MATERIALS LICENSE

Amendment No. 13

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

OFFICIAL RECORD COPY

Licensee	
1. Department of the Army US Army Research Laboratory 2. Aberdeen Proving Ground, Maryland 21055-5066	In accordance with letter dated December 11, 1996, 3. License Number 19-12056-02 is amended in its entirety to read as follows: 4. Expiration Date November 30, 2004 5. Docket or Reference No. 030-04555

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Any byproduct material with atomic numbers 1 through 84	A. Plated and sealed sources	A. Not to exceed 1 millicurie per radionuclide and 5 millicuries total
B. Any byproduct material with Atomic Nos. 3 - 83	B. Any	B. 10 microcuries per radionuclide, not more than 1 millicurie total
C. Cesium 137	C. Sealed source (EON Model SN-PC-2325)	C. 100 millicuries
D. Cesium 137	D. Sealed source (American Nuclear Corporation Model No. 120C)	D. 100 curies
E. Americium 241	E. Plated alpha sources	E. 1 millicurie
F. Americium 241	F. Sealed source (New England Nuclear Corporation Model NER-478C)	F. 500 millicuries

9. Authorized use

A. and B. For use in calibration of instruments.
C. For storage only.
D. For storage only in American Nuclear Corporation irradiator Model 8NC-120-C.
E. For use in Tracer Lab calibrator Model CS1-1, CR for calibration of instruments.
F. For research and development as defined in 10 CFR 30.4.

CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at Aberdeen Proving Ground and at temporary job sites of the licensee anywhere in the United States.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
19-12056-02

Docket or Reference Number
030-04555

Amendment No. 13

(Continued)

CONDITIONS

11. A. Licensed material shall be used by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, George M. Thompson, Ph.D., Chairperson.

B. The Radiation Safety Officer for this license is Richard A. Markland.

12. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 19-12056-02

Docket or Reference Number: 030-04555

Amendment No. 13

(12. continued)

CONDITIONS

F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.

G. The licensee is authorized to collect leak test samples for analysis by the licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

13. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

14. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

15. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material to quantities below the minimum limit specified in 10 CFR 30.35(d), 40.36(b), and 70.25(d) for establishing financial assurance for decommissioning.

16. Licensed material shall not be used in or on human beings.

17. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
19-12056-02

Docket or Reference Number
030-04555

Amendment No. 13

(Continued) CONDITIONS

18. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Application dated March 22, 1994
B. Letter received August 12, 1994
C. Letter received August 19, 1994
D. Letter received August 23, 1994
E. Letter received August 24, 1994
F. Facsimile received September 23, 1994
G. Letter dated December 11, 1996

For the U.S. Nuclear Regulatory Commission

Date JAN - 2 1997

By Original Signed By:
Duncan White

Nuclear Materials Safety Branch
Region I
King of Prussia, Pennsylvania 19406

JAN - 2 1997

Richard L. Hughes
APG Site Operations Director
Department of the Army
US Army Research Laboratory
Aberdeen Proving Ground, Maryland 21005-5066

Dear Mr. Hughes:

This refers to your license amendment request. Enclosed with this letter is the amended license. Please note that as part of this amendment, in accordance with 10 CFR 30.36, effective February 15, 1996, the expiration date of your license has been extended by a period of five years. Your new expiration date is stated in Item 4 of the license.

Please review the enclosed document carefully and be sure that you understand and fully implement all the conditions incorporated into the amended license. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Thank you for your cooperation.

Sincerely,

Original Signed By:

Duncan White
Division of Nuclear Materials Safety

License No. 19-12056-02
Docket No. 030-04555
Control No. 124012

Enclosure:
Amendment No. 13

DOCUMENT NAME: R:\WPS\MLTR\L1912056.02
To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	N	DNMS/RI					
NAME	DWhite							
DATE	01/02/97		01/ /97		01/ /97		01/ /97	

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DEPARTMENT OF THE ARMY
UNITED STATES ARMY RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005-5066

REPLY TO
THE ATTENTION OF

Risk Management Office - APG

11 December 1996

Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, Pennsylvania 19406

Gentlemen:

Reference is made to License SMB-141 and 19-12056-02, Reference 040-06394 and 030-04555, respectively. Request a change to our Environmental Radiological Monitoring Program as described in Internal Operating Procedure 385-518, submitted as part of these licenses:

1. The U.S. Army Research Laboratory (USARL) requests to change or to append our current environmental radiological monitoring program to encompass more ecological compartments in conjunction with the Aberdeen Proving Ground Installation's program change. A study completed in 1995 (Encl 1) conducted by Los Alamos National Laboratory (LANL) suggested some additional sampling media and locations, as well as allevi ated a monthly sampling program.

2. Our lab would like to incorporate some of the changes beginning on 1 April 1997. The program will be documented in a program-document format, as always, and will include the following highlights:

a. Weekly air sampling at our test facilities will continue without change.

b. Water, vegetation and soil samples will remain approximately the same with additional sediment, submerged aquatic vegetation, and animal sampling being added to the program.

c. Sample locations will remain about equal with past locations, but numbering will change.

d. Sample collection will go from monthly to quarterly, which reduces the total samples collected, but increase the quality of sample taken.

3. These changes come at the request of the installation; the new program will both better indicate any adverse environmental impacts, if present, and tie the USARL environmental data into the installation's to better assess total Army radiological impacts at Aberdeen Proving Ground, MD.

4. Points of contact are Mr. Brian R. Moyer or Mr. Richard A. Markland, 410-278-9266.

FOR THE DIRECTOR:

Encl

Richard L. Hughes
RICHARD L. HUGHES
APG Site Operations Director

A CONSOLODATED ENVIRONMENTAL MONITORING PLAN FOR ABERDEEN PROVING GROUND, MARYLAND

Prepared by Michael H. Ebinger
and
Wanye R. Hansen

Environmental Science Group
Los Alamos National Laboratory

Submitted to the
Test and Evaluation Command,
Aberdeen Proving Ground

September, 1995

DRAFT

1.0 Introduction and Background

The U. S. Army operates facilities in Edgewood and Aberdeen under several licenses from the Nuclear Regulatory Commission (NRC). Compliance with each license is time consuming and could potentially result in redoubled efforts to provide the necessary information to demonstrate compliance. In order to consolidate licenses and thereby reduce the effort required for reporting and maintaining the licenses, an environmental radiation monitoring plan (ERM plan) that consolidates existing sampling was needed. This document is the ERM plan that will be implemented to support license consolidation.

Existing sampling plans and environmental data generated from those plans are briefly reviewed as part of the development of the present ERM plan. Sampling, especially at Aberdeen, has been ongoing for several years and should continue. The sampling that has occurred has generally been of good quality. Reporting the results of periodic sampling should be done in a more formal manner under a consolidated NRC license, and the new ERM plan will provide for more efficient reporting of results. The new ERM plan was designed to provide data that can be used for assessing risks to the environment and to humans using Aberdeen and Edgewood areas. Existing sampling is modified and new sampling is proposed based on the results of the long-term DU fate study. In that study, different environmental pathways were identified that would show transport of DU at Aberdeen. Those pathways would also be impacted by other radioactive constituents from Aberdeen and Edgewood areas.

