August 31, 2004

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

Dear Congressman Markey:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of July 21, 2004, in which you raised a number of questions concerning the three missing irradiated spent fuel rod segments at the permanently shutdown Humboldt Bay Nuclear Power Station Unit 3. Responses to your questions are enclosed. NRC has been conducting periodic inspections of Humboldt Bay since the discovery of the missing fuel rod segments and will continue these inspection activities throughout the licensee's search and investigation. NRC is planning to hold a management meeting with the licensee in September 2004 to ensure that all material accountability requirements are being met for spent fuel and other radioactive materials. In addition, a special team inspection is being tentatively scheduled in October 2004 to assess the key elements of the licensee's investigation effort. A summary concerning the situation at Humboldt Bay is provided below.

Humboldt Bay was a 65 megawatt-electric commercial nuclear power reactor that has been permanently shut down since 1976. This reactor is owned and was operated by Pacific Gas and Electric Company. Humboldt Bay is located south of Eureka, California, in Humboldt County. There are operating fossil fuel electric generating units (Units 1 and 2) at the Humboldt Bay site. The Humboldt Bay nuclear plant has been in a safe storage condition (SAFSTOR[1]) since 1988.

During the fall of 2003, the licensee began a detailed examination of the contents of its spent fuel pool in preparation for eventual removal of the fuel assemblies stored in the pool to a dry-cask-storage Independent Spent Fuel Storage Installation. In the process of performing the spent fuel pool examination, the licensee discovered fuel rod fragments that cannot be accounted for by records maintained at the facility. On November 17, 2003, the licensee initially informed NRC personnel by telephone of these findings. This was the first indication that the licensee had material control and accounting issues related to its spent nuclear fuel.

The licensee has postulated that the fuel fragments found in the spent fuel pool originated from defective rods[2] in stainless steel fuel assemblies that were initially used in the reactor during operations in the early 1960s. The licensee speculates that the fragments broke

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[1]SAFSTOR is defined as a method of decommissioning in which the nuclear facility is placed and maintained in safe condition for an extended period of time to permit radioactive material to decay to levels that ease subsequent decontamination and decommissioning of the facility.

[2]A fuel rod is a long slender thin-walled metal tube that holds the fuel (special nuclear material) used in a nuclear reactor. A fuel assembly is a cluster of fuel rods. The first fuel assemblies used at Humboldt Bay Unit 3 were made with stainless steel cladding. The rods were arranged in a 7-by-7 array for a total of 49 fuel rods per assembly. The length of a fuel rod is approximately 84 inches and the diameter is about one-half inch.

off the fuel assemblies during fuel manipulation and handling in the spent fuel pool. On discovery of these fragments, the licensee began an extensive documentation review to determine the origin of the fragments and determine why these fragments were not accounted for in the special nuclear material inventory.

NRC conducted an inspection of the licensee between January 5-9, 2004, and has been closely monitoring the licensee's efforts to determine the origin of the fragments. On March 25, 2004, NRC conducted a spent fuel material control and accounting inspection at Humboldt Bay in accordance with Temporary Instruction 2515/154, "Spent Fuel Material Control and Accounting at Nuclear Plants," dated November 26, 2003, developed to determine the extent to which material control and accounting issues like those at Millstone Unit 1 existed at other plants. This inspection is being conducted at all NRC-licensed operating and decommissioned power reactor and wet storage sites. The results of this inspection at Humboldt Bay suggested the need for a more in-depth (Phase III) inspection, as specified in the instruction. The Phase III inspection at Humboldt Bay will be included in the forthcoming special team inspection effort discussed earlier.

While in the process of performing a record review related to the fragment investigation, the licensee identified a discrepancy on June 23, 2004, that calls into question the location of three segments of a portion of a single spent fuel rod removed from an assembly (designated A-49) in 1968. Records from 1968 indicate that a single fuel rod from assembly A-49 was cut into three 18-inch segments that were placed in a small container with an intention to ship the segments to an off-site lab for analysis. The records further show that the off-site shipment never occurred and that the three 18-inch segments in their special storage container were placed somewhere in the spent fuel pool without a record of the specific location. The licensee has been unable to locate these three 18-inch rod segments in the spent fuel pool and has not found any records documenting a shipment off site. The licensee notes that records of the shipment of assembly A-49 show it was sent to West Valley, New York, for reprocessing on August 6, 1969. The records for the assembly shipment did not mention that a rod had been removed from the assembly.

