



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

March 11, 2020

Mr. Bryan C. Hanson  
Senior Vice President  
Exelon Generation Company, LLC  
President and Chief Nuclear Officer  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 – SAFETY EVALUATION  
RE: SPENT FUEL MANAGEMENT PLAN (EPID L-2019-LLL-0013)

Dear Mr. Hanson:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed reviewing the submittal dated April 5, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19095A009), by Exelon Generation Company, LLC (Exelon or the licensee). In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(bb), the licensee provided an update to the spent fuel management plan for Three Mile Island Nuclear Station, Unit 1 (TMI-1).

By letter dated June 20, 2017 (ADAMS Accession No. ML17171A151), Exelon notified the NRC of its “Certification of Permanent Cessation of Power Operations for Three Mile Island Nuclear Station, Unit 1,” to prematurely and permanently cease power operations at TMI-1 on or about September 30, 2019, pursuant to 10 CFR 50.82(a)(1)(i).

By letter dated September 26, 2019 (ADAMS Accession No. ML19269E480), Exelon notified the NRC that TMI-1 had permanently ceased power operations and that the fuel had been permanently removed from the reactor vessel pursuant to 10 CFR 50.82(a)(1)(ii). In accordance with 10 CFR 50.82(a)(2), the license for TMI-1 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.

The enclosed safety evaluation documents the NRC staff’s review of the updated spent fuel management plan for TMI-1.

B. Hanson

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If you have any questions, please contact me at 301-415-2048 or [Justin.Poole@nrc.gov](mailto:Justin.Poole@nrc.gov).

Sincerely,

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Justin C. Poole, Project Manager  
Plant Licensing Branch I  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:  
Safety Evaluation

cc: Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

UPDATE TO SPENT FUEL MANAGEMENT PLAN

EXELON GENERATION COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) staff has completed reviewing the submittal dated April 5, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19095A009), by Exelon Generation Company, LLC (Exelon or the licensee). In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(bb), the licensee provided the spent fuel management plan (SFMP) for Three Mile Island Nuclear Station, Unit 1 (TMI-1).

By letter dated June 20, 2017 (ADAMS Accession No. ML17171A151), Exelon notified the NRC of its "Certification of Permanent Cessation of Power Operations for Three Mile Island Nuclear Station, Unit 1," to prematurely and permanently cease power operations at TMI-1 on or about September 30, 2019, pursuant to 10 CFR 50.82(a)(1)(i).

By letter dated September 26, 2019 (ADAMS Accession No. ML19269E480), Exelon notified the NRC that TMI-1 had permanently ceased power operations and that the fuel had been permanently removed from the reactor vessel pursuant to 10 CFR 50.82(a)(1)(ii). In accordance with 10 CFR 50.82(a)(2), the license for TMI-1 no longer authorizes operation of the reactor or emplacement or retention of fuel into the reactor vessel.

Prior to the NRC issuing the renewed operating license for TMI-1, Exelon submitted an SFMP to the NRC on April 17, 2009 (ADAMS Accession No. ML091130429), to fulfill the 10 CFR 50.54(bb) requirement to submit an SFMP to the NRC 5 years before expiration of the operating license, which was set to expire in 2014. The April 5, 2019, SFMP supersedes and replaces in entirety the SFMP submitted in 2009.

2.0 BACKGROUND

TMI-1 is located approximately 10 miles southeast of Harrisburg, Pennsylvania. The site includes two reactors: TMI-1 and Three Mile Island Nuclear Station, Unit 2 (TMI-2) and encompasses approximately 440 acres. TMI-1 is a single unit pressurized water reactor with a steel-lined, reinforced-concrete containment structure that was licensed to generate 2,568 megawatts-thermal (MWt). TMI-1 received its operating license on April 19, 1974, and renewed its license on October 22, 2009. The principal structures of TMI-1 include the reactor building,

turbine generator building, fuel handling building, the TMI-1 intake pump and greenhouse structure and the TMI-1 FLEX storage facility, two natural draft cooling towers, circulating water pump houses, waste storage and handling buildings, the long-term steam generator storage building, desilting basins, and administrative buildings. Exelon plans to construct an Independent Spent Fuel Storage Installation (ISFSI) for storage of spent fuel from TMI-1.

The decommissioning approach that has been selected by Exelon for TMI-1 is the SAFSTOR method. Under SAFSTOR, often considered “deferred dismantling,” a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, the plant is dismantled and the property decontaminated. In accordance with 10 CFR 50.82(a)(3), decommissioning will be completed within 60 years of permanent cessation of operations.