The ERM plan presented in this document includes sampling from Edgewood and Aberdeen facilities. The main radioactive constituents of concern at Edgewood are C, P, N, S, H, I, Co, Cs, Ca, Sr and U that are used in radiolabeling different compounds and tracers for different reactions and syntheses. Air and water sampling are the thrust of efforts at the Edgewood area.

Aberdeen is primarily concerned with sampling for DU in the environment, although H and other constituents are possible contaminants. Activities at Ford's Farm, the B-3 and Trench Warfare ranges, Ranges 9 and 14, and indoor ranges has resulted in deposition of significant DU in the environment. While current efforts to reduce the DU added to the environment are underway, previous use of the ranges is responsible for tens of thousands of kilograms of DU in the soils of the B-3 range and Ford's Farm. Sampling at Aberdeen focuses on soil, sediment, vegetation, animals, and water as the media of concern. Complex interactions among ecosystem components result in several pathways of possible DU transport through the environment. The ERM plan will provide the samples that will allow ongoing assessment of the effects of DU in the environment.

The Aberdeen Pulsed Reactor Facility (APRF) has also been included in this ERM plan. Fission and activation products are the primary constituents of concern from the reactor. Previous sampling for the APRF has shown little detection of reactor products in the environment. We modified slightly the sampling for operation of APRF.

Sampling discussed and proposed in this ERM plan is designed to demonstrate compliance with NRC license guidelines and to show at the earliest time potential negative effects on the environment due to use of radioactive materials at Edgewood and Aberdeen. In addition to compliance, the ERM plan will allow assessment of potential adverse effects to threatened and endangered species at APG including Bald Eagles and other animals that are residents of APG. The goal of the ERM plan is to provide the sampling necessary to ensure that operations at Edgewood and Aberdeen are within applicable regulatory guidelines and to provide a means of ensuring that adverse effects to the environment are minimized.

2.0 Edgewood Area

2.1 Possible Contaminants

2.1.1 Radiolabeled Compounds

Several radioactive elements are used in the synthesis of different organic compounds. Radiolabeling is used to follow the course of different reactions, syntheses, and to identify products of reactions. Radioactive forms of P, C, H, S are routinely used in small quantities at APG. Monitoring the environment near Edgewood facilities that use these materials will involve the following release pathways: spilled material, materials treated as waste and disposed of in drains or in laboratory trash, and material vented from laboratories to the atmosphere through hoods and exhaust stacks. In addition, there is a previously used radiation waste area near Chesapeake Bay that requires monitoring.

2.1.2 Material Spills, and Disposal in Drains

Material spilled as part of routine operations must be cleaned up at the time of the spill. A finite amount of waste is created during the cleanup processes that must be disposed of. Laboratory equipment used to clean up spills such as rags, paper wipers, and mops should be discarded in containers specifically designated for radioactive contents. The containers can be monitored in place and as part of normal solid waste removal. Liquids spilled and wastes of the cleanup process should be collected for disposal instead of disposed of through the drain system. Collection of radioactive liquids will allow for better inventory and will aid in safer disposal.

Radioactive material that results from labeling compounds with different radionuclides could be inadvertently released to the environment. Compounds synthesized with radiolabels should be kept in such a way that release to the environment is minimized. The waste created during synthesis of radiolabeled compounds should be collected for disposal.

Radiolabeled compounds could be vented out of stacks and hoods during synthesis or when the labeled materials are used. HEPA filters or other filtration will be checked and changed periodically, and release of the labeled compounds to the environment from the filters is possible. In addition, it is possible that radiolabeled compounds will pass through filters and be released from the stack. Monitoring the air from the stacks will be required to show the amount of material entering the environment from stack gas emissions.

The old radioactive waste area was the place of disposal for different kinds of material including the compounds mentioned above and DU from different operations. The area is fenced at present and contaminants are isolated from the surface environment because the materials have been buried. The potential for contaminant movement must be evaluated periodically in order to show if there is need to mitigate any contaminants leaching through the soil to groundwater or surface water such as Chesapeake Bay. Monitoring data through time will also be useful information if the old radioactive waste area is remediated or considered for such.

2.2 Sampling

2.2.1. Air sampling

Hoods and exhaust stacks on building are the largest potential source of radionuclides released in to the atmosphere. Sampling of stack gases at the stack would show the amount of material entering the atmosphere form the laboratories. Stack monitors are available and could be used for quarterly sampling. Samplers could be used to integrate the amount of radioactive material leaving the laboratories during the quarterly sampling period. Alternatively, stack monitors could be installed so that the stacks are continuously monitored for radiolabeled compounds. Continuos monitoring results should be integrated weekly to provide enough material to produce reliable results.

Sampling of the air around the outside of buildings would also show the extent to which the radioactive materials are dispersed after they are released in to the hood system. Monitoring near buildings would give an estimate of the amount of material that is lost and the amount of material that is redeposited on to soils and vegetation and is thus available for further transport through the environment. Quarterly samples should be collected, each integrating a week of air flow. The week-long integration should provide enough data to show how much material is exhausted and what kind of material is was.

Portable air samples could be easily used for such samples. Portable samplers offer the advantage of being used at different locations, thus

minimizing the cost of air sampling. Samplers with capability to show the volume of air flow and the time of sampling are the minimum equipment needed.

Monitoring during changing of HEPA filters in the stacks should also be conducted in order to show the amount of material that is introduced into the environment from this operation. Portable air samplers and/or hand-held radiation monitors are required during filter changes.

2.2.2 Drains from Sinks to Sewer Lines

Sink drains in laboratories should be monitored for radiolabeled compounds that are disposed of in sinks. As mentioned above, radioactive liquids could be collected in laboratories or nearby to minimize the potential of release to the environment from leaking lines or insufficient water treatment. Quarterly sampling of the effluent from the laboratory buildings is recommended. Logs of materials disposed of in the drains is also recommended.

Building 2100, the AEHA building, is equipped with a drain to be used specifically for radioactive materials. The use of the drain in logged as to the contents of the material disposed of in that drain. Quarterly sampling of effluent from the Building 2100 drain is recommended. Analysis shall be for all compounds used in Building 2100 or disposed of in the radioactive drain from Building 2100.

Monitoring the effluent from Building 2100 and the water treatment facility is also recommended on a quarterly basis. Two sites are recommended. One is the confluence of the Building 2100 effluent stream and the stream flowing to the waste-water treatment facility. The second is along the channel of the stream flowing to the waste-water treatment facility. The second sampling point could also be located at the inlet to the treatment facility and would serve the dual purpose of providing a second environmental sample and as the input concentration for the treatment facility.

