

# POLICY ISSUE

## (Information)

September 20, 2001

SECY-01-0175

FOR: The Commissioners

FROM: William D. Travers  
Executive Director for Operations

SUBJECT: SPENT FUEL MISSING FROM MILLSTONE UNIT 1

### PURPOSE:

To inform the Commission of licensee activities to date and NRC staff plans associated with the two fuel rods apparently missing from the spent fuel pool at Millstone Unit 1.

### BACKGROUND:

In November 2000, the licensee for Millstone Unit 1 informed the NRC that the location of two spent fuel rods could not be determined.

In 1972 a once-burned spent fuel assembly with damaged fuel rods was disassembled to allow testing. During the disassembly, one of the fuel rods was bent and could not be reinserted into the assembly. Another fuel rod was displaced by the installation of a new tie rod in the fuel assembly. These two fuel rods were put into a fuel rod canister used to store individual fuel rods. Records dated 1979 and 1980 show the fuel rods stored in the canister in the northwest corner of the spent fuel pool. Records after 1980 do not identify the location of the spent fuel rods or canister in the fuel pool. Significant work, including two reracks and shipments of miscellaneous irradiated components from the spent fuel pool, took place from 1980 to 1990. In November 2000, a records reconciliation and verification effort, undertaken by the licensee (Northeast Utilities) to support the sale of the Millstone site to Dominion Resources, determined that the location of two full-length irradiated fuel rods was not properly reflected in special nuclear material records.

The licensee has formed a Fuel Rod Accountability Project with a dedicated investigative team. Additionally an independent oversight team is reviewing the overall investigative effort. Although the current licensee for Millstone Unit 1 is Dominion Nuclear Connecticut, the Fuel Rod Accountability Project is directed, staffed, and funded by Northeast Utilities, the former

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licensee for the Millstone units. The continued involvement of Northeast Utilities was a condition of the purchase of the Millstone units by Dominion. Licensee actions taken to locate the fuel rods and determine how they were misplaced include the following:

- ! physical inspections
- ! development of plausible scenarios to be investigated
- ! document reviews
- ! personnel interviews
- ! root cause analyses

The scenario investigation by the Fuel Rod Accountability Project has included review of documentation of the shipments from the site that could have contained the fuel rods. Due to the high contact radiation levels of the rods, only removal from the spent fuel pool in a shielded cask has been considered plausible. The project staff has looked primarily at the recorded dose rates from the packages but has also considered the dates of shipments and the sizes of packages. Although the package size has been an evaluation factor, a wide range of sizes is considered plausible. This is because some radioactive components in the pool, including local power range monitors, are routinely cut into smaller lengths before packaging, and the fuel rods, if mistaken for such components, could also have been cut into smaller lengths.

The NRC staff anticipates that the Fuel Rod Accountability Project will complete its investigation in September 2001. It appears increasingly likely that the fuel rods will not be found on site at Millstone, which leads to the possibility that the fuel rods may have been disposed of in the low-level waste disposal facilities at either Barnwell, South Carolina, or at Richland, Washington, or shipped to the GE-Vallecitos facility.

## DISCUSSION:

### STATUS

#### Health and Safety Issues

The current risk to human health from the missing fuel rods, based on the staff's knowledge to date, appears to be low. If the rods were in and are still in the spent fuel pool in an undetermined location (which appears highly unlikely based on the Fuel Rod Accountability Project's investigations to date), they would have been and are subject to all of the controls for protecting workers and the public that are in place for handling spent fuel in that area. If the rods were mistaken for some other non-fuel component, such as a local power range monitor and were inadvertently shipped offsite, they would have been packaged in shielded shipping containers due to their high radiation levels, and would therefore have met the requirements for external exposure limits. This is because the licensee's radiation monitoring program would have detected the high radiation levels from the rods, an easily identifiable characteristic of the hazard if they were unshielded. Furthermore, the radiation detection instruments at the potential offsite locations would also have detected unshielded spent fuel. If the rods were shipped offsite, there are only three plausible locations – transferred to the GE-Vallecitos facility, where

they would be safely stored in a manner similar to the spent fuel rods at the Millstone site, or a low-level waste (LLW) disposal site, either the Barnwell, South Carolina facility, or the Richland, Washington facility.

At an LLW disposal site, there are two potential risks to members of the public associated with unintended disposal of spent fuel rods. The first is a possible exposure to an inadvertent intruder into a disposal cell. The Commission's regulations in 10 CFR Part 61 (and the compatible regulations of the States of Washington and South Carolina) rely on a combination of 100 years of active institutional controls (to control the use of the disposal facility land), government ownership of the land, siting, waste form, and engineered barriers or depth of burial to protect against inadvertent intrusion. Thus, there is no present hazard from the possible disposal of the fuel rods at an LLW site because inadvertent intrusion is not possible until after the sites are closed. After closure, there is some residual risk from the disposal of LLW (which also has long-lived radionuclides in activated metals), and the staff intends to work with the States of Washington or South Carolina to review and evaluate the incremental risk if the rods are determined to be disposed of at an LLW site.

Another potential hazard at an LLW site is the long term release of radionuclides from the fuel rods. Northeast Utilities estimates the amount of radioactivity in the fuel rods to be approximately 300 curies. (Although the staff has not independently verified that estimate, it appears to be reasonable.) This amount of radioactivity is a small part of the total inventory of several million curies at either disposal site that must already be isolated to protect public health and safety. The specific hazard would depend on such factors as the amounts of specific radionuclides in the spent fuel rods, and site characteristics, such as the rate of potential groundwater transport of radionuclides to offsite locations. The staff also plans to review and evaluate in more detail the risk from offsite releases. Results from the ongoing environmental monitoring and radiation protection programs at the sites have demonstrated that there is no significant risk to the public or workers at this time from operations at each site.

A final consideration in the risk evaluation is the potential dose to workers from finding and exhuming the rods, if they are determined to be buried at a disposal site and if recovery of the rods is deemed necessary. The staff will also review and evaluate the potential doses from these efforts as well as whatever longer term risks might result from leaving the rods in place.

### Nuclear Proliferation Issues

The very high radiation level of the material (contact radiation level of approximately 1600 R/hr in 1980) makes theft difficult, dangerous, and very unlikely. The radiation levels also make the material of limited or no economic value. Moreover, the amount and chemical form of the fissile material contained in the two spent fuel rods make it unlikely that the rods could be used to manufacture a weapon. The uranium in the fuel rods is low-enriched uranium (2.44 percent U-235, 97.56 percent U-238). The amount of U-235 in each rod is about 50 grams. The plutonium created in each rod during its time in the reactor core is estimated to be approximately 20 grams. The 40 grams of plutonium and 100 grams of U-235 contained in the rods would result in the missing material being considered special nuclear material (SNM) of low strategic significance (10 CFR 73.2, "Special nuclear material of low strategic significance").

### Staff Monitoring and Inspection of Licensee's Investigation

Routine inspections have been conducted by Region I inspectors and by the Unit 2 resident inspector, who was formerly the resident inspector at Unit 1. Regional inspectors were on site during January, February, May, June, and August for routine inspections, including oversight of the Fuel Rod Accountability Project's spent fuel investigation. On December 19, 2000, Region I management, in a conference call with the licensee, discussed the investigation status and requested a written update, which the licensee provided to NRC and, during the conference call, NRC offered to conduct weekly conference calls. The calls began on January 2, 2001, and are expected to continue through the end of the Fuel Rod Accountability Project's investigation. The Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Material Safety and Safeguards (NMSS), and Region I staff have regularly participated in these teleconferences. Dominion Nuclear Connecticut, Inc. (DNC) visited Region I on April 23, 2001, to present a status report.

### State Interactions

NRC staff has closely coordinated with the States of Connecticut, Washington, and South Carolina on this matter. Connecticut, Washington, and South Carolina staff participate in the weekly status calls with Northeast Utilities, during which they have an opportunity not only to understand the status of the Fuel Rod Accountability Project's activities but also to ask questions and request assistance. Washington, for example, has requested assistance from Northeast Utilities in a number of areas such as identifying possible shipments to Hanford and the type of disposal container that could have been used. Washington and South Carolina staff have also closely coordinated with NRC staff on their preparatory activities and have informed their respective Governor's Offices of the possibility that the fuel rods may have been shipped to the Hanford or Barnwell sites for disposal. Connecticut staff has continued to closely monitor the Fuel Rod Accountability Project's investigation and is preparing to brief the Governor's office. The Washington Governor's Office asked the State Department of Health staff to take the lead in the State and to complete a number of preparatory activities. The preparatory activities have included briefing key State management, developing background materials, including a set of questions and answers, reviewing disposal facility records and coordinating with U.S. Ecology, the operator of the Hanford LLW site. The Washington State Department of Health staff has requested assistance from NRC staff in several areas, particularly in the development of responses to questions in its set of questions and answers.

NRC staff has also initiated periodic (approximately monthly) conference calls between South Carolina and Washington staff and key NRC staff to discuss the status of the investigation and to coordinate and share information on actions being considered or planned. During a recent call, Department of Energy (DOE) Hanford staff also participated. DOE will help Washington determine whether it is possible to "verify" the placement of the fuel rods at Hanford if shipment to Hanford as LLW is finally identified as a credible scenario by Northeast Utilities. DOE staff will also assist in answering a question from Washington on whether the placement of the fuel rods at Hanford would affect DOE's ability to assume title for the land in 2063, when State of Washington lease of the U.S. Ecology LLW disposal facility from DOE ends.

Northeast Utilities has met with key State staff, including the Governor's Office staff, to discuss the investigation at Millstone.

The staff has not actively engaged in discussions with the State of California regarding this issue since the Fuel Rod Accountability Project's only plausible scenario involving California proposes that the fuel rods were shipped to the General Electric fuel examination facility at Vallecitos. Since the General Electric facility at Vallecitos is licensed by NRC to receive and store spent nuclear fuel, among other activities, this scenario would not involve any State licensing issues. In addition, radiation protection and safeguards programs at Vallecitos would be sufficient to ensure adequate protection of the public if the fuel had been inadvertently transferred there.

#### Press and Local Interest in Event

The local newspaper for the Millstone area (The Day) has reported on the missing spent fuel rods since 3 weeks after the licensee identified the issue. Copies of several recent articles are attached. (Attachment 1).

On February 1, 2001, NRC staff from Region I and from NRR made presentations on the status of NRC activities related to the missing spent fuel to the Millstone 1 Decommissioning Advisory Committee (M1DAC), a subcommittee of the Connecticut State Nuclear Energy Advisory Committee (NEAC). Region I presented an update to the M1DAC on May 3, 2001, and met with the NEAC on May 17, 2001.

#### Congressional Interest

Congressional interest expressed to NRC involved a request from Congressman Markey dated December 20, 2000, for answers to multiple questions on the situation. Chairman Meserve responded to Congressman Markey on February 1, 2001. Copies of both letters are attached. (Attachments 2 and 3).

