



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION II
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September 28, 2000

Carmen Feliciano de Melecio, MD
Secretary of Health
Commonwealth of Puerto Rico
Call Box 70184
San Juan, PR 00936

SUBJECT: NRC INSPECTION REPORT CONCERNING THE ENVIRONMENTAL SURVEY
AT VIEQUES ISLAND, PUERTO RICO

Dear Dr. Feliciano de Melecio:

This refers to the inspection conducted June 6 - June 15, 2000, on Vieques Island, Puerto Rico, in the Eastern Maneuver Area (EMA), the Atlantic Fleet Weapons Training Facility (AFWTF), including the Live Impact Area (LIA), and in civilian areas of the island west of the EMA. The enclosed report presents the results of the direct measurements and analyses of samples taken during that inspection. In summary, there was no depleted uranium (DU) except for that found in the holes from which the Navy had recovered DU penetrators in the LIA. The Navy is currently continuing work to locate and remove DU penetrators from the LIA.

The purpose of our June inspection was to determine if DU penetrators that the U. S. Navy fired in the LIA on February 19, 1999, contaminated the surrounding environment and may subsequently pose a potential for members of the public to receive radiation doses. The NRC's findings regarding the firing of the DU penetrators at the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-01, dated April 19, 2000. The NRC's findings regarding the Navy's efforts to recover the DU from the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-04, dated July 13, 2000. A copy of each of these reports was sent to the Radiological Health Division of the Puerto Rico Department of Health. The NRC continues to review the Navy's efforts to recover the DU from the LIA.

During the inspection, NRC inspectors and representatives from the Radiological Health Division of the Puerto Rico Department of Health obtained direct measurements and collected environmental samples in the areas described above. The inspectors collected samples of soil, vegetation, surface water and the sediment from the locations where surface water samples were obtained. The environmental samples were sent to the Oak Ridge Institute for Science and Education (ORISE), Oak Ridge, Tennessee, for analysis. The entire set of samples was analyzed by gamma spectroscopy and alpha spectroscopy to detect and measure DU and other radioactive materials that may be present in the environment.

Based on the direct survey and environmental sample results, the NRC determined that there was no spread of DU contamination to areas outside of the LIA and that contamination from the DU inside the LIA was limited to the soil immediately surrounding the DU penetrators. With the exception of five soil samples taken from holes where the Navy had recovered DU penetrators, neither the direct measurement nor the environmental sample results identified the presence of radioactive materials other than naturally occurring radioactive materials normally found in the environment. The NRC concluded that members of the public outside of the LIA could not have been exposed to the DU that was fired into the LIA. The inspectors determined that members of the public could only have received a measurable dose from the DU penetrator event if they directly accessed a DU penetrator for extended periods of time. The inspectors did not identify any evidence that members of the public who may have entered the LIA did this.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/NRC/ADAMS/index.html> (the Public Electronic Reading Room).

Should you have any questions concerning this letter, please contact us.

Sincerely,

/RA/

Douglas M. Collins, Director
Division of Nuclear Materials Safety

Enclosure: NRC Environmental Survey
Inspection Report

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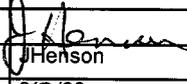
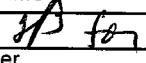
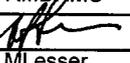
cc w/encl: (Cont'd on page 3)

Carmen Feliciano de Melecio, MD

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

ENVIRONMENTAL SURVEY INSPECTION REPORT

Location: Vieques Island, Puerto Rico

Date: June 6 - 15, 2000

Inspectors: Jay L. Henson, Senior Health Physicist, Region II
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Approved by: Douglas M. Collins, Director
Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Vieques Island Environmental Survey Inspection Report

This special, announced inspection was conducted to determine if depleted uranium (DU) penetrators that the U. S. Navy fired in the Live Impact Area (LIA) at the Atlantic Fleet Weapons Training Facility (AFWTF) on Vieques Island, Puerto Rico, on February 19, 1999, contaminated the surrounding environment and subsequently exposed members of the public to levels of contamination resulting in doses exceeding the limits of 10 CFR 20.1301. The inspection was conducted from June 6 - June 15, 2000, on Vieques Island, Puerto Rico, in the Eastern Maneuver Area (EMA), the Atlantic Fleet Weapons Training Facility (AFWTF), including the LIA, and in civilian areas of the island west of the EMA. The NRC's findings regarding the Navy's firing of the DU penetrators at the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-01, dated April 19, 2000. The NRC's findings regarding the Navy's efforts to recover the DU from the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-04, dated July 13, 2000.

During the inspection, NRC inspectors and representatives from the Radiological Health Division of the Puerto Rico Department of Health obtained direct measurements and collected environmental samples in the areas described above. The inspectors collected samples of soil, vegetation, surface water and the sediment from the locations where surface water samples were obtained. The environmental samples were sent to the Oak Ridge Institute for Science and Education (ORISE), Oak Ridge, Tennessee, for analysis. The entire set of samples was analyzed by gamma spectroscopy and alpha spectroscopy.

Based upon the alpha spectroscopy results, the total uranium results for all but five of the soil and sediment samples ranged from 0.21 ± 0.05 picocuries per gram (pCi/g) to 2.09 ± 0.18 pCi/g. The total uranium results for the vegetation samples ranged from -0.003 ± 0.005 pCi/g to 0.22 ± 0.003 pCi/g. The total uranium results for the water samples ranged from -0.16 ± 0.33 pCi/liter (pCi/L) to 7.0 ± 1.0 pCi/L. The negative numbered results indicate analytical results that were below the background count of the instrument used to analyze the samples and are reported as negative numbers for statistical purposes. These results were indicative of naturally occurring levels of uranium routinely found in environmental samples. The ratios of the radioactivity of the uranium-234 (U-234) to uranium-238 (U-238) and uranium-235 (U-235) to U-238 also indicated that this was natural uranium, not DU.

Five soil samples from the LIA taken in holes from which DU penetrators had been recovered did have total uranium results which indicated the presence of uranium above background levels. The total uranium activity in these samples ranged from 4.02 ± 0.34 pCi/g to 92 ± 12 pCi/g. The ratios of the radioactivity of the U-234 to U-238 and U-235 to U-238 in these samples indicated that the uranium present in these samples was DU.

The NRC determined that based on the direct survey and environmental sample results, there was no spread of DU contamination to areas outside of the LIA and that contamination from the DU inside the LIA was limited to the soil immediately surrounding the DU penetrators. The NRC concluded members of the public outside of the LIA could not have been exposed to the DU that was fired into the LIA. With the exception of the five soil samples taken from holes

where DU penetrators were recovered, neither the direct measurement nor the environmental sample results identified the presence of radioactive materials other than those associated with naturally occurring radioactive materials normally found in the environment. The inspectors determined that members of the public could only have received a measurable dose from the DU penetrator event if they directly accessed a DU penetrator for extended periods of time. The inspectors did not identify any evidence that members of the public who may have entered the LIA did this.

Attachment:

- (1) List of Persons Contacted
List of Acronyms
- (2) Environmental Sample Results
- (3) ORISE Analytical Report

REPORT DETAILS

1. Scope

On February 19, 1999, the U. S. Navy fired DU munitions at targets in the LIA of the AFWTF on Vieques Island, Puerto Rico. Because of public concerns regarding their potential exposure to DU as a result of the DU munitions firing and the continued presence of DU in the LIA, the NRC conducted an inspection at Vieques Island to determine if DU was present in the environment in and around the LIA at levels that could result in public exposures exceeding the limits specified in 10 CFR 20.1301.

2. Background

On February 19, 1999, during a training exercise, two U. S. Marine Corps Harrier aircraft expended 263 ammunition rounds containing DU on the LIA of the AFWTF on Vieques Island, Puerto Rico. The area is a naval weapons firing range, and DU ammunition rounds are not authorized, under NRC regulatory requirements, to be fired there. The NRC was notified of the incident by the Naval Radiation Safety Committee (NRSC) Executive Secretary on March 5, 1999. Between March 10 and 19, 1999, a team comprised of Navy health physics personnel was dispatched to the LIA on Vieques and recovered a total of 57 equivalent penetrators. Some of the DU penetrators were fractured or fragmented on impact with the ground. When these pieces of penetrators were recovered, the recovery team accounted for them by adding up the pieces until they had a quantity of material of approximately the same dimensions as a full penetrator. This composite was termed an "equivalent penetrator."

The NRSC identified the issuance of the DU ammunition and the subsequent firing of it as a Severity Level IV violation of the Navy's master materials license; specifically, a violation of naval radioactive material permit No. 13-00164-L1NP. This permit is issued to the Naval Surface Warfare Center, in Crane, Indiana, and specifies the DU ammunition as war reserve material, deployed only for combat use. The NRC's findings regarding the Navy's firing of the DU penetrators at the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-01, dated April 19, 2000.

As part of its corrective actions, the Navy committed to the recovery of all detectable DU rounds from the LIA on Vieques. A "Survey Work Plan for DU Penetrators" was developed by the Navy and submitted to the NRC on January 10, 2000, for review. The NRC completed its review on March 21, 2000. Between May 31 and June 13, 2000, an inspection was conducted, in part, to determine if licensee personnel performed the DU recovery operations in a radiologically safe manner. The NRC's findings regarding the Navy's efforts to recover the DU from the LIA were addressed in NRC Inspection Report No. 45-23645-01NA/00-04, dated July 13, 2000. The NRC continues to monitor the Navy's efforts to recover the DU penetrators from the LIA.

3. Environmental Survey, Sampling and Analysis Procedures

As described in the *Toxicological Profile for Uranium*, published by the Agency for Toxic Substances and Disease Registry, Public Health Service, U. S. Department of Health & Human Services, September, 1999, uranium is a natural and commonly occurring radioactive element. Rocks, soil, surface and underground water, air, plants and animals all contain varying amounts of uranium. There is about half a teaspoon of uranium in a typical 8-cubic yard dump truck load of soil.

Natural uranium (NU) is a mixture of three types or isotopes of uranium (U-234, U-235 and U-238). The physical and radiological characteristics of NU as described in the Army Environmental Policy Institute technical report, *Health and Environmental Consequences of Depleted Uranium Use in the U.S. Army* are summarized in Table 1.

Table 1

NU Characteristics

Isotope	Weight Percentage	Radioactivity (microcuries/gram)	Contribution to Radioactivity	Half-Life (years)
U-234	0.0058%	6200	50.4%	2.47×10^5
U-235	0.71%	2.2	2.3%	7.1×10^8
U-238	99.28%	0.33	47.3%	4.5×10^9

The processing of uranium for industrial and governmental use can change the ratios of the uranium isotopes. If the fraction of U-235 is increased, it is called enriched uranium. If the portion of U-235 is decreased, it is called DU. Enriched uranium is commonly processed and used as nuclear fuel. DU is generated as a byproduct of the enrichment process. A comparison of the weight percentage of each isotope in NU to DU is in Table 2.

Table 2

Comparison of NU and DU Isotopic Components

	U-234 (%)	U-235 (%)	U-238 (%)	Radioactivity (microcuries/gram)	Radioactivity Ratio U-234/U-238	Radioactivity Ratio U-235/U-238
NU	0.0058	0.71	99.28	0.7	0.97	0.047
DU	0.001	0.2	99.8	0.4	0.18	0.013

The difference in the radioactivity ratios enables the analytical laboratory to distinguish between natural and depleted uranium in environmental samples. For example, if the analysis determines that the radioactivity of U-234 in the sample is approximately equal to the radioactivity of U-238 in the sample, then the uranium present in the sample is NU. If reported radioactivity of the U-234 is much lower than that reported for U-238, then the uranium in the sample is DU. In addition, because of the difference in the ratios of the uranium isotopes, NU has a radioactivity of 0.7 microcuries per gram while DU has a radioactivity of 0.4 microcuries per gram. Therefore the radioactivity of DU is about 60% of that of NU.

When U-238 emits its radiation, it changes or decays through a series of different radioactive materials, including thorium-234, protactinium-234m, U-234, thorium-230 and radium-226. These decay products emit a variety of radiations of different energies including alpha, beta and gamma radiation. The gamma emitting decay products are identified and measured with gamma spectroscopy which can determine the amount of U-238 and U-234 in a sample. The characteristic energies of the alpha particles emitted by some radioactive materials, such as those from U-234, U-235, and U-238, are used to detect and measure the amount of each of alpha emitting radionuclides through alpha spectroscopy.

