposition select differences between TMI-1 and the representative PWR plant assessed in NUREG/CR-6451. The differences assessed are summarized below.

Exelon compiled data in Table 4.1-1 and Table 4.1-2 comparing the input parameters to the representative PWR plant in NUREG/CR-6451 to the corresponding data for TMI-1. NUREG/CR-6451 determines a “critical decay time” which is the time beyond which fuel will not fail in the event that the SFP is drained. NUREG/CR-6451 (at §3.1.3) provides justification for receiving an exemption at approximately 17-months (519 days) after shutdown for PWRs, this is a slightly longer decay time than the zirconium fire period of 488 days which TMI-1 is basing the request for exemption on. In order to evaluate if TMI-1 was conservative with respect to the shorter decay period, Exelon examined the decay heat at TMI-1 and determined that the average fuel assembly decay heat for the most recently offloaded TMI-1 spent fuel 488 days after shutdown will be ~3% less than the decay heat for the average fuel assembly at 519 days for the representative PWR plant in NUREG/CR-6451. This was determined based on Branch Technical Position ASB 9-2 methodology (Reference 9.16) and that the power per fuel assembly at TMI-1 is 16% less than that modeled in NUREG/CR-6451.

A comparison of the parameters for the fuel assembly power, power density, and hydraulic resistance of the 15x15 fuel assemblies at TMI-1 indicated that these parameters are less than those of the 17x17 fuel assemblies modeled in NUREG/CR-6451. Therefore, the NUREG/CR-6451 fuel assembly model is conservative for TMI-1.

The SFP rack configuration was also evaluated and found to be conservative for TMI-1. The configuration / hydraulic resistance of the TMI-1 downcomers and plenum underneath the SFP storage racks is bounded by that modeled in NUREG/CR-6451. Additionally, the hydraulic resistance of the SFP rack loaded cells is less than that of the SFP rack configuration modeled in NUREG/CR-6451 despite TMI-1 having a smaller cell pitch than modeled in the NUREG. This is due to TMI-1 having a larger gap around the fuel assemblies inside the cells due to the individual cells being larger than those in NUREG/CR-6451 and the fuel assemblies having less hydraulic resistance. The bottom orifices on all TMI-1 SFP racks are equal to or larger than those modeled in NUREG/CR-6451. SFP rack materials of construction have minimal impact on results. This is based on Table 3.1 of NUREG/CR-6441 (Reference 9.17) which states that heat conduction in structures (which is what the thermal properties are primarily used for) is of low relative importance when computing clad temperatures. Therefore, differences between TMI-1 and the NUREG/CR-6451 rack materials were considered not germane.

As a result of the comparison Exelon concludes that the TMI-1 SFP conditions are bounded by the NUGREG/CR-6451 benchmark and that the TMI-1 spent fuel would be air coolable at 488-days after permanent shutdown.

Table 4.1-1: Fuel Assembly Decay Heat Parameters

Parameter	NUREG/CR-6451	TMI-1
Plant Data		
Power	1130 MWe (§3.1.1) ~3330 MWt *(Note 1)*	2568 MWt
Assemblies	193 (§3.1.1)	177
MWt/Assembly	17.25 [≈ 3330/193]	14.5
Fuel		
Design	17x17 (p. 3-5)	15x15
Burnup	60 GWd/MTU (§3.1.1)	60 GWd/MTU
Decay Time	~17 months (§3.1.3) (519 days) *(Note 2)*	488 days for most recent offload
Cladding Oxidation Temperature Limit	565°C (§3.1.3)	565°C
MTU/Fuel Assembly	0.461 *(Note 3)*	0.490
Operating Time *(Note 4)*	1604.5 days	2026.4 days
Fuel Assembly Transverse Dimension	8.426" *(Note 5)*	8.382"
Rod Center-to-Center Pitch	0.496" *(Note 3)*	0.568"
Rod Outside Diameter	0.374" *(Note 3)*	0.430"
Spacer Grids per Fuel Assembly	8 *(Note 6)*	8
Active Fuel Height	144" *(Note 3)*	143"
Overall Fuel Rod Length	168" *(Note 6)* (active + inactive length)	154.075"
Fuel Rods per Fuel Assembly	289 *(Note 6)*	208
Guide Tubes per Fuel Assembly	Guide and Instrument Tubes not modeled in NUREG/CR-6441 or NUREG/CR-6451	16
Guide Tube Outside Diameter		0.530"
Instrument Tubes per Fuel Assembly		1
Instrument Tube Outside Diameter		0.493"
Active Volume *(Note 7)*	10,223.6 in^3 (0.1675 m^3)	10,046.9 in^3 (0.1646 m^3)
Power Density *(Note 8)*	103 MWt/m^3	86.5 MWt/m^3

