

UNITED STATES OF AMERICA  
 NUCLEAR REGULATORY COMMISSION  
 OFFICE OF NUCLEAR REACTOR REGULATION

J. E. Dyer, Director

In the Matter of	)	Docket No. 50-271
	)	
Entergy Nuclear Operations, Inc.	)	License No. DPR-28
	)	
Vermont Yankee Nuclear Power Station	)	
	)	

PROPOSED DIRECTOR'S DECISION UNDER 10 CFR 2.206

I. Introduction

By letter dated April 23, 2004, as supplemented on September 10, 2004, Mr. Raymond Shadis of the New England Coalition (the Petitioner) filed a petition pursuant to Title 10 of the *Code of Federal Regulations*, Section 2.206. The Petitioner requested that the U.S. Nuclear Regulatory Commission (NRC) take the following actions as a result of two pieces of fuel rods missing from their documented location in the spent fuel pool (SFP) at the Vermont Yankee Nuclear Power Station (Vermont Yankee):

- (1) require Entergy Nuclear Operations, Inc. (Entergy) to perform an accurate and NRC verified account of the location, disposition, and condition of all irradiated fuel, including fuel currently loaded in the reactor, and
- (2) order the licensee to halt all fuel movement at Vermont Yankee until this inventory is completed.

The Petitioner stated that the basis for the requested actions in the Petition is that because Entergy lost control of the spent fuel inventory at Vermont Yankee and until all spent fuel was accounted for, the Petitioner would have no confidence that Entergy did not put leaking

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fuel or suspected leaking fuel assemblies back into the reactor core during the April 2004 refueling outage.

In a letter dated April 30, 2004, the NRC informed the Petitioner that his request for a fuel inventory verified by the NRC at Vermont Yankee and an order to stop all fuel movement was being referred to the Office of Nuclear Reactor Regulation for appropriate action. This letter stated that a call to discuss the petition with the Office of Nuclear Reactor Regulation's Petition Review Board (PRB) had been arranged for May 5, 2004. By teleconference on May 5, 2004, the Petitioner met with the PRB to discuss the petition and provide additional details in support of this request. This teleconference was transcribed and the transcript is publicly available as a supplement to the petition. The transcript is available in ADAMS (ML041410554) for inspection at the Commission's Public Document Room (PDR), at One White Flint North, Public File Area O1 F21, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible from the ADAMS Public Electronic Reading Room on the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. Persons who do not have access to ADAMS or who have problems in accessing the documents in ADAMS should contact the NRC PDR reference staff by telephone at 1-800-397-4209, 301-415-4737, or by e-mail to [pdrc@nrc.gov](mailto:pdrc@nrc.gov)

By letter dated May 24, 2004, the NRC requested the following information from Entergy:

- (1) document the verification of the inventory of all the special nuclear material (SNM) in the SFP,
- (2) document all other actions it is performing to locate the missing fuel,
- (3) document that the location of the remaining portions of the two spent fuel rod pieces have been verified, and

- (4) provide the results of its actions to locate the missing fuel when the current efforts are completed.

By letter dated June 8, 2004, Entergy responded to the above requests and provided a schedule for these requests related to the petition. The requested information was considered by the staff in its evaluation of the petition. In addition, Entergy issued a licensee event report (LER) on June 17, 2004. An updated LER was issued on September 29, 2004, which provided a summary of the root cause analysis.

By letter dated May 28, 2004, the NRC informed the Petitioner that his request for the NRC to issue an order to immediately stop all fuel movement at Vermont Yankee was moot since all fuel movement for the April 2004 refueling outage had been completed at the time the NRC received the request. During the May 5, 2004, call, the Petitioner stated he understood that all fuel movement had been completed for the April 2004 refueling outage but reaffirmed the petition's request to stop all fuel movement. He stated he understood that at the present time that would limit the request to the SFP. However, the Petitioner stated that he was not averse to moving fuel in the SFP if it was related to the inventory inspection. The Petitioner also stated he wanted an order for a 100 percent verification of the inventory of all the SNM in the SFP. The May 28, 2004, letter stated that the NRC would take action on the remaining request, that was for Entergy to perform an accurate and NRC-verified account of the location, disposition, and condition of all irradiated fuel, including fuel currently loaded in the reactor.

On July 13, 2004, Entergy informed the NRC that it had located the unaccounted-for fuel pieces in a cylindrical container (fuel storage liner) in the SFP. On July 17, 2004, Entergy confirmed that the two missing pieces had been found.