In addition to uranium, other naturally occurring radionuclides are present in soil. As reported in the National Council on Radiation Protection and Measurement's Report No. 45, *Natural Background Radiation in the United States*, these include potassium-40, rubidium-87 and thorium-232 and thorium decay products. The average levels of these radionuclides in soil is depicted in the table below:

Table 3

Major Radionuclide Concentrations in Rock and Soil
(Activity in picocuries/gram)

Rock/Soil Type	Potassium-40	Rubidium-87	Thorium-232	Uranium-238
Types of Igneous Rocks				
Basalt	7	0.9	0.3-0.4	0.2-0.3
Mafic	2-9	0.2-1	0.3	0.3
Salic	30-40	4-5	2.2	1.6
Granite	>30	4-5	1.9	1
Beach sands	<8	<1	0.7	1
Soils	12	1.4	1	0.6 (Normal range from 0.2-2)

The primary emphasis of the NRC inspection was the direct measurement of environmental radiation levels and the collection of environmental samples, including soil, vegetation, surface water and sediment from surface water sources, from the AFWTF, including the LIA, the EMA, and civilian areas between the EMA and the Naval Ammunition Support Department (NASD). Soil sample locations were selected based upon a predetermined grid system, then individual sample points were selected with preference given to points where terrain features caused the accumulation of eroded soil or where elevated radiation levels were indicated from instrument surveys.

At each soil sample location, an area of between 100 and 200 square feet was cleared and scanned using an Eberline Model No. ESP-2 Survey Meter (serial no. 00793, calibrated May 27, 2000) equipped with a Model No. SPA-3, 2 inch by 2 inch sodium iodide (NaI) detector. Five one kilogram surface soil samples (no deeper than six inches) were obtained from within each sample location. A dose rate measurement was obtained from each sample point at the surface and at a distance of one meter above the surface using a Ludlum Model 19 microR meter (serial no. 33546, calibrated August 16, 1999). The five soil samples were mixed together and a dose rate measurement was obtained from the surface of the sample using the Ludlum Model 19 meter and a one minute count of the beta radiation emissions was obtained using an Eberline Model E-600 survey meter (serial no. 01876, calibrated November 12, 1999) with a Model SHP-380 AB probe (alpha/beta scintillation detector). The inspectors divided the mixed sample into four equal sections and took an aliquot from each section until a one kilogram composite sample was collected for laboratory analysis. The inspectors rinsed the shovels and scoops used to collect the soil samples with clean water after each sample to prevent cross contamination of the samples. The inspectors performed daily performance checks of all radiation survey instruments with radiation sources to ensure the instruments were working properly during the entire survey period.

Since the fired DU penetrators remained either on the surface of the ground or within a few inches of the ground surface, the most likely way that the DU could have entered the environment would have been by transport as a result of soil erosion or resuspension into the air of the small particles that may have rubbed off of the penetrators on impact or from the oxidation products that may flake off the penetrators as a result of being exposed to the environment. Members of the public were concerned that the environmental contamination that may result from the presence of the DU in the LIA could be transported outside of the LIA and expose the public to DU. The NRC was aware that the potential transport of the DU into the environment beyond the LIA was of public concern and conducted this inspection and environmental survey to address those concerns.

Even though the most likely place to find DU contamination in the environment was in the soil, vegetation samples including grasses, roots, leaves and fruits were collected from various points on the island. In addition, 1 liter water and 1 kilogram sediment samples were collected from accessible surface water sources. The location of all sample points was determined through the use of a global positioning system device and recorded in decimal degrees.

The environmental samples were sent to the ORISE, Oak Ridge, Tennessee for analysis by alpha and gamma spectroscopy techniques. Gamma spectroscopy would identify the presence of gamma emitting radionuclides in each sample and the alpha spectroscopy would confirm the ratios of the uranium isotopes in each sample. The determination of whether the uranium present in each sample was NU or DU would be based upon the ratios of the U-234, U-235 and U-238 in each sample.

The gamma spectroscopy analysis of each environmental sample performed by ORISE also determined the activity of some of the other naturally occurring radionuclides including potassium-40, thorium-228 and radium-228 (decay products of thorium-232), and radium-226 (decay product of uranium-238).

4. Observations and Findings

A total of 84 soil, 17 vegetation, 7 water and 6 sediment samples were collected during the inspection. A summary of the samples collected is provided in Table 4 below. Table 1 of Attachment 2 includes the location and instrument survey results for the 84 soil samples. Table 2 of Attachment 2 includes the composite sample surface dose rate and beta emission rate from the field survey for each soil sample and the total uranium based on alpha spectroscopy analysis and the potassium-40 (K-40) based on gamma spectroscopy found in each sample.

Table 4

Summary of Collected Samples

Area	Soil	Vegetation	Water	Sediment
LIA	18	1	0	0
EMA	37	8	4	4
VPA	29	8	3	2
Total	84	17	7	6

Direct radiation level measurements and the soil samples collected in the LIA included measurements and collection of samples from each of the camps established by protesters who occupied the range for a period of up to one year (LIA-001 - 004). The protester camps were over a kilometer away from that part of the LIA where the DU penetrators impacted. Sample numbers LIA-005 - 010 were taken along the perimeter of the LIA where it borders the remainder of the AFWTF. Sample numbers LIA-011 - 013 and 014N and 014S were taken from holes from which Navy personnel recovered DU penetrators, and sample numbers LIA-015 - 018 were taken from areas that were down gradient from the target area where several penetrators were recovered and where it appeared eroded soil from the target area accumulated. The only soil samples which were found to contain uranium above natural background levels were numbers LIA-011 - 013 and 014N and 014S, which were from the holes from which DU penetrators had been recovered. Based on the alpha spectroscopy results, the total uranium in these

samples ranged from 4.02 ± 3.5 pCi/g to 92 ± 12 pCi/g. Based upon the radioactivity ratios of the U-234 to U-238 and the U-235 to U-238, it was determined that the elevated uranium detected in these samples was DU. The remainder of the soil samples in the LIA ranged from 0.21 ± 0.05 to 2.09 ± 0.17 pCi/g and the isotopic radioactivity ratios indicated that the uranium detected in these samples was natural uranium.

The soil samples collected in the AFWTF west of Observation Post 1 (OP-1), which was outside of the LIA, and those collected in the EMA were all documented beginning with the designation EMA. Samples were collected along both the north and south shorelines and from accessible areas in the interior of this area of the island. A variety of soil sample types were collected, including beach sand from the recreation areas where members of the public had been allowed access prior to the Navy restricting access to Camp García. The inspectors noted that the dose rates and beta emission rates were extremely low along the beach areas (0.5 - 1.0 microrem/hour [uR/h]) and rose to more typical background dose rates of 4 - 6 uR/h in areas away from the beaches. From review of the analytical results, this variance in the dose rates and beta emission rates correlates with the variance in the concentration of potassium-40 in the soil samples. This is illustrated by the results depicted in Table 2 of Attachment 2. Based on the alpha spectroscopy results, the total uranium in these samples ranged from 0.23 ± 0.05 to 2.09 ± 0.18 pCi/g. The isotopic radioactivity ratios indicated that the uranium detected in all of these samples was NU.

The soil samples collected in the civilian areas of Vieques Island, which is the area between Camp García to the east and the Naval Ammunition Support Department to the west, were documented beginning with the designation VPA. Soil samples were obtained in and around the areas of Isabel Segunda and Esperanza and were obtained in rural areas, along roadsides, in neighborhoods with permission of the property owners, and in public recreation areas. The inspectors noted the same variance in the dose rates and beta emission rates as those measured from samples in the EMA, which correlated with the variance of potassium-40 concentrations in the soil samples. Based on the alpha spectroscopy results, the total uranium in these samples ranged from 0.30 ± 0.05 to 1.79 ± 0.15 pCi/g. The isotopic radioactivity ratios indicated that the uranium detected in all of these samples was NU.

The sample numbers, locations, types and total uranium and potassium-40 results for the vegetation samples collected during the inspection are listed in Table 3 of Attachment 2. Based upon the alpha spectroscopy results, the total uranium contained in these samples ranged from -0.003 ± 0.005 pCi/g to 0.22 ± 0.03 pCi/g. The isotopic radioactivity ratios indicated that the uranium detected in all of these samples was NU.

The sample numbers, locations, sample area description, and total uranium results for the water samples collected during the inspection are listed in Table 4 of Attachment 2. The associated sediment sample results, including K-40, obtained where six of the water samples were collected are listed in Table 5. Based on the alpha spectroscopy results, the total uranium contained in the water samples ranged from -0.016 ± 0.33 pCi/L to 4.60 ± 0.68 pCi/L. The total uranium reported for the sediment samples ranged from 0.50 ± 0.08 pCi/g to 1.58 ± 0.14 pCi/g. The isotopic radioactivity ratios for the water and sediment samples indicated that the uranium detected in all of these samples was NU.

The entire gamma spectroscopy and alpha spectroscopy results for all samples are contained in the ORISE report at Attachment 3.

5. Conclusions

The inspectors determined through the performance of independent direct measurements of radiation levels and the collection and analysis of environmental samples that DU from the firing of DU penetrators into the LIA had not spread to the environment outside the LIA. The inspectors concluded that members of the public were not at risk of being exposed to levels of radiation exceeding the limits in 10 CFR 20.1301. The inspectors did identify areas of DU contamination in the soil in the area from which the Navy had recovered DU penetrators but it did not appear that this contamination had migrated beyond the immediate vicinity of each individual penetrator. The only radioactive materials detected outside of the LIA were naturally occurring materials normally present in the environment. The inspectors concluded that the only way members of the public could have received exposure from the DU penetrators that were fired into the LIA would be from direct contact exposure with the DU penetrators as a result of picking up and handling DU penetrators recovered from the firing range. The inspectors were not aware of any members of the public who had recovered DU penetrators from the LIA.

ATTACHMENT 1

LIST OF PERSONS CONTACTED

CDR D. Farrand, Director, Radiological Controls Program Office, Naval Sea Systems Command
CDR(s) L. Fragoso, Deputy Director of Radiological Health, Norfolk Naval Shipyard
LCDR V. Deinnocentiis, Environmental Project Manager, Radiological Affairs Support Office
Mr. L. Martin, Environmental Project Manager, Radiological Affairs Support Office
Mr. T. Blanton, Environmental Project Manager, Radiological Affairs Support Office
LCDR T. Bracek, Inner Range Manager/Range Control Officer
CAPT N. Delgado (U.S. Marines), Assistant Inner Range Manager/Range Control Officer
Mr. N. Hines, Site Manager (OP1 Compound)
Numerous Explosive Ordnance Disposal Personnel
Several Concerned Private Citizens

LIST OF ACRONYMS

AFWTF - Atlantic Fleet Weapons Training Facility
CPM - Counts per Minute
DU - Depleted Uranium
EMA - Eastern Maneuver Area
LIA - Live Impact Area
NaI - Sodium Iodide
NASD - Naval Ammunition Support Department
NRC - Nuclear Regulatory Commission
NRSC - Naval Radiation Safety Commission
NU - Natural uranium
ORISE - Oak Ridge Institute for Science and Education
pCi/g - picocuries per gram
pCi/L - picocuries per liter
K-40 - potassium 40
uR/hr - Microrem per Hour
U-234 - uranium 234
U-235 - uranium 235
U-238 - uranium 238
VPA - Vieques Public Area

Attachment 2

Environmental Sample Results

TABLE 1
VIEQUES ISLAND ENVIRONMENTAL SURVEY
SOIL SAMPLE INSTRUMENT SURVEYS
LIVE IMPACT AREA

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm) ¹	Area Surface Average (uR/h) ²	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
LIA-001	N18.13208 W065.29639	2500-2800	2.5	2.5	3	177
LIA-002	N18.13599 W065.30566	900-1100	0.8	0.7	1	84
LIA-003	N18.14202 W065.30554	750-950	0.6	0.6	1	82
LIA-004	N18.14325 W065.30119	820-1000	0.9	0.9	1	82
LIA-005	N18.13078 W065.31580	3000-5000	5.8	5.6	5	193

1 - counts per minute; 2 - microrem per hour

Table 1 - Live Impact Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm) ¹	Area Surface Average (uR/h) ²	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	- Composite Sample Surface Beta (cpm)
LIA-006	N18.13394 W065.31490	2800-3200	3.8	4.1	4	155
LIA-007	N18.13730 W065.31434	3400-3900	4.7	4.5	5	224
LIA-008	N18.14020 W065.31287	3700-4400	4.9	4.5	5	244
LIA-010	N18.14272 W065.31149	4600-5000	5.6	5.4	5	233
LIA-011	N18.14307 W065.29134	2300	3	2	4	200
LIA-012	N18.14348 W065.29118	2500	2	2.5	5	131
LIA-013	N18.14372 W065.29110	2700	3	2	4.5	557
LIA-014N	N18.14213 W065.29156	2600	3	2	4.5	627
LIA-014S	N18.14213 W065.29156	2200	2	2	4	297

