VOID SHEET

TO: License Fee Management Branch

FROM: RI

SUBJECT: VOIDED APPLICATION

Control Number: 126170

Applicant: Dept. of the Army

Date Voided: 03-03-99

Reason for Void: Licensee does not have a prepared DP. Will resubmit when it takes place. After Review. SMB-141/40-06394

Rebecca J. Brown 3/3/99
Signature Date

Attachment:
Official Record Copy of
Voided Action

FOR LFMB USE ONLY

Final Review of VOID Completed:

Refund Authorized and processed

No Refund Due

Fee Exempt or Fee Not Required

Comments: 150101

Log completed

Processed by: _____

OFFICIAL RECORD COPY ML 10

9903160350 990303
PDR ADOCK 04006394
B PDR

VOID SHEET

TO: License Fee Management Branch

FROM: RI

SUBJECT: **VOIDED APPLICATION**

Control Number: 125885

Applicant: Department of the Army

Date Voided: December 24, 1998

Reason for Void: Combine with Control 126170 for License No. SMB-141 (040-06394). Before review.

M. A. Perkins 12/24/98
Signature Date

Attachment: Official Record Copy of Voided Action

FOR LFMB USE ONLY

Final Review of VOID Completed:

Refund Authorized and Processed
No Refund Due
Fee Exempt or Fee Not Required

Comments:

Log Completed

Processed By:

OFFICIAL RECORD COPY ML 10

February 18, 1999

Docket No. 040-06394 License No. SMB-141
Control No. 126170

David W. Ore
Site Manager, APG Site Operations
Department of the Army
United States Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5066

Dear Mr. Ore:

This is in reference to your letter dated July 1, 1998 and letter received on October 13, 1998 requesting to amend Nuclear Regulatory Commission License No. SMB-141. In order to continue our review, we need the following additional information:

Your letters concerned the decommission of the area of your facility known as the Transonic Range and included a Health and Safety Plan and Work Plan for a characterization study of the Transonic Range and a dose assessment performed for you by Argonne National Laboratory. On February 8, 1999, I visited your facilities and met with Mr. Richard Markland, Radiation Safety Officer and Michael Styvaert, U.S. Army Industrial Operation Command. During that meeting, I indicated that in order to process your request, we would need to see the final decommissioning plan. I stated that the plan would need to include a discussion of the decontamination techniques to be used, an estimate of the costs, a description of the waste handling procedures, a health and safety plan including surveys to be conducted during the course of decontamination activities, the schedule for completion of the work and details of the final status survey. With regard to the final status survey, you will need to establish a derived concentration guideline to demonstrate compliance with the provisions of 10 CFR 20.1402. You should use Draft Regulatory Guide DG-4006 "Demonstrating Compliance with the Radiological Criteria for License Termination." During the meeting, I indicated that NRC will use this Draft Guide as well as NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" in the evaluation of your decommissioning plan.

Also during the course of the meeting, Mr. Markland estimated that the final plan would be available for our review by August 1999. If there is any change to this proposed target date, please let us know.

We will continue our review upon receipt of this information. Please reply in duplicate to my attention at the Region I Office and refer to Mail Control No. 126170. If you have any technical questions regarding this letter, please call me at (610) 337-5069.

ML10

Thank you for your cooperation.

Sincerely,

Original signed by John R. McGrath

John R. McGrath
Senior Health Physicist
Nuclear Materials Safety Branch 2
Division of Nuclear Materials Safety

Enclosure:
10 CFR Parts 19, 20, and 40

cc:
Richard A. Markland, Radiation Safety Officer

DOCUMENT NAME: B:\DNMS Documents\Def Letter\LSM3-141.wpd 80244923

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	JMcGrath JRM							
DATE	02/18/99		02/ /99		02/ /99		02/ /99	

OFFICIAL RECORD COPY

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

REPLY TO
THE ATTENTION OF

July 1, 1998

040-06394

Risk Management Office

Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, Pennsylvania 19405

Gentlemen,

In a letter dated January 1, 1996, the US Army Research Laboratory (ARL) expressed an intent to decontaminate/decommission an area (Transonic Range) covered by License Number SMB-141. A Health and Safety Plan and a Work Plan for a Characterization Study were also provided.

