



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

March 17, 2010

Vice President, Operations  
Entergy Nuclear Operations, Inc.  
Indian Point Energy Center  
450 Broadway, GSB  
P.O. Box 249  
Buchanan, NY 10511-0249

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NOS. 1 AND 2 - SAFETY  
EVALUATION RE: SPENT FUEL MANAGEMENT PROGRAM AND  
PRELIMINARY DECOMMISSIONING COST ESTIMATE (TAC NOS. ME0020  
AND ME0021)

Dear Sir or Madam:

The Nuclear Regulatory Commission (NRC) staff has completed its review of Entergy Nuclear Operations, Inc. (Entergy's) submittals for Indian Point Nuclear Generating Unit Nos. 1 and 2 (IP1 and IP2) dated October 23, 2008, titled "Unit 1 & 2 Program for Maintenance of Irradiated Fuel and Preliminary Decommissioning Cost Analysis in accordance with 10 CFR 50.54(bb) and 10 CFR 50.75(f)(3)," and July 15, 2009, titled "Reply to Request For Additional Information Regarding Decommissioning Cost Estimate and Irradiated Fuel Management Program." These submittals address how Entergy will meet the requirements for IP1 and IP2 set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Sections 50.54(bb) and 50.75(f)(3).

The NRC staff finds that Entergy's preliminary decommissioning cost estimates for IP1 and IP2 radiological decommissioning, as required by 10 CFR 50.75(f)(3), are reasonable and provide sufficient details to compare the cost with the funding mechanism, which is the radiological decommissioning trust fund (DTF).

The NRC staff notes that Entergy's program for the long-term storage of spent fuel relies on funds from the DTF. Entergy acknowledges that an exemption from 10 CFR 50.82(a)(8) must be approved by the NRC before any funds from the DTF are expended on the management of spent fuel. The NRC will not approve such an exemption if the DTF does not have adequate funds to support both radiological decommissioning and spent fuel management. Therefore, Entergy has committed to adding additional funds to the DTF in the future to support the management of spent fuel. The NRC staff concludes that Entergy's spent fuel management program currently complies with 10 CFR 50.54(bb) and approves the program on a preliminary basis.

The NRC staff notes that these analyses are based on a reported DTF balance that can fluctuate over time. Should there be a material decline in the DTF balance, the staff's analysis and preliminary findings may no longer be valid, and the licensee would be under an obligation under 10 CFR 50.9 to update the DTF balance as well as any changes in projected costs. The NRC staff expects licensees to update their radiological decommissioning cost estimates and spent fuel management program to provide any significant adverse material changes, in conjunction with the filing of the licensee's required periodic report on the status of its decommissioning funding.

Please contact me at (301) 415-2901 if you have any questions on this issue.

Sincerely,

A handwritten signature in black ink that reads "John P. Boska". The signature is written in a cursive style with a large, looping initial "J".

John P. Boska, Senior Project Manager  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-003 and 50-247

Enclosure:  
Safety Evaluation

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO SPENT FUEL MANAGEMENT PROGRAM AND  
THE PRELIMINARY DECOMMISSIONING COST ESTIMATE  
ENTERGY NUCLEAR INDIAN POINT 2, LLC  
AND ENTERGY NUCLEAR OPERATIONS, INC.  
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 1 AND 2  
DOCKET NOS. 50-003 AND 50-247

1.0 INTRODUCTION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(bb), nuclear power plants that are within 5 years of expiration of their operating license must submit a spent fuel management and funding program to the Nuclear Regulatory Commission (NRC) for review and preliminary approval. The program should discuss the means by which the licensee intends to manage and provide funding for the management of spent fuel until the fuel is transferred to the Department of Energy (DOE) for permanent disposal. In the same time period, the licensee is also required by 10 CFR 50.75(f)(3) to submit a preliminary decommissioning cost estimate, which includes an up-to-date assessment of the major factors that could affect the cost to decommission the reactor.

By letter dated October 23, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML083040378), Entergy Nuclear Operations, Inc (Entergy or the licensee) submitted a letter titled "Unit 1 & 2 Program for Maintenance of Irradiated Fuel and Preliminary Decommissioning Cost Analysis in accordance with 10 CFR 50.54(bb) and 10 CFR 50.75(f)(3)", and a supplemental submittal dated July 15, 2009, titled "Reply to Request For Additional Information Regarding Decommissioning Cost Estimate and Irradiated Fuel Management Program" (ADAMS Accession No. ML092050204) in support of the application. This safety evaluation documents the NRC staff's findings resulting from the review of these submittals.