The licensee is performing an expedited examination of all possible locations in the spent fuel pool where the segments might be located. The licensee is also continuing to review plant records. In addition, plant personnel who were on site during the 1968-1969 time period are being interviewed. The licensee formally notified NRC of the three missing fuel rod segments on July 16, 2004. The NRC staff has discussed this issue with officials representing California.

NRC conducted an inspection at Humboldt between July 12-16, 2004, and sent an inspector back to the site on August 6, 2004, to monitor the licensee's action and investigation regarding the three missing 18-inch fuel rod segments. NRC will continue these periodic inspections, including the aforementioned special team inspection. The special team inspection will review the results of the licensee's investigation, assess the root-cause evaluation, determine if Pacific Gas and Electric Company is in compliance with applicable regulations, and identify which findings may have generic implications.

The Commission shares your concerns regarding the location of the three missing spent fuel rod segments and the licensee's inability to account for their disposition. Spent fuel rods are required to be secured and safely stored. Although it is premature to reach any conclusions about their location, we believe it is highly unlikely that the material is in the public domain. NRC will continue to monitor and evaluate Pacific Gas and Electric Company's response to this issue to assess actions to be taken.

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

Sincerely,

/RA/

Nils J. Diaz

Enclosure:
Questions and Answers

Questions and Answers

QUESTION 1. "Please describe how it was discovered that the fuel rod segments were missing from the Humboldt spent fuel pool? When were these fuel rods last accounted for?"

ANSWER 1.

Since 2003, Pacific Gas & Electric (PG&E) plant personnel at Humboldt Bay have been both conducting a complete review of plant records and cataloging the contents of the spent fuel pool (SFP) in preparation for the planned transfer of spent fuel into an on-site Independent Spent Fuel Storage Installation. On June 23, 2004, plant personnel found Onsite Review Committee (OSRC) meeting minutes dated October 2, 1968, that described cutting one fuel rod from fuel assembly A-49 into three 18-inch segments that were placed into a small container (1 -1 /2 inch, schedule 40 pipe) in preparation for shipment to the Battelle Memorial Institute in Columbus, Ohio, for analysis. The meeting minutes further state that the shipment to Battelle was subsequently canceled and that the small container with the three 18-inch fuel rod segments was returned to the SFP, with the specific location in the SFP unidentified. The minutes also state that the remnants of the 84-inch long fuel rod from which the three 18-inch segments were cut were placed in the central storage container within the SFP.

On June 25, 2004, after further research, PG&E found shipping records indicating that on August 6, 1969, the entire A-49 fuel assembly was shipped to Nuclear Fuel Services Inc., in West Valley, New York, for reprocessing. The shipping record did not mention that a rod had been removed from the A-49 fuel assembly. This contradicts the OSRC meeting minutes that indicated one fuel rod from A-49 remained in the SFP. Further review of records did not resolve the discrepancy, so on June 29, 2004, PG&E verbally notified the U.S. Nuclear Regulatory Commission (NRC) Region IV office of the possibility that three fuel rod segments removed from A-49 might be missing.

On July 7, 2004, PG&E began a physical search of the central storage container in the SFP for the remnant portions of the A-49 rod and the three 18-inch segments. On July 9-11, 2004, PG&E identified what appears to be the remnant portions of the A-49 rod in the central storage container in the SFP, as described in the 1968 OSRC meeting minutes. However, the three 18-inch segments were not found in the central storage container. The licensee formally notified NRC of the three missing fuel rod segments on July 16, 2004.

PG&E is continuing a thorough search of the remaining storage containers in the SFP and other possible areas in the SFP where the three fuel rod segments may be located. The search is a painstaking process performed under tight procedural guidance that could take several more weeks to complete. In addition, PG&E is continuing its review of plant records and is interviewing plant personnel who were on site during the 1968-1969 period, to find further evidence that may expedite location of the three fuel rod segments. NRC inspectors were on site during the week of July 12, and returned to the site on August 6, 2004, to monitor the licensee's search activities. Inspectors will continue to visit the site periodically throughout the licensee's search and investigation.