Table 1 - Live Impact Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm) ¹	Area Surface Average (uR/h) ²	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
LIA-015	N18.14165 W065.29156	1100	1	1	4	102
LIA-016	N18.14194 W065.29137	1100	1	1	4	115
LIA-017	N18.14159 W065.29145	1200	1	1	4	---
LIA-018	N18.14139 W065.29140	1200	1	1	4.5	121

TABLE 1**EASTERN MANEUVER AREA**

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
EMA-001	N18.12728 W065.31945	1600-1700	1.7	1.4	1	124
EMA-002	N18.12732 W065.33067	2600-2900	3	2.9	3	149
EMA-004	N18.12583 W065.33108	710-960	0.9	1	1.5	112
EMA-005	N18.13251 W065.33620	2000-2400	2.3	2.4	2	120
EMA-008	N18.13665 W065.33807	2300-2900	3	3.2	3	123
EMA-009	N18.14244 W065.33485	2800-3700	4.2	3.9	4	147
EMA-012	N18.14634 W065.33112	850-950	0.8	1.2	1.5	105
EMA-013	N18.14634 W065.33112	950-1200	1.3	1.5	1.5	121

Table 1 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
EMA-014	N18.14703 W065.32869	2400-2900	2.9	3.2	2.5	134
EMA-015	N18.14837 W065.34129	2600-3570	3.6	3.2	3	122
EMA-017	N18.14837 W065.34129	3400	4	---	---	---
EMA-018	N18.14837 W065.34129	3600	4	---	---	---
EMA-019	N18.15107 W065.35094	2400-3170	3	2.6	3.5	150
EMA-020	N18.12496 W065.33565	1120-1400	1.2	1.2	2	101
EMA-023	N18.12083 W065.33907	1110-1660	1	1	1.5	111
EMA-024	N18.11447 W065.34659	1700-2450	2.2	2.5	2	126
EMA-025	N18.13925 W065.33968	2530-2870	3.1	3.5	3	166

Table 1 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
EMA-026	N18.13888 W065.34649	2300-2980	3.4	2.9	3	133
EMA-027	N18.15326 W065.35942	1220-1640	1.3	1.5	1	95
EMA-028	N18.15374 W065.36934	4450-5300	5.6	5.7	5	225
EMA-029	N18.15760 W065.37546	2320-2650	2.4	2.6	3	149
EMA-030	N18.13595 W065.36066	2450-2800	2.8	3.2	3	99
EMA-031	N18.13551 W065.36827	3580-4060	4.8	4.9	4	191
EMA-034	N18.12521 W065.36814	656-921	0.7	0.9	0.5	74
EMA-036	N18.11560 W065.38617	2430-2840	3.1	2.9	2.5	---
EMA-037	N18.11157 W065.37781	900-1140	1	0.9	1	81
EMA-038	N18.11298 W065.38126	750-850	0.6	0.9	0.5	82

Table 1 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
EMA-041	N18.11318 W065.39434	1680-2030	2.2	2.3	2.5	111
EMA-042	N18.1118 W065.39983	1670-1800	1.9	2.4	3	130
EMA-043	N18.10961 W065.41164	1910-2090	1	1	1	108
EMA-044	N18.10837 W065.41210	1100-1300	0.9	1.3	1.8	91
EMA-045	N18.10811 W065.41665	1370-1650	1.6	1.9	1.5	87
EMA-046	N18.10787 W065.42491	1830-2190	1.7	2	1.5	94
EMA-047	N18.13501 W065.40646	2930-3270	3.5	4	3.5	140
EMA-048	N18.12846 W065.41405	2920-3190	3.8	3.3	4	168
EMA-049	N18.12230 W065.42011	3220-3770	3.7	4.6	5	149
EMA-053	N18.12659 W065.42358	2730-3680	3.9	3.7	4	148

TABLE 1

VIEQUES PUBLIC AREAS

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
VPA-002	N18.14710 W065.43925	2740-3200	3.6	3.4	3	139
VPA-003	N18.15273 W065.43530	2330-2650	2.8	2.6	3	144
VPA-004	N18.15866 W065.42486	1340-1650	1.7	1.8	1	105
VPA-005	N18.14132 W065.44637	3220-3390	3.8	4	4	176
VPA-007	N18.12002 W065.43803	3340-3840	4.4	4.6	5	162
VPA-008	N18.13993 W065.46391	3080-3740	4.3	4.2	4.5	176
VPA-009	N18.14222 W065.46661	2490-2900	3.1	3.1	3	134
VPA-010	N18.11409 W065.44816	3600-4110	4.6	5.2	4	143
VPA-011	N18.10104 W065.46478	3370-4240	4.3	4.6	4.5	170

Table 1 - Vieques Public Areas - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
VPA-012	N18.11753 W065.47322	3710-4510	4.7	5.5	5	185
VPA-013	N18.13202 W065.46130	3870-4390	5	5.1	5	181
VPA-014	N18.13153 W065.45071	2920-3170	3.5	3	3	121
VPA-016	N18.12302 W065.44742	3990-4440	4.5	4.9	5	173
VPA-017	N18.09719 W065.46338	1830-2010	1.9	2	2	116
VPA-020	N18.09774 W065.46360	3110-3740	4.4	4.4	3.8	160
VPA-021	N18.11354 W065.46933	4360-5140	5.7	5.6	5	226
VPA-022	N18.13936 W065.48181	2160-2530	2.5	2.2	2.5	126
VPA-023	N18.13413 W065.47079	4570-5120	5.6	5.6	5	209
VPA-025	N18.12593 W065.49512	4080-4630	5.7	5.6	5.5	192

Table 1 - Vieques Public Areas - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Area Gamma Scan (cpm)	Area Surface Average (uR/h)	Area 1 Meter Above Surface Average (uR/h)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)
VPA-026	N18.11938 W065.50315	4620-5260	6.3	6.2	6	192
VPA-027	N18.10819 W065.48740	3450-4330	4.9	4.9	5	165
VPA-030	N18.11214 W065.47694	3400-4010	4.1	3.9	4	172
VPA-031	N18.09486 W065.47285	1910-2190	2.3	2.3	2	130
VPA-032	N18.11447 W065.44035	3440-3880	4.6	5.1	4.5	156
VPA-033	N18.10563 W065.44808	3130-4240	4.4	4.3	3.5	184
VPA-034	N18.10534 W065.43817	2450-2900	3.3	3.1	3.5	129
VPA-035	N18.12341 W065.45472	4770-5010	5.6	5.6	5	172
VPA-037	N18.13034 W065.45496	3800-4160	4.4	4.4	5	185
VPA-038	N18.13953 W065.45276	3640-4120	4.4	4.5	3	171

TABLE 2

VIEQUES ISLAND ENVIRONMENTAL SURVEY

**SOIL SAMPLE INSTRUMENT SURVEY
AND
LABORATORY ANALYSIS RESULTS**

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
LIA-001	N18.13208 W065.29639	3	177	0.37 ± 0.07	12.26 ± 0.56
LIA-002	N18.13599 W065.30566	1	84	2.09 ± 0.17	0.26 ± 0.15
LIA-003	N18.14202 W065.30554	1	82	1.51 ± 0.14	0.40 ± 0.13
LIA-004	N18.14325 W065.30119	1	82	1.60 ± 0.14	0.54 ± 0.17
LIA-005	N18.13078 W065.31580	5	193	0.51 ± 0.07	14.67 ± 0.68
LIA-006	N18.13394 W065.31490	4	155	0.22 ± 0.05	11.59 ± 0.67
LIA-007	N18.13730 W065.31434	5	224	0.56 ± 0.07	16.96 ± 0.89

Table 2 - Live Impact Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
LIA-008	N18.14020 W065.31287	5	244	0.42 ± 0.06	19.50 ± 0.93
LIA-010	N18.14272 W065.31149	5	233	0.53 ± 0.07	17.52 ± 0.91
LIA-011	N18.14307 W065.29134	4	200	27.1 ± 3.5	2.78 ± 0.25
LIA-012	N18.14348 W065.29118	5	131	4.02 ± 0.34	5.44 ± 0.47
LIA-013	N18.14372 W065.29110	4.5	557	92 ± 12	2.57 ± 0.28
LIA-014N	N18.14213 W065.29156	4.5	627	43.4 ± 5.7	0.75 ± 0.20
LIA-014S	N18.14213 W065.29156	4	297	25.3 ± 3.1	0.80 ± 0.19
LIA-015	N18.14165 W065.29156	4	102	0.24 ± 0.06	0.71 ± 0.18
LIA-016	N18.14194 W065.29137	4	115	0.30 ± 0.06	0.56 ± 0.16
LIA-017	N18.14159 W065.29145	4	---	0.29 ± 0.06	0.97 ± 0.20
LIA-018	N18.14139 W065.29140	4.5	121	0.32 ± 0.06	0.95 ± 0.17

TABLE 2

EASTERN MANEUVER AREA

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
EMA-001	N18.12728 W065.31945	1	124	0.69 ± 0.08	5.30 ± 0.47
EMA-002	N18.12732 W065.33067	3	149	0.43 ± 0.07	8.49 ± 0.54
EMA-004	N18.12583 W065.33108	1.5	112	1.93 ± 0.16	0.59 ± 0.15
EMA-005	N18.13251 W065.33620	2	120	0.33 ± 0.06	4.82 ± 0.42
EMA-008	N18.13665 W065.33807	3	123	0.29 ± 0.06	6.03 ± 0.39
EMA-009	N18.14244 W065.33485	4	147	0.52 ± 0.07	10.74 ± 0.66
EMA-012	N18.14634 W065.33112	1.5	105	1.40 ± 0.14	0.84 ± 0.18
EMA-013	N18.14634 W065.33112	1.5	121	1.26 ± 0.13	6.50 ± 0.39
EMA-014	N18.14703 W065.32869	2.5	134	0.44 ± 0.06	10.16 ± 0.67
EMA-015	N18.14837 W065.34129	3	122	0.50 ± 0.07	7.88 ± 0.54

Table 2 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
EMA-017	N18.14837 W065.34129	---	---	0.55 ± 0.08	8.81 ± 0.62
EMA-018	N18.14837 W065.34129	---	---	0.45 ± 0.07	8.19 ± 0.59
EMA-019	N18.15107 W065.35094	3.5	150	0.49 ± 0.08	5.78 ± 0.47
EMA-020	N18.12496 W065.33565	2	101	1.61 ± 0.14	1.52 ± 0.27
EMA-023	N18.12083 W065.33907	1.5	111	0.35 ± 0.06	4.03 ± 0.31
EMA-024	N18.11447 W065.34659	2	126	0.25 ± 0.05	8.39 ± 0.62
EMA-025	N18.13925 W065.33968	3	166	0.23 ± 0.05	11.17 ± 0.64
EMA-026	N18.13888 W065.34649	3	133	0.48 ± 0.07	4.89 ± 0.44
EMA-027	N18.15326 W065.35942	1	95	1.26 ± 0.12	2.65 ± 0.29
EMA-028	N18.15374 W065.36934	5	225	0.52 ± 0.07	18.87 ± 0.81
EMA-029	N18.15760 W065.37546	3	149	0.94 ± 0.10	6.79 ± 0.59

Table 2 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
EMA-030	N18.13595 W065.36066	3	99	0.77 ± 0.09	3.26 ± 0.34
EMA-031	N18.13551 W065.36827	4	191	1.05 ± 0.11	7.70 ± 0.53
EMA-034	N18.12521 W065.36814	0.5	74	1.36 ± 0.13	0.56 ± 0.18
EMA-036	N18.11560 W065.38617	2.5	---	0.39 ± 0.07	7.53 ± 0.44
EMA-037	N18.11157 W065.37781	1	81	1.31 ± 0.13	1.00 ± 0.21
EMA-038	N18.11298 W065.38126	0.5	82	1.78 ± 0.15	0.27 ± 0.15
EMA-041	N18.11318 W065.39434	2.5	111	0.33 ± 0.06	4.49 ± 0.37
EMA-042	N18.1118 W065.39983	3	130	0.32 ± 0.05	5.93 ± 0.47
EMA-043	N18.10961 W065.41164	1	108	1.23 ± 0.12	6.54 ± 0.42
EMA-044	N18.10837 W065.41210	1.8	91	1.85 ± 0.15	0.38 ± 0.16
EMA-045	N18.10811 W065.41665	1.5	87	1.90 ± 0.16	0.87 ± 0.20