2.0 BACKGROUND

The Indian Point site is located in Buchanan, New York, about 24 miles north of New York City. There are three reactors at the Indian Point site, Indian Point Nuclear Generating Unit No. 1 (IP1), Indian Point Nuclear Generating Unit No. 2 (IP2), and Indian Point Nuclear Generating Unit No. 3 (IP3). IP1 and IP2 are owned by Entergy Nuclear Indian Point 2, LLC, and operated by Entergy Nuclear Operations, Inc. IP3 is owned by Entergy Nuclear Indian Point 3, LLC, and operated by Entergy Nuclear Operations, Inc. IP2 and IP3 are still operating. IP1 was shut

Enclosure

down in October of 1974. The operation was suspended because the plant's emergency core cooling system did not satisfy the criteria that came into effect after its start up. Since that time, IP1 has remained shut down in a long-term storage configuration with the spent fuel initially stored in water in the spent fuel pool. Concerns with spent fuel pool leakage prompted a decision to relocate the spent fuel to dry storage casks located at an independent spent fuel storage installation (ISFSI) built by Entergy at the site. The relocation process was completed in 2008. IP1 is expected to remain in a long-term storage configuration until it can be decommissioned simultaneously with IP2.

IP2 and IP3 are still in operation, with license expiration dates of September 28, 2013, and December 12, 2015, respectively, although Entergy has applied for license renewal for IP2 and IP3. Entergy stated that if IP2 ceases operation in 2013, IP2 would then be placed into safe storage (SAFSTOR) for a period up to 60 years, at which time IP2 would be decontaminated and dismantled. Entergy stated that its intention is to decommission IP1, IP2, and IP3 as an integrated site activity.

Entergy is seeking renewal of the operating licenses for IP2 and IP3. In the event that IP2 does cease operations in 2013, Entergy will comply with existing NRC licensing requirements, including the operation and maintenance of the systems and structures needed to support continued operation of the IP2 spent fuel pool and the ISFSI located on the site.

### 3.0 REGULATORY REQUIREMENTS AND CRITERIA

#### 3.1 Regulatory Requirements on Management of Spent Fuel (10 CFR 50.54(bb))

Section 50.54(bb) states in 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 the 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 to Support the 10 CFR 50.54(bb) Review

For the NRC staff to evaluate and provide preliminary approval of the spent fuel management and funding program, the submittal should include:

- Estimated cost to isolate the spent fuel pool and fuel handling systems.
- 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 DOE takes possession of the fuel;
- Estimated cost for the preparation, packaging, and shipping of the fuel to the DOE;
- Estimated cost to decommission the spent fuel storage facility; and
- Brief discussion of the selected storage method or methods, and the estimated time for these activities.

### 3.2 Regulatory Requirement on Funding of Radiological Decommissioning (10 CFR 50.75(f)(3) and (f)(5))

Section 50.75(f)(3) states: "Each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission."

Section 50.75(f)(5) requires a licensee to include plans, with the preliminary cost estimate, to adjust decommissioning funding levels to demonstrate a reasonable level of assurance that funds will be available when needed to cover the cost of decommissioning. The preliminary cost estimate should include a comparison to the minimum decommissioning funding amount based on the formulas in 10 CFR 50.75(c), and an assessment of the major factors that could affect the preliminary cost estimate.

#### 3.2.1 Criteria to Support the 10 CFR 50.75(f)(3) Review

NUREG-1713, entitled "Standard Review Plan for Decommissioning Cost Estimates for Nuclear Power Reactors," Section C1, provides additional guidance on the information that is to be addressed in the preliminary cost estimate. The principal factors to be addressed are:

- Decommissioning option/method anticipated;
- Potential for known or suspected contamination of the facility or site;
- Low-level radioactive waste (LLW) disposition plan;
- Preliminary schedule of decommissioning activities; and
- Any other factors that could significantly affect the cost to decommission.

The cost estimate should provide costs for each of the following:

- Pre-decommissioning engineering and planning - decommissioning engineering and planning prior to completion of reactor defueling;
- Reactor deactivation - deactivation and radiological decontamination of plant systems to place the reactor into a safe, permanent shutdown condition;
- Safe storage - safe storage monitoring of the facility until dismantlement begins (if storage or monitoring of spent fuel is included in the cost estimate, it should be shown separately);
- Dismantlement - radiological decontamination and dismantlement of systems and structures required for license termination (if demolition of uncontaminated structures and site restoration activities are included in the cost estimate, they should be shown separately); and
- LLW disposition - LLW packaging, transportation, vendor processing, and disposal.

