June 24, 2004

The Honorable Edward J. Markey
United States House of Representatives
Washington, D.C. 20515

Dear Congressman Markey:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of April 22, 2004, in which you raised a number of questions concerning the accountability for two irradiated spent fuel rod segments missing from the Vermont Yankee Nuclear Power Station (Vermont Yankee). Responses to your questions are enclosed. The NRC staff is conducting a special inspection to investigate the missing fuel rod segments. More information may become available as the special inspection progresses.

In March 2004, the NRC's resident inspector at Vermont Yankee performed an inspection of Entergy's (the licensee's) program for control of special nuclear material. The resident inspector used an inspection procedure that was recently updated based on lessons learned from a similar event which occurred at the Millstone Nuclear Power Station in 2000. The inspection identified concerns with the method used by Entergy to perform the physical inventory of the two spent fuel rod segments. On April 20, 2004, in response to the resident inspector's concerns, Entergy used an underwater video device to determine if the two spent fuel rod segments were in the storage container in the spent fuel pool, but could not locate them. On April 21, 2004, Entergy notified the NRC that the spent fuel rod segments were missing. Entergy is conducting an investigation that includes an additional underwater video inspection of the entire spent fuel pool, a review of Entergy's radioactive material shipment records, personnel interviews, and identification of possible disposal locations. On May 19, 2004, Entergy reported to the NRC that the underwater video inspection of the spent fuel pool was essentially complete but had not located the spent fuel rod segments.

The NRC staff has closely monitored Entergy's actions and investigation since its formal report to the NRC staff on April 21, 2004, that the two spent fuel rod segments were not in their documented location in the spent fuel pool. During our special inspection, the NRC will review the results of Entergy's investigation, assess the root cause evaluation, determine if Entergy is in compliance with applicable regulations, and identify which findings may have generic implications. The NRC will use the results of the ongoing special inspection at Vermont Yankee and the findings from materials control and accounting inspections at other facilities to determine the need for generic communications, inspection, enforcement, or other regulatory actions. The NRC staff has discussed this issue with individuals representing Vermont and neighboring States, as well as Washington and South Carolina, where low level radioactive waste is shipped for final burial.

The Commission shares your concerns regarding the two missing spent fuel rod segments. Spent fuel rods are required to be secured and safely stored. While it is premature to reach any conclusions about their location, we believe it is highly unlikely that the material is in the public domain. The NRC will continue to monitor and evaluate Entergy's response to this issue to assess actions to be taken.

Please feel free to contact us if you have any questions.

Sincerely,

/RA/

Jeffrey S. Merrifield
Acting Chairman

Enclosure:
Questions and Answers

Questions and Answers

QUESTION 1. "Please describe how it was discovered that the two Vermont Yankee fuel rods were missing? When were these fuel rods last accounted for?"

ANSWER 1.

In March 2004, the Nuclear Regulatory Commission's (NRC's) resident inspector at Vermont Yankee performed an inspection of Entergy's program for control of special nuclear material (SNM). The inspection identified concerns with the method used by Entergy to perform the physical inventory of the two spent fuel rod segments. On April 20, 2004, in response to the resident inspector's concerns with the inventory methods, Entergy performed an underwater video inspection of the storage container for the two spent fuel rod segments and found that they were not in the container, which was in the spent fuel pool. Entergy is conducting an investigation that includes an underwater video inspection of the spent fuel pool, a review of Entergy's radioactive material shipment records, personnel interviews, and identification of possible disposal locations. On May 19, 2004, Entergy reported to the NRC that the visual inspection of the spent fuel pool was essentially complete and that the underwater video inspection did not locate the spent fuel rod segments.

The two spent fuel rod segments are about one-half inch in diameter and about 9 inches and 17.75 inches in length, respectively. They had broken off from full-length fuel rods during repair work on a fuel assembly in 1980. According to Entergy documents prepared at the time, the segments were placed in a 5-gallon stainless steel container, which is fitted with two vertical stainless steel pipes to hold the fuel rod segments, and is stored on the bottom of the spent fuel pool. Entergy last physically verified the two spent fuel rod segments in January 1980. Entergy's records indicate that the two spent fuel rod segments were placed in the special container in the bottom of the spent fuel pool following the 1980 repair work on a fuel assembly.