Table 2 - Eastern Maneuver Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
EMA-046	N18.10787 W065.42491	1.5	94	2.09 ± 0.18	0.22 ± 0.18
EMA-047	N18.13501 W065.40646	3.5	140	0.72 ± 0.09	5.87 ± 0.50
EMA-048	N18.12846 W065.41405	4	168	0.49 ± 0.07	11.49 ± 0.56
EMA-049	N18.12230 W065.42011	5	149	0.43 ± 0.07	11.72 ± 0.72
EMA-053	N18.12659 W065.42358	4	148	0.53 ± 0.07	11.65 ± 0.59

TABLE 2

VIEQUES PUBLIC AREAS

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
VPA-002	N18.14710 W065.43925	3	139	0.52 ± 0.08	8.66 ± 0.61
VPA-003	N18.15273 W065.43530	3	144	0.30 ± 0.05	8.25 ± 0.60
VPA-004	N18.15866 W065.42486	1	105	1.13 ± 0.13	2.52 ± 0.33
VPA-005	N18.14132 W065.44637	4	176	0.71 ± 0.12	10.26 ± 0.73
VPA-007	N18.12002 W065.43803	5	162	0.67 ± 0.09	12.28 ± 0.75
VPA-008	N18.13993 W065.46391	4.5	176	0.72 ± 0.09	9.73 ± 0.67
VPA-009	N18.14222 W065.46661	3	134	0.32 ± 0.06	10.67 ± 0.67
VPA-010	N18.11409 W065.44816	4	143	0.72 ± 0.10	13.62 ± 0.78
VPA-011	N18.10104 W065.46478	4.5	170	0.75 ± 0.09	13.70 ± 0.74

Table 2 - Vieques Public Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
VPA-012	N18.11753 W065.47322	5	185	0.80 ± 0.10	14.44 ± 0.70
VPA-013	N18.13202 W065.46130	5	181	0.73 ± 0.09	13.04 ± 0.80
VPA-014	N18.13153 W065.45071	3	121	0.46 ± 0.07	7.73 ± 0.58
VPA-016	N18.12302 W065.44742	5	173	0.78 ± 0.10	14.8 ± 1.0
VPA-017	N18.09719 W065.46338	2	116	1.79 ± 0.15	4.00 ± 0.36
VPA-020	N18.09774 W065.46360	3.8	160	0.82 ± 0.11	13.28 ± 0.83
VPA-021	N18.11354 W065.46933	5	226	0.81 ± 0.10	19.27 ± 0.89
VPA-022	N18.13936 W065.48181	2.5	126	0.37 ± 0.06	7.69 ± 0.57
VPA-023	N18.13413 W065.47079	5	209	0.82 ± 0.09	15.30 ± 0.76
VPA-025	N18.12593 W065.49512	5.5	192	0.93 ± 0.11	15.35 ± 0.90

Table 2 - Vieques Public Area - Soil Samples

Sample No.	Coordinates (latitude & longitude in digital degrees)	Composite Sample Surface (uR/h)	Composite Sample Surface Beta (cpm)	Total Uranium (pCi/g)	Potassium-40 (pCi/g)
VPA-026	N18.11938 W065.50315	6	192	0.73 ± 0.09	16.03 ± 0.90
VPA-027	N18.10819 W065.48740	5	165	0.66 ± 0.09	12.92 ± .064
VPA-030	N18.11214 W065.47694	4	172	0.70 ± 0.09	12.51 ± 0.69
VPA-031	N18.09486 W065.47285	2	130	1.09 ± 0.12	7.42 ± 0.46
VPA-032	N18.11447 W065.44035	4.5	156	0.68 ± 0.09	11.73 ± 0.69
VPA-033	N18.10563 W065.44808	3.5	184	0.73 ± 0.09	16.72 ± 0.88
VPA-034	N18.10534 W065.43817	3.5	129	0.85 ± 0.10	12.35 ± 0.82
VPA-035	N18.12341 W065.45472	5	172	0.82 ± 0.10	18.2 ± 1.1
VPA-037	N18.13034 W065.45496	5	185	0.69 ± 0.09	15.70 ± 0.89
VPA-038	N18.13953 W065.45276	3	171	0.64 ± 0.10	12.66 ± 0.74

TABLE 3

VIEQUES ISLAND ENVIRONMENTAL SURVEY

VEGETATION SAMPLE RESULTS

SAMPLE NO.	COORDINATES (latitude & longitude in digital degrees)	VEGETATION TYPE	TOTAL URANIUM (pCi/g)	POTASSIUM-40 (pCi/g)
LIA-009	N18.14020 W065.31287	Tall grass	0.011 ± 0.004	4.00 ± 0.68
EMA-003	N18.12732 W065.33067	Tall grass	0.03 ± 0.01	5.94 ± 0.64
EMA-006	N18.13251 W065.33620	Tall, leafy plant	-0.003 ± 0.005	4.71 ± 0.43
EMA-007	N18.13665 W065.33807	Tall grass	0.007 ± 0.004	6.16 ± 0.57
EMA-016	N18.14837 W065.34129	Tall grass	0.01 ± 0.01	7.18 ± 0.41
EMA-035	N18.12521 W065.36814	Leaves from small diameter tree	0.01 ± 0.01	6.11 ± 0.40
EMA-050	N18.11308 W065.38142	Grape-like fruit from tree at beach	0.01 ± 0.01	4.47 ± 0.30
EMA-051	N18.11308 W65.38142	Leaves from tree with grape-like fruit	-0.00 ± 0.01	2.45 ± 0.15

Table 3 - Vegetation Samples

SAMPLE NO.	COORDINATES (latitude & longitude in digital degrees)	VEGETATION TYPE	TOTAL URANIUM (pCi/g)	POTASSIUM-40 (pCi/g)
EMA-052	N18.12659 W065.42358	Tall grass	0.02 ± 0.01	5.59 ± 0.47
VPA-006	N18.14132 W065.44637	Tall grass	0.01 ± 0.01	5.17 ± 0.43
VPA-015	N18.13153 W065.45071	Carrot-like root from waxy, broad-leafed plant	0.22 ± 0.03	2.36 ± 0.16
VPA-018	N18.09719 W065.46338	Grape-like fruit from tree at beach	0.005 ± 0.0031	1.71 ± 0.15
VPA-019	N18.09719 W065.46338	Leaves from tree with grape-like fruit	0.004 ± 0.004	4.13 ± 0.28
VPA-024	N18.13413 W065.47079	Tall grass	0.02 ± 0.01	5.26 ± 0.52
VPA-036	N18.12341 W065.45472	Tall grass	0.01 ± 0.01	9.55 ± 0.54
VPA-039	N18.13953 W065.45276	Fruit from mango tree	0.004 ± 0.002	1.11 ± 0.09
VPA-042	N18.13953 W065.45276	Fruit from mango tree	0.002 ± 0.002	1.45 ± 0.12

TABLE 4
VIEQUES ISLAND ENVIRONMENTAL SURVEY
WATER SAMPLE RESULTS

SAMPLE NO.	COORDINATES (latitude & longitude in digital degrees)	SAMPLE AREA DESCRIPTION	TOTAL URANIUM (pCi/liter)
EMA-011	N18.14554 W065.33257	Lagoon	7.0 ± 1.01
EMA-022	N18.12361 W065.33546	Lagoon	1.26 ± 0.44
EMA-033	N18.12651 W065.37013	Lagoon	4.60 ± 0.68
EMA-039	N18.11300 W065.39153	Lagoon	1.41 ± 0.41
VPA-001	N18.15556 W065.44253	Municipal water supply	-0.16 ± 0.33
VPA-028	N18.11192 W065.48726	Small, rural stream	0.17 ± 0.46
VPA-040	N18.15148 W065.44273	Stream in Isabel Segunda	0.84 ± 0.37

TABLE 5

VIEQUES ISLAND ENVIRONMENTAL SURVEY

SEDIMENT SAMPLE RESULTS

SAMPLE NO.	COORDINATES (latitude & longitude in digital degrees)	SAMPLE AREA DESCRIPTION	TOTAL URANIUM (pCi/g)	POTASSIUM-40 (pCi/g)
EMA-010	N18.14554 W065.33257	Lagoon	0.50 ± 0.08	11.06 ± 0.68
EMA-021	N18.12361 W065.33546	Lagoon	1.12 ± 0.10	4.31 ± 0.41
EMA-032	N18.12651 W065.37013	Lagoon	1.18 ± 0.12	6.58 ± 0.43
EMA-040	N18.11300 W065.39153	Lagoon	1.58 ± 0.14	0.50 ± 0.15
VPA-029	N18.11192 W065.48726	Small, rural stream	0.69 ± 0.08	16.36 ± 0.87
VPA-041	N18.15148 W065.44273	Stream in Isabel Segunda	0.80 ± 0.09	7.16 ± 0.54

Attachment 3

Oak Ridge Institute for Science and Education Analytical Report

ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

August 24, 2000

Mr. Jay Henson
U.S. Nuclear Regulatory Commission
Region II, Suite 23T85
61 Forsyth Street
Atlanta, GA 30303

SUBJECT: REPORT FOR ANALYSIS OF WATER, SOIL, AND VEGETATION SAMPLES FROM VIEQUES ISLAND, PUERTO RICO (DOCKET NUMBER 030-29462)[RFTA NO. 00-009]

Dear Mr. Henson:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) received seven water, 90 soil, and 17 vegetation samples from Vieques Island, Puerto Rico, on June 16, 2000. The entire set of samples was analyzed by gamma spectroscopy and alpha spectroscopy. The results from the gamma spectroscopy analysis are presented in Tables 1-3. The isotopic uranium results from alpha spectroscopy are presented in Tables 4-6. A case narrative is attached to explain the analytical results and to document any problems that occurred during the analytical process.

ESSAP's Quality Control (QC) procedures were followed for these analyses with the addition of 20 percent duplicate analyses for each analytical method, at the request of NRC Region II. Analytical and instrumentation QC for these analyses were within acceptable limits. The QC files are available for your review upon request.

If you have any questions, please contact me at (865) 241-3242 or Wade Ivey at (865) 576-9184.

Sincerely,



Dale Condra
Laboratory Manager
Environmental Survey and
Site Assessment Program

RDC:dka

Enclosure

cc w/o enclosure:

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CASE NARRATIVE FOR ANALYTICAL RESULTS FROM THE ANALYSIS OF SOIL, VEGETATION, AND WATER SAMPLES FROM VIEQUES ISLAND, PUERTO RICO

The gamma spectroscopy results for each sample were reviewed for the presence of uranium and for other isotopes that may have been identified by the system software. Only natural occurring material was found in the samples collected outside the live impact area. There were five soil samples taken inside the live impact area that contained depleted uranium (DU).

The uranium concentrations for samples collected outside the live impact area generated by gamma spectroscopy were confirmed by alpha isotopic analysis. The uranium isotopic results for the soil samples ranged from 0.10 pCi/g to 1.06 pCi/g of U-234 and 0.11 pCi/g to 0.82 pCi/g for U-238. The isotopic uranium results for the vegetation samples ranged from -0.001 pCi/g to 0.148 pCi/g of U-234 and -0.001 pCi/g to 0.08 pCi/g for U-238. The isotopic uranium results for the water samples ranged from -0.08 pCi/L to 3.40 pCi/L of U-234 and 0.08 pCi/L to 3.22 pCi/L for U-238.

For the five contaminated soil samples collected inside the live impact area, the uranium isotopic results were higher than the results generated by gamma spectroscopy. The uranium isotopic results indicated that the contaminant was depleted uranium (DU). The DU is probably surface contamination due to the way it was introduced into the area. Therefore the difference in the alpha isotopic and gamma spectroscopy results can be reasonably accounted for by the non-homogeneity of the sample.

In order to address the above contention, it was decided to count the sample aliquots from which the alpha spectroscopy fraction was taken by gamma spectroscopy. The two samples with the highest DU concentrations (S084/LIA-013 and S085/LIA-014N) were selected. The results from the gamma counts were statistically equal to the results from the alpha spectroscopy analysis for the same sample fraction. The U-238 alpha spectroscopy and gamma spectroscopy results for S084 were 80 ± 11 and 79.5 ± 4.5 pCi/g, respectively. The U-238 alpha spectroscopy and gamma spectroscopy results for S085 were 34.7 ± 7.2 pCi/g and 34.8 ± 3.0 , respectively.