Notes:

1) The thermal power of the representative PWR in NUREG/CR-6451 is not provided; therefore, an approximate value based on 34% thermal efficiency is used. This approach and value have been tacitly accepted as evidenced by the NRC referring Fort Calhoun (Reference 9.18) to the Kewaunee analysis (Reference 9.19) that developed/used a thermal power of 3330 MWt.

2) The number of days is computed as 17/12*366 days since a longer decay period results in less decay heat and is more conservative for comparing to TMI-1 with a shorter decay period.

3) Refer to Table 2.2 of NUREG/CR-6441 (Reference 9.17).

4) Operating time (t_o) is computed using the burnup (GWd/MWt), plant thermal power (MWt), number of in the core fuel assemblies (n_{FA}), and uranium mass per fuel assembly (MTU/FA).

$$t_o = \frac{GWd}{MTU} * \frac{MTU}{FA} * \frac{n_{FA}}{MWt} * \frac{1000\ MW}{1\ GW}$$

5) The PWR example in NUREG/CR-6441 utilizes a 17x17 fuel assembly from a 193-fuel assembly core with a uranium mass of 0.461 MTU. Table 2.2 of ORNL/TM-9591 (Reference 9.20) and Table 5.3 of ORNL/TM-11018 (Reference 9.21) indicates that this is the uranium mass for a standard Westinghouse 17x17 fuel assembly. Therefore, this dimension is based on a standard Westinghouse 17x17 fuel assembly from Table 2.2 of ORNL/TM-9591 (Reference 9.20).

6) Refer to Table A.3 of NUREG/CR-6441 (Reference 9.17).

7) Active Volume = Active Fuel Height * (Fuel Assembly Transverse Dimension)^2

8) Power Density = (MWt/Fuel Assembly) / Active Volume

Table 4.1-2: Spent Fuel Rack Parameters

Parameter	NUREG/ CR-6451	TMI-1 *(Note 1)*			
		SFP A-I	SFP A-IIB	SFP A-IIM	SFP B
Design *(Note 2)*	HD	HD	HD	HD	Water Gap
Material *(Note 2)*	SS	SS	SS	SS	SS
Pitch *(Note 3)*	10.40”	11.07”	9.216” *(Note 4)*	9.216” *(Note 4)*	13.625”
Bottom Orifice	5” dia.	5” dia.	5” dia.	5” dia.	5.13”x9.25” (7.8” dia.) *(Note 5)*
Opening per Cell *(Note 6)*	8.75”x8.75”	9”x9”	9”x9”	9”x9”	9.12”x9.12”
Cell Wall Thickness	0.185”	0.187”	0.216”	0.216”	0.187”
Neutron Absorber	Not mentioned	Boral	Boral	Metamic	None
Downcomer Width	3”	1-15/16” minimum (~14 linear ft), majority > 4”			> 6”
Plenum Height Under Racks	6”	6.25” *(Note 7)*	6.25” *(Note 7)*	6.25” *(Note 7)*	9.5”
SFP Perimeter	119 ft *(Note 8)*	175 ft			115 ft
Downcomer Area	29.75 ft^2 (2.764 m^2)	> 58.3 ft^2 *(Note 9)*			> 57.5 ft^2 *(Note 9)*
Fuel Assemblies in SFP	1460	1293			372