#### Material Control and Accounting (MC&A) Inspections

The inspection of MC&A at power reactors was a regional responsibility until 1988, when resources for MC&A inspections were deleted from the regions' budgets. After 1988 the regions performed MC&A inspections at reactors only in response to events. NRR has oversight responsibility for the regions' safeguards programs at reactors.

The Inspection Procedure (IP 85102, "Material Control and Accounting - Reactors") that the regions followed has objectives to (1) determine whether the licensee has limited its possession and use of SNM to the locations and purposes authorized under license, and (2) determine whether the licensee has implemented an adequate and effective program to account for and control the SNM in its possession. The procedure's inspection requirements include the following: "Conduct a random spot-check of new fuel, irradiated fuel in spent fuel pool, sources, test specimens, etc., by comparing actual location with that indicated on loading diagrams, transfer forms, or other accounting records, as applicable. Check ten assemblies or bundles of new and irradiated fuel, and one source, test specimen...." The inspection procedure does not specifically address individual fuel rods.

Discussions with some NRC staff who had experience conducting MC&A inspections at reactors 10 years ago indicated that the inspectors would have taken random samples from each of the distinct populations, such as fuel elements, fuel assemblies, and sources. Therefore, unless the inspectors were made aware that fuel elements were stored separately from the assemblies, a sample for inspection would be drawn from the total spent fuel pool's population of fuel elements whether in assemblies or separated from assemblies, rather than a portion from the population in assemblies and a portion from the population separated from assemblies. It is not likely that an inspector following IP 85102 would have discovered the discrepancy in the records. The version of IP 85102 discussed here was issued on March 29, 1985. NRC staff was unable to locate records of the MC&A inspections conducted at Millstone Unit 1.

An ANSI standard (ANSI N15.8-1974 , "Nuclear Material Control Systems for Nuclear Power Plants," endorsed by Regulatory Guide 5.29) that was in effect in 1979-1980 reads:

"The basic unit of control for nuclear material shall be the nuclear fuel assembly. Each nuclear fuel assembly shall be identified in the material control records by its serial numbers and location. Nuclear material contained in fuel elements, not part of an assembly, shall be separately identified in all material control records."

Under 10 CFR 70.51 and 70.58, a reactor licensee is required to keep records showing the receipt, inventory (including location), disposal, acquisition, and transfer of all SNM. Each record of receipt, acquisition, or physical inventory of SNM must be retained as long as the licensee retains possession of the material and for three years following transfer of such material. Physical inventories of SNM must be performed annually.

Nuclear power reactors are required to report to the NRC:

1. Semiannual material balance reports concerning SNM received, produced, possessed, transferred, consumed, disposed of, or lost.
2. Semiannual statements of the composition of the ending inventory .
3. A Nuclear Material Transaction Report whenever the licensee transfers or receives SNM, or when it makes corrections to its material balance.

Reports submitted to the NRC under these provisions did not indicate that the two fuel rods were no longer in the licensee's inventory, because the licensee did not apparently recognize at the time that it may have transferred the rods to another licensee.

#### Discrepancy in NUREG-0725

A representative from Millstone called the Spent Fuel Project Office staff in mid-May 2001 to ask why the NRC revised the spent fuel shipment data for shipments of spent fuel from Millstone to the GE-Valleccitos facility in the 1991 issuance of "Public Information Circular for Shipments of Irradiated Reactor Fuel," NUREG-0725, Revision 7. The earlier issuances of NUREG-0725 beginning with the first issuance in 1980 (Revision 0) through the 1989 issuance (Revision 6) reported the total spent fuel shipped in three shipments from 1980 - 1983 to be 36 kgs of combined element net weight of uranium and plutonium. The 1991 Revision 7 of NUREG-0725 changed that total to 43 kgs.

Based on the staff's review of the files, the staff concluded that the 1991 revision to the NUREG-0725 report changing the total shipped from 36 kgs to 43 kgs was an error by the staff. The correct total for the 1980 - 1983 shipments should be 36 kgs.

#### Agency Obligations/Regulatory Authority

NRC and Washington State or South Carolina share regulatory authority if the missing fuel rods are determined to be located in the LLW sites in Washington State or South Carolina (storage at GE-Vallecitos would be authorized under existing NRC license).

As a general rule, NRC retains regulatory authority over spent nuclear fuel and greater-than-Class C material associated with reactor operations. As provided in Section 111(b)(2) of the Nuclear Waste Policy Act of 1982 (NWPA), the disposal of spent fuel is a Federal responsibility. The NRC has not relinquished, in any agreement with an Agreement State, regulatory authority for spent fuel stored at a reactor site. In this case, if it is determined that the NRC licensee transferred spent fuel to an LLW site, it was an unauthorized transfer, since it was not authorized by the Commission's regulations or Millstone's license. In addition, NRC could determine that the recipient is in unauthorized possession of the material. Thus, if the spent fuel is determined to be at the LLW site in Washington State or South Carolina, NRC has the regulatory authority to require appropriate remedial action to be taken by its licensee and, if warranted, to require the spent fuel to be returned to an entity authorized to possess it. The exercise of that authority would depend on the circumstances, with the health and safety impacts of recovering the fuel and returning it to an entity authorized to possess it balanced against the impacts of leaving it at the burial site.

Washington and South Carolina, as Agreement States, regulate disposal of LLW at the Hanford and Barnwell sites respectively. The States' license includes authorization to dispose of limited quantities of SNM in accordance with Section 274 of the Atomic Energy Act of 1954, as amended. If the spent fuel is determined to be at the LLW site in Washington State or South Carolina, even though the fuel may be within the SNM limits in the license, Washington or South Carolina will likely determine that it was not an authorized disposal, since the State's license did not authorize its licensee to dispose of spent fuel. Spent fuel is explicitly excluded from the definition of low-level waste in 10 CFR 61.2 and compatible State regulations. Thus, if the spent fuel is found at the LLW site in Washington State or South Carolina, the States have the complementary regulatory authority to require remedial action to be taken and, if warranted, to require the spent fuel to be returned to an entity authorized to possess it.

#### PLANNED STAFF ACTIONS

##### Communication Plan

A communication plan has been developed to ensure that the appropriate staff personnel and stakeholders are informed of new developments in the Fuel Rod Accountability Project's investigation and NRC's follow up. A copy of the plan is attached. (Attachment 4).

### Notifications

Once the licensee determines the spent fuel rods are lost, it will have to make a notification to the Operations Center within one hour under the provisions of 10 CFR 70.52. When this notification is received, the staff will inform other Federal agencies that could receive press inquiries such as the Department of Energy, the Federal Emergency Management Agency, and the Environmental Protection Agency and the State agencies. The purpose of this notification will be to ensure that the other agencies have a clear and common understanding of the situation and that there is no present hazard based on NRC's present understanding of the situation.

### Follow-up Inspection

As discussed above, routine inspections have been conducted by Region I inspectors and by the Unit 2 resident inspector, who was formerly the resident inspector at Unit 1. Following up on these routine inspections performed at Millstone 1, the NRC staff is planning a special inspection to be conducted after the Fuel Rod Accountability Project's final investigative report is submitted. This inspection, to be led by Region I with assistance from NRR, NMSS, and OSTP, will enable the staff to independently assess actions taken by the licensee and Northeast Utilities.

The general objectives of this inspection are to:

1. Conduct a thorough and systematic review of the Fuel Rod Accountability Project's investigation into the circumstances of spent nuclear fuel missing from the Millstone 1 spent fuel pool. Determine the adequacy of the Fuel Rod Accountability Project's investigation, based upon its completeness and the thoroughness of records reviews and interviews.
2. Assess the Fuel Rod Accountability Project's determination of root cause. Identify alternative causes if appropriate. Develop independent conclusions regarding what caused the loss of the spent fuel rods, if it is determined that the rods are, in fact, lost.
3. Independently verify selected Fuel Rod Accountability Project records and interviews.

### Potential Enforcement

If the NRC staff determines that regulatory requirements concerning accountability, possession, packaging, and transportation have been violated, the staff will consider whether enforcement action should be taken.

### Options for Addressing Potential Disposal of Fuel Rods at an LLW Disposal Site

Although the location of the fuel rods, or portions of the fuel rods, is still unknown at this time, Northeast Utilities is nearing the completion of its inspection of the spent fuel pool, and may soon conclude that the rods are not on site. The focus of the investigation will then turn to their possible disposal at an LLW site, either the U.S. Ecology facility in Richland, Washington, or the Duratek facility in Barnwell, South Carolina. As noted in an earlier section of this paper, the NRC staff has been coordinating with these States on the possibility of such disposal of the fuel rods,

and the NRC staff has thus far generally addressed safety and jurisdictional issues. With a conclusion that the rods are not on site, however, specific actions will need to be taken to address disposal at an LLW site.

The fundamental issues associated with disposal are whether the rods, or portions of rods, can be located in a disposal trench and whether they should be exhumed. The NRC staff is taking a number of steps to obtain the information needed to address these issues. First, the NRC staff plans to perform its own scoping analysis of the potential safety impacts from the possible disposal of the fuel rods in either LLW site. The NRC staff will examine the potential impact on an inadvertent intruder, using assumptions similar to those used in the development of 10 CFR Part 61 and in Washington State's approval of the disposal of the Trojan reactor vessel at the U.S. Ecology LLW facility in Richland, Washington. The NRC staff will also evaluate the potential long-term dose impacts to an offsite individual from potential leaching of the radionuclides in the fuel rods into groundwater. Although the inventory of radioactivity is low (300 curies) compared to the total inventory at the sites (millions of curies), some longer lived radionuclides in spent fuel need to be considered.

The NRC staff is evaluating with the States of Washington and South Carolina plans to obtain more in-depth evaluations of the impact of the potential disposals of the fuel rods. Any organization that conducts such studies would need to have the special expertise required for this work, have access to the extensive site and waste characterization data and assumptions used in computer modeling of radiation exposures to members of the public, and be acceptable to all of the principal stakeholders. In addition, arrangements for funding of such a study by the utility would need to be worked out. To determine potential safety impacts, the NRC staff, in coordination with the States, has begun initial planning for determining if the rods can be located and exhumed. The NRC staff will evaluate the feasibility of such investigations, if exhumation is necessary, and will use this information for generally defining the work that may be required. Some of the issues being examined are whether radiation detection equipment is capable of locating fuel rods in the trenches, whether boreholes or larger scale removal of trench covers might be needed for detection, and what the potential dose impacts would be to workers involved in these efforts. An important consideration will be the risks associated with leaving the material in place over the long term, as compared with the risks (i.e., dose to workers) associated with removing it. The principal objectives at this time are to investigate feasibility, obtain consensus with State officials on approaches, and develop information for defining what work may have to be performed by the utility or its contractor in locating the rods on site.

### Long-Term Actions

The staff is considering the following long-term actions:

1. Issue generic correspondence as appropriate for root cause determination.
2. Determine if the current NRC requirements for tracking and reporting SNM transactions provide information adequate for complete accounting of spent nuclear fuel.