Based on the licensee's presentation of the facts, the last accounting of the fuel rod segments was when the rod was still part of assembly A-49 (sometime before October 1968).

Enclosure

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

ANSWER 2.

The NRC staff has closely monitored PG&E's actions and investigation since PG&E first informed NRC of the three missing 18-inch rod segments. NRC conducted an on-site inspection concerning this matter during the week of July 12-16, 2004, and an inspector returned to the site on August 6, 2004, to monitor the licensee's action and investigation regarding the three missing 18-inch fuel rod segments. Before the licensee's report of the three missing rod segments, NRC had conducted inspections at Humboldt Bay that involved material control and accounting (MC&A)-related concerns during the week of January 5-9, 2004, and on March 25, 2004. NRC will continue to conduct periodic inspections throughout the licensee's search and investigation and is planning a special team inspection tentatively scheduled in October 2004. The special team inspection will examine the results of PG&E's investigation, assess the licensee's root-cause determination, determine if PG&E is in compliance with applicable regulations, and identify any findings that may have generic implications.

QUESTION 3. "In light of the fact that the Humboldt Bay Nuclear Power Plant is unable to account for the whereabouts of these fuel rod segments, do you believe that the licensee has complied with NRC requirements to establish, maintain and follow its material control and accounting procedures to ensure it can account for the special nuclear material in its possession? Why or why not?"

ANSWER 3.

It would be premature to speculate as to what compliance issues may arise related to the missing rod segments at Humboldt Bay. The licensee is still searching its SFP and conducting extensive reviews of spent fuel pool documentation. NRC is planning follow-up inspections, during which it will evaluate PG&E's compliance with all applicable regulatory requirements, including MC&A requirements. Should violations be identified, NRC will follow its enforcement policy (NUREG-1600) to determine appropriate enforcement sanctions. NRC will formally document the inspection findings when the inspection is complete.

QUESTION 4. "In your February 1, 2001 letter, you said that it was unlikely that the two spent fuel rods were stolen from Millstone, because 'The very high radiation level of the material makes theft difficult, dangerous, and very unlikely' and 'amount and chemical form of the fissile material contained in the two spent fuel rods make it unlikely, in our judgment, that the rods could be used to assist in the manufacture of a weapon.' However, the September 11th terror attacks have demonstrated that terrorists may be willing to commit suicide in order to cause harm to America, and may be willing to devote many years to the planning and execution of such an attack. Moreover, the Humboldt nuclear reactor ceased operations in 1976, so the levels of radioactivity contained in the fuel rod segments that are missing may be different.

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

ANSWER 4.

ANSWER 4(a).

Although NRC has not performed a formal evaluation of this possibility, the potential for theft or diversion has been considered. The information NRC has received from the licensee's investigation and the NRC inspections does not indicate that the fuel segments were stolen or diverted. In addition, the physical security at the site and the extensive array of radiation detectors make it highly unlikely that the missing fuel rod segments could have been diverted or stolen without detection. However, NRC expects the licensee to address this unlikely possibility in a root-cause analysis and will evaluate the licensee's assessment in follow-up inspections.

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

ANSWER 4(b).

First, it should be noted that the amount and enrichment of the fissile material in these rod segments is far less than what would be needed for a nuclear weapon. Furthermore, extracting that material from the rod segments would require chemical processing capabilities generally only possessed by governments.

As for the use of these rod segments in a crude radiological dispersal device (RDD), the rod segments are in a particularly non-dispersible form. If used in a crude RDD, it is most likely the rod segments would break up into relatively large discrete pieces, which would not travel far from the site of the explosion, making them easily identifiable for retrieval. Contamination could extend over a few city blocks or more.

ANSWER 4(c).

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

QUESTION 5. "Please list all reactors (both operating and decommissioning) that
a) have conducted a spent fuel inventory since September 11, 2001 (as well as the date on which the inventory was conducted and whether any fuel rods or fuel rod segments were found to be missing) and
b) plan to conduct such an inventory, as well as the date on which it is expected to occur."

ANSWER 5(a).