#### 4.0 EVALUATION

##### 4.1 Evaluation of the Program to Manage and Fund the Storage of All Irradiated Fuel for IP1 and IP2

As required by 10 CFR 50.54(bb), Entergy estimated the cost associated with the long-term management of spent fuel for IP2 at \$178.26 million and the remaining cost for IP1 fuel at \$3.01 million (note: all dollar values identified in this evaluation are indicated in 2007 dollars unless otherwise noted). The long-term management of the spent fuel for IP2 starts with the initial storage of recently irradiated fuel in the spent fuel pool for a period of at least 5 years, which is needed to allow a reduction in the decay heat generation before transfer to long-term storage in the onsite ISFSI. Interim storage of the IP2 spent fuel, until the DOE takes receipt, will be in the IP2 fuel storage building's spent fuel pool and the ISFSI. IP2 is projected to have accumulated a total of 1,672 spent fuel assemblies by the end of its currently licensed operations in 2013. An ISFSI has been constructed within the owner controlled area, and all the IP1 spent fuel (160 fuel assemblies), as well as some IP2 spent fuel, is currently stored there. This facility will also be used for post-shutdown dry fuel storage. If DOE has started to take receipt of spent fuel before 2021, some IP2 fuel assemblies may be transferred from the spent fuel pool directly to DOE. Otherwise, the assemblies stored in the IP2 fuel storage building's spent fuel pool will be loaded into canisters (typically 32 fuel assemblies are placed in each canister) and moved into storage casks on the ISFSI pad by 2021. Entergy estimated the annual cost associated with dry storage for the period from 2022 to 2045 at about \$2.7 million per year. Entergy projects that all spent fuel could be removed from the site as early as 2043, through transfer to DOE. The 2043 date is based on an assumed 2017 start date for repository operations and the expected schedule for receipt of fuel by DOE. The NRC staff considered the effect if DOE does not start taking receipt of spent fuel in 2017. A delay does not have a large impact, as the licensee estimates the annual storage cost is about \$2.7 million per year and is already included up to 2045. Site decommissioning work is scheduled to start in 2064. Even then, decommissioning can proceed with the ISFSI still intact, as has been demonstrated at other reactors. The ISFSI is operated and maintained by IP2, although it includes five IP1 canisters. Direct costs include the procurement of multi-purpose storage canisters and storage overpacks (casks) for the canisters, as well as the loading and transfer costs associated with transferring the spent fuel from the pool to the ISFSI pad or into a DOE transport cask and the eventual transfer of the fuel to the DOE. The direct cost of \$59.1 million for IP2 is a subset of the \$178.26 million. The licensee stated that, following transfer of the fuel to the DOE, the ISFSI will be decontaminated to the extent necessary to remove radioactive contamination at an estimated cost of \$1.8 million. Conventional demolition and restoration of the ISFSI is estimated to cost an additional \$1.3 million.

Entergy has submitted a license renewal application for IP2 and IP3. If IP2 ceases operation in 2013, Entergy will be required to comply with existing licensing requirements, including the operation and maintenance of the systems and structures needed to support continued operation of the spent fuel pool. Entergy has committed to place an additional \$110 million into the decommissioning trust fund (DTF) in 2026 to ensure the storage costs for the spent fuel are funded. The licensee applied a real rate of return of 2.0 percent to its analysis and deducted the annual expenses associated with SAFSTOR. Entergy acknowledged the need for an exemption pursuant to 10 CFR 50.12 to use the radiological DTF for anything beyond decommissioning activities as defined in 10 CFR 50.2. Entergy further acknowledged the need for Commission approval pursuant to 10 CFR 50.82(a)(3) for completion of decommissioning beyond 60 years

for IP1, as Entergy's current plan for IP1 predicts decommissioning over a longer period. In addition, Entergy stated that it will also comply with applicable license termination requirements in accordance with 10 CFR 50.82 with respect to plant shutdown and post-shutdown activities including seeking such NRC approvals and on such schedules as necessary to satisfy these requirements consistent with the continued storage of spent fuel.