3. Identify and recommend changes to NRC regulations and NRC oversight concerning special nuclear material control and accounting at power reactors that may be necessary to prevent similar incidents from occurring. Ensure affected states, other NRC and state licensees, and other stakeholders are kept informed of the NRC activities.
4. The Commission will be informed of significant developments pertaining to this issue.

Unless otherwise directed by the Commission, this paper will be made public 5 days after issuance.

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William D. Travers  
Executive Director  
for Operations

- Attachments:
1. Selected Newspaper Articles
  2. Letter from Congressman Markey dated December 20, 2000
  3. Reply to Congressman Markey dated February 1, 2001
  4. Communication Plan

# Top Mid-Columbia Stories

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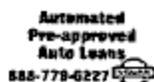
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## Nuclear fuel rods' location elusive

This story was published 7/11/2001

**By John Stang**  
Herald staff writer

Two lost Connecticut nuclear fuel rods could be buried at US Ecology's low-level radioactive waste site at Hanford.

Or maybe they're stashed away at a similar site in South Carolina.

A lab near San Francisco is a possibility.

Heck, the two rods could still be hidden in the giant pool of water in Connecticut where they were last confirmed seen about 21 years ago.

Right now, no one knows.

"They're just as likely not to be here, as they could be here," said Jeffrey Merrifield, a commissioner on the Nuclear Regulatory Commission Tuesday in Richland.

These two rods -- thin zirconium and aluminum alloy cylinders 13 feet long, a 12-inch thick and filled with depleted uranium pellets -- are the only fuel rods that have been totally lost in American nuclear history, according to the Hartford Courant newspaper in Connecticut. The only other American case of lost nuclear fuel involved a piece smaller than a rod.

If the rods show up at US Ecology's site, the risk

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to people is almost nonexistent, NRC officials said. "As an immediate health and safety concern, that is not the issue," Merrifield said.

The rods hold about 300 curies of radiation, which are masked among the at least 3 million curies radiating from material already buried at US Ecology's site, he said. However, the highly radioactive fuel takes much longer to decay than low-level radioactive wastes.

It is premature to speculate on any potential health or environmental risks until it is confirmed the rods are buried at Hanford and their conditions are known, said John Erickson, director of the radiation protection division for Washington's Department of Health. The state health department is briefed weekly on the search for the rods.

"The utility (that lost the fuel) still believes the rods are in the spent fuel pool," Erickson said.

US Ecology officials could not be reached for comment Tuesday evening. US Ecology is a private company that leases some central Hanford land for a commercial low-level waste site.

According to NRC officials and the Hartford Courant, this is what happened:

The two rods come from Unit No. 1 at the three-reactor Millstone complex in Connecticut that Northeast Nuclear Energy Co. owned until four months ago. In 1972, operators bent the two rods during some repair work, making them useless in the reactor's core, where the fuel has tight tolerances to function properly.

So the rods were put in a long container, which was stored in the 45-foot-deep, water-filled spent fuel basin next to the reactor.

Then last December, Northeast Nuclear workers inventoried the fuel in the basin to prepare for selling the Millstone complex to Dominion Nuclear Connecticut for \$1.3 billion the following April. Workers could not find the two rods in the basin, and the latest paperwork confirming their presence is dated 1980.

Wine Press

Northwest

Snake Dams

Hanford Reach

The Millstone spent fuel basin holds about 140,000 fuel rods. That basin also holds other equipment, containers and control rods -- much of which can be classified as low-level radioactive wastes.

Meanwhile, the NRC is keeping tabs on Northeast Nuclear's search with the utility expected to send a report on the matter to the federal agency in one or two months, Merrifield said.

Occasionally, Northeast Nuclear sent fuel rods to General Electric Co.'s Valecitos lab near San Francisco, which examines damaged fuel rods, Merrifield said. And the possibility exists that the container holding the two rods was mistaken for low-level radioactive wastes and removed from the basin.

So if the rods are not verified not to be in Millstone's basin, it is possible they might have been sent to the GE Valecitos lab, US Ecology's Hanford site or Chem-Nuclear's low-level radioactive waste site in Barnwell, S.C.

Although US Ecology's Hanford site can legally accept waste from only 11 Western states today, it was allowed to receive wastes from all over the nation in 1980, Merrifield said.

If the fuel rods went to Hanford or Barnwell, they would have been shipped in containers with enough shielding to protect people near them and to mask the highly radioactive fuel from the standard checks conducted at the two low-level waste sites, Merrifield said.

If it is verified that the rods went to Hanford, they would not be immediately dug up because of the risk to those excavating them, NRC and state officials said. Plus the rods likely would be buried deep, making exposure risk slight, they said.

If this scenario materializes, studies would be needed to determine the next move, Erickson said.

Meanwhile, the NRC would have to figure out the circumstances of how the fuel was lost before deciding if any fines or increased scrutiny are called for, NRC officials said.

In 1999, Northeast Nuclear pleaded guilty in federal court to willful pollution and falsifying training records -- resulting in a \$10 million fine.

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## Watchdog group has scenario for missing fuel rods

By [Paul Choiniere](#) - [More Articles](#)

Published on 5/30/2001

**Waterford** — The missing spent nuclear fuel rods at the closed Millstone 1 nuclear plant may have been mistaken for tubes used to monitor reactor activity, cut into pieces and shipped in a container to a low level radioactive waste dump, according to the Union of Concerned Scientists.

The organization monitors activity at the nation's nuclear plants and has been critical of Millstone Nuclear Power Station's failure to keep track of the fuel rods.

A spokeswoman for Northeast Utilities confirmed that the scenario described by the Union of Concerned Scientists is one of many that is being looked at as part of an internal investigation into the misplaced fuel rods. The spokeswoman, Deborah Beauchamp, said interviews with current and former Millstone 1 employees began nine days ago. She said it was far too soon to speculate about what happened to the fuel rods.

"The scenario outlined is no more or less likely than any of a number of scenarios that are being looked at," she said.

The missing rods are also the subject of a federal investigation that could result in criminal charges.

David Lochbaum, a nuclear engineer with the Union of Concerned Scientists, said the component referred to in the organization's scenario is the one that most resembles a fuel rod. Called an **LPRM dry tube** — **Local Power Range Monitor** — it is about the same size and shape as a fuel rod.

Nuclear instruments are inserted through the dry tubes into the reactor to calibrate core monitoring systems. There are more than three dozen of the tubes in the reactor and they have to be replaced every several years, he said.

Damaged and worn out dry tubes are stored in the plant's waste storage pool to allow them to radioactively cool before disposal. Using remotely-operated equipment, they are chopped up into two- and three-foot sections under the water and placed in disposal canisters for shipment to a low-level radioactive waste dump.

It is possible, Lochbaum said, that the missing fuel rods were chopped up in the same manner without the equipment operators ever realizing what they were. The storage container used to shield the radiation would have prevented detection of the rods by radiation monitors when the container was removed from the pool and shipped.

According to the Union of Concerned Scientists, the missing fuel rods contain 101.4 grams of fissile uranium and 40.2 grams of plutonium. They should produce a dose rate of 850 Rem per hour, enough to cause a lethal radiation exposure in about 30 minutes, Lochbaum said. By comparison, a fuel assembly that has just been removed from a reactor produces enough radiation to kill in seconds.

Lochbaum said all the evidence suggests that if the fuel pins were shipped and disposed, they were inside a radiation-safe container and pose no threat to public health. Lochbaum said he believes that if the fuel pins were misplaced within the storage pool, they would have been found by now.

"The pool is large, but not that large," he said. "We're not talking about searching the ocean for a needle."

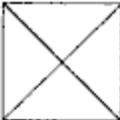
Beauchamp, however, said misplacement of the fuel rods in the pool remains a viable possibility.

Though Northeast Utilities sold the Millstone Nuclear Power Station to Dominion Nuclear Connecticut in April for \$1.3 billion, NU remains in charge of the missing fuel investigation because the fuel rods were misplaced on its watch.

Millstone 1 last operated in November 1995. Millstone 2 and 3 continue to operate at the nuclear station.

On Dec. 14, 2000, the Nuclear Regulatory Commission was officially notified that the rods could not be accounted for. The rods are 13-feet, 2-inches long and about one-half inch in diameter. The two fuel rods were damaged and removed from a fuel assembly in October 1972. A map dated April 30, 1980, showed the fuel rods located inside a storage canister in the Millstone 1 spent fuel pool. The next spent fuel map, dated Sept. 18, 1980, showed neither the canister nor the fuel rods.

By the end of the summer NU expects to complete the internal investigation into what happened

to the fuel rods. 

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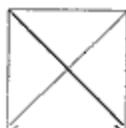


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## They've Gotta Be Somewhere

By [Kenton Robinson](#) - [More Articles](#)

Millstone 1 officials visited King of Prussia, Pa., recently to tell the Nuclear Regulatory Commission what they think happened to the two fuel rods that went missing during a high-level radioactive waste inventory in November.

During this meeting, Frank Rothen, vice president of nuclear services for former Millstone owner Northeast Utilities, said that when investigators make a final report on the matter in June, they either will have (a) found the lost fuel rods or (b) found that they cannot find the fuel rods.

If it turns out to be (b), he said, they will make an educated conjecture as to where they might be.

Meanwhile, they are investigating 27 "plausible" scenarios as to how these items may have gotten lost.

If that seems like a lot of scenarios, consider this: Bob Fairbank, project manager for the investigation, said this list was narrowed down from 72.

We don't mean to seem unsympathetic. Who among us hasn't lost her car keys or even — from time to time — his car?

And we recognize that this is serious business. After all, lost radioactive fuel rods are not the same as lost car keys.

(For one thing, the fuel rods are about a half-inch in diameter and 13 feet long and tend to pose a slightly larger hazard to living things.)

But we couldn't help but wonder: If the best you can do after considering 72 scenarios is to come up with an educated conjecture, then have you really considered all the possibilities?

We did a little brainstorming here, tapping into our own experiences, and came up with over a dozen scenarios that we're willing to bet were never even considered.

We think one of the following could explain the missing fuel rods:

n They fell into the crack behind your sofa cushions.

n The cleaning lady misplaced them. This happens to us all the time. Whenever our cleaning lady comes to tidy up, it takes us weeks to find everything she has "put away."

n Have you looked in the back of the fridge lately? Yeah, back there behind that cottage cheese with the green hair.

n They're under those leaves you never got around to raking up last fall.

n Remember last year's employee picnic? Remember that skinny barbequed kielbasa that somehow just didn't taste right?

n Someone's kids took them to school for show and tell.

n The guys on that MTV Jackass show used them as poles for their urban gondolas. (Kids, please, don't try this at home.)

n They're right in front of you. You know how when you're looking for something, it's sometimes in plain sight? What are those things you've been stepping over as you walk into your offices every day? As our mother always said, "If they were a snake, they would have bitten you."

n They're parked about halfway down Row Z34 in the mall parking lot.

n They have vanished into another dimension beyond time and space.

n They're with the elusive red map. You know, the original red-lined map showing the boundaries of the Mashantucket Pequot Tribe's federally established reservation that everyone's been looking for.

n They — and you and the red map — are merely constructs of the matrix.

n A Star Trek crew came back and retrieved them to save the universe during one of those time travel episodes.

n Space aliens abducted them for use as anal probes. Think about that the next time you're abducted.

n Homer Simpson threw them out the car window.