Notes:

1) TMI-1 has two spent fuel pools; SFP A and SFP B. SFP A has two regions (Region I and Region II). Region II has two different fuel rack absorber material; Boral and Metamic. SFP A-I refers to SFP A Region I, SFP A-IIB refers to SFP A Region II with Boral racks, and SFP A-IIM refers to SFP A Region II with Metamic racks.
2) Abbreviations: HD = high density; SS = stainless steel
3) Pitch = center to center distance from cell to cell
4) This pitch implies a shared wall with the adjacent cell.
5) Equivalent diameter = $2 * (L * W / \pi)^{1/2}$ consistent with Attachment A to Reference 9.19. See Table 4.1-1, Note 1.
6) These represent inner dimension values since SFP rack cells are typically square.
7) The SFP A plenum height is the nominal leg height (4.75”) plus the bearing pad height (1.5”).
8) The SFP perimeter is the border cross sectional area divided by the border thickness (p. A-11 of NUREG/CR-6441 (Reference 9.17)); i.e. perimeter = 2.764 m^2 / 0.0762 m * 3.2808 ft/m.
9) Downcomer area is based on the downcomer width and SFP perimeter.

Fuel Pool Drain Down Event

TMI-1 analyzed a drain down event of the SFP to determine a dose rate curve at the EAB and Control Room. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," Supplement 1 (Reference 9.22), Section 4.3.9, identifies that a SFP drain down event is a beyond design basis event. Although the analysis described in the section above, demonstrated a significant release of radioactive material from the spent fuel is not possible in the absence of water cooling after 488 days following permanent cessation of power operations, the potential exists for radiation exposure to an offsite individual in the event that shielding of the fuel is lost. The SFP water and the concrete pool structure serve as radiation shielding. A loss of water shielding above the fuel could increase the offsite radiation levels because of the gamma rays streaming up out of the SFP being scattered back to a receptor at the site boundary.

The site-specific offsite and Control Room radiological impacts of a postulated complete loss of SFP water were assessed in Technical Evaluation 623073, "TMI Spent Fuel Pool Draindown Shine Dose Rate Evaluation, Revision 0," (Reference 9.23). With a decay of 365 days from shutdown the dose rate at the EAB would be 4.04×10^{-1} mrem/hour not crediting the shielding from the Fuel Handling Building (FHB) roof. Crediting the FHB roof structure, the dose rate at the EAB would be 4.6×10^{-10} mrem/hour.

The EPA PAGs were developed to respond to a mobile airborne plume that could transport and deposit radioactive material over a large area. In contrast, the radiation field formed by gamma scatter from a drained SFP would be stationary rather than moving and would not cause transport or deposition of radioactive materials. The extended period required to exceed the EPA PAG limit of 1 Rem TEDE would allow sufficient time to develop and implement onsite mitigative actions and provide confidence that additional offsite measures could be taken without planning if efforts to reestablish shielding over the fuel are delayed.

Additionally, the Control Room radiological impacts of a postulated complete loss of SFP water at 365 days after shutdown determined that the gamma radiation dose rate in the Control Room would be below 0.1 mrem/hour.

4.2 Conclusion

The Hottest Fuel Assembly Adiabatic Heatup analysis supports that 488 days from permanent shutdown in the event of a SFP drain down event there would be sufficient time (≥10 hours) to take mitigative actions in response to events that could lead to a zirconium fire. In addition, the TMI-1 SFP conditions were determined to be bounded by the analysis of NUREG/CR-6451 benchmark demonstrating that the SFP would be air coolable at 488 days after permanent shutdown.

Regarding the dose assessments, as described above, with a decay time of 365 days from permanent shutdown, the dose for the FHA or the BDBE SFP drain down event would be below regulatory limits. The 365-day threshold is conservative with respect to the requested effective date of 488 days after permanent shutdown.