TABLE 1

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S001	VPA-002	0.13 ± 0.27 ^b	0.16 ± 0.13	<0.07	0.15 ± 0.03	0.19 ± 0.04	0.16 ± 0.4	<0.11	<2.6	8.66 ± 0.61
768S002	VPA-003	0.29 ± 0.30	0.08 ± 0.18	<0.07	0.11 ± 0.03	<0.05	0.13 ± 0.04	0.10 ± 0.07	<2.4	8.25 ± 0.60
768S003	VPA-004	0.37 ± 0.22	0.47 ± 0.18	0.08 ± 0.06	0.05 ± 0.02	<0.06	<0.06	<0.10	<3.0	2.52 ± 0.33
768S004	VPA-005	0.41 ± 0.36	0.28 ± 0.20	<0.09	0.16 ± 0.03	0.27 ± 0.05	0.22 ± 0.05	<0.11	<2.6	10.26 ± 0.73
768S005	VPA-007	<0.36	--- ^c	<0.08	0.19 ± 0.03	0.24 ± 0.04	<0.06	<0.11	<2.6	12.28 ± 0.75
768S006	VPA-008	0.08 ± 0.27	0.21 ± 0.20	<0.08	0.14 ± 0.02	0.19 ± 0.04	0.19 ± 0.04	0.19 ± 0.09	<2.4	9.73 ± 0.67
768S007	VPA-009	<0.33	---	<0.07	0.15 ± 0.02	0.16 ± 0.04	<0.06	0.16 ± 0.08	<2.3	10.67 ± 0.67
768S008	VPA-010	0.32 ± 0.32	0.15 ± 0.15	<0.08	0.18 ± 0.03	0.19 ± 0.04	<0.06	0.15 ± 0.08	<2.5	13.62 ± 0.78
768S009	VPA-011	0.10 ± 0.29	0.40 ± 0.15	<0.07	0.15 ± 0.02	0.26 ± 0.04	0.17 ± 0.04	<0.10	<2.5	13.70 ± 0.74
768S010	VPA-012	<0.25	---	<0.06	0.13 ± 0.02	0.23 ± 0.04	0.21 ± 0.03	0.17 ± 0.06	<1.6	14.44 ± 0.70
768S010D ^d	VPA-012	0.42 ± 0.32	0.23 ± 0.15	<0.08	0.17 ± 0.03	0.28 ± 0.04	0.23 ± 0.04	<0.11	<2.2	13.93 ± 0.77

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S011	VPA-013	0.19 ± 0.32	0.01 ± 0.14	<0.08	0.17 ± 0.03	0.24 ± 0.05	0.19 ± 0.05	0.21 ± 0.08	<2.5	13.04 ± 0.80
768S012	VPA-014	0.07 ± 0.24	0.17 ± 0.16	<0.07	0.11 ± 0.03	0.11 ± 0.03	<0.06	0.15 ± 0.08	<2.2	7.73 ± 0.58
768S012D	VPA-014	0.25 ± 0.19	0.17 ± 0.10	<0.06	0.13 ± 0.02	0.17 ± 0.03	<0.05	0.15 ± 0.06	<1.6	8.14 ± 0.50
768S013	VPA-016	0.39 ± 0.36	0.56 ± 0.23	<0.15	0.25 ± 0.07	0.32 ± 0.09	<0.12	<0.21	<4.7	14.8 ± 1.0
768S014	VPA-017	0.64 ± 0.24	0.74 ± 0.13	0.05 ± 0.05	0.07 ± 0.02	0.27 ± 0.04	0.29 ± 0.04	<0.07	<1.7	4.00 ± 0.36
768S014D	VPA-017	0.76 ± 0.24	0.74 ± 0.15	0.04 ± 0.05	0.08 ± 0.02	0.26 ± 0.03	0.24 ± 0.03	<0.06	<1.8	3.95 ± 0.32
768S015	VPA-020	0.68 ± 0.43	0.36 ± 0.17	<0.09	0.17 ± 0.03	0.25 ± 0.05	<0.07	<0.12	<2.6	13.28 ± 0.83
768S016	VPA-021	0.36 ± 0.26	0.19 ± 0.11	<0.07	0.21 ± 0.03	0.26 ± 0.04	0.24 ± 0.03	0.22 ± 0.08	<2.2	19.27 ± 0.89
768S017	VPA-022	0.09 ± 0.27	0.23 ± 0.16	<0.07	0.10 ± 0.02	0.16 ± 0.04	<0.06	<0.11	<2.2	7.69 ± 0.57
768S018	VPA-023	0.04 ± 0.28	0.36 ± 0.12	<0.07	0.21 ± 0.03	0.25 ± 0.04	<0.06	0.20 ± 0.06	<2.2	15.30 ± 0.76

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM),
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S019	VPA-025	0.70 ± 0.44	0.49 ± 0.22	<0.10	0.24 ± 0.04	0.32 ± 0.05	0.31 ± 0.06	0.23 ± 0.11	<2.9	15.35 ± 0.90
768S019D	VPA-025	0.20 ± 0.35	0.66 ± 0.25	<0.15	0.31 ± 0.09	0.41 ± 0.10	0.40 ± 0.06	0.25 ± 0.12	<4.9	15.13 ± 0.98
768S020	VPA-026	0.26 ± 0.33	0.12 ± 0.15	<0.09	0.27 ± 0.04	0.26 ± 0.05	<0.07	<0.13	<2.7	16.03 ± 0.90
768S021	VPA-027	0.34 ± 0.19	0.35 ± 0.12	<0.06	0.14 ± 0.02	0.24 ± 0.04	0.20 ± 0.03	0.14 ± 0.05	<1.8	12.92 ± 0.64
768S022	VPA-029	0.21 ± 0.30	0.35 ± 0.15	<0.11	0.15 ± 0.02	0.18 ± 0.04	<0.07	<0.12	<3.4	16.36 ± 0.87
768S022D	VPA-029	0.11 ± 0.25	0.09 ± 0.10	<0.07	0.13 ± 0.02	0.19 ± 0.03	0.15 ± 0.04	0.02 ± 0.07	<2.2	16.89 ± 0.74
768S023	VPA-030	0.32 ± 0.27	0.15 ± 0.13	0.04 ± 0.05	0.12 ± 0.03	0.20 ± 0.04	0.16 ± 0.03	<0.09	<2.0	12.51 ± 0.69
768S024	VPA-031	0.49 ± 0.18	0.58 ± 0.11	<0.06	0.10 ± 0.02	0.19 ± 0.03	0.18 ± 0.03	0.10 ± 0.04	<1.6	7.42 ± 0.46
768S025	VPA-032	0.17 ± 0.26	0.21 ± 0.13	<0.07	0.15 ± 0.02	0.21 ± 0.04	0.18 ± 0.04	<0.10	<2.1	11.73 ± 0.69
768S026	VPA-033	0.39 ± 0.32	0.24 ± 0.19	<0.08	0.15 ± 0.03	0.31 ± 0.05	0.26 ± 0.05	<0.10	<2.8	16.72 ± 0.88
768S026D	VPA-033	0.54 ± 0.35	0.46 ± 0.16	<0.08	0.17 ± 0.03	0.27 ± 0.05	<0.07	<0.11	<2.6	15.60 ± 0.86
768S027	VPA-034	0.33 ± 0.26	0.64 ± 0.22	<0.13	0.15 ± 0.05	0.26 ± 0.07	<0.10	0.23 ± 0.11	<3.8	12.35 ± 0.82

TABLE 1 (Continued)

**CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S028	VPA-035	0.64 ± 0.38	0.33 ± 0.20	<0.16	0.28 ± 0.08	0.33 ± 0.09	<0.13	<0.21	<4.3	18.2 ± 1.1
768S029	VPA-037	0.13 ± 0.36	0.39 ± 0.19	<0.09	0.17 ± 0.03	0.24 ± 0.05	0.22 ± 0.05	0.12 ± 0.07	<2.6	15.70 ± 0.89
768S030	VPA-038	0.10 ± 0.22	0.42 ± 0.16	<0.11	0.16 ± 0.05	0.23 ± 0.06	<0.08	0.15 ± 0.08	<2.7	12.66 ± 0.74
768S031	VPA-041	0.24 ± 0.20	0.48 ± 0.13	<0.10	0.09 ± 0.03	0.16 ± 0.05	<0.07	<0.11	<2.4	7.16 ± 0.54
768S032	EMA-001	0.57 ± 0.22	0.58 ± 0.15	<0.09	0.07 ± 0.03	<0.06	<0.06	<0.10	<2.7	5.30 ± 0.47
768S032D	EMA-001	0.44 ± 0.19	0.31 ± 0.14	<0.05	0.09 ± 0.02	0.09 ± 0.03	<0.03	<0.05	<1.3	5.49 ± 0.37
768S033	EMA-002	0.19 ± 0.25	0.17 ± 0.19	<0.07	0.14 ± 0.02	0.18 ± 0.04	<0.05	<0.09	<1.9	8.49 ± 0.54
768S034	EMA-004	0.63 ± 0.22	0.64 ± 0.16	0.03 ± 0.04	<0.02	<0.03	<0.03	<0.04	<1.7	0.59 ± 0.15
768S035	EMA-005	0.16 ± 0.21	0.12 ± 0.12	<0.08	0.15 ± 0.04	0.17 ± 0.05	0.13 ± 0.03	0.09 ± 0.06	<2.4	4.82 ± 0.42
768S036	EMA-008	0.20 ± 0.16	0.17 ± 0.10	<0.05	0.11 ± 0.02	0.11 ± 0.03	0.11 ± 0.02	0.09 ± 0.05	<1.1	6.03 ± 0.39

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM),
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S036D	EMA-008	0.21 ± 0.19	0.18 ± 0.13	<0.09	0.15 ± 0.04	0.14 ± 0.04	0.16 ± 0.03	<0.11	<2.3	6.28 ± 0.49
768S037	EMA-009	0.27 ± 0.28	0.23 ± 0.16	<0.08	0.22 ± 0.03	0.20 ± 0.04	0.20 ± 0.05	0.19 ± 0.08	<2.4	10.74 ± 0.66
768S038	EMA-010	0.36 ± 0.31	0.08 ± 0.18	<0.08	0.16 ± 0.03	<0.05	<0.06	0.20 ± 0.09	<2.5	11.06 ± 0.68
768S039	EMA-012	0.59 ± 0.20	0.61 ± 0.15	0.01 ± 0.03	0.02 ± 0.01	<0.03	<0.03	<0.04	<1.4	0.84 ± 0.18
768S040	EMA-013	0.53 ± 0.14	0.41 ± 0.13	<0.05	0.04 ± 0.01	0.08 ± 0.02	<0.03	<0.04	<1.4	6.50 ± 0.39
768S040D	EMA-013	0.60 ± 0.22	0.27 ± 0.17	<0.08	0.05 ± 0.02	0.10 ± 0.03	<0.05	<0.09	<2.4	6.11 ± 0.46
768S041	EMA-014	0.15 ± 0.24	0.36 ± 0.15	<0.10	0.17 ± 0.05	0.19 ± 0.05	0.16 ± 0.04	<0.13	<3.0	10.16 ± 0.67
768S042	EMA-015	0.53 ± 0.26	0.41 ± 0.16	<0.08	0.22 ± 0.03	0.21 ± 0.04	0.19 ± 0.05	0.24 ± 0.08	<2.3	7.88 ± 0.54
768S043	EMA-017	0.29 ± 0.27	0.39 ± 0.17	<0.08	0.24 ± 0.03	0.24 ± 0.05	0.22 ± 0.04	0.29 ± 0.07	<2.3	8.81 ± 0.62
768S044	EMA-018	0.05 ± 0.30	0.28 ± 0.16	<0.08	0.21 ± 0.03	0.22 ± 0.04	0.23 ± 0.04	0.21 ± 0.09	<2.1	8.19 ± 0.59