2.2.3. Soil, Sediments, and Water

The waste-water treatment facility will be monitored according to various federal and state regulations such as the Clean Water Act. Sampling for influent and effluent water will be done in accordance with the applicable regulations and not in addition to those requirements. Monitoring for all radioactive compounds shall be conducted.

Sediments from released from the facility also require monitoring if such sediments are released. Samples of the sediments should be collected and analyzed at the same time the water samples are collected and

analyzed or at least quarterly. Sediments retained in the treatment facility or sediments that are disposed of should be monitored quarterly and when the sediments are packaged or prepared for disposal.

Quarterly sampling of the effluent water as it flows into the Bush River and Chesapeake Bay should be collected unless these samples are collected more frequently under regulations governing the waste-water treatment facility. In addition to water samples, samples of sediment at the confluence of the effluent stream and the Bush River should be collected at the time the water samples are collected. Vegetation samples from the area should be collected yearly, and samples of fish, Blue crabs, and other shellfish should be collected yearly at the confluence. Analytes of interest will be the same as for the water samples.

Soils of the radioactive waste area will be sampled at the surface to a depth of about 5 inches (10cm). Soil samples will be analyzed for the same constituents as for air and water samples from Edgewood and will also include DU and any other radionuclides that were potentially disposed of at this site. The list of constituents compiled from a limited number of interviews with Edgewood personnel include DU, possibly some Th, ^{3}H, and ^{60}Co. Screening the first samples by way of gross alpha, gross beta and gamma detection would show the presence of excess radioactivity. If an excess is expected, or when a more comprehensive list of constituents is compiled, more specific analyses such as α-spectroscopy will be used.

Surface water on or collecting down gradient from the radiation waste area shall be sampled quarterly. Analytes of interest include all those that are suspected or known in the waste that was disposed of at the site. Collection of water and sediment running off the waste site should be done yearly to estimate the amount of material, if any, washed from the site.

Potential groundwater contamination is also a concern. We did not locate any monitoring wells at the site. However, wells down gradient from the disposal site and between the site and Bush River/Chesapeake Bay should be considered. Two wells would provide valuable data for monitoring releases from the disposal site. If wells exist, they should be sampled quarterly for the same constituents as for all other samples from the disposal area.

Vegetation and biotic life that grow or live at the site should be sampled as part of the quarterly monitoring plan. Samples of the animals that inhabit periodic or permanent surface water are of particular interest as these may be the most sensitive to uptake of radioactive compounds. Ten samples of vegetation and ten of the biotic community that use that

vegetation are recommended. the sampling location can change each quarter as long as the vegetation, soil, surface water (if applicable) and biotic samples are from the same locations.

3.1.3 Ranges 9 and 14

Ranges 9 and 14 are used for testing full-size munitions components. Tests are carried out in enclosures that contain all materials tested. Munitions are fired into targets inside the enclosures by way of enclosed firing paths. Thus, the munitions are isolated from the environment during the entire test.

Recirculated air is used inside the enclosures in much the same way as at Range 110, except the capacity is larger in order to handle the larger volume of air inside the Range 9 and Range 14 enclosures. Air is blown through HEPA filters to trap DU and other particulates, and is either returned to the enclosure or released to the atmosphere. HEPA filters are located on the roof of each enclosure, and are changed regularly.

Release pathways are similar as for Range 110. However, the probability of release of DU particulates to the environment is greater at Ranges 9 and 14 because of the size of the enclosures and the added traffic through the facility to accommodate full-scale testing. Because of the complexity of the facility, environmental sampling is already part of the existing environmental surveillance of the sites. Samples of soil, vegetation, and water are collected and analyzed quarterly. Air samples from around the enclosure are collected annually. Exhaust stack monitoring is done during each test, thus there are data on release of DU due to one test or several. No changes in the current air sampling are recommended for either Range 9 or Range 14.

Currently there are 409 samples collected annually from Range 9 including monthly and yearly samples. Shifting the monthly collection to quarterly and modifying the sampling to include additional water, sediment and animals samples reduces the number of samples yearly to 180. The decreased number of samples will not compromise the objective of monitoring potential DU migration. Instead, quarterly sampling will provide adequate data on the major compartments of the food web and will allow annual assessment of the environment with regard to DU transport. Decreasing the number of samples and increasing the number of ecosystem components sampled will strengthen the APG environmental program. Table 1 shows the current sampling plan and the new quarterly plan.

There are 352 samples collected monthly and annually at Range 14. We recommend adding animal sampling at five locations and changing the monthly sampling to quarterly. As with Range 9, the number of samples decreases to 180 per year under the new sampling scheme, and more complete coverage of the ecosystem components is attained. The new

3.0 Aberdeen Area

3.1 Army Research Laboratory (ARL) Facilities

3.1.1 Existing ERM

The present ERM plan for the ARL facilities is detailed in SOP 385-506 (ARL, 1990). The plan calls for yearly and quarterly samples of soil, water, and vegetation, as well as continuous air samples.

3.1.2 Range 110 (Indoor Range)

Range 110 is the indoor firing range in Building 309 at ARL. Quarter-sized mock-ups of DU munitions are fired at various types of targets at Range 110. The facility is enclosed and isolated from the outside environment in order to completely contain all material that is tested.

All air from the testing area is recirculated through a series of HEPA filters to remove particulates. Since the result of DU penetrator impact with hard targets is aerosolized particles, the HEPA filters limit the spread of DU contamination. The HEPA filters is maintained regularly, and changing of filters is recorded for reference. Monitoring for airborne particulates in the control room is not currently done during routine operations.

DU release pathways to the environment are limited to particulates that pass the HEPA filters or are released during filter changes, DU particulates that escape during routine maintenance operations of the firing area such as cleaning the debris, and DU particulates that are taken out of the building as contamination on clothing. DU particulates escaping during filter changes is the most likely contribution of DU to the environment, followed by disposal of the material that is removed from the firing area during routine firing operations. Personnel change clothing before and after working in the firing area, thus DU dispersed via contaminated clothing is minimized.

R110

Sampling to determine release of DU to the environment shall include air sampling at the point where air from the building interior is vented to the atmosphere and several other locations that would be affected by the plume from the vent. High volume air samplers should be run for several hours during routine operations to determine if DU is passing the HEPA filters. High volume air samplers placed downwind from the air exhaust will provide the estimates of DU released form the facility and deposited in the environment. The downwind samplers should be used quarterly as part of environmental surveillance. Soil samples from the vicinity of each air sampler shall also be taken and analyzed as part of environmental surveillance.

Table 1. Current and modified environmental sampling at ARL facilities. X is a current and proposed sample, O is an omitted sample currently collected, M stands for monthly sampling, A stands for annual sampling, and N are the new samples.

Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal
Transonic Range						
1						
2						
3						
4						
5						
6						
7	X	X	X			
8	X	X	X		N	N
9	X				N	N
10	X					
11	X	X				
12	X	X				
13	X	X	X			
14	X	X	X			
15	X	X	X		N	N
16	X					
17	X					
18	X					
19	X	N				
20	X	N				N
21	X					N
22	X					
23	X					
24	X					
25 (moves to wetland NW of current location)	O	N	N		N	N
26	X					
27	X					
28	X					
29	X					
30	X					
31	X	N				
32	X					N
33	X					
34	X					
35	X					
36	X					
37	X					
38	X					

Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal
Locust Point						
1	X	X				
2	X					
3	X	X				
4	X	N				N
5	X	X				
6	X	N				
7	X	X				N
8	X					
9	X					
10	X	X				
11	X					
12	X	X				
13	X					
14	X	X				
15	X	X				
16	X					
17	X	X				
18	X					
19	X	X				
20	X					N
21	X					
22	X					
23	X	X				
24	X					N
25	X					
26	X	X				
27	X	X				
New (in Chesapeake Bay near Compactor and current #4)		N (aquatic)	N		N	N
New (in Bay, out from Sample #3)		N (aquatic)	N		N	N
Range 14						
1	X	X				
2	X	X				N
3	X	X				N
4	X	X				
5	X	X				N
6	X					
7	X					
8	X	X				N

Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal
9	X					
10	X					
11	X					
12	X	X				
13	X					
14	X					
15	X					
16	X					
17	X					
18	X	X				
19	X					
20	X					
21	X	X				
22	X					
23	X					
24 not found						
25	X					
26	X					
27	X	X				
28	X					
29	X					
30	X	X				
						N

39 (collect water and sediment in wetland to the south)	X	X	N		N	N
40	X					
Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal
41	X					
42	X					
43	X					
44	X					
45	X					
46	X					
47	X					
48						
49	X					
50	X					
51	X					
52	X					
53	X					
54	X					
55	X					
56	X					
57						
58						
59						
60	X	X				
61	X					
62	X					
63	X	X				
64	X	X	X			
65	X	X				
66	X					
67 (new, in wetland east of Bombproof)			N		N	N

- at least ten samples of the surrounding soils should be collected annually to determine if DU is released from the storage drums;
- at least ten vegetation samples should be collected for analysis from the same locations as the soil samples.

The vegetation samples should be split, with half washed of surface residue and half left as is. Analysis of both splits will show if DU has migrated via resuspension and rainsplash and if DU has leached to the roots and taken up by plants.

There is a plate storage area in the vicinity of the soil stored at Locust Point. We recommend that the surface activity of the plate pile be measured annually and that five samples of soil be collected within about 10 meters of the center of the pile. These samples and measurements will provide the estimate of DU migration from the plate pile.

The Old Plate Pile located near Range 9 is also an area of importance to environmental monitoring. The plate from previous tests was stored near shore and is a potential source of DU to Chesapeake Bay. Five samples of soils, vegetation, sediment from the Bay, and water from the Bay should be collected. The vegetation samples should include terrestrial and aquatic samples if there are obvious aquatic plants within about 5 meters of shore near the plate pile. Five individuals or a sufficient number of individuals to make five samples of aquatic biota should also be collected with each sediment and water sample. Transport of DU contamination from plates by resuspension or rainsplash is of low probability, so splitting terrestrial vegetation samples from this site is not recommended. Removal of the plate to a location with potentially less impact, such as Locust Point where the other plate is stored, is also recommended.

Shifting monthly sampling to quarterly as at Range 9 and Range 14 reduces the number of samples from 436 to 180. Again, the reduced number of samples provides better coverage of the ecosystem components involved in DU transport processes, and a more defensible environmental monitoring program results.

3.1.5 Transonic Range

Topsoil at the target area of the Transonic Range was removed to reduce the residual DU contamination. The soil was placed in drums and stored at Locust Point as discussed previously. Continued monitoring of the Transonic area that was cleaned and the areas not cleaned should continue.

Sampling at Transonic was modified to give better coverage of ecosystem components than under the current plan. Several new vegetation, sediment, and animal samples are proposed, and two new surface water samples are suggested in the wetlands near the target areas. The new samples will provide the diverse data needed to assess potential effects of DU on the environment. The yearly sampling increases the number of samples collected from 83 to 110 in order to accommodate the need for increased coverage of the different ecosystem components.

The proposed changes in environmental sampling at Range 9, Range 14, Locust Point and Transonic result in a net decrease of about 530 samples annually. The cost saving represented by 530 fewer analyses is augmented by the added value of the data obtained. The new samples were designated after analysis of the data from the long-term DU fate study. That study suggested the sediment-surface water-animal pathways as the best indicator of DU transport through the environment. We included the suggestions from the long-term study in this sampling plan.

3.2 CSTA Facilities

3.2.1 CSTA Environmental Monitoring Plan

Table 2 lists the sample locations and sampling frequency for the different types of samples required by the CSTA ERM plan (CSTA, 1990a). Sample locations 8, 11, 12, 14, 15, and 18 establish background radiation at APG. Samples are collected annually from these locations, and we recommend only minor modifications. Locations 6-8 are Ford's Farm, BTD, and Hard Target Storage Area, respectively. Currently only groundwater samples are required at each site, and the wells are located upgradient from other wells used for environmental sampling. We recommend adding soil, vegetation, and animal sampling at locations 6-8. The added data will help complete the data set for Ford's farm, BTD, and the Hard Target Storage Area.

Samples are collected semiannually or quarterly from the B-3 Range (locations 11-23), Ford's Farm (locations 24-32), BTD (locations 33-41), the Hard Target Storage Area (locations 42-45), and Chesapeake Bay Estuaries (locations 46-48). We recommend changing soil, surface water, groundwater, sediment, and vegetation sampling to quarterly at all locations. Quarterly sampling gives more consistent monitoring of DU transport at each location and provides a data set that can show trends in DU concentrations with time. Annual sampling of animals during hunting and fishing seasons provides adequate data on the potential transfer of DU to humans. Specific modifications to sampling frequency and location

will be made in the appropriate sections below. The current and proposed new samples are listed in Table 3.

The modifications discussed will increase the number of samples analyzed and reported annually. The increased number of samples provides an improved reconnaissance of the CSTA DU areas. One improvement is the coverage of the areas of interest is more complete than in previous ERM plans (*e.g.*, CSTA, 1990a). A second improvement is in the types of samples collected at each location. Pathway analysis indicates that DU can move through the food chain at APG. Figure 1 illustrates the principle by showing the possible uptake pathways of DU for deer. The modified ERM plan will provide data on DU uptake at different points in the food chain. Thus, the monitoring data can be used to estimate uptake of DU by animals and humans using simplified uptake or screening models. Estimation using models was not possible without large uncertainties using data from the CSTA ERM plan (1990a).