### 3.0 REGULATORY EVALUATION

#### 3.1 Regulatory Requirement (10 CFR 50.54(bb))

The regulation under 10 CFR 50.54(bb) states, in relevant part:

For nuclear power reactors licensed by the NRC, the licensee shall, within 2 years following permanent cessation of operation of the reactor or 5 years before expiration of the reactor operating license, whichever occurs first, submit written notification to the Commission for its review and preliminary approval of the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository.

##### 3.1.1 Criteria and Information Evaluated to Support the 10 CFR 50.54(bb) Review

Similar to reviews of other SFMPs,<sup>1</sup> the NRC staff reviewed the following information submitted in support of the TMI-1 SFMP to evaluate and provide preliminary approval of the spent fuel management (SFM) and funding program:

- Estimated cost to isolate the spent fuel pool (SFP) and fuel handling systems. For the decontamination (DECON) option, the cost to isolate the SFP and fuel handling systems may be considered part of the preparation for DECON;
- Estimated cost to construct an ISFSI or a combination of wet/dry storage;
- Estimated annual cost for the operation of the selected option (wet or dry storage or a combination of the two) until the U.S. Department of Energy (DOE) takes possession of the fuel;

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<sup>1</sup> Recent reviews include safety evaluations by the Office of Nuclear Reactor Regulation related to the SFMP of Exelon Generation Company, LLC, Oyster Creek Nuclear Generating Station, Docket No. 50-19 (ADAMS Accession No. ML18255A174); Omaha Public Power District, Fort Calhoun Station, Unit 1, Docket No. 50-285 (ADAMS Accession No. ML18017B005); the SFMP of Southern California Edison Company, San Onofre Nuclear Generating Station, Units 2 and 3, Docket Nos. 50-361 and 50-362 (ADAMS Accession No. ML15182A256); and the updated SFMP of Duke Energy Florida, Inc., Crystal River Unit 3 Nuclear Generating Plant, Docket No. 50-302 (ADAMS Accession No. ML14344A408).

- Estimated cost for the preparation, packaging, and shipping of the fuel to the DOE;
- Estimated cost to decommission the spent fuel storage facility;
- Brief discussion of the selected storage method or methods and the estimated time for these activities; and
- Information identifying the source of funds for managing spent fuel.

### 3.1.2 SFM Strategy

The NRC requires (as discussed in 10 CFR 50.54(bb)) that licensees establish a program “to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository.” Pending transfer of the fuel to DOE (Secretary of Energy), Exelon will store fuel on an interim basis in the SFP and/or the ISFSI located at the TMI-1 site. Exelon stated that a licensed ISFSI will be built by early 2021 to support the decommissioning operations at TMI-1. Exelon stated that the ISFSI facility will be able to accommodate the inventory of spent fuel remaining in the SFP at the time of permanent shutdown. After the required cooling time, the spent fuel will be loaded in fuel storage canisters and moved to the ISFSI. Once the SFP is emptied of fuel, Exelon currently plans to place the facility in a SAFSTOR condition. The ISFSI will continue to operate until the transfer of spent fuel to DOE is complete.

Assuming DOE’s generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority and that DOE begins removing spent fuel from commercial facilities in 2030 with an annual capacity of 3,000 metric tons of uranium, spent fuel is projected by Exelon to remain at the TMI-1 site for approximately 16 years after the termination of operation (spent fuel is projected by Exelon to be removed from the TMI-1 site by the end of 2035). Any delay in transfer of fuel to DOE or decrease in the rate of acceptance will correspondingly prolong the transfer process and result in spent fuel remaining at the site longer than anticipated.

Operation and maintenance costs for the storage facilities (ISFSI and SFP) are reflected in the TMI-1 decommissioning cost estimate (DCE) dated April 5, 2019, and include the costs for staffing the facilities and maintenance of necessary operational requirements, as well as security, insurance, and licensing fees. The estimate includes the costs to purchase, load, and transfer the fuel storage canisters to the ISFSI and to decommission the ISFSI.

## 4.0 TECHNICAL EVALUATION

### 4.1 Evaluation of the SFMP Estimated Costs

The SFMP provided Exelon’s SFM strategy, referred to the DCE for the schedule for SFM activities, and provided the cost estimate (2019 dollars) and funding for SFM.