Because TMI-1 was permanently shut down on September 20, 2019, the end of the zirconium fire period will occur on January 20, 2021. The requested approval date of November 30, 2020 will enable Exelon adequate time before January 20, 2021, to arrange for the reduced insurance coverage allowed by the exemption.

5.0 JUSTIFICATION FOR EXEMPTIONS AND SPECIAL CIRCUMSTANCES

10 CFR 50.12 states that the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of the regulations of Part 50 which are authorized by law and are otherwise in the public interest. As discussed below, this exemption request satisfies the provisions of Section 50.12.

5.1 Exemptions

A. The exemption is authorized by law

10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50, as the Commission determines are authorized by law. The proposed reduction in onsite property damage insurance coverage to a level of $50 million is consistent with SECY-96-256 and the exemption would not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. The NRC has granted exemptions granted to other licensees for insurance reductions of the same regulation being requested here by Exelon and have been previously determined to be authorized by law and granted (see Section 6.0 of this attachment).

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 are predicated on the assumption that the reactor is operating. With the TMI-1 reactor permanently shut down and defueled there is 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, 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 TMI-1'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.

5.2 Special Circumstances

Pursuant to 10 CFR 50.12(a)(2), the NRC will not consider granting an exemption to its regulations unless special circumstances are present. Exelon has determined that special circumstances are present because TMI-1 is permanently shut down and defueled, therefore the radiological source term at the site is reduced from that associated with reactor power operation. With the reactor power plant permanently shut down and defueled, the design basis accidents and transients postulated to occur during reactor operation will no longer be possible. In particular, the potential for a release of a large radiological source term to the environment from the high pressures and temperatures associated with reactor operation will no longer exist.

A. Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. (10 CFR 50.12(a)(2)(ii))

The underlying purpose of 10 CFR 50.54(w)(1) is to require sufficient property damage insurance to ensure funding of onsite post-accident recovery stabilization, and decontamination costs following an accident at an operating nuclear power plant. The requirements of 10 CFR 50.54(w)(1) were developed taking into consideration the risks associated with an operating nuclear power reactor, including the potential consequences of a release of radioactive material from the reactor. However, the regulation does not take into consideration the reduced potential for, and consequences of, nuclear incidents at a facility that has been permanently shut down.

The radiological consequences of accidents that will remain possible at TMI-1 in the permanently shutdown and defueled condition are substantially lower than those at an operating plant. Following 365 days after shutdown, it will no longer be possible for the radiological consequences of the design basis accident at TMI-1 to exceed the limits of the EPA PAGs at the EAB.

The proposed reduction in the level of onsite insurance coverage from $1.06 billion to $50 million will continue to serve the underlying purpose of the rule by requiring a level of financial protection commensurate with the significant reduction in the probability and consequences of nuclear incidents at TMI-1. Consistent with the NRC's conclusions documented in SECY-00-145 (Reference 9.5), the proposed reduction in the level of onsite insurance coverage would continue to require sufficient property damage insurance to ensure funding for onsite post-accident recovery, stabilization, and decontamination costs in the unlikely event of an accident at TMI-1.

Therefore, application of the requirement 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 this rule and special circumstances are present as defined in 10 CFR 50.12(a)(2)(ii).

B. 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. (10 CFR 50.12(a)(2)(iii))

Continued application of the requirement to maintain $1.06 billion in onsite insurance coverage for TMI-1 would result in undue hardship and costs being incurred by the TMI-1 decommissioning trust fund for the purchase of unnecessary levels of onsite insurance coverage.

As stated in Section 6.0 of this attachment, other licensees of permanently shutdown power reactors have been granted exemptions by the NRC to the subject regulation in the same or lower insurance amounts being requested by Exelon for TMI-1.

Therefore, compliance with the rule would result in an 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 and the special circumstances required by 10 CFR 50.12(a)(2)(iii) exist.