This letter is to inform your office of the progress being made in the decommissioning effort.

The Characterization Study has been completed and a contract has been awarded to the Argon National Laboratory to use the review Characterization Study and prepare a Decommissioning Plan. The Plan was due back to ARL in June 1998 but has not been received yet. As soon as the plan is available a copy will be submitted for your review/approval.

The timing and extent of the final decommissioning of the facility is dependent upon the recommendations of Argon and your office, future use of the facility and funding. As soon as possible after the Argon Plan is received we will prepare a timeline for your approval.

My point of contact for this action is Mr. Richard A. Markland. Please feel free to contact him at any time on (410) 278-6354.

Sincerely,

Pamela E. Fry
for David Ore
Director, Site Operations

COMBINE WITH 126170
12-24-98
VOID 12/24/98 ~~125885~~

OFFICIAL RECORD COPY ML 10 ~~JUL 17 1998~~

DEPARTMENT OF THE ARMY
U.S. ARMY RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005-5066

REPLY TO
THE ATTENTION OF

January 24, 1996

Risk Management, Aberdeen Division

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

Ladies and Gentlemen:

The U.S. Army Research Laboratory (ARL) at Aberdeen Proving Ground (APG), Maryland submitted a letter of intent to your office dated December 9, 1994 that indicated ARL's desire to decontaminate the Transonic Range Facility under NRC license number: SMB-141. At that time we indicated a decommissioning plan would be prepared and forwarded to your office.

Enclosed, please find one copy of the following plans:

1. Health and Safety Plan for Radiological Characterization
2. Work Plan for Radiological Characterization.

These plans describe in detail the first leg of the decontamination effort for this range facility required to determine the extent of contamination at this facility. Please review the plans at your convenience.

Results from the characterization and planning documents for future work in this area will be forthcoming. We wish to inform your office that due to the presence of unexploded ordnance in the area under the grid, the actual decontamination effort will be somewhat delayed for health and safety reasons. We will however, keep the NRC informed of any changes in the status of this project.

My point of contact for this action is Mr. Richard A. Markland. Please feel free to contact him at any time on (410) 278-6345.

Sincerely,

Richard L. Hughes

RICHARD L. HUGHES
Director, APG Site Operations

2 Encls
as

126170
~~125805~~
APR 12 1996

OFFICIAL RECORD COPY ML 10

TRANSONIC RANGE
DEPLETED URANIUM STUDY AREA

Health and Safety Plan
for
Radiological Characterization

Prepared For:

U.S. Army Directorate of Safety,
Health and Environment,
Health Physics Office
Aberdeen Proving Ground, Maryland

Contract No.: DAAD-05-93-D-7053

Delivery Order No.: 0058

Prepared By:



General Physics Corporation
6700 Alexander Bell Drive
Columbia, Maryland 21046

January 1996

APR 12 1996

DEPARTMENT OF ARMY
Directorate of Safety, Health, and Environment
Aberdeen Proving Ground, Maryland

Transonic Range
Depleted Uranium Study Area

Health and Safety Plan

Radiological Characterization Activities

January 1996

CONCURRENCE:

APGSA, Chief,
Installation Safety Office
Directorate of Safety, Health and Environment RR 12 FEB 96 Richard C. Allen 12 Feb 96
Date

APGSA
Radiation Protection Officer Ralph Vanderbeck 1/19/96
Date

Program Manager,
General Physics Corporation D. Ceresani 1/19/96
Date

Quality Assurance Officer,
General Physics Corporation 1/19/96
Date

Project Safety Officer,
General Physics Corporation 1/19/96
Date

Chief, Industrial Hygiene Branch
Kirk U.S. Army Health Clinic 1/19/96
Date

Copies Provided to ATC Safety, ARL Safety

STATEMENT OF UNDERSTANDING

My signature below certifies that I have read, understood, and agree to comply with the guidelines and requirements set forth in the Depleted Uranium Study Area HASP for Radiological Characterization Activities.