On September 10, 2004, the Petitioner supplemented his petition to request that the NRC require the licensee to restore its documentation of the location and condition of all SNM

at Vermont Yankee, and that the NRC verify the accuracy and completeness of the documentation. In a September 22, 2004, conference call, the PRB discussed the supplemental letter with the Petitioner and his consultants. This teleconference was transcribed and the transcript is publicly available as a supplement to the Petition. In this call, the Petitioner stated that the inspections to date to verify assembly location and number were not of the veracity to ensure that the all fuel rods or pieces have been correctly identified and accounted for. In addition, the Petitioner stated that the identification of the fuel rod pieces was questionable. On October 5, 2004, the NRC sent Entergy a letter requesting additional information. Entergy responded to this letter on November 19, 2004.

II. Discussion

On April 21, 2004, Entergy made a 10 CFR 50.72 notification that two short spent fuel rod pieces were not in their documented location in the SFP.

On April 22, 2004, the NRC initiated a special inspection to review the licensee's actions to locate the fuel and evaluate the causes for the potentially missing spent fuel pieces at Vermont Yankee. At the same time, Entergy initiated action to perform a comprehensive search of the SFP, perform a core load verification, verify the location of the remaining damaged spent fuel rod sections stored in the bundles, and perform a records review in an effort to determine the location of the missing pieces.

By letter dated May 21, 2004, the NRC requested the licensee to document the various actions to account for all SNM in the SFP. This letter also asked the licensee to document actions to locate the missing fuel pieces, verify the location of the remaining portions of the two spent fuel rods, and provide the results of these efforts to the NRC. In its June 8, 2004, response, Entergy stated it had verified that: (1) every spent fuel assembly is in its documented location in the SFP racks, and (2) that the remaining portions of the fuel rods that were the

source of the unaccounted-for fuel rod pieces were in their documented locations. Entergy's LER dated June 17, 2004, provides additional details on their physical inspection of the SFP.

Entergy stated that it had fully verified the documented position of 100 percent of fuel assemblies in the SFP by comparing the serial numbers on the fuel assemblies to the serial numbers recorded on the SFP map for each rack position, with no discrepancies noted. During the special inspection, the inspectors independently selected 219 of the rack positions shown on the SFP map and compared the serial numbers of fuel assemblies shown in those positions on the inspection videotapes with the expected serial numbers. The inspectors identified no discrepancies in the samples reviewed. The inspectors verified the location of selected non-fuel SNM (i.e., fission detectors) by comparing the actual serial number of the item to the inventory sheet. The inspectors also verified the balance of non-fuel SNM inventory by matching the tamper-evident seal number to the corresponding item shown on the inventory sheet. The licensee's 100 percent inspection of fuel assemblies in the SFP and the NRC's special inspection has provided the NRC a high level of confidence that all spent fuel assemblies at Vermont Yankee are accounted for and in their documented locations.

The Petitioner also requested that a verification of the core be performed. Core load verification (i.e., verifying the location and orientation of each individual fuel assembly within the reactor core) is performed at Vermont Yankee in accordance with Vermont Yankee Operating Procedure (OP) 1411, "Core Verification," following any reconfiguration of fuel assemblies within the core, including mid-cycle and refueling outages. In accordance with OP 1411, these verifications are performed visually with the aid of an underwater video camera. Entergy personnel videotaped these verifications in addition to documenting the completion of verifications in OP 1411.

As part of the NRC normal refueling activity inspection at Vermont Yankee, the NRC inspectors discussed the core loading verification process with Entergy reactor engineering personnel. Every refueling outage, the licensee performs a 100 percent inspection with 100 percent independent verification of the fuel assemblies in the reloaded core not only for location, but for orientation. During refueling outage (RFO) 24, an initial verification of the core loading was performed by two individuals; a reactor engineer and a training instructor. The reactor engineer used an underwater video camera and a video monitor to read the serial number of each fuel assembly installed in the core, while the training instructor verified that the number read by the reactor engineer matched the corresponding fuel assembly number indicated on the core loading map. Two additional individuals, a reactor engineer and a reactor engineering supervisor, performed independent verifications of the core loading using a similar method and a separate video monitor. All fuel assemblies were verified to be properly loaded and oriented during this effort.