6.0 PRECEDENT

The exemption request for 10 CFR 50.54(w)(1) is consistent with exemption requests that recently have been issued by the NRC for other nuclear power reactor facilities beginning decommissioning. Specifically, the NRC granted similar exemptions to Exelon Generation

Company, LLC, for Oyster Creek (Reference 9.24); Southern California Edison Company for SONGS, Units 1, 2, and 3 (Reference 9.25); Duke Energy Florida, Inc., for Crystal River Unit 3 (Reference 9.26); Entergy Nuclear Operations, Inc., for Vermont Yankee (Reference 9.27); and Dominion Energy Kewaunee, Inc. for Kewaunee Power Station (Reference 9.28).

TMI-2 was previously granted a similar exemption from the onsite insurance requirements by the NRC based on the significant reduction in risk associated with its permanently shutdown and defueled status. (Reference 9.29)

Similar to the current request, these precedents each resulted in exemptions from the requirements in 10 CFR 50.54(w)(1).

7.0 ENVIRONMENTAL ASSESSMENT

The proposed exemption meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(25), because the proposed exemption involves: (i) no significant hazards consideration; (ii) no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; (iii) no significant increase in individual or cumulative public or occupational radiation exposure; (iv) no significant construction impact; (v) no significant increase in the potential for or consequences from radiological accidents; and (vi) the requirements from which the exemption is sought involve: < … > (H) surety, insurance or indemnity requirements. Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed exemption.

(i) No Significant Hazards Consideration Determination

Exelon has evaluated the proposed exemption to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92 as discussed below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The proposed exemption has no effect on structures, systems, and components (SSCs) and is unrelated to the capability of any plant SSC to perform its design function. The proposed exemption would not increase the likelihood of the malfunction of any plant SSC.

   When the exemption become effective, there will be no credible events that would result in doses to the public beyond the exclusion area boundary (EAB) that would exceed the Environmental Protection Agency (EPA) Protective Action Guides (PAGs). The probability of occurrence of previously evaluated accidents is not increased, since most previously analyzed accidents will no longer be able to occur and the probability and consequences of the remaining Fuel Handling Accident (FHA) are unaffected by the proposed amendment.

   Therefore, the proposed exemption does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Do the proposed exemptions create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

The proposed exemption does not involve a physical alteration of the plant. No new or different type of equipment will be installed and there are no physical modifications to existing equipment associated with the proposed exemption. Similarly, the proposed exemption will not physically change any SSCs involved in the mitigation of any accidents. Thus, no new initiators or precursors of a new or different kind of accident are created. Furthermore, the proposed exemption does not create the possibility of a new accident as a result of new failure modes associated with any equipment or personnel failures. No changes are being made to parameters within which the plant is normally operated, or in the setpoints which initiate protective or mitigative actions, and no new failure modes are being introduced.

Therefore, the proposed exemption does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Do the proposed exemptions involve a significant reduction in a margin of safety?

   Response: No

   The proposed exemption does not alter the design basis or any safety limits for the plant. The proposed exemption does not impact station operation or any plant SSC that is relied upon for accident mitigation.

   Therefore, the proposed exemption does not involve a significant reduction in a margin of safety.

Based on the above, Exelon concludes that the proposed exemption presents no significant hazards consideration, and, accordingly, a finding of "no significant hazards consideration" is justified.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

There are no expected changes in the types, characteristics, or quantities of effluents discharged to the environment associated with the proposed exemption. There are no materials or chemicals introduced into the plant that could affect the characteristics or types of effluents released offsite. In addition, the method of operation of waste processing systems will not be affected by the exemption. The proposed exemption will not result in changes to the design basis requirements of SSCs that function to limit or monitor the release of effluents. All the SSCs associated with limiting the release of effluents will continue to be able to perform their functions. Therefore, the proposed exemption will result in no significant change to 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.

The proposed exemption does not involve any physical alterations to the plant configuration or any changes to the operation of the facility that could lead to a significant increase in individual or cumulative occupational radiation exposure.