Oh sure, we know what you're going to say: These are not "plausible" scenarios.

But how plausible is it that a nuclear power plant just happened to misplace two highly radioactive fuel rods?

As we said, these ain't car keys.



## Nuclear fuel rods still missing after further searching

*Spots in storage pool most likely to contain rods already examined*

By [Paul Choiniere](#) - [More Articles](#)

Published on 2/2/2001

**Waterford** — The odds are increasing that officials at Millstone Nuclear Power Station may never be able to account for two spent nuclear fuel rods first discovered missing in November following an audit of the spent fuel storage pool.

Robert V. Fairbank, project team manager for the missing fuel investigation, said personnel recently completed searching those sections of the Millstone 1 spent fuel storage pool considered most likely to contain the fuel rods. The search of those areas, accounting for about 20 percent of the pool, turned up nothing.

"We had every expectation that those efforts would result in us finding those rods, but unfortunately that wasn't the case," Fairbank said.

The update on the missing fuel rod situation was provided to the Millstone 1 Decommissioning Advisory Committee during a meeting Thursday night held at the station's training center. Only a few members of the general public attended the meeting.

Plant personnel are now digging in for an extensive search that could drag into the summer, extending past the April 1 date when Dominion Resources Inc. is scheduled to finalize its \$1.3 billion purchase of Millstone from Northeast Utilities. Frank Rothen, vice president of decommissioning activities at the closed Millstone 1 plant, said the investigation team would remain in place after Dominion takes control.

Fairbank said the next several weeks will be spent planning how to search the other 80 percent of the spent fuel pool, sections where the highly radioactive nuclear waste is packed more tightly together and where there are fewer "nooks and crannies" where the fuel rods could have been inserted. The company is also examining thousands and thousands of records for some clue as to what happened to the two errant rods.

Also in attendance at Thursday's meeting were representatives of the Nuclear Regulatory Commission. Todd J. Jackson, a health physicist with the NRC, said the agency has confirmed that this is the first time in the history of the nuclear industry that spent nuclear fuel has not been accounted for.

Michael T. Masnik, chief of the decommissioning section of the NRC's Division of Licensing Project Management, said the case is being viewed with great seriousness by the federal regulatory agency. Failure to account of nuclear fuel is a violation of federal regulations, but Masnik refused to speculate what action the agency may ultimately take. At this point it will continue to monitor NU's investigation.

Joseph Coleman, an East Lyme resident and member of the advisory committee, said it appears ever more likely the fuel rods will never be located. If the fuel rods are not found in the pool there will be no other options to pursue, he said.

"It seems to me that at that point there's not much more you can do, except run up the flag and say, 'We lost them,'" Coleman said.

The last reference to the fuel rods in Millstone records, dating back 20 years ago, stated the rods were stored in a special container in a corner of the 38-foot deep storage pool.

Masnik said there is no reason to believe the fuel rods pose a threat to public safety. NU officials have said the two fuel rods might have either been moved to a different location in the spent fuel storage pool and the change not properly recorded, or they could have been accidentally shipped off site to low-level radioactive waste dumps in either South Carolina or the state of Washington. In either case, say company officials, they would be safely contained.

Legally, there is no place to take spent nuclear fuel in this country. Shipping the two fuel rods, accidentally or not, would have been a violation of federal regulations. Masnik said if it is determined the fuel rods were shipped, the NRC will then have to determine if it is better to retrieve them or leave them be.

A records review discovered the problem of the misplaced rods and an internal Millstone report was filed Nov. 16. May 1979 engineering notes refer to the two fuel rods — 13-feet, 2-inches long and a half-inch in diameter — as being stored in a special container in the northwest corner of the pool. An April 1980 report confirmed that location. But a September 1980 inventory of the spent fuel pool makes no mention of the fuel rods, first removed during an inspection of possible fuel rod damage in 1972.

A special crane and remote cameras are being used to conduct the storage pool search.

The NRC officials said they do not expect the incident to hold up the sale to Dominion and NU executives have promised to take full responsibility for the cost of finding them and any liability that may result. ■

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January 8, 2001

## A Sheepish Hunt for Missing Fuel Rods

By DAVID M. HERSZENHORN

**W**ATERFORD, Conn., Jan. 6 — If they could enlist the public in their high-pressure search, officials at the huge Millstone nuclear power plant here would be forced to post a sign saying something like this: "Lost: two spent nuclear fuel rods, 12 feet long and slender as a pinkie finger. Last seen in April 1980. Highly radioactive. May have been mistakenly shipped to South Carolina or Washington. Reward."

It may sound like a scene from "The Simpsons," but Millstone's predicament is quite real and, federal regulators say, unprecedented in the nation's highly regulated atomic energy industry. While there is virtually no risk to the public — wherever they are, the rods are almost certainly stored safely, officials say — their misplacement has both alarmed people who live near Millstone and highly embarrassed the plant's operators.

The episode is the latest black eye for Millstone, which is about to be sold and has been trying to rebuild its reputation after garnering one of the worst safety records of any nuclear power plant in the country. In the mid-1990's, all three of the reactors at Millstone were closed for safety violations; units 2 and 3 have since reopened. Officials decided it was not cost effective to reopen Millstone 1. And in 1999, the nuclear subsidiary of Northeast Utilities, which owns Millstone, pleaded guilty to 23 federal felonies and was fined a record \$10 million.

Rather than fear, the general reaction on all sides has been a mixture of frustration, dark humor, disgust and disbelief. "It seems unbelievable to me, with all the experts you have over there, how you could lose something like this," a grandmother and retired correction officer, Billie Staub, told plant officials at a public hearing in Waterford Town Hall on Thursday night. Another person asked if they realized they were the "laughingstock" of the industry.

Chagrined Millstone managers seemed to realize this only too well. At the hearing, they offered two theories, that the rods were still somewhere in the plant's spent fuel pool or that they had mistakenly been shipped to an out-of-state disposal center. "We're not at all pleased that it happened," said the decommissioning officer for Millstone 1, Frank Rothen. "The feeling is that's the only two places it could be."

While a mistaken shipment of spent fuel would constitute a violation of federal regulations, neither scenario would present any danger to the public, regulatory officials said. Still, the explanations were met with anger and derision from local residents who have long been suspicious of Millstone because of its checkered past. "Maybe they're in the town dump," one heckler at the meeting called out. "Or on the Little League field."

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For conspiracy theorists, the disappearance of two highly radioactive fuel rods offers a chance for breathless speculation. Reconstituted fuel rods could, theoretically, be used to make plutonium. Perhaps the rods were stolen by international terrorists. Or domestic militia members. Or maybe it was a political plot, an effort to discredit Northeast Utilities just as it is preparing to sell Millstone to Dominion Resources, a Virginia energy company.

But even some of Millstone's staunchest opponents concede that there is virtually no way the rods could have left the plant in anything but a properly protected shipping cask without setting off numerous alarms. "Superman, maybe," said Pete Reynolds, a former Millstone employee who worked on the refueling floor and said he was fired in 1994 after reporting safety violations. "These are not made out of kryptonite. He's the only one I know of that could have walked away with it."

Mr. Reynolds added, "Anybody with any common sense that knows anything at all about nuclear power, they are just laughing."

The federal Nuclear Regulatory Commission, however, did not seem amused. "Obviously we are concerned that they are not able to trace where these rods are," said Diane Screnci, an agency spokeswoman. "We are maintaining close contact to stay up on the status of this investigation."

Officials discovered that the two rods were missing in November during a routine inventory conducted as part of the effort to decommission the plant's original reactor, Millstone 1, permanently. Millstone documents last account for the rods in April 1980, listing their location in a container in the plant's spent fuel pool. But as of September 1980, plant records no longer accounted for them.

Last month, officials carried out an initial search of the pool, more than 900 square feet of borated water, 40 feet deep, where old fuel rods and other radioactive garbage and debris are kept. The pool contains nearly 2,900 bundles of rods called fuel assemblies. But they found no sign of the two missing rods.

One reason they are difficult to locate is that they were not part of a bundle that rods are usually kept in.

The General Electric Company, which manufactured the rods, had removed them from the bundle in 1972 to make some repairs. In the process, one was damaged and the other could not be refitted into the bundle. Instead, they were stored in a container and put into the spent fuel pool, said Peter Hyde, a Millstone spokesman.

A team of experts from G.E.'s nuclear division are now in Waterford to assist Millstone with a more thorough search of the spent fuel pool. Millstone officials, who stressed that whatever mistake that was made occurred two decades ago, said they are also searching through hundreds of thousands of pages of old records to figure out what happened.

If the rods are not in the pool, one possibility is that they were mistaken for long tubelike radioactivity monitors that plant employees use and often dispose of in the spent fuel pool. Discarded monitors are often cut up and shipped off with other

radioactive garbage to low-level waste centers. The radioactive waste is wrapped in a liner and shipped in a special cask, both of which are made with lead and concrete. At the dump sites, the waste is buried in accordance with federal regulations.

On the streets of Waterford and neighboring Niantic, those who knew about the missing rods seemed more disappointed than scared. "The fact that there was an error is ridiculous," said Deborah Cohen, a tile artist, standing outside a local supermarket. "This shouldn't happen in a nuclear power plant ever."

At the public hearing, Ellen Lazerow asked if Millstone officials "behind closed doors" had ever looked at each other, uttered an expletive and wondered, "What's the worst-case scenario?" Larry Temple, the general manager of Millstone 1, pondered the question for a couple of seconds before replying, "I would have to say, yes."

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## Missing fuel rods no risk to public, NU officials say

*Audience skeptical at meeting on decommissioning*

By [Paul Choiniere](#) - [More Articles](#)

Published on 1/5/2001

**Waterford** — Officials involved with the decommissioning of the closed Millstone 1 nuclear plant tried to reassure an often-skeptical audience Thursday that the failure to account for two misplaced radioactive fuel rods poses no threat to public safety.

A discussion about the fuel rods dominated the meeting of the Millstone 1 Decommissioning Advisory Committee. The group's meetings are usually sparsely attended, but Thursday's session attracted about 50 people who squeezed into a basement meeting room in Town Hall.

After listening to repeated assurances from Millstone officials that there is no public safety threat, advisory panel member Geri Winslow of Waterford said she had heard enough.

"I don't know how you can keep saying there is no danger since you don't where they are. The danger to public safety may be remote, but there has to be some," Winslow said.