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th -234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S045	EMA-019	0.29 ± 0.34	0.02 ± 0.12	<0.07	0.20 ± 0.03	0.19 ± 0.04	0.17 ± 0.04	0.20 ± 0.07	<2.0	5.78 ± 0.47
768S046	EMA-020	0.69 ± 0.22	0.88 ± 0.18	0.04 ± 0.04	0.03 ± 0.02	<0.05	<0.05	<0.08	<2.6	1.52 ± 0.27
768S046D	EMA-020	0.81 ± 0.23	0.73 ± 0.17	<0.06	0.02 ± 0.02	<0.04	<0.03	<0.05	<1.5	1.74 ± 0.26
768S047	EMA-021	0.62 ± 0.26	0.41 ± 0.18	<0.07	0.03 ± 0.02	<0.04	<0.04	<0.07	<2.0	4.31 ± 0.41
768S048	EMA-023	0.32 ± 0.18	0.21 ± 0.14	<0.04	0.08 ± 0.01	0.09 ± 0.02	<0.04	0.08 ± 0.04	<1.2	4.03 ± 0.31
768S049	EMA-024	<0.32	---	<0.07	0.07 ± 0.03	<0.05	<0.05	<0.09	<2.2	8.39 ± 0.62
768S050	EMA-025	0.18 ± 0.23	0.20 ± 0.15	<0.06	0.11 ± 0.02	0.13 ± 0.03	0.16 ± 0.03	<0.08	<2.0	11.17 ± 0.64
768S051	EMA-026	0.15 ± 0.25	0.47 ± 0.16	<0.07	0.20 ± 0.03	0.25 ± 0.04	0.22 ± 0.04	0.18 ± 0.08	<2.0	4.89 ± 0.44

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S052	EMA-027	0.66 ± 0.20	0.50 ± 0.13	<0.07	0.05 ± 0.01	0.07 ± 0.02	<0.04	<0.07	<1.7	2.65 ± 0.29
768S052D	EMA-027	0.37 ± 0.18	0.13 ± 0.11	<0.05	0.03 ± 0.01	0.06 ± 0.02	<0.03	<0.05	<1.4	2.42 ± 0.24
768S053	EMA-028	0.26 ± 0.22	0.34 ± 0.13	<0.06	0.16 ± 0.02	0.19 ± 0.03	0.21 ± 0.03	<0.08	<1.8	18.87 ± 0.81
768S054	EMA-029	0.31 ± 0.24	0.28 ± 0.18	<0.11	0.11 ± 0.04	0.13 ± 0.05	<0.08	<0.13	<2.8	6.79 ± 0.59
768S055	EMA-030	0.20 ± 0.28	0.28 ± 0.11	<0.07	0.18 ± 0.03	0.28 ± 0.04	0.22 ± 0.04	0.17 ± 0.07	<1.9	3.26 ± 0.34
768S055D	EMA-030	0.32 ± 0.20	0.32 ± 0.12	<0.06	0.21 ± 0.03	0.25 ± 0.03	0.22 ± 0.03	0.13 ± 0.05	<1.3	3.35 ± 0.29
768S056	EMA-031	0.30 ± 0.29	0.65 ± 0.16	<0.08	0.41 ± 0.05	0.36 ± 0.05	0.36 ± 0.05	0.45 ± 0.09	<2.2	7.70 ± 0.53
768S057	EMA-032	0.58 ± 0.22	0.57 ± 0.12	<0.06	0.16 ± 0.02	0.19 ± 0.03	0.13 ± 0.03	0.19 ± 0.06	<1.7	6.58 ± 0.43
768S058	EMA-034	0.70 ± 0.24	0.52 ± 0.16	<0.06	0.02 ± 0.02	<0.03	<0.04	<0.06	<2.1	0.56 ± 0.18
768S059	EMA-036	0.25 ± 0.17	0.12 ± 0.10	<0.05	0.12 ± 0.02	0.18 ± 0.03	<0.04	0.16 ± 0.04	<1.3	7.53 ± 0.44

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th -234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S060	EMA-037	0.46 ± 0.19	0.69 ± 0.14	0.02 ± 0.04	0.09 ± 0.04	<0.04	<0.05	<0.09	<2.0	1.00 ± 0.21
768S060D	EMA-037	0.66 ± 0.17	0.58 ± 0.12	0.08 ± 0.04	0.05 ± 0.01	0.06 ± 0.02	<0.03	<0.05	1.6 ± 1.1	1.13 ± 0.17
768S061	EMA-038	0.82 ± 0.21	0.60 ± 0.16	0.04 ± 0.05	0.03 ± 0.02	0.09 ± 0.03	<0.04	<0.05	<2.0	0.27 ± 0.15
768S062	EMA-040	0.64 ± 0.20	0.80 ± 0.14	<0.05	0.02 ± 0.01	0.05 ± 0.02	<0.03	<0.04	<1.4	0.50 ± 0.15
768S063	EMA-041	<0.24	---	<0.06	0.10 ± 0.02	0.15 ± 0.03	<0.05	0.13 ± 0.05	<1.7	4.49 ± 0.37
768S064	EMA-042	0.14 ± 0.22	0.24 ± 0.13	<0.07	0.15 ± 0.02	0.12 ± 0.03	<0.05	0.17 ± 0.07	<2.0	5.93 ± 0.47
768S065	EMA-043	0.45 ± 0.20	0.47 ± 0.10	<0.06	0.08 ± 0.01	0.27 ± 0.04	0.22 ± 0.03	<0.06	<1.5	6.54 ± 0.42
768S066	EMA-044	0.81 ± 0.23	0.32 ± 0.12	0.06 ± 0.05	0.01 ± 0.01	0.22 ± 0.03	0.21 ± 0.03	<0.04	2.2 ± 1.1	0.38 ± 0.16
768S067	EMA-045	0.79 ± 0.23	0.75 ± 0.17	0.04 ± 0.05	0.02 ± 0.02	0.26 ± 0.03	0.22 ± 0.03	<0.05	1.77 ± 0.96	0.87 ± 0.20
768S067D	EMA-045	0.78 ± 0.21	0.72 ± 0.15	0.06 ± 0.05	0.03 ± 0.02	0.29 ± 0.05	0.25 ± 0.04	<0.07	<2.4	0.88 ± 0.19
768S068	EMA-046	0.80 ± 0.30	0.78 ± 0.21	0.06 ± 0.06	<0.03	0.59 ± 0.13	0.55 ± 0.06	<0.07	<2.4	0.22 ± 0.18

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th -234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S069	EMA-047	0.30 ± 0.30	0.33 ± 0.15	<0.08	0.22 ± 0.03	0.27 ± 0.05	<0.07	0.23 ± 0.08	<2.2	5.87 ± 0.50
768S070	EMA-048	0.20 ± 0.16	0.24 ± 0.11	<0.05	0.11 ± 0.02	0.13 ± 0.03	0.12 ± 0.03	0.10 ± 0.04	<1.5	11.49 ± 0.56
768S071	EMA-049	<0.40	---	<0.11	0.14 ± 0.04	0.20 ± 0.06	<0.08	<0.12	<3.1	11.72 ± 0.72
768S072	EMA-053	0.28 ± 0.20	0.28 ± 0.11	<0.06	0.12 ± 0.02	0.16 ± 0.03	0.16 ± 0.03	0.14 ± 0.05	<1.8	11.65 ± 0.59
768S073	LIA-001	0.12 ± 0.16	0.13 ± 0.11	<0.05	0.07 ± 0.01	0.12 ± 0.02	<0.03	<0.05	<1.4	12.26 ± 0.56
768S074	LIA-002	1.04 ± 0.27	0.84 ± 0.18	0.06 ± 0.05	0.02 ± 0.02	0.10 ± 0.03	<0.05	<0.06	<1.8	0.26 ± 0.15
768S074D	LIA-002	1.01 ± 0.20	0.85 ± 0.13	0.03 ± 0.03	0.01 ± 0.01	0.06 ± 0.02	<0.03	<0.04	0.73 ± 0.92	0.44 ± 0.16
768S075	LIA-003	0.51 ± 0.19	0.55 ± 0.13	<0.05	0.02 ± 0.01	0.08 ± 0.02	<0.03	<0.04	1.81 ± 0.70	0.40 ± 0.13
768S076	LIA-004	0.61 ± 0.20	0.65 ± 0.17	<0.08	<0.03	<0.06	<0.06	<0.06	<2.0	0.54 ± 0.17

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S076D	LIA-004	0.59 ± 0.22	0.59 ± 0.15	<0.05	<0.02	<0.04	<0.04	<0.04	2.31 ± 1.27	0.56 ± 0.17
768S077	LIA-005	0.04 ± 0.18	0.11 ± 0.14	<0.07	0.20 ± 0.02	0.21 ± 0.03	0.23 ± 0.04	0.24 ± 0.06	<1.9	14.67 ± 0.68
768S078	LIA-006	0.20 ± 0.24	0.20 ± 0.13	<0.09	0.09 ± 0.02	0.12 ± 0.03	<0.06	0.06 ± 0.05	<2.6	11.59 ± 0.67
768S079	LIA-007	0.19 ± 0.21	0.15 ± 0.20	<0.10	0.09 ± 0.02	0.12 ± 0.04	<0.07	<0.11	<3.2	16.96 ± 0.89
768S080	LIA-008	<0.31	---	<0.07	0.10 ± 0.02	0.13 ± 0.03	<0.05	0.12 ± 0.06	<2.4	19.50 ± 0.93
768S081	LIA-010	0.29 ± 0.28	0.26 ± 0.13	<0.11	0.19 ± 0.03	0.24 ± 0.04	<0.08	0.27 ± 0.10	<3.7	17.52 ± 0.91
768S081D	LIA-010	0.42 ± 0.28	0.10 ± 0.14	<0.08	0.17 ± 0.03	0.23 ± 0.04	0.20 ± 0.03	0.23 ± 0.07	<2.1	18.61 ± 0.79
768S082	LIA-011	10.34 ± 0.60	9.91 ± 0.51	0.21 ± 0.06	0.06 ± 0.02	0.23 ± 0.03	0.20 ± 0.03	0.10 ± 0.04	12.2 ± 1.6	2.78 ± 0.25

TABLE 1 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN SOIL SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g)								
		U-238 by Th-234	U-238 by Th-234 ^a	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768S082D	LIA-011	9.72 ± 0.66	13.29 ± 0.71	0.18 ± 0.07	0.13 ± 0.04	0.33 ± 0.08	0.28 ± 0.04	<0.10	13.0 ± 2.3	2.55 ± 0.31
768S083	LIA-012	1.21 ± 0.27	1.19 ± 0.21	<0.08	0.12 ± 0.02	0.20 ± 0.04	0.15 ± 0.03	0.13 ± 0.06	<2.1	5.44 ± 0.47
768S084	LIA-013	46.5 ± 2.1	44.0 ± 2.1	0.59 ± 0.10	0.05 ± 0.02	<0.04	<0.04	<0.06	52.4 ± 4.1	2.57 ± 0.28
768S084B ^c	LIA-013	79.5 ± 4.9	71.4 ± 4.3	1.3 ± 0.4	<0.15	<0.23	<0.23	<0.37	73 ± 15	3.4 ± 1.71
768S085	LIA-014(N)	16.24 ± 0.90	17.5 ± 1.0	0.24 ± 0.10	0.04 ± 0.03	0.18 ± 0.05	0.16 ± 0.03	<0.08	20.0 ± 2.8	0.75 ± 0.20
768S085B ^c	LIA-014N	34.8 ± 3.0	34.4 ± 2.6	0.4 ± 0.3	<0.12	<0.21	<0.23	<0.33	50 ± 11	<1.89
768S086	LIA-014(S)	14.52 ± 0.76	14.03 ± 0.79	0.18 ± 0.09	0.03 ± 0.02	0.19 ± 0.04	0.15 ± 0.03	<0.05	19.2 ± 2.4	0.80 ± 0.19
768S087	LIA-015	0.02 ± 0.21	0.09 ± 0.13	<0.05	0.02 ± 0.01	0.09 ± 0.02	<0.05	<0.06	<1.5	0.71 ± 0.18
768S088	LIA-016	0.23 ± 0.18	0.02 ± 0.13	<0.05	0.02 ± 0.01	0.17 ± 0.03	0.15 ± 0.03	<0.05	<1.3	0.56 ± 0.16
768S089	LIA-017	0.20 ± 0.20	0.17 ± 0.12	<0.05	0.03 ± 0.01	0.14 ± 0.03	0.15 ± 0.03	<0.06	<1.6	0.97 ± 0.20
768S090	LIA-018	0.16 ± 0.13	0.12 ± 0.09	<0.04	0.03 ± 0.01	0.19 ± 0.03	0.18 ± 0.03	<0.04	<1.0	0.95 ± 0.17

^aThe concentrations in this column are from the 93 keV photopeak of Th-234 and are used to verify the presence of Th-234 from U-238.

^bUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^c --- =Verification peak used for confirming the presence of Th-234. No data provided when key line yields MDC value.