As part of the NRC normal refueling activity inspection at Vermont Yankee, the inspectors performed an independent review of 128 fuel assembly locations (34 percent of core load) comparing Entergy's "as left" core map to the core verification videotape generated during the performance of OP 1411. Among the 128 fuel assemblies reviewed, the NRC inspection included 20 previously burned fuel assemblies which had not been in core during the last operating cycle and 4 fuel assemblies adjacent to the calculated "most reactive" control rod. The NRC inspection verified that the 128 bundles in the sample were in their documented locations. In addition, the NRC inspectors compared the pre-RFO 24 SFP map to the as-left core map to verify that no leaking fuel assemblies had been reinserted into the core. The NRC inspectors did not identify any core fuel loading discrepancies and did not identify any instances where leaking fuel had been reinserted into the core. Based on the licensee's 100 percent

inspection and verification results and the results of the NRC's sample inspection, the NRC has a high level of confidence that the locations of the fuel assemblies in the reloaded core were accurate.

The Petitioner's supplement expressed concerns about the correct identification of the fuel rod pieces that had been found. Based on this concern, the staff requested information from the licensee regarding the identification of the fuel rod pieces. Entergy performed a document search and confirmed that the only fuel pieces or segments of fuel rods ever sent offsite went to General Electric (GE) at Vallecitos in 1979. In addition, documentation has determined that the segments and pieces sent to GE at Vallecitos were not related to the pieces of two failed fuel rods in the liner. There are no records of shipments of fuel rod pieces or segments to any other facility. Entergy has no records of ever receiving any fuel pieces or segments from GE at Vallecitos or from any other facility. GE has confirmed that due to the destructive nature of the post-irradiation examination, all spent nuclear fuel from Vermont Yankee will be stored at Vallecitos until disposal. Therefore, there is reasonable evidence that the fuel rod pieces in the fuel storage liner are from Vermont Yankee.

Following discovery of the two spent fuel rod pieces, the NRC special inspection focused on understanding the basis for Entergy's conclusion that the two spent fuel rod pieces were, in fact, the same two spent fuel rod pieces which had been misplaced. Entergy verified that the two spent fuel rod pieces were the unaccounted spent fuel rod pieces by measuring radiation levels and making estimates of the length and diameter of the pieces. Entergy's conclusion was supported by the following:

- Lengths of the two found spent fuel rod pieces were consistent with the lengths of the two misplaced spent fuel rod pieces, based on visual comparison with items of known length.
- Radiation measurements inside and outside of the fuel storage liner were consistent with the expected radiation levels based upon Entergy's detailed radiological characterization of the two misplaced spent fuel rod pieces.
- Diameter of the two spent fuel rod pieces was consistent with the diameter of the original fuel rods based on boroscope observation.
- Only two spent fuel rod pieces were misplaced and two spent fuel rod pieces were recovered. No other record discrepancies were identified indicating any other unaccounted for SNM.
- The fuel storage liner discovered on July 13, 2004, was consistent with the 1980 log entries and other documentation referring to a fuel storage liner.
- Entergy interviewed a former employee who had been involved in the transfer of the two spent fuel rod pieces from the fuel storage bucket to the fuel storage liner on January 21, 1980. While the individual did not specifically recall the transfer activity, his description of the fuel storage liner used to store broken spent fuel rod pieces matched the fuel storage liner discovered on July 13, 2004.
- A GE invoice dated August 9, 1979, indicated that a fuel storage liner was provided to Vermont Yankee to contain broken fuel pins. This invoice indicated the intent to use the fuel storage liner to contain broken spent fuel rod pieces, the first of which was broken on April 23, 1979. This invoice and documents provided by GE were consistent with the fuel storage liner found in the SFP by Entergy and the 1980 SNM Transfer Form.



Based on the review of videotape records, the NRC inspectors compared the lengths of the two spent fuel rod pieces to the known distance between reference markings on a probe and independently confirmed the two spent fuel rod pieces in the fuel storage liner were 9 inches and 17 inches in length. The NRC inspectors determined that Entergy's radiological characterization of the two spent fuel rod pieces was acceptable. The NRC inspectors determined that Entergy had sufficient supporting information to conclude that the two spent fuel rod pieces found were the two misplaced spent fuel rod pieces. Based on the above, the NRC staff is confident that Entergy's characterization of the two spent fuel rod pieces supports the conclusion that the fuel storage liner opened in the SFP on July 13, 2004, contained the two spent fuel rod pieces described in the records.

