June 20, 2006

MEMORANDUM TO: George Pangburn, Director
Division of Nuclear Materials Safety, RI

FROM: Scott C. Flanders, Deputy Director ***/RA/***
Environmental & Performance
Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Nuclear Material Safety
and Safeguards

SUBJECT: RESPONSE TO TECHNICAL ASSISTANCE REQUEST DATED FEBRUARY 23, 2006, FOR THE UNIVERSITY OF PUERTO RICO

Region I submitted a Technical Assistance Request, dated February 23, 2006, requesting screening criteria or a dose assessment to determine if a tree and its surrounding area, containing not more than 196 microcuries of cesium-137 may be released for unrestricted use. The Performance Assessment Section has completed its review of the University of Puerto Rico site and has provided an Technical Evaluation Report (enclosed). Based upon our review, staff finds that the dose from exposure to residual radioactive materials at this site would be sufficiently low to allow unrestricted release of this site in accordance with 10 CFR 20.1402.

If you have questions regarding this review, please contact Shamica Walker of my staff. She can be reached at 301-415-5142.

Enclosure: Technical Evaluation Report

cc: Elizabeth Ullrich

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Technical Evaluation Report
Related to University of Puerto Rico, 52-01986-04
June 14, 2006

1.0 Background

On November 16, 2005, the University of Puerto Rico requested an amendment to Materials License 52-01986-04 to remove requirements for restricting access to a tree in Study Area 4 of the University of Puerto Rico El Verde Research Station. The University of Puerto Rico intends to release the site for unrestricted use in compliance with requirements of 10 CFR 20.1402. Therefore, residual radioactivity levels that are distinguishable from background remaining at the site at the time of license termination cannot result in a total effective dose equivalent to an average member of the critical group that exceeds 25 mrem/y.

In September 1968, a tree of the species *Matayba domingensis* in Study Area 4 of the University of Puerto Rico El Verde Research Station was injected with 460 microcuries of cesium-137 (Cs-137). This was performed by the Puerto Rico Nuclear Center at the University of Puerto Rico in order to study mineral cycling and metabolism. The study was sponsored by the U.S. Atomic Energy Commission.

The tree in Study Area 4 is currently authorized on the University of Puerto Rico License No. 52-01986-04, with requirements to fence the area and post it as containing radioactive materials. The University has requested to amend its license to release this area for unrestricted use, based on the results of studies performed by the DOE. The licensee states that the DOE Office of Legacy management will maintain records and respond to any public inquiries for the site.

2.0 Technical Evaluation

The Nuclear Regulatory Commission (NRC) staff evaluated the DOE analyses, as provided by the licensee, to demonstrate compliance with 10 CFR 20.1402 using the general guidance for dose modeling in NUREG-1757, Volume 2.

NRC staff reviewed the following documents related to this site: (1) a July 2005 document from DOE (ML05355045), (2) a March 19, 1993 letter to NRC from DOE (ML060470461), and (3) an August 16, 1993 letter to NRC from DOE (ML060470455). These documents also contained enclosures of other reports, such as, additional DOE reports of the site and site survey reports.

2.1 Source Term

The tree was injected with 460 microcuries of Cs-137. According to a 1994 DOE report, a core sample of wood at the injection site was determined to contain 77.4 picocuries of Cs-137 per gram of material (pCi/g), and a root sample was determined to contain 109 pCi/g. The report also stated that leaves collected from the surface near the tree roots contained 5.5. pCi/g.

For the soil region, surveys results in the 1994 DOE report provided a maximum concentration of 370 pCi/g of soil within 0.1 square-meter near the root system of the tree, 10 pCi/g to 250 pCi/g within several meters of the tree, and 1 to 2.5 pCi/g at 5 meters from the tree. Prior to this report (around the early 1980's), the DOE removed 43 kilograms of soil contaminated with Cs-137, but no assessment was performed on the amount of Cs-137 removed.

Given the half-life of 30 years for Cs-137 and that 460 microcuries were injected into the tree in September 1968, then 193 microcuries (FCi) remains in the tree and surrounding area as of May 2006. The staff considers this assumption leads to a conservative source term and considers this a valid approach for bounding the analysis.

2.2 Exposure Scenarios

In the 1994 report by the DOE, an evaluation of the future impact of the radioactivity at Study Area 4 on workers and the public was performed. The following two conditions were analyzed: (1) the site will continue as a research area within the National Forest and, (2) the area will be released for development, in which timber would be cut and burned and the land surface graded to allow construction of access roads and other improvements.