^dDuplicate analysis of samples designated by D.

^eGamma spectroscopy results are from the same sample fraction that was used for alpha isotopic analysis.

TABLE 2

**CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN VEGETATION SAMPLES BY GAMMA SPECTROSCOPY
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g wet weight)							
		U-238 by Th-234	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768V001	EMA-003	<0.45 ^a	<0.14	0.001 ± 0.042 ^b	<0.06	<0.07	<0.13	<3.8	5.94 ± 0.64
768V002	VPA-006	<0.20	<0.06	0.005 ± 0.021	<0.03	<0.03	<0.06	<1.7	5.17 ± 0.43
768V002D ^c	VPA-006	<0.35	<0.11	0.009 ± 0.030	<0.05	<0.05	<0.11	<3.3	4.82 ± 0.53
768V003	EMA-006	<0.28	<0.09	<0.030	<0.04	<0.04	<0.08	<2.3	4.71 ± 0.43
768V004	EMA-007	<0.43	<0.09	0.01 ± 0.04	<0.04	<0.05	<0.10	<2.9	6.16 ± 0.57
768V005	LIA-009	<0.62	<0.14	<0.050	<0.07	<0.07	<0.14	<4.0	4.00 ± 0.68
768V006	VPA-015	<0.09	<0.02	0.01 ± 0.01	<0.01	<0.01	<0.02	<0.7	2.36 ± 0.16
768V007	EMA-016	0.10 ± 0.25	<0.06	0.01 ± 0.02	<0.03	<0.03	<0.06	<1.9	7.18 ± 0.41
768V008	VPA-018	<0.11	<0.02	<0.009	<0.01	<0.01	<0.02	<0.7	1.71 ± 0.15
768V008D	VPA-018	<0.07	<0.02	<0.007	<0.01	<0.01	<0.02	<0.6	1.94 ± 0.14
768V009	VPA-019	0.04 ± 0.13	<0.04	<0.013	<0.02	<0.02	<0.04	<1.1	4.13 ± 0.28
768V010	VPA-024	<0.38	<0.09	0.014 ± 0.034	<0.04	<0.04	<0.08	<2.7	5.26 ± 0.52
768V011	EMA-035	<0.23	<0.07	<0.02	<0.03	<0.03	<0.07	<2.1	6.11 ± 0.40
768V012	VPA-036	<0.31	<0.07	<0.03	<0.03	<0.04	<0.07	<2.3	9.55 ± 0.54
768V012D	VPA-036	<0.35	<0.10	0.017 ± 0.028	<0.05	<0.05	<0.10	<3.1	9.68 ± 0.61
768V013	VPA-039	<0.06	<0.01	0.004 ± 0.005	<0.01	<0.01	<0.01	<0.4	1.11 ± 0.09

TABLE 2 (Continued)

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
 IN VEGETATION SAMPLES BY GAMMA SEPECTROSCOPY
 VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g wet weight)							
		U-238 by Th-234	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Ra-228 by Ac-228	U-238 by Pa-234m	K-40
768V014	VPA-042	<0.08	<0.02	<0.01	<0.01	<0.01	<0.02	0.39 ± 0.70	1.45 ± 0.12
768V015	EMA-050	<0.19	0.01 ± 0.04	0.013 ± 0.017	<0.02	<0.02	<0.05	<1.3	4.47 ± 0.30
768V016	EMA-051	0.03 ± 0.10	<0.02	0.004 ± 0.007	<0.01	<0.01	<0.02	<0.7	2.45 ± 0.15
768V017	EMA-052	<0.31	<0.09	<0.033	<0.05	<0.05	<0.09	<2.7	5.59 ± 0.47

^aNo data provided for peak used to verify presence of Th-234.

^bUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^cDuplicate analysis of samples designated by D.

TABLE 3

CONCENTRATIONS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
 IN WATER SAMPLES BY GAMMA SPECTROSCOPY
 VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/L)						
		U-238 by Th-234	U-235	Th-228 by Pb-212	Ra-226 by Pb-214	Ra-226 by Bi-214	Th-228 by Bi-212	Ra-228 by Ac-228
768W001	VPA-001	<20	<6.5	4.9 ± 3.5 ^a	<2.7	0.7 ± 4.9	<16	<5.4
768W002	EMA-011	<34	<7.9	<2.8	<3.6	<3.9	<22	<7.4
768W003	EMA-022	1 ± 28	0.7 ± 9.3	2.0 ± 2.9	<5.1	<5.3	<31	<11
768W004	VPA-028	<33	<7.7	2.6 ± 2.6	<3.6	<3.8	<21	<7.2
768W004D	VPA-028	<34	<7.7	1.8 ± 3.1	<3.6	<3.7	<22	<7.2
768W005	EMA-033	3 ± 34	<6.6	0.3 ± 3.3	<2.8	<2.9	<17	<5.7
768W006	EMA-039	<37	<11	<3.8	<5.0	<5.2	<30	<9.6
768W007	VPA-040	<34	<7.8	2.5 ± 4.7	<3.6	<3.8	<22	<7.3

^aUncertainties represent the 95% confidence level, based on total propagated uncertainties.

TABLE 4

**CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentration (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium ^a
768S001	VPA-002	0.24 ± 0.06 ^b	0.03 ± 0.03	0.25 ± 0.05	0.52 ± 0.08
768S002	VPA-003	0.13 ± 0.03	0.01 ± 0.01	0.17 ± 0.04	0.31 ± 0.05
768S003	VPA-004	0.62 ± 0.10	-0.00 ^c ± 0.03	0.51 ± 0.08	1.13 ± 0.13
768S004	VPA-005	0.34 ± 0.08	0.02 ± 0.03	0.35 ± 0.08	0.71 ± 0.12
768S005	VPA-007	0.32 ± 0.06	-0.00 ± 0.02	0.35 ± 0.06	0.67 ± 0.09
768S005D ^d	VPA-007	0.36 ± 0.07	0.01 ± 0.01	0.39 ± 0.07	0.76 ± 0.10
768S006	VPA-008	0.33 ± 0.06	0.01 ± 0.02	0.38 ± 0.06	0.72 ± 0.09
768S007	VPA-009	0.16 ± 0.04	0.00 ± 0.02	0.16 ± 0.04	0.32 ± 0.06
768S008	VPA-010	0.40 ± 0.07	-0.01 ± 0.04	0.33 ± 0.06	0.72 ± 0.10
768S009	VPA-011	0.36 ± 0.06	0.02 ± 0.01	0.37 ± 0.06	0.75 ± 0.09
768S010	VPA-012	0.41 ± 0.07	0.01 ± 0.02	0.38 ± 0.06	0.80 ± 0.10
768S010D	VPA-012	0.37 ± 0.07	0.01 ± 0.01	0.33 ± 0.06	0.71 ± 0.09
768S011	VPA-013	0.35 ± 0.06	0.03 ± 0.02	0.35 ± 0.06	0.73 ± 0.09
768S012	VPA-014	0.21 ± 0.05	0.02 ± 0.01	0.23 ± 0.05	0.46 ± 0.070
768S013	VPA-016	0.35 ± 0.07	0.00 ± 0.02	0.43 ± 0.07	0.78 ± 0.10

TABLE 4 (Continued)

**CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S014	VPA-017	0.88 ± 0.11	0.06 ± 0.03	0.85 ± 0.10	1.79 ± 0.15
768S015	VPA-020	0.42 ± 0.08	0.03 ± 0.02	0.37 ± 0.07	0.82 ± 0.11
768S015D	VPA-020	0.37 ± 0.06	0.03 ± 0.02	0.33 ± 0.06	0.73 ± 0.09
768S016	VPA-021	0.38 ± 0.07	-0.00 ± 0.01	0.44 ± 0.07	0.82 ± 0.10
768S017	VPA-022	0.18 ± 0.04	0.01 ± 0.01	0.18 ± 0.04	0.37 ± 0.06
768S018	VPA-023	0.36 ± 0.06	0.02 ± 0.02	0.44 ± 0.07	0.82 ± 0.09
768S019	VPA-025	0.37 ± 0.07	0.01 ± 0.02	0.55 ± 0.09	0.93 ± 0.11
768S020	VPA-026	0.37 ± 0.06	0.02 ± 0.02	0.34 ± 0.06	0.73 ± 0.09
768S020D	VPA-026	0.28 ± 0.06	0.01 ± 0.01	0.30 ± 0.06	0.59 ± 0.08
768S021	VPA-027	0.34 ± 0.06	0.02 ± 0.02	0.31 ± 0.06	0.67 ± 0.09
768S022	VPA-029	0.32 ± 0.06	0.02 ± 0.01	0.35 ± 0.06	0.69 ± 0.08
768S023	VPA-030	0.35 ± 0.06	0.02 ± 0.02	0.32 ± 0.06	0.69 ± 0.09
768S024	VPA-031	0.55 ± 0.09	0.01 ± 0.01	0.52 ± 0.08	1.08 ± 0.12
768S025	VPA-032	0.33 ± 0.06	0.02 ± 0.02	0.33 ± 0.06	0.68 ± 0.09
768S025D	VPA-032	0.29 ± 0.05	0.02 ± 0.02	0.29 ± 0.05	0.60 ± 0.08

TABLE 4 (Continued)

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S026	VPA-033	0.39 ± 0.07	0.03 ± 0.02	0.31 ± 0.06	0.73 ± 0.09
768S027	VPA-034	0.41 ± 0.07	0.00 ± 0.02	0.44 ± 0.07	0.85 ± 0.10
768S028	VPA-035	0.42 ± 0.08	0.02 ± 0.02	0.38 ± 0.07	0.82 ± 0.10
768S029	VPA-037	0.34 ± 0.06	0.01 ± 0.01	0.34 ± 0.06	0.69 ± 0.09
768S030	VPA-038	0.30 ± 0.07	-0.01 ± 0.02	0.36 ± 0.07	0.65 ± 0.10
768S030D	VPA-038	0.33 ± 0.06	0.01 ± 0.01	0.32 ± 0.06	0.66 ± 0.08
768S031	VPA-041	0.37 ± 0.07	0.06 ± 0.03	0.37 ± 0.06	0.80 ± 0.09
768S032	EMA-001	0.37 ± 0.06	0.01 ± 0.01	0.31 ± 0.05	0.69 ± 0.08
768S033	EMA-002	0.21 ± 0.05	-0.01 ± 0.02	0.23 ± 0.05	0.43 ± 0.07
768S034	EMA-004	1.06 ± 0.12	0.05 ± 0.03	0.82 ± 1.10	1.93 ± 0.16
768S035	EMA-005	0.16 ± 0.04	0.00 ± 0.02	0.17 ± 0.04	0.33 ± 0.06
768S035D	EMA-005	0.18 ± 0.04	0.02 ± 0.01	0.15 ± 0.04	0.35 ± 0.06
768S036	EMA-008	0.15 ± 0.04	0.00 ± 0.02	0.14 ± 0.03	0.29 ± 0.06
768S037	EMA-009	0.25 ± 0.05	-0.00 ± 0.02	0.27 ± 0.05	0.52 ± 0.07
768S038	EMA-010	0.29 ± 0.05	-0.02 ± 0.04	0.23 ± 0.05	0.50 ± 0.08

TABLE 4 (Continued)

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S039	EMA-012	0.72 ± 0.10	0.03 ± 0.02	0.65 ± 0.09	1.40 ± 0.14
768S040	EMA-013	0.60 ± 0.09	0.03 ± 0.03	0.63 ± 0.09	1.26 ± 0.13
768S040D	EMA-013	0.61 ± 0.09	0.05 ± 0.02	0.51 ± 0.08	1.17 ± 0.12
768S041	EMA-014	0.20 ± 0.04	0.02 ± 0.01	0.22 ± 0.04	0.44 ± 0.06
768S042	EMA-015	0.25 ± 0.05	0.01 ± 0.01	0.24 ± 0.05	0.50 ± 0.07
768S043	EMA-017	0.25 ± 0.06	0.02 ± 0.02	0.28 ± 0.06	0.55 ± 0.08
768S044	EMA-018	0.19 ± 0.05	0.02 ± 0.02	0.24 ± 0.05	0.45 ± 0.07
768S045	EMA-019	0.23 ± 0.06	0.01 ± 0.01	0.25 ± 0.06	0.49 ± 0.08
768S045D	EMA-019	0.26 ± 0.05	0.01 ± 0.02	0.31 ± 0.06	0.58 ± 0.08
768S046	EMA-020	0.80 ± 0.10	0.05 ± 0.03	0.76 ± 0.10	1.61 ± 0.14
768S047	EMA-021	0.62 ± 0.08	0.03 ± 0.02	0.47 ± 0.07	1.12 ± 0.10
768S048	EMA-023	0.17 ± 0.04	0.01 ± 0.01	0.17 ± 0.04	0.35 ± 0.06
768S049	EMA-024	0.13 ± 0.03	0.01 ± 0.01	0.11 ± 0.03	0.25 ± 0.05
768S050	EMA-025	0.10 ± 0.03	0.01 ± 0.01	0.12 ± 0.03	0.23 ± 0.05
768S050D	EMA-025	0.15 ± 0.04	-0.00 ± 0.01	0.12 ± 0.03	0.27 ± 0.05