(vi) There is no significant construction impact.

No construction activities are associated with the proposed exemption.

(v) There is no significant increase in the potential for or consequences from radiological accidents.

See the no significant hazards considerations discussion in Item (i)(1) above.

(vi) The requirements from which exemption is sought involve: (H) surety, insurance or indemnity requirements.

The requirements from which the exemption is sought involve financial protection and for the indemnification and limitation of liability of licensees pursuant to Section 170 of the Atomic Energy Act of 1954, as amended and 10 CFR 50.54(w)(1).

8.0 CONCLUSION

Pursuant to the provisions of 10 CFR 50.12, Exelon is requesting a permanent exemption from 10 CFR 50.54(w)(1) for TMI-1. Based on the considerations discussed above, the requested 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. In addition, special circumstances are present as set forth in 10 CFR 50.12.

9.0 REFERENCES:

9.1 Letter from J. Bradley Fewell (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, *"Certification of Permanent Cessation of Power Operations for Three Mile Island Nuclear Station, Unit 1,"* dated June 20, 2017 (ADAMS Accession No. ML17171A151)

9.2 Letter from Michael P. Gallagher (Exelon Generation Company, LLC), *"Certification of Permanent Removal of Fuel from the Reactor Vessel for Three Mile Island Nuclear Station, Unit 1,"* dated September 26, 2019 (Accession No. ML19269E480)

9.3 Commission Paper, SECY-96-256, *"Changes to the 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)

9.4 Staff Requirements Memo, *"Re: SECY-96-256, Changes to Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors,"* dated January 28, 1997 (ADAMS Accession No. ML15062A454)

9.5 Commission Paper, SECY-00-0145*, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning,"* dated June 28, 2000 (ADAMS Accession No. ML003721626)

9.6 Commission Paper, SECY-01-0100*, "Policy Issues Related to Safeguards, Insurance, and Emergency Preparedness Regulations at Decommissioning Nuclear Power Plants Storing Fuel in Spent Fuel Pools,"* dated June 4, 2001 (ADAMS Accession No. ML011450420)

9.7 Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission – *"Three Mile Island Nuclear Station, Unit 1 – Post-Shutdown Decommissioning Activities Report,"* dated April 5, 2019 (ADAMS Accession No. ML19095A041)

9.8 Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission – *"Spent Fuel Management Plan for Three Mile Island Nuclear Station – Unit 1,"* dated April 5, 2019 (ADAMS Accession No. ML19095A009)

9.9 Letter from Michael P. Gallagher (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission – *"Request for Exemptions from Portions of 10 CFR 50.47 and 10 CFR 50, Appendix E,"* dated July 1, 2019 (ADAMS Accession No. ML19182A104)

9.10 C-1101-900-E000-088*, "Fuel Handling Accident Dose Consequence – Post Permanent Shutdown,"* Revision 0, dated May 11, 2018

9.11 *"Environmental Protection Agency Protective Action Guides and Planning Guidance for Radiological Incidents, Draft for Interim Use and Public Comment,"* dated March 2013

9.12 C-1101-202-E410-476, *"DECOM Spent Fuel Pool Thermohydraulic Analysis,"* Revision 1, dated March 6, 2018

9.13 Commission Paper, SECY-99-168, *"Improving Decommissioning Regulations for Nuclear Power Plants,"* dated June 30, 1999 (ADAMS Accession No. ML992800087)

9.14 NUREG-1738, *"Technical Study of Spent Fuel Accident Risk at Decommissioning Nuclear Power Plants,"* dated February 2001 (ADAMS Accession No. ML010430066)

9.15 NUREG/CR-6451, *"A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shutdown Nuclear Power Plants,"* dated April 1997 (ADAMS Accession No. ML082260098)

9.16 Branch Technical Position ASB 9-2, *"Residual Decay Energy for Light-Water Reactors for Long-Term Cooling,"* included in NUREG-0800, Revision 2, "Standard Review Plan."