Table 2. Current sampling locations and collection frequencies for CSTA ERM Plan. Compiled from Table 3-2, SOP 385-328 (CSTA, 1990a).

Sample Type	CSTA Location	Frequency
Air	1-10, 13, 14, 25, 34, 42,	Annual
Soil	1-3, 13, 14, 29-32, 38-41, 43,	Annual (1-3) Semiannual (remainder)
Sediment	1-3, 11, 12, 15, 17-18, 23-24, 33, 46-48	Annual (1-3, 46-48) Semiannual (11, 12, 15, 17, 18) Quarterly (23-24, 33)
Surface Water	1-4, 11-15, 17-18, 23-24, 33, 46-48	Annual (1-4, 46-48) Semiannual (11, 13-15, 17-18) Quarterly (23-24, 33)
Ground Water	5-8, 13-14,16, 19-22,24,26-28, 35-37, 43-45	Annual (5-8) Semiannual (13-14, 16) Quarterly (19-22, 24, 26-28, 35-27, 43-35)
Deer, Crabs, Game Animals	1-3, 14, 19, 21, 24, 33, 49-48	Annual
Vegetation	2-3, 13-14, 16, 19-22, 30-32, 38-41, 43	Annual (2-3) Semiannual (remainder)

Table 3. Current and new sample types and locations for CSTA Facilities, APG. From Table 3-3, SOP 385-328 (CSTA, 1990a). "X" indicates current sample, "N" is a new sample type or location.

Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal	Air
Background Locations							
1	X	N	X		X	X	
2	X	X	X		X	X	
3	X	X	X		X	X	
4			X				
5	N	N		X		N	
6	N	N		X		N	
7	N	N		X		N	
8	N	N		X		N	
9							X
10							X
B-3 Range							
11			X		X	N	X
12			X		X	N	
13	X	X	X	X	N	N	X
14	X	X	X	X	N	N	X
15	N	N	X		X	N	
16	N	X		X		N	
17	N	N	X		X	N	
18	N	N	X		X	N	
19	N	X		X		N	
20	N	X		X		N	
21	N	X		X		N	
22	N	X		X		N	
23			X		X	N	
Ford's Farm							
24			X		X	X	
25							X
26	N	N		X		N	
27	N	N		X		N	
28	N	N		X		N	
29	X	X				N	
30	X	X				N	
31	X	X				N	
32	X	X				N	

Table 3, continued

Location	Soil	Vegetation	Surface Water	Ground-Water	Sediment	Animal	Air
BTD Area							
33			X		X	X	X
34	N	N		X		N	
35	N	N		X		N	
36	N	N		X		N	
37	X	X				N	
38	X	X				N	
39	X	X				N	
40	X	X				N	
41							
Hard Target Storage Yard							
42	X	X		X		N	X
43	N	N		X		N	
44	N	N		X		N	
45							
Chesapeake Bay Estuaries							
46			X		X	X	
47			X		X	X	
48			X		X	X	

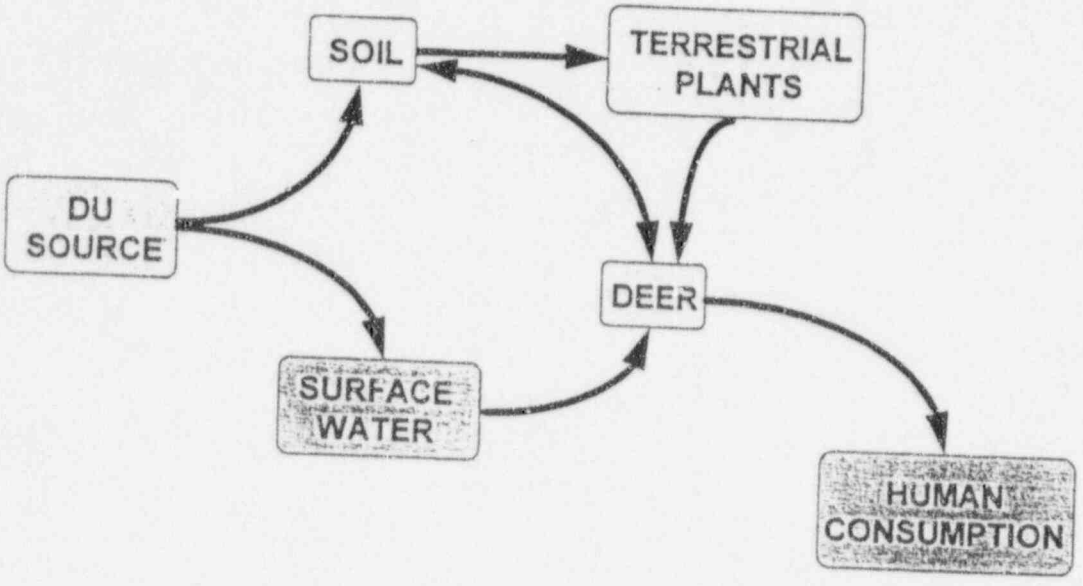

Figure 1. Food chain model for DU uptake by deer and humans from consumption of soil, terrestrial plants, and surface water. Model shows that consumption of deer is the only pathway for DU to humans.

3.2.2 DU Soft Target Range

The impact area downrange from the Trench Warfare (TW) and B-3 targets at 4000 meters has been contaminated by DU testing. Testing began in the 1970s and continues. Two catch boxes were built in 1992, one for TW and one for B-3. The catch boxes stop 90 to 95% of the penetrators fired at the targets and prevent deposition of DU penetrators downrange. Because of the catch boxes, deposition of DU fragments has decreased dramatically since the catch boxes went into operation.

Recovery efforts downrange from about 4000 meters to 9000 meters were successful in removing about 20% of the inventory that was fired at APG. Risk of injury or death to personnel recovering the fragments and the limited visibility of the impact area due to vegetation cover resulted in suspending recovery operations. Thus, there is approximately 70,000 kg of DU fragments remaining in the soils and surface water of the impact area. The remaining fragments could adversely affect the ecosystem of the impact area.

Currently there are two soil sampling locations on the B-3 Range, both at the TW and B-3 catch boxes. The number of soil samples must be increased significantly to show the amount of DU present in soils and to determine if the DU is transporting off the impact area. Soil samples from 4000 m to about 8000 m downrange from the firing positions would show the concentrations of DU in the soils that receive the most impact from DU testing. Soil samples should be collected from sampling locations 16-23. collection of these samples should not greatly change the current sampling scheme, and there will be added benefit from added data about the B-3 range soils.

Additional sampling at the catch box locations will be implemented in order to estimate the contribution of catch box fill material to the environment. Sand and DU fragments are occasionally ejected from the catch box by incoming penetrators. DU contamination was measured on the access road to the B-3 catch box, and high concentrations of DU were measured in the pond that formed on the downrange side of the same catch box. Soil, vegetation, water, and biological samples are recommended in the vicinity of the catch boxes.