TABLE 4 (Continued)

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S051	EMA-026	0.24 ± 0.05	0.01 ± 0.01	0.23 ± 0.04	0.48 ± 0.07
768S052	EMA-027	0.64 ± 0.09	0.05 ± 0.02	0.57 ± 0.08	1.26 ± 0.12
768S053	EMA-028	0.25 ± 0.05	0.02 ± 0.02	0.25 ± 0.05	0.52 ± 0.07
768S054	EMA-029	0.50 ± 0.07	0.02 ± 0.01	0.42 ± 0.07	0.94 ± 0.10
768S055	EMA-030	0.39 ± 0.07	0.02 ± 0.01	0.36 ± 0.06	0.77 ± 0.09
768S055D	EMA-030	0.31 ± 0.06	0.01 ± 0.01	0.30 ± 0.06	0.62 ± 0.08
768S056	EMA-031	0.54 ± 0.08	0.01 ± 0.01	0.50 ± 0.08	1.05 ± 0.11
768S057	EMA-032	0.63 ± 0.09	0.02 ± 0.02	0.53 ± 0.08	1.18 ± 0.12
768S058	EMA-034	0.71 ± 0.10	0.04 ± 0.02	0.61 ± 0.08	1.36 ± 0.13
768S059	EMA-036	0.17 ± 0.05	0.01 ± 0.02	0.21 ± 0.04	0.39 ± 0.07
768S060	EMA-037	0.68 ± 0.10	0.04 ± 0.02	0.59 ± 0.09	1.31 ± 0.13
768S060D	EMA-037	0.66 ± 0.09	0.02 ± 0.01	0.57 ± 0.08	1.25 ± 0.12
768S061	EMA-038	0.91 ± 0.11	0.05 ± 0.03	0.82 ± 0.10	1.78 ± 0.15
768S062	EMA-040	0.78 ± 0.10	0.03 ± 0.02	0.77 ± 0.10	1.58 ± 0.14
768S063	EMA-041	0.16 ± 0.04	-0.01 ± 0.02	0.18 ± 0.04	0.33 ± 0.06

TABLE 4 (Continued)

**CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S064	EMA-042	0.15 ± 0.04	0.01 ± 0.01	0.16 ± 0.04	0.32 ± 0.05
768S065	EMA-043	0.60 ± 0.09	0.03 ± 0.02	0.60 ± 0.08	1.23 ± 0.12
768S065D	EMA-043	0.59 ± 0.08	0.03 ± 0.02	0.55 ± 0.08	1.17 ± 0.11
768S066	EMA-044	1.00 ± 0.12	0.04 ± 0.02	0.81 ± 0.10	1.85 ± 0.15
768S067	EMA-045	0.99 ± 0.12	0.03 ± 0.02	0.88 ± 0.11	1.90 ± 0.16
768S068	EMA-046	1.04 ± 0.13	0.05 ± 0.03	1.00 ± 0.12	2.09 ± 0.18
768S069	EMA-047	0.36 ± 0.06	0.01 ± 0.01	0.35 ± 0.06	0.72 ± 0.09
768S070	EMA-048	0.24 ± 0.05	0.01 ± 0.01	0.24 ± 0.05	0.49 ± 0.07
768S070D	EMA-048	0.24 ± 0.05	0.02 ± 0.02	0.25 ± 0.05	0.51 ± 0.07
768S071	EMA-049	0.18 ± 0.04	0.02 ± 0.02	0.23 ± 0.05	0.43 ± 0.07
768S072	EMA-053	0.27 ± 0.05	0.01 ± 0.01	0.25 ± 0.05	0.53 ± 0.07
768S073	LIA-001	0.16 ± 0.05	0.03 ± 0.02	0.18 ± 0.04	0.37 ± 0.07
768S074	LIA-002	1.08 ± 0.13	0.05 ± 0.02	0.96 ± 0.11	2.09 ± 0.17
768S075	LIA-003	0.80 ± 0.11	0.02 ± 0.02	0.69 ± 0.10	1.51 ± 0.14
768S075D	LIA-003	0.83 ± 0.09	0.03 ± 0.02	0.70 ± 0.08	1.56 ± 0.13

TABLE 4 (Continued)

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S076	LIA-004	0.81 ± 0.10	0.04 ± 0.03	0.75 ± 0.10	1.60 ± 0.14
768S077	LIA-005	0.26 ± 0.05	0.00 ± 0.01	0.25 ± 0.05	0.51 ± 0.07
768S078	LIA-006	0.11 ± 0.04	0.01 ± 0.02	0.10 ± 0.04	0.22 ± 0.05
768S079	LIA-007	0.29 ± 0.05	0.02 ± 0.01	0.25 ± 0.05	0.56 ± 0.07
768S080	LIA-008	0.21 ± 0.05	0.04 ± 0.02	0.17 ± 0.04	0.42 ± 0.06
768S080D	LIA-008	0.19 ± 0.04	0.02 ± 0.02	0.14 ± 0.03	0.35 ± 0.06
768S081	LIA-010	0.25 ± 0.05	0.01 ± 0.02	0.27 ± 0.05	0.53 ± 0.07
768S082	LIA-011	3.13 ± 0.62	0.31 ± 0.17	23.7 ± 3.5	27.1 ± 3.5
768S083	LIA-012	0.58 ± 0.08	0.06 ± 0.03	3.38 ± 0.33	4.02 ± 0.34
768S084	LIA-013	10.4 ± 1.7	1.21 ± 0.36	80 ± 11	92 ± 12
768S085	LIA-014(N)	4.99 ± 0.92	0.48 ± 0.22	37.9 ± 5.6	43.4 ± 5.7
768S085D	LIA-014(N)	4.53 ± 0.83	0.57 ± 0.23	31.4 ± 4.6	36.5 ± 4.6
768S086	LIA-014(S)	3.17 ± 0.59	0.26 ± 0.14	21.9 ± 3.1	25.3 ± 3.1
768S087	LIA-015	0.06 ± 0.04	0.02 ± 0.02	0.16 ± 0.04	0.24 ± 0.06
768S088	LIA-016	0.09 ± 0.04	0.01 ± 0.01	0.20 ± 0.04	0.30 ± 0.06

TABLE 4 (Continued)

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN SOIL SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768S089	LIA-017	0.14 ± 0.05	0.01 ± 0.02	0.14 ± 0.04	0.29 ± 0.06
768S090	LIA-018	0.18 ± 0.04	0.00 ± 0.01	0.14 ± 0.04	0.32 ± 0.06
768S090D	LIA-018	0.13 ± 0.05	0.00 ± 0.02	0.17 ± 0.05	0.30 ± 0.07

^aValues calculated by summing concentrations and propagating uncertainties.

^bUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^cThese values are zero due to rounding.

^dDuplicate analysis of samples designated by D.

TABLE 5

**CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN VEGETATION SAMPLES
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium ^a
768V001	EMA-003	0.012 ± 0.005 ^b	0.004 ± 0.004	0.012 ± 0.005	0.028 ± 0.008
768V002	VPA-006	0.007 ± 0.004	0.001 ± 0.003	0.004 ± 0.004	0.012 ± 0.006
768V003	EMA-006	-0.001 ± 0.004	-0.001 ± 0.002	-0.001 ± 0.003	-0.003 ± 0.005
768V004	EMA-007	0.004 ± 0.003	0.000 ^c ± 0.001	0.003 ± 0.002	0.007 ± 0.004
768V004D ^d	EMA-007	0.003 ± 0.002	0.001 ± 0.001	0.002 ± 0.002	0.006 ± 0.003
768V005	LIA-009	0.007 ± 0.003	0.000 ± 0.001	0.003 ± 0.002	0.010 ± 0.004
768V006	VPA-015	0.14 ± 0.03	0.000 ± 0.006	0.08 ± 0.02	0.22 ± 0.03
768V007	EMA-016	0.006 ± 0.007	0.001 ± 0.005	0.001 ± 0.004	0.01 ± 0.01
768V008	VPA-018	0.002 ± 0.002	0.000 ± 0.001	0.003 ± 0.002	0.005 ± 0.003
768V008D	VPA-018	0.003 ± 0.002	0.000 ± 0.001	0.001 ± 0.002	0.004 ± 0.003
768V009	VPA-019	0.004 ± 0.003	-0.000 ± 0.001	0.001 ± 0.002	0.001 ± 0.004
768V010	VPA-024	0.009 ± 0.006	0.004 ± 0.006	0.008 ± 0.005	0.021 ± 0.010
768V011	EMA-035	0.008 ± 0.005	-0.001 ± 0.003	0.003 ± 0.004	0.010 ± 0.007
768V012	VPA-036	0.008 ± 0.008	-0.003 ± 0.004	0.008 ± 0.007	0.013 ± 0.011
768V012D	VPA-036	0.002 ± 0.003	0.001 ± 0.002	0.003 ± 0.002	0.006 ± 0.004
768V013	VPA-039	0.002 ± 0.001	0.001 ± 0.001	0.001 ± 0.001	0.004 ± 0.002

TABLE 5

CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN VEGETATION SAMPLES
VIEQUES ISLAND, PUERTO RICO

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/g dry weight)			
		U-234	U-235	U-238	Total Uranium
768V014	VPA-042	0.001 ± 0.001	-0.000 ± 0.001	0.001 ± 0.001	0.002 ± 0.002
768V015	EMA-050	0.006 ± 0.005	0.001 ± 0.003	0.006 ± 0.003	0.013 ± 0.007
768V016	EMA-051	-0.000 ± 0.005	-0.001 ± 0.003	0.001 ± 0.003	-0.000 ± 0.007
768V016D	EMA-051	0.002 ± 0.002	0.001 ± 0.002	0.000 ± 0.002	0.003 ± 0.004
768V017	EMA-052	0.009 ± 0.004	0.003 ± 0.003	0.005 ± 0.004	0.017 ± 0.006

^aValues calculated by summing concentrations and propagating uncertainties.

^bUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^cThese values are zero due to rounding.

^dDuplicate analysis of samples designated by D.

TABLE 6

**CONCENTRATIONS OF ALPHA EMITTING ISOTOPES OF URANIUM
IN WATER SAMPLES
VIEQUES ISLAND, PUERTO RICO**

ESSAP Sample ID	NRC Region II Sample ID	Radionuclide Concentrations (pCi/L)			
		U-234	U-235	U-238	Total Uranium ^a
768W001	VPA-001	-0.39 ± 0.27 ^b	0.15 ± 0.12	0.08 ± 0.14	-0.16 ± 0.33
768W002	EMA-011	3.40 ± 0.77	0.39 ± 0.23	3.22 ± 0.62	7.01 ± 1.01
768W003	EMA-022	0.65 ± 0.33	0.03 ± 0.12	0.58 ± 0.26	1.26 ± 0.44
768W003D ^c	EMA-022	0.69 ± 0.27	0.05 ± 0.13	0.69 ± 0.27	1.43 ± 0.41
768W004	VPA-028	-0.08 ± 0.33	-0.15 ± 0.19	0.40 ± 0.26	0.17 ± 0.46
768W005	EMA-033	2.34 ± 0.50	0.14 ± 0.14	2.12 ± 0.44	4.60 ± 0.68
768W006	EMA-039	0.74 ± 0.30	0.12 ± 0.15	0.55 ± 0.23	1.41 ± 0.41
768W006D	EMA-039	0.70 ± 0.24	0.17 ± 0.14	0.52 ± 0.19	1.39 ± 0.34
768W007	VPA-040	0.54 ± 0.28	0.09 ± 0.17	0.21 ± 0.17	0.84 ± 0.37

^aValues calculated by summing concentrations and propagating uncertainties.

^bUncertainties represent the 95% confidence level, based on total propagated uncertainties.

^cDuplicate analysis of samples designated by D.