The NRC staff’s review of the licensee’s submittal included the SFM activities and associated cost elements found in the TMI-1 SFMP and site-specific DCE. The SFMP and associated costs estimated by Exelon total \$158.6 million (2019 dollars). The NRC staff reviewed estimates for major SFM activities and funding requirements including for SFM infrastructure; spent fuel operation, maintenance, and isolation costs; ISFSI construction, operation, and

maintenance costs; emergency planning costs; safe storage and dormancy costs; and spent fuel transfer costs. The NRC staff notes that an ISFSI will be built by 2021 to accommodate the inventory of spent fuel in the spent fuel pool. The canisters for the dry storage of spent fuel on the ISFSI have yet to be determined by Exelon.

With regard to spent fuel removal from the reactor site, the licensee indicated that its plan for spent fuel remains dependent on DOE's ability to remove spent fuel from the site in a timely manner. Accordingly, the plan is based upon a 2030 start date for DOE's acceptance of spent fuel from the industry and, considering the order by which DOE plans to retrieve spent fuel from individual nuclear power facilities, including from TMI-1. The licensee is, therefore, assuming that DOE will complete spent fuel removal from TMI-1 by the end of 2035. The licensee maintains its position that DOE has a contractual obligation to accept spent fuel from TMI-1 in a timely manner. The NRC staff accepts these assumptions regarding the final disposition of TMI-1 spent fuel as DOE, per the Nuclear Waste Policy Act of 1982, entered into contracts with owners and generators of commercial spent nuclear fuel to begin taking title to (i.e., legal ownership of) the spent nuclear fuel.

With regard to the cost estimate for the SFMP and related activities at TMI-1, the NRC staff evaluated the \$158.6 million (2019 dollars) estimated cost for reasonableness. In doing so, the NRC staff considered cost information from independent sources and compared data against information provided by other licensees. One such study, "Blue Ribbon Commission on America's Nuclear Future" (Blue Ribbon Commission report), dated January 2012, provides to DOE cost and cost considerations for the operation and maintenance of spent fuel storage at shutdown sites. Costs cited in that report range from \$4.5 million to \$8 million per year (2012 dollars) for SFM at shutdown sites.<sup>2</sup> These costs adjusted for inflation (2019 dollars) are \$5 million and \$9.2 million, respectively. Accounting for inflation and considering the SFMP operational period with the TMI-1 site-specific costs, the NRC staff determined that the cost estimate provided by Exelon, on the average (approximately \$9.1 million), is within the range of costs cited in the report. The NRC staff acknowledges that potential site-specific variances may exist among individual SFMPs. Based on the foregoing, the NRC staff finds the \$158.6 million cost estimate for SFM to be reasonable.

#### 4.2 Evaluation of the Program to Manage and Provide Funding of All Spent Fuel

According to Exelon, to the extent that the trust fund balance exceeds costs required for radiological decommissioning, trust fund monies, in conjunction with Exelon operating revenues, will be used to pay for SFM costs. On October 16, 2019 (ADAMS Accession No. ML19259A175), the NRC approved an exemption request to allow the use of excess funds from the TMI-1 decommissioning trust for SFM activities.

As an additional potential source of funding for TMI-1 SFM costs, Exelon also will rely on reimbursements from DOE to fund SFMP activities, pursuant to the terms of the settlement agreement between Exelon and the U.S. Government, concerning DOE's breach of its contract to accept and dispose of spent fuel and high-level waste at TMI-1.<sup>3</sup> DOE has agreed to reimburse Exelon for costs incurred attributable to DOE's failure to meet its contractual obligations for the transfer of spent fuel from TMI-1 and other Exelon nuclear plants.

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<sup>2</sup> See page 35 of Blue-Ribbon Commission report.

<sup>3</sup> Settlement Agreement between DOE and Exelon (including Commonwealth Edison Company and AmerGen Energy Company), signed and executed August 5, 2004, as amended by the Addendum to the Settlement Agreement signed May 4, 2009.

Based on Exelon's plan to fund SFM costs with excess funds from the TMI-1 decommissioning trust and Exelon operating revenues, as well as anticipated payments from DOE reimbursements as earlier cited, the NRC staff concludes that Exelon's SFMP complies with 10 CFR 50.54(bb).

#### 5.0 CONCLUSION

Based on the NRC staff's review of the estimates for major SFM activities and funding requirements, the staff finds that the activities and associated costs of the TMI-1 SFMP appear reasonable.

Principal Contributor: E. Tabakov

Date: March 11, 2020

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 DATED MARCH 11, 2020

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**ADAMS Accession No.: ML20065J476**

\*by memo      \*\*by e-mail

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