9.17 NUREG/CR-6441 (BNL-NUREG-52494), *"Analysis of Spent Fuel Heatup Following Loss of Water in a Spent Fuel Pool,"* published March 2002 (ADAMS Accession No. ML021050336)

9.18 E-mail capture from J. Kim (USNRC) to E. Matzke (Omaha Public Power District*), "Final RAI for Fort Calhoun Exemption from 10 CFR 50.54(w)(1), On-site Property Damage Insurance (MF9665),"* dated August 24, 2017 (ADAMS Accession No. ML17236A345)

9.19 Evaluation ETE-NAF-20130072, Revision 0, *"Kewaunee Spent Fuel Pool Zirconium Fire Parameter Comparison"* (ADAMS Accession No. ML14029A064)

9.20 ORNL/TM-9591, V1&R1, *"Physical and Decay Characteristics of Commercial LWR Spent Fuel,"* prepared by Oak Ridge National Laboratory, issued January 1986

9.21 ORNL/TM-11018, *"Standard- and Extended-Burnup PWR and BWR Reactor Models for the ORIGEN2 Computer Code,"* prepared by Oak Ridge National Laboratory, published December 1989.

9.22 NUREG-0586, *"Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,"* Supplement 1, published November 2002

9.23 Technical Evaluation 623073, *"TMI Spent Fuel Pool Draindown Shine Dose Rate Evaluation, Revision 0,"* dated May 28, 2018

9.24 Letter from J. G. Lamb (NRC) to B. C. Hanson (Exelon Generation Company, LLC), *"Oyster Creek Nuclear Generating Station – Exemption from the Requirements of 10 CFR 50.54(w)(1), Concerning Onsite Property Damage Insurance (EPID L-2018-LLE-0004),"* dated December 19, 2018 (ADAMS Accession No. ML18228A852)

9.25 *"San Onofre Nuclear Generating Station, Units 1, 2, and 3 – Exemption from the Requirements of Title 10 of the Code of Federal Regulations, Part 50, Section 54(w)(1) Concerning Onsite Property Damage Insurance (CAC Nos. L53097, L53098, and L53099),"* dated December 29, 2017 (ADAMS Accession No. ML17355A023)

9.26 Letter from J. B. Hickman (NRC) to T. D. Hobbs (Crystal River Nuclear Plant), *"Crystal River Unit 3 Nuclear Generating Plant – Exemption from the Requirements of Title 10 of the Code of Federal Regulations, Section 50.54(w)(1) Concerning Insurance for Post-Accident Site Decontamination (TAC No. L53108),"* dated March 16, 2016 (ADAMS Accession No. ML16020A448 & ML16020A463)

9.27 Letter from J. D. Parrott (NRC) to Vice President, Operations (Entergy Nuclear Operations, Inc.), *"Vermont Yankee Nuclear Power Station – Exemption from the Requirements of Title 10 of the Code of Federal Regulations, Part 50, Section 50.54(w)(1), Concerning Insurance for Post-Accident Site Decontamination (CAC No. MF3981),"* dated April 15, 2016 (ADAMS Accession Nos. ML16012A193 & ML16012A197)

9.28 Letter from T. J. Wengert (NRC) to D. A. Heacock (Dominion Energy Kewaunee), *"Kewaunee Power Station – Exemption from the Requirements of Title 10 of the Code of Federal Regulations, Part 50, Section 50.54(w)(1) Concerning Insurance for Post-Accident Site Decontamination (TAC No. MF3915),"* dated April 3, 2015 (ADAMS Accession No. ML15033A245)

9.29 Letter from L. H. Thonus (NRC) to J. W. Lanenbach (GPU Nuclear, Inc.), *"Exemption form Insurance Coverage Limit of 10 CFR 50.54(w) (TAC No. MA5066),"* dated July 21, 1999 (ADAMS Accession No. 9907230242 – Legacy Library)