The NRC has conducted materials control and accounting (MC&A) inspections at Vermont Yankee in the past. However, prior to the most recent inspection, the NRC had not performed an inspection at Vermont Yankee specifically to verify that the two spent fuel rod segments in question were in the spent fuel pool.

In general, the NRC conducts MC&A inspections to determine whether licensees have limited their possession and use of SNM to the locations and purposes authorized by their operating licenses. In addition, during these inspections, the NRC determines whether licensees have implemented adequate and effective programs to account for and control the SNM in their possession. Findings from MC&A inspections at power reactors prior to 1988 did not indicate that there were major deficiencies in power reactor licensees' MC&A programs. At that time, the NRC considered there was low risk of improper storage of spent fuel at a power reactor since physical and radiological characteristics of spent fuel made it highly unlikely that spent fuel could be safely removed from the fuel pool without proper equipment and procedures. Therefore, in 1988, the NRC chose to allocate inspection resources to other more risk-significant issues. In 2001, the NRC staff conducted a reexamination of MC&A vulnerabilities as part of a comprehensive review of the NRC's Safeguards and Security Program which was conducted in response to the terrorist activities of September 11, 2001, and in response to the report of two missing fuel rods at the Millstone Nuclear Power Station (Millstone) Unit 1.

In November 2000, the licensee for Millstone Unit 1 reported to the NRC that two fuel rods, each about 12 feet in length and containing about 300 curies of radioactive material, were missing from the spent fuel pool. As part of the lessons learned from that event, the NRC staff developed Temporary Instruction (TI) 2515/154, "Spent Fuel Material Control and Accounting at Nuclear Plants," dated November 26, 2003, to enhance the NRC's inspection of licensees' MC&A programs. The TI provides specific inspection guidance to NRC inspectors and consists of three phases. The first phase requires the NRC resident inspector to determine, through interviews, if a licensee has ever removed irradiated fuel rods from a fuel assembly. If the answer is yes, phase two of the TI is then implemented. Phase two of the TI determines, through detailed questions, if a licensee's MC&A program is adequate to account for items located in the spent fuel pool. If it is determined that a licensee's MC&A program has deficiencies, then phase three of the TI is implemented. Phase three is a much more detailed inspection of the MC&A program, which is conducted by experienced MC&A inspectors and includes verifying the location in the spent fuel pool of all spent fuel rods that have been separated from their parent fuel assemblies.

QUESTION 2. "What is the Commission doing to ascertain the whereabouts of the Vermont Yankee fuel rods? Please describe all investigative actions taken or planned to be taken."

ANSWER 2.

The NRC staff has closely monitored Entergy's actions and investigation since Entergy formally reported to the NRC staff on April 21, 2004, that the two spent fuel rod segments were not in their storage container in the spent fuel pool. The NRC is currently in the process of conducting a special inspection at Vermont Yankee to investigate the missing spent fuel rod segments. During the inspection, the NRC will review the results of Entergy's investigation, assess the root cause determination, determine if Entergy is in compliance with applicable regulations, and identify which findings may have generic implications. The charter for the special inspection was issued on April 30, 2004.[1]

QUESTION 3. "What is the Commission doing to obtain an inventory of all spent nuclear fuel at all nuclear reactors in the U.S.? If no such inventory is planned, why not, since it is clear from both the Vermont and Connecticut cases that this could be an industry-wide problem?"

ANSWER 3.

The NRC's regulations at Title 10 of the *Code of Federal Regulations* (10 CFR), Part 74, Section 74.19, require licensees to perform an annual physical inventory of all SNM in their possession, including spent fuel. Licensees are also required to maintain current records of spent fuel pool inventories. The NRC's regulations at 10 CFR 74.13 require nuclear reactor licensees to submit an annual report of their inventory of SNM to the Nuclear Materials

[1]The special inspection charter is available for public inspection at the NRC's Public Document Room, located at One White Flint North, File Public Area O1 F21, 11555 Rockville Pike (first floor), Rockville, Maryland. It is also accessible from the Agencywide Documents Access and Management System's (ADAMS) Public Electronic Reading Room on the Internet at the NRC Web site, http://www.nrc.gov/reading-rm/adams.html, using Accession No. ML041240493.

Management and Safeguards System (NMMSS). NMMSS is operated for both the NRC and the Department of Energy. Also, 10 CFR 74.15 requires licensees to submit a report to NMMSS of any transfer of SNM.