Five samples each of soil. vegetation, animals, and surface water if available with sediments from the same locations should be collected at each of the catch boxes. Animal samples ideally would always be of the same species. Samples collected should be at least five of one species during each sampling time. Mice or earthworms are candidates since the usual range of both is limited to an area of tens of square meters and

mice or worms capture near the catch boxes probably ranged within the area. Other animals as available are also adequate for the needs of the environmental monitoring program.

Air monitoring at the catch boxes should be implemented periodically during firing and during maintenance. Aerosolization of DU on the soft-target ranges is minimal, but small particles will abrade from penetrators as they impact the sand in the catch boxes. The small particles could be resuspended when penetrators impact the sand and act as a source of contamination for vegetation surfaces. Small particles could be respired by workers during maintenance of the catchboxes. Portable air sampling devices should be used in different locations around the catch boxes to determine the range of DU concentrations in air.

Large volume, portable air samplers are recommended for air monitoring since the portable instruments can be moved readily to new locations. Sampling should occur quarterly and should continue for an entire firing day. The quarterly samples should be taken for one to four hours continuously. Rates of DU fragment deposition and the actual range of concentrations in air will be determined by these samples. In addition, the air sampling should be done annually when no penetrator testing occurs to determine the background U concentration.

CSTA funded installation of several groundwater wells on the TW and B-3 ranges at the catch boxes and downrange (CSTA, 1990). The wells were intended for environmental sampling and were used during the DU risk assessment and during routine environmental monitoring.

Several of the wells selected for use in the DU risk assessment were contaminated with excess bentonite or material used to pack the well head. The excess bentonite in water sampled for the DU risk assessment required that samples be drawn from alternate wells. Since the wells are a valuable resource for APG, we recommend that they be developed so that all wells can be used as intended. Development means that each well be pumped for several minutes to several hours to remove the excess bentonite in the water. Well development may have to be repeated if the water contains bentonite after initial development.

3.2.3. BTD Area

The sampling locations presently used at the BTD Area will provide adequate monitoring for DU migration. Table 3-2 and Figure 3-3 of SOP 385-328 (CSTA, 1990a) detail the sampling locations, the type of samples that will be collected, and the frequency with which the location is sampled.

The current sampling plan calls for soil and vegetation samples from four locations semiannually. The locations will provide the estimate of DU release to the environment from activities at BTD. We recommend adding biological samples annually to the sampling plan. Analyses of animals using the area of interest will show the amount of DU ingested by the animals and carried on their pelts. Five biological samples from one of the four soil/vegetation locations should be collected at the same time one of the semiannual soil/vegetation samples is collected. The species selected should be the same from year to year to ensure comparability in the results. Candidates include mice or other small mammals that consume vegetation and water in the area, and soil macrofauna such as earthworms, as well as other species that live in the BTD area. The choice of species to sample should be made by APG personnel who know the fauna of the area and can select representative species. Samples of game animals killed from locations within about 500 m of the BTD Area should be included in the biological sampling.

Air sampling at BTD should be augmented to include samples from the locations of the soil/vegetation samples. Air samplers can be run during DU operations or at any other time. The additional air samples will show the amount of DU migrating via resuspension during BTD activities or will confirm that DU is not resuspended. One or two portable air samplers should be set-up annually at one of the soil/vegetation sampling locations.

3.2.4 Ford's Farm (Superbox)

Open-air testing of DU munitions against hard targets produced significant aerosolization of DU penetrators at Fords Farm (Stoezel *et al*, 1983). The contamination from the open-air tests has been monitored in the soils, surface water, and vegetation as part of the CSTA ERM plan. Continued monitoring of the area is recommended since open-air testing contamination has been detected in most environmental monitoring to date.

The existing ERM plan calls for soil and vegetation sampling at four locations 100 m from the Superbox enclosure. Two modifications are recommended. First, four new sampling locations should be added to the existing four locations. The new locations should be about 500 m from the enclosure in the same directions as the existing sample locations. The new locations will provide a more thorough assessment of DU migration from previous open-air tests at Ford's Farm. The new locations and those existing should be sampled quarterly.

The second modification is to include biological samples in the annual sampling. The biological samples should be taken at the same time as the soil and vegetation samples, and from the same location as one of the

soil/vegetation samples. Five individuals of larger animals such as mice, rabbits, or snakes, should be collected via trapping or hunting. In addition, earthworms could be collected from the local soils. If earthworms are included in the sampling, the number of worms collected should make a mass large enough for meaningful analysis.

Deer and other game animals taken from within about 1000 meters of Ford's Farm should be sampled and analyzed for DU. Samples of game animals would be taken annually in conjunction with the fall deer hunting seasons.

Air monitoring at Superbox will be similar to that done at Ranges 9 and 14. The area surrounding the Superbox facility will be monitored quarterly using portable air sampling devices. Samples will be collected during operations at Superbox in order to estimate the amount of DU that is released as a result of testing. Sampling should also be conducted when no testing is in progress to establish ambient air concentration of DU particulates.

3.2.6. Hard Target Storage Yard

The Hard Target Storage Yard is a potential source of DU migration. DU leaches from contaminated targets and could migrate to soils, groundwater, or vegetation near the site.

Current sampling includes soil, groundwater, and vegetation in the plate pile area. We recommend adding an additional soil sampling location to better cover the potential leaching of DU from targets, and sampling of five animals of the same species to evaluate DU uptake.

4.0 Aberdeen Pulsed Reactor Facility (APRF)

4.1 Existing ERM

Environmental sampling is conducted quarterly and reported annually by CSTA personnel (CSTA, 1986, 1987). There has been only minimal environmental exposure to radiation and radioactive products from the reactor in over 25 years of operation (ORNL, 1993). Results of environmental monitoring confirm that most of the environmental radiation is due to naturally occurring radioisotopes, fallout from world-wide nuclear testing, and depleted uranium from the APG DU testing program discussed above.

Soil, water, and vegetation samples are collected from twelve stations around APG (CSTA, 1896). The samples provide adequate coverage for estimating the exposure of the environment to APRF-caused radiation. Water samples at Stations 1 and 2 near the APRF reactor building are not specifically called for in the ERM plan (CSTA, 1986). According to the annual reports, however, water

samples have been collected and analyzed. We recommend that water samples at Stations 1 and 2 be collected as part of the routine environmental sampling program for APRF.

Station 7, located on Spesutie Island, has produced samples with probable DU contributions in the past (CSTA, 1992; Price, 1989). We recommend closer investigation of the soils, vegetation, and water in the area of Station 7. Specifically, we recommend that the potential contribution of DU from the DU testing program be evaluated. If continuing contributions of DU are likely, Station 7 should be used as an additional sampling location for monitoring the DU range. Also, the source of the DU should be investigated to find out if it comes from ARL operations at Ranges 9 or 14, from storage of soils and used plate material, or if it comes from the B-3 range (soft target range) operations of CSTA.