Reactors (both operating and decommissioning) are required by NRC regulations at Title 10 of the *Code of Federal Regulations* (10 CFR), Part 74, Section 74.19, to perform an annual physical inventory of all special nuclear material (SNM) in their possession. This physical inventory requirement extends to all reactors, unless specifically exempted from this requirement because of other protective measures in place, and includes spent fuel. Specific inventory dates may vary throughout the year, depending on licensee operational and administrative considerations. Licensees are required to maintain records of physical inventories performed, but the NRC does not maintain a separate listing of this information. The information is available for NRC inspection at licensee sites. The only licensees to date that have reported MC&A issues related to missing or possibly missing spent fuel are Millstone Unit 1, Vermont Yankee, and Humboldt Bay.

Because of special circumstances, NRC exempted Humboldt Bay, in a letter dated January 13, 1989, from conducting the annual physical inventories of the spent fuel in its possession per the requirements under 10 CFR 74.19(c). NRC issued Humboldt Bay such an exemption because of a unique design feature of the SFP. The Humboldt Bay SFP employs a special cover with security seals. Since the cover prevents direct observation of the spent fuel,

an inventory cannot be conducted with the cover in place. Humboldt Bay was granted an exemption from conducting the annual inventory of the spent fuel as long as the cover is installed and the security seals have not been compromised. As a consequence of the design feature and related inventory exemption, the period between physical inventories of the spent fuel exceeded 12 months.

ANSWER 5(b).

NRC has been performing inspections using Temporary Instruction (TI) 2515/154, "Spent Fuel Material Control and Accounting at Nuclear Plants," dated November 26, 2003, to obtain information on licensee MC&A performance. This effort, which is ongoing, consists of three phases. Phases I and II are preliminary inspections conducted by the Resident Inspectors, and have been completed at all the plants. NRC is currently evaluating the information gathered during Phases I and II and plans to conduct additional inspections at some plants under Phase III. The TI calls for the inspections to be completed by November 2005. In addition, NRC issued Information Notice (IN) 2004-12 to all licensees on June 25, 2004. IN 2004-12 emphasized the need for licensees to review their MC&A programs (including physical inventory) to avoid the problems encountered at Millstone Unit 1 and Vermont Yankee.

QUESTION 6. "(a) Has Entergy been fined for its failure to properly store its spent fuel rods at the Vermont Yankee plant?"
"(b) Has PG&E been fined for its failure to properly store or account for its spent fuel rods at Humboldt Bay? If not, why not?"

ANSWER 6(a).

NRC has not taken any enforcement action against Entergy. Although Entergy recently located the rod segments in its SFP, the root-cause evaluation as to why it lost track of the fuel rod pieces is still under review. NRC's inspection is still on-going and is not expected to be completed until September. If there are findings from this inspection that indicate violations of NRC regulations occurred, they will be considered under the NRC enforcement process.

ANSWER 6(b).

Similar to the response to Question 6 (a), the licensee's investigation at Humboldt Bay is still ongoing. The licensee has yet to issue any reports or findings as to the final status of the fuel rod segments or the root cause of its MC&A problems. NRC will conduct follow-up inspections when more information is available. It is currently premature to speculate on what enforcement outcome is appropriate, and the NRC has not arrived at any enforcement decisions.

QUESTION 7. "(a) Why did the two robotic searches of the spent fuel pool at Vermont Yankee fail to turn up the now-found spent fuel rod segments?"
"(b) Does this incident provide the Commission with information regarding the adequacy of such searches?"

ANSWER 7(a).

The spent fuel rod segments were stored in a unique 40-inch aluminum cylinder, which is unlike a typical storage container, but is similar to several other aluminum structures and tools in the pool. The licensee stated in its press release that it did not include this container in its initial search because the container was previously thought to be part of an existing in-pool structure. When the licensee learned that General Electric (GE) had designed and sent a pipe-like cylinder for the fuel-rod pieces, it rechecked the videotape and noticed that this cylinder could be the canister that GE sent. Subsequent inspection of the cylinder revealed the fuel rod segments.

ANSWER 7(b).

After the licensee's and NRC's investigations of this issue are complete, the Commission will have better information about the root cause of the failure to locate the fuel and the adequacy of the searches. The Commission will use the findings from this inspection, as appropriate, to determine what actions, if any, should be implemented for other facilities regarding their spent fuel accountability.