The NRC is currently conducting inspections at all U.S. commercial nuclear power plants to determine if there are any MC&A issues at other plants. As previously stated, the NRC issued TI 2515/154 for this purpose.

QUESTION 4. "The licensee of the Millstone nuclear reactor was fined only $288,000 for its failure to keep track of its spent fuel. How much will Entergy be fined for its failure to keep track of the spent nuclear fuel at Vermont Yankee?"

ANSWER 4.

The NRC's special inspection is still in progress. It is premature to speculate on what enforcement outcome is appropriate.

QUESTION 5. "10 CFR 70.51(c) states that 'a power reactor licensee is required to establish, maintain and follow written material control and accounting procedures that are sufficient to enable the licensee to account for the special nuclear material (SNM) in its possession.' In light of the fact that Vermont Yankee is unable to account for the whereabouts of these two missing fuel rods, do you believe that the licensee has complied with this requirement? Why or why not?"

ANSWER 5.

The NRC is conducting a special inspection at Vermont Yankee and is still in the process of discovery. Part of the special inspection charter is to review Entergy's compliance with all applicable MC&A regulatory requirements. The NRC will formally evaluate and document the inspection findings when the inspection is complete. Note that 10 CFR 70.51(c) has been replaced by 10 CFR 74.19(b).

QUESTION 6. "10 CFR 70.51(d) states that a power reactor licensee is required to conduct a physical inventory of all SNM in its possession at intervals not to exceed 12 months.' Given the fact that the two fuel rods apparently were not identified as missing in any physical inventory conducted by Entergy, do you believe that Entergy has complied with this requirement? Why or why not?"

ANSWER 6.

As indicated in the response to Question 5 above, the NRC's special inspection is ongoing at Vermont Yankee. Part of the special inspection charter is to review Entergy's compliance with all applicable MC&A regulatory requirements. The NRC is still in the process of discovery. An annual inventory was being performed at Vermont Yankee by the licensee. However, the effectiveness of the inventory is in question. Note that 10 CFR 70.51(d) has been replaced by 10 CFR 74.19(c).

QUESTION 7. "According to the Commission's February 1, 2001 letter to me regarding the Millstone missing spent fuel case, (see http://www.house.gov/markey/lssues/iss nuclear ltr010201.pdf), a variety of civil and criminal penalties can be imposed for violations of Commission regulations, including fines of up to $100,000 per day prior to 1986 and fines of up to $110,000 beginning in 1986. What would be the maximum civil monetary penalty incurred by Entergy in this case, assuming full application of the $100,000-110,000 per day civil penalty mentioned in your letter?"

ANSWER 7.

As previously stated, the NRC's special inspection at Vermont Yankee is ongoing. The NRC has not arrived at any enforcement decisions, thus, it is premature to speculate on what enforcement outcome is appropriate.

In accordance with the NRC's Enforcement Policy, fines can be up to $100,000 per day for violations identified before 1996, $110,000 per day for violations identified between 1996 and October 4, 2000, and $120,000 per day for violations identified after that date. In general, the NRC considers civil penalties for commercial nuclear power plants if the violation was (1) a significant, willful violation, (2) a significant violation for impeding or impacting the regulatory process, or (3) a significant violation associated with actual consequences, such as a radiation overexposure to the public or plant personnel above regulatory limits. If a violation does not meet any of these descriptions, it is addressed through the NRC's Significance Determination Process (SDP) within the Reactor Oversight Process. If a violation associated with findings that the SDP evaluates as having "greater than very low" safety significance is identified, it would be cited in a Notice of Violation requiring a written response. Typically, in such cases, no civil penalty is assessed and the finding is entered into the Action Matrix to determine the type of inspection the NRC will conduct to verify that the finding was properly addressed. The more significant the inspection finding, the more extensive the NRC's inspection/verification process will be. The NRC reserves the use of discretion in assessing civil penalties for particularly significant violations.

QUESTION 8. "In your February 1, 2001 letter, the Commission stated that 'following the completion of the NRC's inquiry [into the Millstone matter], we will consider whether industry-wide generic action is warranted.' Did you conclude that industry-wide generic action was warranted? If so, what action? If not, why not, and will you take such action now that a second such case has been revealed?"

ANSWER 8.

Yes. The NRC decided that industry-wide generic action was warranted.