Air sampling at various locations around APG and near the APRF indicate that little or no airborne fission products or activation products have been detected. The annual reports of environmental sampling data (*e.g.*, CSTA 1992) show that sampling stations at Michaelsville and Bldg. 938 are the only stations used for air sampling. We recommend that an additional air sampling station be established in the Edgewood area. Alternatively, filters from air samplers used for the DU testing program can be analyzed for reactor products in addition to DU. Using filters from several stations would increase the coverage significantly and would be a minimal impact to the environmental monitoring program for APRF.

Emissions from the stack in the reactor building show minimal loss of reactor products to the ambient atmosphere. Monitoring of the stack emissions during APRF operations should continue without modification.

5.0 Analytical Methods for DU

5.1 DU Analysis

α-Spectroscopy is frequently used to determine the concentrations of ^{234}U, ^{235}U, and ^{238}U in soil, vegetation, and biological samples (*e.g.*, Price, 1991). Continued use of α-spectroscopy is recommended because of its. Isotopic ratios determined by α-spectroscopy are subject to relatively large variation due to sample preparation and analysis of small quantities of ^{234}U, and ^{235}U. α-Spectroscopy is not the only analytical tool for determining total and/or isotopic U in samples. Inductively-coupled plasma/mass spectroscopy (ICP-MS) and instrumental neutron activation analysis (NAA) are two other analytical techniques that could be used to measure total U and/or U isotope ratios in samples. Kinetic phosphorimetric analysis (KPA) is not an isotopic method but will provide high quality data on total U relatively inexpensively.

ICP-MS is currently gaining acceptance for the analysis of U and DU in different media. Detection limits are similar to α-spectroscopy, sample preparation is simplified compared to α-spectroscopy, and ICP-MS is less expensive per sample, on average, than α-spectroscopy. Isotope mass ratios and total U mass-based concentrations are obtained from ICP-MS, and mass concentrations are easily converted to activities based on the measured isotope ratios. Isotope ratios determined from ICP-MS tend to have less analytical error than the same ratios calculated from α-spectroscopy. ICP-MS was successfully used in previous work with APG soil and sediment samples as well as APG soil, sediment, and water samples (Ebinger *et al*, 1990). Sizes of samples from soils, vegetation, and biota required for analysis range from about 1 to 5 g of dried sample (10-20 g wet, depending on the nature of the sample), or roughly the same size as for α-spectroscopy.

The ICP-MS analysis involves sample digestion of some samples in order to render the analyte to a form compatible with the technique. Standard methods of preparation and analysis should be adopted before the first samples are analyzed so that all total U and U isotope analyses can be compared. Standard EPA methods (*e.g.*, 200.7) for metal extraction from soil and vegetation samples could be adopted for use in this ERM plan with little or no modification to the methods.

Instrumental neutron activation analysis (NAA) involves excitation of U nuclei in a sample, then measuring the radiation emitted from the excited nuclei (Gladney *et al* 1976, 1978, 1980; Gonzales *et al*, 1988). ^{238}U and ^{235}U produce radiation of characteristic energies that are proportional to the amount of each isotope in a sample. The energies emitted from the ^{238}U and ^{235}U give quantitative estimates of the isotopic ratio, thus the source of U is established. NAA also quantifies the total concentration of U in a sample, and this quantity is converted to an activity-based concentration similarly to ICP-MS data.

NAA requires little sample preparation but does require slightly larger sample sizes than ICP-MS or α-spectroscopy. Preparation of most samples consists of oven drying for 24 hours at about 110° C. Some biological samples may need to be dried and ashed, but there are no chemical digestions or extractions to perform. The main drawback of NAA is the need for a research nuclear reactor facility or accelerator source of neutrons. Brookhaven National Laboratory, the University of Arizona, the University of Missouri, and Texas A & M University are potential providers of NAA capability. The requirement to use a reactor facility may limit the number of samples that could be submitted for analysis. Despite the drawbacks, however, NAA is a method that should be considered.

Kinetic phosphorimetric analysis (KPA) is an instrumental method that uses a tunable laser to excite the U or DU in a sample. The excited sample then luminesces in direct proportion to the concentration of U or DU in the sample (Brina and Miller, 1992). KPA is another method that requires little to no sample

preparation and can be used to determine total U in soil, sediment, biological, human urine, and water samples. KPA, like ICP-MS, is gaining popularity in the analytical market place.

KPA is a sensitive method of analysis with reported detection limits for U of 1 to 5 ng/L (3.9×10^{-4} to 1.95×10^{-3} pCi/l) in water and 1 to 3 ng/g (3.9×10^{-4} to 1.17×10^{-3} pCi/g) in soils. Reported data agree favorably with data obtained using other methods and tend to show higher precision (Brina and Miller, 1992). Commercial KPA also tends to be less expensive per sample than ICP-MS or α-spectroscopy, therefore providing one possible means to increase cost effectiveness of environmental sampling. However, KPA is not a technique that can be used to obtain the isotopic distribution of U (or other analytes) in samples. The reported data are total U with no information about the possible sources of the U. The low cost of the method, ease of sample preparation and analysis, increasing availability for commercial use or for on-site installation, and the high accuracy and precision of the method indicate that KPA could be used as a quantitative screening method. The high accuracy and precision of the data obtained from KPA screening would also a cost effective means to augment the environmental sampling.

A two-phase analysis of environmental samples is suggested. The first phase would use KPA to detect U in samples. The second phase would be triggered by samples above a specified concentration, such as 10 µg/g-soil. Samples exceeding the specified concentration would be analyzed again with a different method. ICP-MS or α-spectroscopy will be used in the second phase to determine the isotopic ratio of the U in the sample, thereby providing U activity or isotopic ratios. Analysis of environmental samples in two stages would be a powerful and cost-effective tool for monitoring the fate of DU in the APG environment.

5.2 Quality Control/Quality Assurance (QA/QC)

Regulatory Guide 4.15 (NRC, 1979) provides guidance for implementing a QA/QC program that will assure the quality of data from the environmental monitoring program. The following discussion is based on Regulatory Guide 4.15.

5.2.1 Organizational Structure and Responsibilities

The existing ERM plan (CSTA, 1986) discusses the organizational structure and responsibilities of the staff with regard to environmental sampling for the APRF operations. The responsibilities for sampling the DU testing area of the CSTA staff and contractors is detailed in SOP 385-328 (CSTA, 1990a). These documents do not show clearly the lines of responsibility for an ERM plan that encompasses the entire proving ground (Aberdeen and Edgewood areas). We recommend that the organizational structure and the responsibilities of CSTA staff and

contractors be formalized and appended to this ERM plan. The formalization shall include a flow chart showing the various duties and responsible persons for each duty. For example, of the Radiation Safety Officer is responsible for reporting results of quarterly monitoring data to the ERM coordinator, and this line of communication should be clearly indicated.