The officials insisted, however, that they are sure the high-level radioactive waste material is somewhere safe, they are just not sure where.

Bryan Ford, who is director of decommissioning at Millstone 1, said the two fuel rods might have been moved to a different location in the spent fuel storage pool and the change not properly recorded. Or they could have been accidentally shipped off site to low-level radioactive waste dumps in either South Carolina or the state of Washington. In either case, Ford said, they would be safely contained. Ford works for Entergy, the New Orleans-based company hired by Northeast Utilities to decommission and dismantle much of the Millstone plant.

There is no other reasonable explanation as to where the fuel rods could be, Ford said. If the fuel rods had been moved without the proper storage canister numerous alarms would have sounded, he said. And there is no place the canisters could have gone except to a licensed disposal site.

The problem for Millstone-owner Northeast Utilities is that, legally, there is no place to take spent nuclear fuel. Shipping the two fuel rods, accidentally or not, would have been a violation of federal regulations.

A Millstone assessment team concluded the probability that the fuel rods are in the storage pool is equal to, and perhaps slightly greater than, the probability that they were shipped.

A records review discovered the problem of the misplaced rods and an internal Millstone report was filed Nov. 16. May 1979 engineering notes refer to the two fuel rods — 12 feet long and the thickness of a man's finger — as being stored in a special container in the northwest corner of the pool. An April 1980 report confirmed that location. But a September 1980 inventory of the spent fuel pool makes no mention of the fuel rods, first removed during an inspection of possible fuel rod damage in 1972.

Inspections of the storage pool using remote cameras have turned up nothing. On Saturday, Millstone workers, assisted by General Electric personnel, will begin lifting fuel assemblies out of their storage racks

in the pool. Cameras will be used to examine the rack for signs of the fuel rods. There are 2,884 fuel assemblies stored in the pool and the inspection will be a painstaking process taking as long as three months, said Frank Rothen, vice president of nuclear services and the NU official who is overseeing the decommissioning by Entergy.

At the same time, Ford said, tens of thousands of documents are being reviewed to see if any refer to the two fuel rods.

"We feel like the answer is in there somewhere, in the paper trail," said Larry Temple, general manager of decommissioning and an Entergy employee.

Rothen refused to speculate whether the missing fuel rod problem could delay the transfer of Millstone ownership to Dominion Entergy, a sale that is supposed to be finalized in April. To break up the NU monopoly and encourage competition in the electric power industry, Millstone station and its two operating reactors were offered for sale at auction. Entergy bid \$1.3 billion.

Bob Blodgett, a Waterford resident, said Millstone may be operating well now, but has a history of slipshod operations.

"How can we say alarms didn't go off and were ignored?" asked Blodgett. "You guys have inherited a lot of deceit and mistrust that were associated with that plant."

Nancy Burton, attorney for the Connecticut Coalition Against Millstone, called the mix up over the fuel rods "a betrayal of the public trust."

But Ronald McKeown, director of the group Friends of a Safe Millstone, said that while the misplaced rods is not good news, the company's openness about it is.

"This new leadership of Millstone has lived up to their word of rectifying problems and protecting the public," he said. "We have every hope and expectation that a strong adherence to safety and sense of responsibility to the public will continue." ■

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## Public invited to quiz Millstone officials about missing fuel rods

*Meeting Thursday will delve into the incident*

By [Paul Choiniere](#) - [More Articles](#)

Published on 1/3/2001

**Waterford** — The public will have its first chance to ask questions about the missing fuel rods at the Millstone 1 nuclear plant when a citizens' advisory committee meets Thursday at Town Hall here.

Pearl Rathbun of Niantic, co-chair of the Millstone 1 Decommissioning Advisory Committee, said plant personnel will provide the committee an update on efforts to locate the two fuel rods. The meeting begins at 7 p.m. There will be an opportunity for the public to ask questions and make comments, she said.

During an inventory in November of the spent nuclear fuel stored at the Millstone 1 plant it was discovered that the two fuel rods could not be accounted for. According to Northeast Utilities, the high-level nuclear waste may have been accidentally shipped to a low-level radioactive waste facility in Washington or North Carolina. It also may still be in the storage pool, but not in the location where it was supposed to be.

### Not seen as a public threat

Spent nuclear fuel is considered high-level radioactive waste and its disposal at a low-level facility would be a federal violation, the company has conceded. NU has said the missing spent fuel does not pose a public health threat.

Millstone 1 has not operated since 1995. The spent fuel was inventoried in preparation for the sale of Millstone Nuclear Power Station to Dominion Energy. In April the Virginia utility is expected to take ownership of Millstone station, which also has two operating reactors.

The spent fuel rods are about a dozen feet long and the width of a man's finger. In 1972 a bundle of the fuel rods was examined for potential damage. In the process the two now-missing rods were bent and could not be reused. A document dating to April 1980 refers to the fuel being stored in the pool, but in a follow-up inventory conducted in September 1980, there is no mention of the two rods.

Pete Hyde, an NU spokesman, said company personnel, using remote cameras, are now doing an "exhaustive search" of the spent fuel pool where the highly-radioactive nuclear waste is stored.

General Electric, which manufactured the plant and the fuel, is assisting in the operation.

The 12-member nuclear advisory committee was appointed by the state's Nuclear Energy Advisory Council to monitor the progress of dismantling the closed nuclear plant. Until the news of the missing spent fuel surfaced, the decommissioning had proceeded without incident.

Like most people who heard the news, Rathbun said she was surprised to learn two fuel rods could not be accounted for.

"My reaction was: 'They're 12-foot long and very radioactive, aren't they a little hard to misplace?'" she said. ■

## Activists: Missing rods reason for NRC review

By [Paul Choiniere](#) - [More Articles](#)

Published on 12/23/2000

**Waterford** — The Nuclear Regulatory Commission wants to take a closer look at whether the misplacement of two spent fuel rods at the Millstone 1 nuclear plant raises doubts about the ability of the company to safely handle more spent fuel at its Millstone 3 reactor.

On Nov. 28 Northeast Utilities received approval of a license amendment that allows it to increase the amount of spent fuel in the Millstone 3 storage pool from 756 assemblies to 1,860 assemblies. Each assembly has 264 spent fuel rods. The company needs the additional capacity to handle the spent fuel the plant will produce from now until its license expires in 2025.

Anti-nuclear activists had attempted to block the license amendment, contending that the addition of more spent fuel would increase the chance of a nuclear accident, particularly if mistakes are made in the way the spent fuel rods are organized in the storage pool.

On Oct. 26 the best hope for stopping the amendment appeared to pass when the Atomic Safety and Licensing Board denied the request for a full-fledged evidentiary hearing. The board ruled that Millstone operators have demonstrated the ability to safely handle the increased fuel storage.

But given the new information that two spent fuel rods were misplaced at the closed Millstone 1 plant, the Connecticut and Long Island Coalitions Against Millstone are asking that the matter be reopened. The five-member Nuclear Regulatory Commission has ordered the licensing board to consider the request to reopen. The board, in turn, has ordered NU and the NRC staff to file responses to the coalitions' motion by Jan. 8.

Meanwhile U.S. Rep. Edward J. Markey, D-Mass., a member of the Commerce Committee, has written to NRC Chairman Richard A. Meserve asking for a full accounting of all the facts surrounding the missing fuel rod problem.

"The regulation of nuclear material is vital to protecting our public's health and safety," wrote Markey. "Therefore, I urge the commission to thoroughly investigate this matter and to take steps to prevent similar incidents from occurring in the future."

Nancy Burton, the attorney representing the coalitions, said if given the chance, her clients could make a very good case that the misplacement of highly radioactive fuel rods shows that plant operators are not prepared to safely handle a larger amount of fuel storage at Millstone 3.

Pete Hyde, a company spokesman, said it would fully comply with any orders issued by the NRC. He said the plans at Millstone 3 and the issue of the missing fuel rods at Millstone 1, a problem dating back 20 years or more, are totally unrelated.

One of three reactors at Millstone station, Millstone 1 last operated in 1995 and has been permanently shut down. Millstone 2 and 3 are fully operational.

Workers at Millstone 1 are trying to locate the two fuel rods in the spent fuel storage pool at the plant.

They say it is possible that the fuel rods were accidentally shipped off site, most likely to low-level radiation waste dumps in South Carolina or Washington. That the fuel rods were not where they were supposed to be was discovered during an inventory of all nuclear waste at Millstone station. The inventory was conducted in preparation for transferring Millstone ownership to Dominion Energy of Virginia.

Spent fuel is considered high-level radioactive waste and its disposal at a low-level facility would be a federal violation.

The spent fuel rods are about a dozen feet long and the width of a man's finger. In 1972 an assembly was examined for potential damage and, in the process, the two now-missing fuel rods were bent and could not be used. A document dating to April 1980 refers to the fuel, but in a follow-up inventory conducted in September 1980, there is no mention of the two rods. ■

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**OPINION**

**Looking For Pins In A Hot Haystack**

By **CHRISTOPHER KEATING**  
**The Hartford Courant**

December 20, 2000

It's not like misplacing a pair of gloves.

Those could be stuffed into a pocket, perched on a dresser, kicked under the car seat - maybe left at the supermarket.

But how do you lose track of two 12-foot nuclear fuel pins that - if anybody tried to walk away with them - would deafen the thief with alarms before he dropped dead of massive radiation?

Although they aren't sure how it happened, officials at the now closed Millstone 1 nuclear plant learned last month that an apparent record-keeping error 20 years ago has left them unable to locate two highly radioactive pins.

Officials believe the pins are either sitting safely with 140,000 others in a 45-foot-deep storage pool at the nuclear complex in Waterford or were safely shipped to a nuclear facility in California.

"Wherever they are, we're certain they're safe," said Peter Hyde, a Millstone spokesman. "They would not have gotten off this site without setting off every monitor around."

Nuclear regulatory authorities agreed there was no danger to the public.

But Nancy Burton, an attorney for the Connecticut Coalition Against Millstone, said the revelation of the missing pins is "absolutely mind-boggling" because of the high level of radioactivity.



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"I can understand losing a pair of glasses, but not two highly radioactive rods that have to be isolated from the public for 100,000 years," Burton said. "That's probably a conservative number. If they just found out, they weren't doing their job for 20 years."

The pins - whose uranium dioxide has been depleted, but remain highly radioactive - are among tens of thousands that have fueled the plant. About the width of an adult's pinky finger, they hold enriched uranium pellets in the same way a pencil holds lead, Hyde said.

They were not known to be unaccounted for until an inventory was taken for Dominion Resources Inc. of Virginia, which is buying the three-reactor Millstone complex from NU for \$1.3 billion.

The missing pins are the latest embarrassment for a nuclear complex that once was held up as a model for safe operation, but in later years was tainted by scandal, unsafe operation and record penalties.

NU pleaded guilty in federal court last year to felony criminal counts for its actions at Millstone and agreed to pay a record \$10 million in penalties for nuclear safety and environmental violations. The company pleaded guilty to willfully violating the federal Clean Water Act and 19 counts of knowingly falsifying training

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records for employees who sought to become nuclear plant operators.