Where the site would continue as a research area, direct gamma radiation was considered to be the primary exposure pathway from Cs-137 in the soil and tree. It was assumed that a university staff member would be exposed to the maximum level of direct gamma radiation at 1 m above the ground surface for 1 hour annually and the resulting dose would be 0.01 mrem/y above background. DOE also analysed exposure via the surface water pathway and a drinking water pathway. It was concluded that the surface water pathway was negligible and the dose from the drinking water pathway was 0.001 mrem/y.

For the site development condition, DOE used the residential scenario developed in NUREG/CR-5512 and determined that the resulting dose would be 17 mrem/y. DOE also considered two process in which the tree would be burned where (1) the tree is burned in place and all the Cs-137 remains in the ash and would be combined with soil during grading, and (2) that all of the Cs-137 is volatilized, creating an inhalation exposure potential. For the scenario where the Cs-137 remains in the ash, the resulting dose was determined be 17 mrem/y. DOE used procedures from National Council on Radiation Protection Commentary #3 for the volatization scenario and estimated a committed dose equivalent of 8.2×10^{-4} mrem.

NRC staff agrees with the procedures used by DOE to determine the effects from volatization. However, there was not enough information in the report for staff to determine how DOE calculated its doses for the other scenarios. The July 1995 document states that additional dose modeling was performed in 1997 using RESRAD, but RESRAD dose assessments were not discussed in the 1997 evaluation.

2.3 Independent Analysis

NRC staff performed an independent calculation to determine if the concentration would meet the NRC screening value of 11 pCi/g for Cs-137 in soil. Because concentration levels fall between 1 to 2.5 pCi/g at 5 meters from the tree, staff assumed that contaminated soil was bounded by a 5 meter radius from the center of the tree. The following additional assumptions were made: (1) all contamination is in the top 15 centimeters of soil, (2) 193 FCi of Cs-137

remains due to material decay, and (3) the soil has a density of 1 g/cm^3. Therefore, 193 FCi of Cs-137 uniformly distributed within 1.2 E7 cm^3 of soil would result in a concentration of 16 pCi/g.

NRC's calculation assumed Cs-137 was only found in the soil and not in the tree. Considering Cs-137 is known to be distributed in both the tree and the soil, staff believes the concentration of Cs-137 is likely to be less than the estimated value of 16 pCi/g. Also, many soils have a higher density than that of 1g/cm^3, which was assumed. The University of Puerto Rico site is presently used for research and is not expected to be developed for commercial, farming or residential uses for several decades. Due to the 30 year half-life of Cs-137, it would take an additional 18 years to reach the screening concentration of 11 pCi/g, assuming all Cs-137 is in soil. In addition, the screening value for Cs-137 in soil is based on a residential farming scenario, which assumes a combined outdoor and gardening exposure time of 43.12 days/year. Considering the site's current use and its limited access, it is unlikely that persons would be present in the area of the tree for this length of time. Because the NRC staff analysis is considered to be conservative, staff finds a concentration of 16 pCi/g to be acceptable.

Staff also considered the possibility of clearance of the tree where it could be cut down and processed for recycling or used for construction. Study Area 4 is accessible only from a trail, which includes a cable suspension bridge and steep climbs. This limited access trail precludes use of heavy equipment to cut down the tree or remove it from the area. In addition, the *Matayba domingensis* tree is not a species typically used for construction. Therefore, staff finds that it is unlikely that the tree would be cut down and reused.

3.0 Summary and Conclusions

The NRC staff has reviewed the supporting documents conducted by DOE and other related documents for the University of Puerto Rico site. This review was based upon the guidance in NUREG-1757, Volume 2, for conducting dose assessment to demonstrate compliance with the termination rule.

More information was needed to review the DOE dose assessment, therefore; staff performed an independent calculation for the site. Using several conservative assumptions, the concentration of Cs-137 in soil was determined to be 16 pCi/g, which was compared against the NRC screening value of 11 pCi/g. Because the staff calculation was conservative, and the screening value assumes a scenario of a residential farmer, which is unlikely for this site, staff finds that the dose from the exposure to residual radioactive materials at this site would be sufficiently low to allow unrestricted release of this site in accordance with 10 CFR 20.1402.

4.0 References

Consolidated NMSS Decommissioning Guidance, Vol 2. (NUREG-1757), Office of Nuclear Material Safety and Safeguards, Washington, DC, September 2003.

Residal Radioactive Contamination from Decommissiong, PNL - 7994, Vol 1. (NUREG/CR-5512), W.E. Kennedy, Jr. And D. L. Strenge, Pacific Northwest Laboratory, October 1992.

Screening Techniques for Determining Compliance with Environmental Standards, NCRP Commentary No. 3, National Council on Radiation Protection and Measurements, January 1989.