Based on lessons learned from the Millstone Unit 1 event, the NRC issued TI 2515/154. The NRC is currently conducting inspections at all U.S. commercial nuclear power plants in accordance with the TI to determine if there are any MC&A issues at other plants. The development of this TI began in 2001; however, the events of September 11, 2001, caused a delay in completing the TI.

The NRC will determine the need for further generic communications, inspection, enforcement or other regulatory actions based on the results of the ongoing special inspection at Vermont Yankee and the findings from the TI 2515/154 MC&A inspections at other facilities.

QUESTION 9. "In your February 1, 2001 letter, you said that it is unlikely that the two spent fuel rods were stolen, because 'The very high radiation level of the material makes theft difficult, dangerous, and very unlikely' and 'amount and chemical form of the fissile material contained in the two spent fuel rods make it unlikely, in our judgment, that the rods could be used to assist in the manufacture of a weapon.' However, the September 11th terror attacks have demonstrated that terrorists may be willing to commit suicide in order to cause harm to America, and may be willing to devote many years to the planning and execution of such an attack.

a) Have you evaluated the possibility that the fuel rods may have been stolen or diverted?
b) Isn't it possible that rather than trying to use the fissile material from these weapons for a nuclear explosive device or weapon, terrorists might want to use it for a crude radiological weapon, or 'dirty bomb' aimed at dispersing radioactive materials in a populated area?
c) What would be the worst-case public health, safety, and environmental consequences of detonation of a 'dirty bomb' fabricated from the two Vermont Yankee spent fuel rods?"

ANSWER 9(a).

Yes. As stated in response to Question 2 above, the NRC is in the process of conducting a special inspection at Vermont Yankee to investigate the circumstances surrounding the missing spent fuel rod segments. The NRC continues to believe that the missing spent fuel rod segments do not pose a threat to public health and safety as it is highly unlikely that the material is in the public domain. Given the security of the site and the extensive array of radiation detectors at the site, it is highly likely that the unaccounted for fuel segments are in a location designed to deal with radioactive waste. They could only have been removed from the site in heavily shielded containers, which would be shipped directly to other controlled, safe locations.

The NRC staff is confident that the radiation detectors in the area of the spent fuel pool would have alarmed if the spent fuel rod segments or any other highly radioactive material stored in the pool were inadvertently removed from the spent fuel pool in an unshielded container. Besides the radiation detectors located within the plant, there are additional radiation detectors located at personnel exit points. These detectors monitor each worker exiting the plant's protected area. These are very sensitive detectors designed to alarm at radiation levels slightly above natural background. These detectors help ensure that workers do not leave the site with contaminated clothing, equipment, or radioactive material.

Even if the spent fuel rod segments were inadvertently mixed with other radioactive waste that was stored in the spent fuel pool, and then removed from the site, they would be subject to rigorous controls and oversight. The waste is processed, packaged, and prepared for shipment in a specially shielded container. The shielded container is loaded onto a transport truck and a

radiation survey is performed to verify that the radiation levels from the container meet NRC and U.S. Department of Transportation (DOT) regulatory requirements. Once in a shielded container, the two spent fuel rod segments would not be detected by the required radiation survey as long as the radiation levels meet NRC and DOT regulatory requirements. However, rigorous shipping controls are used for packages containing radioactive waste to ensure that packages shipped from plants are received by the waste disposal facilities.

ANSWER 9(b).

First, we would note that there is a very small amount of fissile material in these rod segments, far less than needed for a nuclear weapon. Furthermore, extracting that material from the rod segments would require chemical processing capabilities generally only possessed by governments.

As for the use of these rod segments in a crude radiological dispersal device (RDD), note that the shorter-lived radionuclides have decayed significantly in the almost quarter century since the rod segments were in the reactor's core. The rod segments are also in a particularly non-dispersable form. If used in a crude RDD, it is most likely the rod segments would break up into relatively large discrete pieces, which would not travel far from the site of the explosion making them easily identifiable for retrieval. Contamination could extend over a few city blocks or more. Processing the material into a more dispersable form would require considerable effort and then could not be considered a crude RDD.

ANSWER 9(c).

If radioactive material typical of a fuel rod segment were used in a dirty bomb, the radioactive material could contaminate an area of a few city blocks or more, depending on the size of the explosive, the amount of radioactive material used, and weather conditions. It is unlikely that significant, immediate health effects or prompt fatalities would result, other than from the explosion itself. Over the long-term, people who were contaminated or exposed to elevated radiation levels may have a very small increased risk of cancer.