Ernest C. Hadley, an attorney for Millstone whistleblower George Galatis, said Tuesday that he was not surprised that pins are unaccounted for.

"It's entirely consistent with the way they've always done business there," Hadley said. "The lack of accountability is alarming. They ain't making chocolates over there. Why their license was not revoked a long time ago is beyond me."

But one of the company's chief critics, whistleblower Paul Blanch, said he sees no connection between the missing pins and the later problems that culminated with the shutdown of all three Millstone plants in 1996.

When NU unknowingly lost track of the pins in 1980, NU had a different management team and was known as a leader in the industry for safe operation, he said.

"Up until the mid-'80s, Millstone was operated properly," Blanch said. "This was an honest mistake. I definitely don't see the connection [with other problems at Millstone]. It's not there."

If this type of mystery seems rare, it is. The Nuclear Regulatory Commission has never seen a similar case, said Neil A. Sheehan, an NRC spokesman. A preliminary review of the commission's records showed only one case in which nuclear fuel was reported missing, but never an entire pin, he said.

"It raises concerns for us that highly radioactive fuel is nowhere to be found," Sheehan said. "It's fair to characterize it as sloppy record-keeping."

The NRC has not taken action against NU, and Sheehan said it is premature to say whether any fines might be imposed.

The NRC, the company and Blanch all say there is no reason to believe that the radioactive material might be in an unsafe spot or that anyone in the general public is in any danger.

In the meantime, a team is working overtime to try to locate the pins.

"We are going to search every square

inch of that pool, and it's going to take from three weeks to a month," said Hyde, the Millstone spokesman.

"If they did leave the site, they definitely left in a shielded, lead-and-steel cask to protect the public health and safety. They were not supposed to be shipped, but if they were, they were sent in a safe way."

The tale begins in 1972, when a condenser leaked and saltwater from Long Island Sound got inside the pure-water reactor vessel. General Electric, which built Millstone 1, was called in to rebuild the fuel bundles, and the workers disassembled the fuel equipment.

During that process, two fuel pins became bent, according to NU's report to the Nuclear Regulatory Commission. Those two bent pins, containing burned uranium, were then placed in the storage pool, and company records show that they remained in the pool until early 1980.

But the records from September 1980 show that the pins, whose exterior skin is made of zirconium and aluminum alloys, were no longer on the special "map" that shows the location of the pins in the pool.

No one seemed to notice until last month when workers for Entergy Inc., the decommissioning contractor, were conducting an inventory in advance of Dominion's takeover of the plant in April 2001.

John Redding, a spokesman for GE Nuclear Energy, said in a telephone interview Tuesday night that there is no reason to believe the pins would have been shipped back to GE, which manufactured them.

"We placed those in storage for Northeast Utilities, and that was the end of our job," Redding said from California. "We don't own them. They own them, and would have the responsibility for disposing of them."

Hyde rejected the suggestion that the missing pins might indicate that Millstone 1 was operated in a sloppy fashion 20 years ago.

"It wasn't lax in the 1980s, but the safeguards of today weren't in place

then," Hyde said. "Today, it simply wouldn't happen here because the record-keeping is extremely demanding."

At NU's other nuclear power plants - Millstone 2 and 3, and the now closed Connecticut Yankee plant in Haddam Neck - all pins have been accounted for, officials said.

Now Millstone workers have their fingers crossed that they will solve the mystery.

"Time will tell," Hyde said. "We're just going to keep looking."

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## If your gifts glow, call NU

Published on 12/20/2000

If you wake up Christmas morning and find two 12-foot-long rods hanging out of your Christmas stocking, call the Nuclear Regulatory Commission. Speed-dial that telephone if poles set off a Geiger counter, or glow brighter than the lights on your tree. And consider changing your behavior, for Santa might have left a gift more spiteful and certainly more creative than coal: the items could be the spent-fuel rods missing from Northeast Utilities' Millstone Unit 1.

Humor aside, the loss of the rods is an extremely serious event. Most officials say that no nuclear plant in the country has ever lost one spent-fuel rod, let alone two. NU managers are understandably worried, and are determined to find the rods and figure out how they got lost in the first place.

Because the movement of nuclear waste in the plants is recorded, Millstone knows the rods were in the spent-fuel pool of Unit 3 between 1972 and 1980. But then references to the rods disappeared from the records. Employees may have erroneously shipped the rods off the property with other nuclear waste, or the rods may still be in the plant, maddeningly concealed among the 150,000 fuel rods in the spent-fuel pool.

Workers discovered that the spent-fuel rods were gone while preparing an inventory of the plant prior to the sale of the units to Dominion Energy of Virginia. NU management wants to account for the fuel rods before giving Dominion the keys to the front doors in April.

It's not fair, really. This is not the Millstone that once was the poster child for all that could go wrong at a nuclear plant. Just under five years ago, Millstone made the cover of Time Magazine for the ham-handed way the place was run. Operations are different now, mostly due to the leadership of Leo Olivier, senior vice president and chief nuclear officer, and Bruce Kenyon, president of generation.

The units are performing well, perhaps better than at any time in their history. They are producing power at a bottom-basement cost of 4 cents per kilowatt hour. That's comparable to electricity from new, gas-fired turbines. Employee morale is up; the number of employee concerns are down. Millstone 3 has run for a record of more than 535 days, and Millstone 2 has been operating for more than 200 days.

Things are good, and employees have earned the right to be proud of the plants' performance. They've worked so hard, and past events were so discouraging for such a long period of time.

The last thing the company needs is a visit from the ghosts of mishaps past. Yet, until the fuel rods are accounted for, this incident will add a smudge to the record, even if the rods weren't lost on the watch of present managers. ■

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## Anti-Nuke Groups: Missing Fuel Rods Raise Serious Questions About Safety Procedures

By [Paul Choiniere](#) - [More Articles](#)

Published on 12/19/2000

**Waterford** — A coalition of anti-nuclear groups contends that the Atomic Safety and Licensing Board should reconsider its approval of plans by Millstone Nuclear Power Station to reorganize nuclear waste storage racks at the Millstone 3 plant, a move needed to handle the nuclear waste the plant is generating.

New revelations that operators of the station's Millstone 1 unit cannot locate two spent fuel nuclear rods raise serious questions about the ability of nuclear personnel to safely handle more spent fuel at the Millstone 3 plant, claim the anti-nuclear activists.

On Oct. 26, the licensing board rejected a request by the Connecticut and Long Island Coalitions Against Millstone to hold a full-fledged hearing into the plans to allow more storage capacity at Millstone 3.

The coalitions and their attorney, Nancy Burton, said the case should be reopened and a hearing held because the problems at Millstone 1 is important new evidence.

In its ruling the licensing board ruled that Millstone-owner Northeast Utilities "has demonstrated that it can adhere to administrative controls, with adequate safety margin and defense-in-depth, without posing an undue or unnecessary risk to plant workers or the public."

In her motion for a rehearing filed Monday, Burton said the accounts about Millstone 1 change everything.

"It is (our) position that, had the licensing board been made aware that NU is unable to account for two highly radioactive spent fuel rods at Unit 1, it would have been unable to make such a finding and it would have been legally compelled to commence an evidentiary hearing as requested," states the motion for a rehearing.

NU maintains the failure to track the two missing fuel rods at Millstone 1 dates back to procedures used 20 years ago or more and are not relevant to the way the nuclear station is operated today.

One of three reactors at Millstone station, Millstone 1 last operated in 1995 and has been permanently shut down. Millstone 2 and 3 are fully operational.

Workers at Millstone 1 are trying to locate the two fuel rods in the spent fuel storage pool at the plant.

They say it is possible, however, that the fuel rods were accidentally shipped off site, most likely to low-level radiation waste dumps in South Carolina or Washington.

Spent fuel is consider high-level radioactive waste and its disposal at a low-level facility would be a federal violation.

It is possible, according to company officials, that the fuel rods were mistaken for detectors that are used in the reactor core. The detectors are similar in appearance to fuel rods and can be shipped to low-level waste facilities.

During an inventory being done in advance of the transfer of Millstone ownership to Dominion Energy, it was discovered that two of the uranium-filled fuel rods could not be accounted for at Millstone 1.

There are 2,884 fuel assemblies in the pool, collectively containing about 160,000 fuel rods, according to records filed by Northeast Utilities with the Nuclear Regulatory Commission.

The spent fuel rods are about a dozen feet long and the width of a man's finger. In 1972 an assembly was examined for potential damage and, in the process, the two now-missing fuel rods were bent and could not be used. A document dating to April 1980 refers to the fuel, but in a follow-up inventory conducted in September 1980, there is no mention of the two rods.

All the spent fuel stored at the Millstone 2 and 3 plants has been accounted for. Both plants are in operation. Dominion Energy of Virginia, which bid \$1.3 billion to buy the Millstone plants, is expected to take control of the station in April. NU was required to auction off the nuclear station as part of the state law deregulating the electric power generation industry.

The Nuclear Regulatory Commission is awaiting the outcome of NU's investigation before determining what action to take, according to a spokesman. ■

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## Millstone can't seem to find two spent fuel rods

By [Paul Choiniere](#) - [More Articles](#)  
Published on 12/9/2000

**Waterford** — Operators at the closed Millstone 1 nuclear plant have misplaced two highly-radioactive fuel rods. Company officials are expressing confidence the fuel rods are being stored safely; they are just not sure where.

Entergy Inc., the company cleaning up the nuclear plant that last operated in 1995, discovered the problem when it was doing an inventory of all the spent fuel produced by the plant during 25 years of service. It could not account for the two fuel rods that were removed from the reactor back in 1972.

The fuel rods could be in the plant's spent fuel storage pool, but not located yet, or they may have been transported to a General Electric facility in California, which manufactured them, according to company and federal officials. A more unlikely scenario, said the company, is that the fuel rods were transported to a radioactive waste dump.

Joe Besade, a Waterford resident and member of the Connecticut Coalition Against Millstone, made light of the confusion.

"Northeast Utilities thinks the deadly spent fuel rods are in a state beginning with 'C,' but not Colorado," Besade said. "So they're either on the East Coast or the West Coast. It's a good thing NU has narrowed it down."

Pete Hyde, a spokesman for the company, said the issue is attributable to a past problem in record keeping and is not reflective of how the nuclear station is run today.

"The record keeping at Millstone 2 and 3 is meticulous," said Hyde of the two operating plants at Millstone.

Filled with uranium pellets needed to trigger an atomic reaction, the spent fuel rods are 12-feet long and the width of a finger. Inside a nuclear reactor, hundreds of rods are grouped together in bundles called fuel assemblies. In 1972 an assembly was damaged and disassembled by General Electric. During the process the two fuel rods in question were bent and could not be reused.