We also recommend that names of the people responsible for a particular task be listed on the flow chart. Turnover in personnel is expected, thus a yearly revision of the flow chart and/or organization chart should be produced. The organization chart and flow chart should be incorporated into the annual report of the ERM program.

5.2.2 Specification of Personnel Qualifications

Personnel involved in the ERM in any way should meet minimum qualifications for the tasks they are assigned. For example, annual reports (*e.g.*, CSTA 1992) state that samples were collected by Health Physics personnel. The qualifications required to complete satisfactorily the sampling job satisfactorily shall be listed and included as part of the implementation of this ERM plan. There should be a specification of qualification or a job description for each position in the organizational chart.

Personnel involved in sampling and analysis of the samples should be trained to maintain the quality of the samples. Such training should include instruction on the different procedures such as sample packaging, the actions or omissions that would compromise the quality of the data, and examinations of the proficiency of personnel to implement and maintain the QA/QC program.

5.2.3 Operating Procedures

Written procedures for all parts of the ERM plan shall be developed where there are none or revised where procedures already exist. The activities for which written procedures should be developed and implemented include but are not limited to sample collection, sample preparation, sample shipping and receiving, calibration and operation of field instruments, calibration and operation of laboratory instruments, data reporting and reduction, and compilation of annual reports. More specific examples of procedures include soil sampling for DU analysis, water sampling and preservation, and field cleaning of sampling instruments.

Procedures should be developed by the persons responsible for a particular part of the sampling program, the Radiation Safety Officer, and other personnel with knowledge of the tasks in question. Review of the procedures should be conducted by personnel not directly involved in the

development of the procedures and who are knowledgeable about the process for which the procedure is developed. Personnel responsible for tasks should be trained to complete the tasks within scope of the procedure. Training of all personnel shall be documented and reviewed periodically. Reviews will be completed by a team made up of CSTA personnel who conduct ERM sampling and personnel who are not regularly assigned to ERM efforts. Refresher training or additional training will be recommended during the annual review.

5.2.4 Records

Recording the activities of the ERM program is essential to ensuring that the data collected are of the highest quality. Accurate records also serve to document deviations from procedures or to show areas where procedures should be modified.

Sample tracking is one of the main reasons to maintain adequate records of ERM activities. Data generated from samples collected in the field must be demonstrably sound in quality. Thus, records of sample collection, preparation, handling before and during analysis, and reporting data derived from the samples should be maintained as an integral part of the ERM plan. An example of sample tracking is taken from the data reported from sampling at APRF (Price, 1989). Samples from Station 7 had higher activity than all other samples. Additional analysis confirmed the original findings. The records kept allowed proper identification of the original sample and the ability to prepare a replicate sample from the original. Records also showed that the reported values for the Station 7 sample were significantly higher than other samples. Better quality records would have indicated the conditions of Station 7 such as proximity to the ARL DU facilities and the B-3 range. Also, high-quality records could be searched at any time to show how often samples from Station 7 gave high activity values.

Records from field sampling should indicate who the samplers were, deviations from procedures, and the procedures being used at the time. Logbooks would serve the recording purposes well, especially for field sampling. Chain of custody forms such as AEHA Form 235 for each sample would provide the history of the sample from sample collection to reporting the results to the person responsible for compiling the data. Laboratory notebooks are essential for recording instrumental conditions, deviations from procedures, and observations about the samples during laboratory analysis. All records provide a reference for the workers involved as well as an indicator that demonstrates to investigators that proper and consistent procedures were followed in the ERM program.

5.2.6 Laboratory QC

Quality control in the laboratory involves recording many kinds of information including but not limited to the types of instruments used for measurements, calibration results and calibration frequency of the instruments, the efficiency of the measurements, and deviations in the analysis or preparation of samples that could compromise the quality of data. Use of standards of reliable quality (*i.e.*, traceable to NIST, calibration standards that are not outdated) and appropriate application is another important aspect of laboratory QA/QC.

Quality control in the laboratory also involves determination of lowest levels of detection for different analytes of interest, reporting the error in a particular measurement or in a data set, and demonstrating the proper functioning of the instruments in use for particular measurements. Analysis of process blanks, control samples, and instrument blanks will help ensure the data are of highest quality. Sampling personnel will develop a means to include known or replicate samples in the samples submitted for analysis. Results of the control samples will be a routine part of the annual report of environment sampling.

5.2.7 Data Reduction and Reporting

All methods of data reduction shall be recorded with sample calculations included. Data reductions methods include but are not limited linear regressions, statistical tests of significance, conversion to mass or activity units, and spatial representation of data at APG. The goal of recording the methods is to be able to conduct a similar analysis of the data at any time in the future and, hopefully, produce the same results as reported.

Reporting the raw data is an essential part of the annual reports. The annual reports shall serve and the repository for environmental monitoring data. ERM data will be readily available through the annual reports in this manner.

5.2.8 Review of ERM Data

ERM data will be reviewed annually to ensure that samples were collected according to procedures and that all procedures were followed in deriving the data from samples. The reviewer will include personnel who are not routinely involved in sampling and analysis as well as people outside the ERM program who are familiar with the procedures. The results of the review will be a separate report that is referenced in the annual report of the ERM program. Deficiencies in the data set will be addressed by the ERM program leader, and necessary changes in procedures or training will be made and documented.

5.2.9 SOP 385-328

The current CSTA environmental monitoring plan addresses the above concerns about quality control and quality assurance. The information in the SOP also contains information pertinent to sampling for constituents other than DU including other metals, volatile components (solvents), and samples for drinking water quality. We recommend adherence to the SOP, especially in regard to sampling, sample handling (chain of custody), and data reporting and review. SOP 385-328 and procedures briefly mentioned in SOP 385-506 (ARL) and for the APRF facility should be reviewed periodically by personnel involved in sampling, data handling, and data reporting.

6.0 References

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BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03511
STATUS CODE: 0
FEE CATEGORY: EX 3P
EXP. DATE: 20041130
FEE COMMENTS: 3P IS CORRECT
DECOM FIN ASSUR REQD: N

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
APPLICANT/LICENSEE: ARMY, DEPARTMENT OF THE
RECEIVED DATE: 961212
DOCKET NO: 3004555
CONTROL NO.: 124012
LICENSE NO.: 19-12056-02
ACTION TYPE: AMENDMENT

2. FEE ATTACHED
AMOUNT: ---/------
CHECK NO.: ---/------

3. COMMENTS
Reference 124011

SIGNED Brown, R. J.
DATE 12/18/96

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED /__/)

1. FEE CATEGORY AND AMOUNT: ----------

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:
AMENDMENT ----------
RENEWAL ----------
LICENSE ----------

3. OTHER ----------

SIGNED ----------
DATE ----------