The Petitioner's supplement also expressed concerns that the inventory of assemblies was not sufficiently rigorous. Fuel rods were routinely moved during fuel reconstitution efforts and fuel assembly inspections. However, the licensee confirmed that following fuel assembly inspections, each fuel rod was typically returned to the location from which it was removed. Procedure OP-1403, "Fuel Bundle Non-Destructive Testing and Reconstitution," Rev. 16, describes the methods used for examining fuel assemblies and individual rods, and it specifies that records be created for accountability of fuel rods moved. While discussed generally in procedure OP-1403, the NRC inspectors interviewed Entergy personnel who also described in detail the method used to track configuration changes made to fuel assemblies through the movement of individual fuel rods, such as during reconstitutions. When a rod was removed from an assembly, the action was recorded on the notebook page for that assembly along with a note indicating where the rod was moved. Exchange of one rod for another was also recorded on the notebook page, creating the record that enabled tracking of the movements of individual fuel rods among assemblies. When all such changes to an assembly have been

completed during a manipulation, the current SNM inventory of that reconstituted fuel assembly was adjusted to reflect the incremental additions and subtractions appropriate for the fuel rods added and removed. Therefore, every fuel rod moved from one assembly to another is tracked on fuel rod transfer forms and inventory documentation so that every fuel rod can be traced back to where it came from.

Entergy reviewed the records of all individual rod movements within the SFP as part of the SNM Investigation Team's work and identified no discrepancies. During the SNM investigation, Entergy selected seven fuel assemblies and did a physical inspection and verification of vacant fuel rod positions, broken fuel rods, and full-length fuel rods that had been moved about 20 years ago. Entergy compared the results with its fuel records and identified no discrepancies. The seven assemblies were selected on the basis that they contained fuel rods which had been manipulated and therefore had a higher probability of misplacing a fuel rod. The seven assemblies included four assemblies that were associated with the two failed fuel rods in question, one assembly associated with shipment of fuel pieces to GE Vallecitos, and two fuel cages (i.e., containers) for storing rods and pieces of rods. The fuel rods and pieces came from the reconstitution efforts during the early 1970s. The fuel inventory has accounted for all rods and pieces in the assemblies and the inventory has been properly documented. The inspectors reviewed a sample of these records and found that each rod movement in the sample reviewed was properly recorded in the affected fuel assembly.

Therefore, the NRC as a result of the inventory performed by Entergy and verified by a NRC's special inspection and routine inspections has concluded that Entergy is in full compliance with regulatory requirements to account for all SNM in its possession.

Entergy's investigation required the movement of seven fuel bundles. Entergy has not moved any spent fuel in the SFP not related to this investigation since April 21, 2004. In

addition, Entergy moved a fuel storage liner in the SFP that was found to contain the two missing fuel pieces.

III. Conclusion

The NRC staff has reviewed the basis for the Petitioner's requested actions. The Petitioner's request to stop all fuel movement was moot since all fuel movement for the April 2004 refueling outage had been completed before receipt of the petition. As noted above, seven fuel assemblies and the fuel storage liner with the two rod pieces were moved as part of the licensee's investigation. The NRC has concluded, based on the licensee's inventory to confirm the total number of fuel assemblies and their locations, the location of the individual rods, the successful location of the two fuel rods pieces in the SFP, the core verifications, and documentation of the inventory, that as of July 13, 2004, Entergy is in full compliance with regulatory requirements to account for all SNM in its possession. Therefore, the petitioner's request that the licensee perform a detailed and verifiable inventory of all SNM, and restore the documentation of all SNM, and that the NRC verify these actions, has been granted. It is noted that, while the petitioner requested that the NRC order the licensee to perform the actions discussed above, the licensee voluntarily performed the actions, obviating the need for an order. Furthermore, because the licensee has restored its inventory of SNM, there is no need for the NRC to take action to prohibit fuel movement.

In addition, the Petitioner stated that because Entergy lost control of the spent fuel inventory at Vermont Yankee, he had no confidence that Entergy did not put leaking fuel or suspected leaking fuel assemblies back into the reactor core during the last refueling outage. The NRC inspectors verified that no leaking fuel assemblies were reloaded in the reactor core. Although the NRC has concluded that Entergy is now in compliance with regulatory requirements to account for all SNM, the special inspection report issued on

December 2, 2004, identified an apparent violation of 10 CFR 74.19, "Material Control and Accounting of Special Nuclear Material - Recordkeeping" related to the two spent fuel rod pieces. The NRC is considering escalated enforcement action for this incident.

As provided in 10 CFR 2.206(c), a copy of this director's decision will be filed with the Secretary of the Commission for the Commission to review. As provided for by this regulation, the decision will constitute the final action of the Commission 25 days after the date of the decision unless the Commission, on its own motion, institutes a review of the decision within that time.

Dated at Rockville, Maryland, this        day of January 2005.

FOR THE NUCLEAR REGULATORY COMMISSION

J. E. Dyer, Director  
Office of Nuclear Reactor Regulation