Millstone officials say their records show the two rods were put in a special storage box inside the plant's spent fuel pool, where all the nuclear waste produced by the reactor is stored. Records dated 1979 and 1980 show the box stored in the northwest corner of the spent fuel pool. It is not there now and records after 1980 do not refer to it at all.

Since 1980 significant work has been done in the storage pool, with spent fuel assemblies moved around and into different racks as space in the pool began to get tighter.

Due to the unique nature of the special fuel rod box, Millstone operators do not consider it likely the fuel rods were shipped out as waste, but until the items are accounted for, they can't rule it out. There is no national facility for storing the fuel rods, classified as high-level waste. It would have been a federal violation to take such material to a low-level radioactive waste dump.

Hyde said Millstone officials will locate the fuel rods. The Nuclear Regulatory Commission is monitoring the situation. An NRC official refused to speculate about the location of the fuel rods.

"We just don't know at this point," said Todd J. Jackson, lead NRC inspector for the Millstone 1 decommissioning. "There is no way to know where it went."

Jackson said it was premature to discuss the potential for penalties against NU.

Hyde said the most likely scenario is that the fuel rods were relocated and are still in the 40-foot-deep spent fuel pool.

A container that may house the rods has been seen in the pool, but Millstone needs GE's assistance to inspect it. All work must be done in the pool using remotely-operated equipment and cameras. The water shields the radiation.

The ability to monitor spent fuel was the subject of recent hearings involving Millstone. The Connecticut Coalition Against Millstone, which has its office in Mystic, sought unsuccessfully to block a license amendment at the Millstone 3 reactor.

The amendment will allow Millstone 3 engineers to reconfigure and add storage racks at that plant so more waste can be stored in the spent fuel pool.

Opponents had argued the additional spent fuel increased the chance of an accident in the event fuel was placed in the wrong position in the pool.

In dismissing the coalition's petition opposing the amendment, the Atomic Safety and Licensing Board ruled in October that the company "has demonstrated it can adhere to administrative controls with adequate safety margin and defense-in-depth."

David A. Lochbaum, a nuclear safety engineer for the Union of Concerned Scientists, testified for the coalition at the hearings. He said news of the misplaced fuel rods is disquieting.

"It's further proof that company promises to always put the fuel rods in only the right places in the Unit 3 spent fuel pool will probably be broken," he said. ■

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Representative Edward J. Markey

TO:

Chairman Meserve

FOR SIGNATURE OF :

\*\* PRI \*\*

CRC NO: 00-0739

Chairman

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AND CONSUMER PROTECTION  
  
BUDGET COMMITTEE  
RESOURCES COMMITTEE  
(on leave)

**Congress of the United States**  
**House of Representatives**  
**Washington, DC 20515-2107**

December 20, 2000

Mr. Richard A. Meserve  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Chairman Meserve:

I am writing in regard to the Commission's Daily Event Report #37596 (December 15, 2000) and the NRC Weekly Report from November 24, 2000, which report on two missing fuel rods from the Millstone Nuclear Power Station Unit 1. As you know, Millstone 1 is in the process of being decommissioned. During that procedure, workers have found that the box containing the two fuel rods, originally stored in a spent fuel pool at the plant, was not listed in any inventory after 1980—meaning that these highly radioactive spent fuel rods may have been missing for the last 20 years. This is disturbing news.

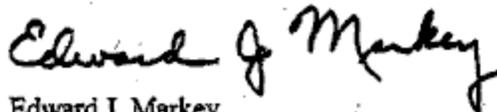
An article in *The New London Day* on December 15, 2000, reports on the possibility that the rods were shipped to low-level radioactive waste facilities in Barnwell, SC, or Richland, WA. The NRC Weekly Report suggests that they may have been shipped to General Electric (GE). More disturbing is the possibility that the rods are not in the possession of any licensed facility or have been stolen. In order to better understand the facts and circumstances surrounding this situation, I request your response to the following questions:

- (1) What Commission requirements govern the storage of spent fuel at nuclear power plants? What procedures and policies are licensees required to follow to verify that no material is lost, stolen, or diverted? What fines or other penalties can the Commission impose if a licensee fails to adhere to such requirements? Does the Commission intend to impose any such fines or penalties in this case?
- (2) According to the aforementioned article in *The Day*, Leon J. Olivier, a senior vice president and chief nuclear officer at Millstone, and Bruce Kenyon, president of generation for Northeast Utilities, indicated that they had no knowledge of any other commercial nuclear plant that had misplaced spent nuclear fuel. Is the Commission aware of any other instances of lost or misplaced spent fuel? Will the Commission require its licensees to review the inventories of all other nuclear power facilities in the U.S. to determine if other discrepancies exist? Are utilities required to periodically review their inventories to find whether these types of discrepancies exist? How can we know whether the missing rods at Northeast Utilities are an isolated incident or evidence of a more widespread phenomenon?

- (3) According to the article in *The Day*, radioactive waste at the facilities in South Carolina and Washington "is not buried in a precise location." Why not? Do these sites record at least the quantity of the materials that are buried? Why wouldn't these sites require a knowledge of the inventories on their premises? What are the potential public health consequences of storing high-level waste like the spent fuel rods at low-level radioactive waste facilities? What are the consequences for the workers at those facilities? What penalties are normally imposed on licensees for sending materials to an improper facility? Does the Commission intend to impose any fines or other penalties in this case?
- (4) According to the NRC Weekly Report, there is a box in the spent fuel pool at Millstone 1 that workers were not able to examine without assistance from GE. What sort of equipment and expertise was required from GE to do this examination? Why are those resources and expertise not located at the Millstone facility?
- (5) What assurances can the Commission provide that the spent fuel rods have not been stolen? What would be the proliferation consequences of the diversion of this material?
- (6) I would like to receive a copy of the written report that the licensee is required to file with the Commission 30 days after making the initial telephone report of the discovery pursuant to 10 CFR 20.2201.

The regulation of nuclear material is vital to protecting our public's health and safety. Therefore, I urge the Commission to thoroughly investigate this matter and to take steps to prevent similar incidents from occurring in the future. I appreciate your attention to these matters, and I would appreciate a response by January 18, 2001. If you have any questions regarding my request, please contact Brendan Plapp or Jeff Duncan of my staff at 202-225-2836.

Sincerely,



Edward J. Markey  
Member of Congress

February 1, 2001

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

Dear Congressman Markey:

I am responding to your letter of December 20, 2000, in which you asked several questions concerning the accountability for two irradiated fuel rods presumed missing from the Millstone Nuclear Power Station, Unit 1 (Millstone 1). Our responses to your specific questions are enclosed. Please recognize that we are early in our review of this event and are still pursuing clarification of a number of issues. The answers we are providing are based on our current knowledge. The licensee is continuing its investigation and we will continue to monitor its actions. As you requested, a copy of the Licensee Event Report, dated January 11, 2001, is provided, including a time-line of the licensee's actions leading to the discovery of the condition.

The licensee's initial investigation consisted of visual inspection of the spent fuel pool, review of vendor and licensee fuel and fuel shipping records, and personnel interviews. Since then, the licensee has retrieved records and reviewed potentially relevant documentation, such as vendor fuel reconstitution records, spent fuel pool maps, control room logs, radiation work permits, material transfer forms, and waste shipment records. The licensee intends to conduct additional spent fuel pool visual inspections and personnel interviews and have further communications with representatives from the licensed radioactive waste facilities in Barnwell, South Carolina, and Hanford, Washington.

The U.S. Nuclear Regulatory Commission (NRC) staff has closely monitored the licensee's investigation since the licensee formally reported to the staff by telephone on December 14, 2000, that it could not locate the two fuel rods. In addition, the NRC staff has discussed the event with individuals representing the States of South Carolina and Washington, which have possible involvement as Agreement States, and will continue to engage them in the event follow up.

In closing, let me emphasize that I share your concerns regarding this issue. Because of the potential health and safety implications, the NRC views the control of spent nuclear fuel to be of great importance. At this point, it is highly likely that the two missing fuel rods are either still located in the Millstone 1 spent fuel pool, or are buried at a licensed radioactive waste disposal site, thereby posing little or no threat to public health and safety. However, the NRC will closely monitor and evaluate the licensee's response to this event to assess actions to be taken to preclude future similar events. If the missing fuel rods are buried at a low-level waste disposal site, we will assess what corrective actions may be required.

2

If you have further comments or questions, please contact me.

Sincerely,

*/RA/*

Richard A. Meserve

Enclosure: Questions and Answers

## Questions and Answers

- Q. “What Commission requirements govern the storage of spent fuel at nuclear power plants?”
- A. NRC requirements governing the monitoring, inventory and record keeping for storage of spent fuel at nuclear power plants are provided in Title 10 of the Code of Federal Regulations (10 CFR), Part 70, “Domestic Licensing of Special Nuclear Material,” and in particular Section 70.51, “Material balance, inventory, and records requirements.” The requirements that address the manner in which the fuel is stored are provided in 10 CFR Part 50 Appendix A, 10 CFR 50.68, 10 CFR Part 72, and the specific license for the facility.
- Q. “What procedures and policies are licensees required to follow to verify that no material is lost, stolen, or diverted?”
- A. In accordance with 10 CFR 70.51(c), 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 addition, in accordance with 10 CFR 70.51(d), a power reactor licensee is required to conduct a physical inventory of all SNM in its possession at intervals not to exceed 12 months.

The licensee is also required to maintain records on the inventory (including location), disposal, and transfer of all SNM, which includes plutonium, uranium-233 (U-233), and uranium enriched in the isotopes U-233 or U-235. According to the requirements of 10 CFR 70.51(b)(5), the licensee must retain records of transfer from the facility for the life of the license, but may dispose of material acquisition and physical inventory records three years after the transfer is made.

Further, pursuant to the requirements of 10 CFR 70.54(a) and 74.15(a), the licensee must submit a Nuclear Material Transaction Report to the Nuclear Material Management and Safeguards System (NMMSS), operated for both NRC and the Department of Energy, every time its facility transfers (or receives) SNM.

Finally, in accordance with 10 CFR 70.53(a)(1) and 74.13(a)(1), at least twice a year, the licensee must submit material balance reports concerning SNM received, produced, possessed, transferred, consumed, disposed of, or lost, and an inventory composition report to NMMSS. NMMSS reconciles each licensee’s report with a report generated from NMMSS and requests investigation of any differences. NRC participates in reconciliations when a reconciliation cannot be accomplished by NMMSS and the reactor licensee. The NMMSS is discussed further in a subsequent response.

Enclosure

Q. "What fines or other penalties can the Commission impose if a licensee fails to adhere to such requirements?"

A. Violations of NRC regulations are subject to civil enforcement action and may also be subject to criminal prosecution. After identifying an apparent violation, the NRC makes an assessment in accordance with its Enforcement Policy.