The NRC staff finds the spent fuel management program estimates to be reasonable, based on a cost comparison with similar decommissioning reactors, while acknowledging that there are large uncertainties and potential site-specific variances. The NRC staff also finds that adding the \$110 million to the DTF in 2026 should ensure that sufficient funds are available for the management of the spent fuel. The NRC staff preliminarily approves Entergy's spent fuel management program for IP1 and IP2, conditioned upon the filing and granting of an exemption to use DTF funds for fuel management costs. The NRC did not give credit for any other funding source for spent fuel management costs.

#### 4.2 Evaluation of the Preliminary Radiological Decommissioning Cost Estimate for IP2

Entergy estimated the radiological decommissioning cost of IP2 to be approximately \$685.1 million in 2008 dollars. Entergy has elected to use the SAFSTOR option with decommissioning starting in 2064 and completed by 2073.

Prior to starting the detailed review of the cost estimate, the NRC staff reviewed the estimate to confirm that the supporting systems/structures necessary to support the safe operation had been identified in the estimate. The validity of the cost estimate is based on a reasonable estimate of the cost to decommission the supporting systems and structures, as well as confirming that all of the major equipment necessary to support operation was included.

The licensee has divided the estimated total cost of \$685.1 million into the following principal categories/activities: decontamination costs; support systems/component removal; packaging; transportation; waste disposal; program management; insurance and regulatory fees; miscellaneous equipment costs; energy costs; characterization and licensing surveys; and site and operating and maintenance costs. The licensee included a timeline and an annual cost projection that identifies when these activities will take place, and the costs associated with each of these items. In addition, Appendix A of Enclosure 2 of the licensee's submittal dated October 23, 2008, identified the contingency factors for the major activities with an overall average contingency of 17.26 percent. The NRC staff reviewed the contingency factors and the work difficulty factors used in the cost estimate and found them to be reasonable.

The NRC staff recognizes that a significant uncertainty exists regarding the low-level waste disposal cost for Class B and C radioactive materials since the Barnwell, South Carolina, waste disposal site no longer accepts waste from Non-Atlantic Compact members. These materials are about 0.1% of the waste volume. The staff concluded that the waste volume estimates were in a reasonable range. For disposal cost estimating purposes, the disposal rate is reasonable based on the mix of waste and the available disposal options. However, when new disposal facilities become available, or if the South Carolina disposal site reopens to members outside its compact, disposal rates will likely be higher. As proposed by Entergy, the Class A radioactive waste, which makes up most of the volume, can be disposed of at the Energy Solutions disposal site in Clive, Utah. Entergy's cost estimate addressed the costs of disposal of an estimated

379,000 cubic feet of contaminated soil at an estimated cost of \$17.7 million, and also identified an estimated 1.26 million cubic feet of contaminated soil for IP1 at an estimated cost of \$64.6 million.

The DTF balance could be subject to decline, depending on the performance of DTF investments. The licensee's decommissioning cost analyses were initially based on a DTF balance for radiological decommissioning of \$347.20 million as of December 31, 2007, and were later reanalyzed using the DTF balance of \$312.39 million as of December 31, 2008, with a further increase to \$326.96 million as of July 31, 2009 (see the Entergy letter dated August 13, 2009, ADAMS Accession No. ML092260720). The NRC staff noted that although the DTF is sufficient to pay for radiological decommissioning, it does not have the funds to also cover all the costs associated with spent fuel management. Table 2.1 of the supplemental submittal, dated July 15, 2009, addressed the initial potential shortfall in funding for spent fuel management (assuming the December 31, 2008, trust fund balance, and a 2% real rate of return on the DTF) by committing to make a \$110 million contribution to the trust fund in 2026. The NRC staff's analysis confirmed Entergy's proposed contribution of \$110 million will result in the DTF having sufficient funds to pay for radiological decommissioning and spent fuel management. If there is a change in the DTF balance that materially impacts the licensee's cost analysis, or if new disposal rates are significantly higher, the licensee would be obliged under 10 CFR 50.9 to update any significant changes in the projected cost or available funds.

The NRC staff finds the preliminary cost estimate for radiological decommissioning of IP2 is not unreasonable, and that the DTF balance, as of July 31, 2009, will be sufficient to fund the radiological decommissioning.