Three primary enforcement sanctions are available: a Notice of Violation (NOV), a civil penalty, or an order. An NOV identifies a requirement and how it was violated, and formally cites the violation pursuant to 10 CFR 2.201, "Notice of violation;" it normally requires a written response. A civil penalty is a monetary fine imposed under the authority of Section 234 of the Atomic Energy Act of 1954, as amended (AEA). The AEA allows for penalties of up to \$100,000 per violation per day. The Debt Collection Improvement Act of 1996 raised the amount to \$110,000. An order modifies, suspends, or revokes a license or requires specific actions be taken by a licensee or a person. The Commission's authority to issue orders under Section 161 of the AEA is broad and covers any area of licensed activity that affects the public health and safety. NOVs and civil penalties may be issued for violations. Orders may be issued for violations or because of public health or safety issues.

Q. "Does the Commission intend to impose any such fines or penalties in this case?"

A. The NRC staff's inquiry into the circumstances leading to the loss of accountability is still ongoing. When complete, we will apply the Enforcement Policy to determine the appropriate enforcement action. The NRC staff notes, however, that any civil sanction may be limited by the statute of limitations, 28 U.S.C. § 2462, "Time for commencing proceedings," which is applicable to the NRC as well as other government agencies.

Q. "According to the aforementioned article in *The Day*, Leon J. Olivier, a senior vice president and chief nuclear officer at Millstone [1], and Bruce Kenyon, president of generation for Northeast Utilities, indicated that they had no knowledge of any other commercial nuclear plant that had misplaced spent nuclear fuel. Is the Commission aware of any other instances of lost or misplaced spent fuel?"

A. The other instances the Commission is aware of are as follows:

In 1990, a nuclear power plant shipped one more irradiated fuel rod than planned. The licensee discovered the discrepancy in 1991 and notified the NRC and the NMMSS, and corrected its records. The extra rod was protected along with the rest of the shipment.

On several occasions, licensees have reported "lost" or "missing" spent fuel, but in each case the spent fuel was known to be contained in the reactor coolant system, the spent fuel pool, or a refueling pathway, and thus was secure within the facility.

- Q. "Will the Commission require its licensees to review the inventories of all other nuclear power facilities in the U.S. to determine if other discrepancies exist?"
- A. NRC is closely monitoring the licensee's investigation to determine exactly what happened to the two Millstone 1 fuel rods. Following the completion of the NRC's inquiry, we will consider whether industry-wide generic action is warranted.
- Q. "Are utilities required to periodically review their inventories to find whether these types of discrepancies exist?"
- A. A power reactor licensee is required to conduct a physical inventory of all SNM in its possession at intervals not to exceed 12 months in accordance with 10 CFR 70.51(a)(8) and 10 CFR 70.51(d) .
- Q. "How can we know whether the missing rods at Northeast Utilities are an isolated incident or evidence of a more widespread phenomenon?"
- A. Licensee SNM inventory and transaction data are required to be reported to the National Nuclear Material Accounting Database via the NMMSS. The NMMSS maintains information on facility inventories, shipper-receiver differences, and inventory differences. The transaction information is used to match reported shipments with corresponding receipts. Twice a year, licensees reconcile facility records with the NMMSS information to identify anomalies in facility records. The NRC staff is still investigating why the Millstone 1 anomaly was not identified in 1980 or in later years by the licensee or NMMSS. Based on the results of our investigation, we may elect to require additional actions at other facilities.
- Q. "According to the article in *The Day*, radioactive waste at the facilities in South Carolina and Washington 'is not buried in a precise location.' Why not?"
- A. Regulations provided in 10 CFR 61.80, "Maintenance of records, reports, and transfers," require that the licensee record and document, among other things, the quantity of radioactive wastes in a shipment and the location of disposal in the site. Since South Carolina and Washington are Agreement States, the low-level waste disposal facilities in these States are regulated by State agencies. Both States have adopted regulations compatible with 10 CFR Part 61, including provisions for recording the location of disposals.

The regulations at 10 CFR Part 61 became effective in January 1983 and the State regulations were adopted subsequent to 1983. If the Millstone 1 fuel rods were shipped to either of these sites before 1983, the specific requirements of those regulations would not have been applicable. However, according to officials from South Carolina and Washington, the locations of disposed wastes were being recorded during the early 1980s. Thus, both facilities could retrieve waste, if necessary, because of the existence of records for the location of specific disposals.

Q. “Do these sites record at least the quantity of the materials that are buried? Why wouldn’t these sites require a knowledge of the inventories on their premises?”

A. The quantities of radioactive materials are and must be recorded. Thus, the inventories are required to be known. The records for disposal are based in part on the shipping manifest provided to the waste storage facility by the licensee shipping the material.

Q. “What are the potential public health consequences of storing high-level waste like the spent fuel rods at low-level radioactive waste facilities?”

A. Currently there is no evidence that the Millstone 1 spent fuel rods were disposed of at a low-level waste site. The Commission’s regulations in 10 CFR Part 61 (and the compatible regulations in the States of Washington and South Carolina) rely on a combination of 100 years of active institutional controls (to control land use at the facility), government ownership of land, and engineered barriers or depth of burial to isolate highly radioactive wastes from people. However, because the fuel rods remain highly radioactive longer than low-level waste, there is a potential for higher doses to possible intruders after the Part 61 controls are no longer in effect. There is no present hazard from the disposal of the two fuel rods from Millstone 1 at a low-level waste facility.

Another potential hazard is that radionuclides released from the fuel rods could migrate into the groundwater, eventually exposing members of the public to radiation. The licensee estimates the amount of radioactivity in the fuel rods to be approximately 300 curies. (Although we have not independently verified that estimate, it appears to be reasonable.) This amount of radioactivity is a tiny part of the total inventory of several million curies at each site that must already be isolated to protect the public health and safety. Thus, the incremental effect of the fuel rods on public health and safety from groundwater would be small. The hazard would depend on such factors as the specific radionuclides in the waste and site specific characteristics, such as how fast the groundwater moves.

Q. “What are the consequences for the workers at those facilities?”

A. Radiation exposure of workers at the disposal facilities are governed by radiation protection programs. The doses they receive from radioactive materials are continuously monitored to ensure that the doses are within regulatory limits. Both facilities routinely dispose of some low-level waste with relatively high radiation levels and have procedures in place for ensuring that doses to workers are not only within the regulatory limits but as low as is reasonably achievable. Therefore, we anticipate no significant consequences for the workers.

Q. “What penalties are normally imposed on licensees for sending materials to an improper facility?”

A. The penalties for transporting or disposing of materials improperly are based on the circumstances of each case. The Commission considers the quantity and radioactivity of the materials, the exposure risk to workers or members of the public, and the effect on the environment. The Commission also considers the underlying causes for the violation and the licensee’s efforts to identify and correct the problem.

- Q. "Does the Commission intend to impose any fines or other penalties in this case?"
- A. As noted previously, the NRC staff's inquiry is still ongoing. If the staff determines that the SNM was transported or disposed of improperly by the licensee, the staff will apply the Enforcement Policy to determine the appropriate enforcement action. The NRC staff notes, however, that any civil sanction may be limited by the statute of limitations, 28 U.S.C. § 2462, "Time for commencing proceedings," which is applicable to the NRC as well as other government agencies.
- Q. "According to the NRC Weekly Report, there is a box in the spent fuel pool at Millstone 1 that workers were not able to examine without assistance from GE [General Electric]. What sort of equipment and expertise was required from GE to do this examination?"
- A. The box referred to in the NRC Weekly Report is an in-pool GE storage container, designated SRP-2D, for segmented test fuel rods. Segmented test rods were used at Millstone 1 in the 1970s and early 1980s as part of a joint GE-utility program to evaluate fuel performance. The SRP-2D container is constructed like a fuel bundle, with a lower tie plate, an upper tie plate, and spacers. A bundle channel encases the SRP-2D assembly to provide torsional support, preventing flexing during handling.

Because the channel housing would have to be removed and the upper tie plate may have to be removed to see if the missing fuel rods had been placed in SRP-2D, the licensee contracted with qualified GE personnel experienced in bundle disassembly activities to perform the inspection. Anticipating that special tools might be necessary to disassemble the container, the licensee also contracted with GE to provide those tools.

- Q. "Why are those resources and expertise not located at the Millstone [1] facility?"
- A. Millstone 1 employs personnel who are qualified to perform fuel handling activities, including dechanneling. However, bundle disassembly activities, such as upper tie plate removal, are not routine operations and are not normally performed by station personnel. GE personnel performed the last bundle disassembly activities at Millstone 1 in the early 1980s. The licensee decided it was safer to use experienced GE personnel for the recent storage container examination. The special tools (which were in fact not required for the examination) are used too infrequently to justify their purchase.
- Q. "What assurances can the Commission provide that the spent fuel rods have not been stolen?"
- A. The very high radiation level of the material makes theft difficult, dangerous, and very unlikely. The radiation levels also make the material of limited or no economic value. Moreover, the 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. Had a theft occurred for the purpose of terrorism or radiological sabotage, it would be expected that such a threat would have materialized in the 20 years over which the discrepancy is believed to have existed. No such threat has been identified.

- Q. "What would be the proliferation consequences of the diversion of this material?"
- A. The two fuel rods pose no risk of proliferating nuclear weapons. The uranium (U-235) in the fuel rods is low-enriched uranium (2.44%). The amount of U-235 in each rod is about 50 grams. The plutonium created in each rod during its time in the reactor core is estimated to be approximately 20 grams. In general, the NRC considers proliferation consequences to be small for SNM quantities less than 5000 grams of highly enriched uranium (>20% U-235) or 2000 grams of plutonium, or a combination thereof (10 CFR 73.2, "Special nuclear material of low strategic significance").
- Q. "I would like to receive a copy of the written report that the licensee is required to file with the Commission 30 days after making the initial telephone report of the discovery, pursuant to 10 CFR 20.2201."
- A. A copy of the licensee's report is attached.

Attachment:  
Licensee Event Report

## COMMUNICATION PLAN

### Significant Status Updates

NRR will assure that key staff personnel and outside stakeholders (see attached list) are notified promptly.

OSP will assure that involved States are notified.

Q&As (continually being revised as new info/issues emerge) will have been provided to OPA and other NRC liaison offices to respond to outside inquires.

### 70.52 Report

Same as above plus:

IRO notifications will made. Recipients will have been pre-briefed that this is a known event which the NRC has been following for nine months.

### Final Investigation Report

(Note: these actions will begin when the results of the investigation are provided to the NRC and other stakeholders not necessarily when the report is issued)

Same as Significant Status Updates plus:

If investigation concludes that fuel rods are at an LLW site, initiate detailed discussions with involved State(s) on appropriate course of action. (Alternatives, considerations, cost benefit analysis including examinations and testing possible and/or required, licensing requirements and options) Preliminary discussion have already taken place.

### Final Root Cause Report

(Note: these actions will begin when the results of the Fuel Rod Accountability Project's investigation are provided to the NRC and other stakeholders not necessarily when the report is issued)

Initiate generic communications as appropriate.

Millstone Missing Fuel Contact List

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