#### 4.3 Evaluation of the Preliminary Radiological Decommissioning Cost Estimate for IP1

Entergy estimated the radiological decommissioning cost of IP1 to be approximately \$441.6 million in 2008 dollars. Entergy has elected to use the SAFSTOR option with decommissioning starting in conjunction with IP2 in 2064 and completed by 2073. In a letter requesting additional information, dated May 13, 2009 (ADAMS Accession Number ML091120544), the NRC staff reminded Entergy that 10 CFR 50.82(a)(3) requires that decommissioning be completed within 60 years of permanent cessation of operations, or else NRC permission must be obtained to extend the decommissioning period. As the NRC issued an Order on June 19, 1980, revoking the authority for IP1 to operate, the 60 years would be reached for IP1 in 2040. Entergy responded in their letter of July 15, 2009, that they will request permission from the NRC to extend the safe storage period for IP1. Section 50.82(a)(3) recognizes that the presence of other nuclear facilities at the site could be a valid reason to delay the start of decommissioning.

The NRC staff reviewed the estimate to confirm that the supporting systems/structures necessary to support the safe operation had been identified in the estimate. The validity of the cost estimate is based on a reasonable estimate of the cost to decommission the supporting systems and structures, as well as confirming that all of the major equipment necessary to support operation was included.



The licensee included a timeline and an annual cost projection that identifies when these activities will take place, and the costs associated with each of these items. In addition, Appendix A of Enclosure 1 of the licensee's submittal dated October 23, 2008, identified the contingency factors for the major activities with an overall average contingency of 14.6 percent. The NRC staff reviewed the contingency factors and the work difficulty factors used in the cost estimate and found them to be reasonable.

The NRC staff recognizes that a significant uncertainty exists regarding the low-level waste disposal cost for Class B and C radioactive materials since the Barnwell, South Carolina, waste disposal site no longer accepts waste from Non-Atlantic Compact members. These materials are about 0.1% of the waste volume. The staff concluded that the waste volume estimates were in a reasonable range. For disposal cost estimating purposes, the disposal rate is reasonable based on the mix of waste and the available disposal options. However, when new disposal facilities become available, or if the South Carolina disposal site reopens to members outside its compact, disposal rates will likely be higher. As proposed by Entergy, the Class A radioactive waste, which makes up most of the volume, can be disposed of at the Energy Solutions disposal site in Clive, Utah. Entergy's cost estimate addressed the costs of disposal of an estimated 1.26 million cubic feet of contaminated soil for IP1 at an estimated cost of \$64.6 million, and also identified an estimated 379,000 cubic feet of contaminated soil for IP2 at an estimated cost of \$17.7 million.

The DTF balance could be subject to decline, at least in the short run. The licensee's decommissioning cost analyses were initially based on an IP1 DTF balance for radiological decommissioning of \$271.19 million as of December 31, 2007, and were later reanalyzed using the DTF balance of \$235.35 million as of December 31, 2008. The NRC staff's analysis shows that the DTF has sufficient funds to pay for radiological decommissioning and spent fuel management for IP1. If there is a change in the DTF balance that materially impacts the licensee's cost analysis, or if new disposal rates are significantly higher, the licensee would be under an obligation under 10 CFR 50.9 to update any significant changes in the projected cost or available funds.

The NRC staff finds the preliminary cost estimate for radiological decommissioning of IP1 is not unreasonable, and that the DTF balance, as of December 31, 2008, will be sufficient to fund the radiological decommissioning.

## 5.0 CONCLUSION

The NRC staff finds that Entergy's program for the long-term storage of spent fuel and the preliminary cost estimate for radiological decommissioning of IP1 and IP2 are adequate and provide sufficient details associated with the funding mechanisms. The NRC staff, therefore, concludes that the licensee's spent fuel management program for IP1 and IP2 complies with 10 CFR 50.54(bb) and approves the program on a preliminary basis. In addition, the NRC staff finds that the preliminary cost estimates for radiological decommissioning of IP1 and IP2 comply with the requirements of 10 CFR 50.75(f)(3) and the NRC staff finds that the preliminary cost estimates are not unreasonable.

However, if there are changes in the DTF balances that materially impact the licensee's cost analysis, or if new disposal rates are significantly higher, the licensee would be obliged under 10 CFR 50.9 to update any significant changes in projected cost, or available funds.

Principal Contributors: Clayton L. Pittiglio  
John P. Boska

Date: March 17, 2010

Please contact me at (301) 415-2901 if you have any questions on this issue.

Sincerely,

*/ra/*

John P. Boska, Senior Project Manager  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-003 and 50-247

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