PRINTED NAME	SIGNATURE	DATE

PRINTED NAME	SIGNATURE	DATE

Table of Contents

1.0 INTRODUCTION 1

1.1 Applicability 1
1.2 Plan Amendments and Review 1

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES 2

2.1 Key Project Personnel 2
2.2 Project Responsibilities 2
2.2.1 Program Manager 2
2.2.2 QA Officer 2
2.2.3 Safety Officer 2
2.2.4 Project Manager 3
2.2.5 Field Health and Safety Officer 3
2.2.6 Field Operations Manager 4

3.0 SAFETY AND HEALTH RISK ANALYSIS 5

3.1 Site Description and Historical Background 5
3.2 Site Hazard Identification and Assessment 9
3.3 Task Specific Hazards 9
3.3.1 Identification 9
3.3.2 General Assessment and Mitigation 9
3.3.3 DUSA UXO Hazards 11
3.3.4 DUSA Radiation Hazards 12
3.3.5 DUSA Physical Hazards 12
3.3.6 DUSA Task Specific Hazards 13
3.3.6.1 Field Investigations 13
3.3.6.2 UXO Sweeps 13
3.3.6.3 Gridding the Site 13
3.3.6.4 Radiation Surveys 14
3.3.6.5 Geophysical Surveys Using EM-61 14
3.3.6.6 Soil Sampling 14
3.3.6.7 Bulding and Structure Surveys 14

4.0 TRAINING 15

5.0 MEDICAL SURVEILLANCE 16

Table of Contents (continued)

6.0 PERSONAL PROTECTIVE EQUIPMENT 17

6.1 General Site Working Uniform 17
6.2 Task Specific PPE Requirements 17
6.3 Reassessment of PPE Requirements 18

7.0 MONITORING 20

7.1 Monitoring Instruments 20
7.2 Monitoring Procedures 20
7.2.1 Site Radiation Monitoring 20
7.2.2 Task Specific Monitoring 20

8.0 SITE CONTROL 22

8.1 Site Work Zones 22
8.2 Site Access/Site Security 23
8.3 Site Communication 23
8.4 Safe Work Practices 23
8.4.1 General 23
8.4.2 Buddy System 24

8.5 Site Mapping 24

9.0 DECONTAMINATION 25

10.0 EMERGENCY RESPONSE PLAN 26

10.1 Emergency Personnel and Telephone Numbers 26
10.2 Emergency Recognition and Prevention 26
10.3 Emergency Equipment 27
10.4 Emergency Communications 27
10.5 Evacuation Routes 27
10.6 Emergency Procedures 29
10.6.1 Life-Threatening Emergencies 29
10.6.2 Personnel Injury in the Contamination Reduction Zone 30
10.6.3 Personnel Injury in the Support Zone 30
10.6.4 Fire or Explosion 30
10.6.5 Protective Equipment Failure 30
10.6.6 UXO Discovery 30

Table of Contents (continued)

10.7 Emergency Reporting 31

11.0 HAZARD COMMUNICATION 32

APPENDIX A UXO Contractor Site Operations and Safety Plans and Site Specific Addendum
APPENDIX B Heat Stress and Cold Extremes Information and Guidelines
APPENDIX C Lyme Disease Information and Guidelines
APPENDIX D Training and Medical Documentation

List of Figures

Figure 1 Location of Aberdeen Proving Ground 6

Figure 2 Location of the Transonics Range Study Area on APG 7

Figure 3 Transonics Range and Location of DU Study Area 8

Figure 4 DU Study Area 10

Figure 5 Evacuation Routes to Johns Hopkins Riverside and Harford Memorial Hospital 28

List of Tables

Table 1 Physical Properties and Symptoms of Exposure 11

Table 2 Task-Specific PPE Requirements 18

Table 3 Task Monitoring and Actions 21

Table 4 Emergency Organizations and Numbers 26

Table 5 Local Area Medical Facilities 29

1.0 INTRODUCTION

The following Health and Safety Plan (HASP) specifies safety and occupational health precautions for all personnel involved in Radiological Characterization (RC) Study activities at the Transonic Range Deleted Uranium Study Area (DUSA) on the Aberdeen Area of Aberdeen Proving Ground (APG). This Plan demonstrates compliance with the requirements for the protection of workers engaged in hazardous waste operations that are set forth in U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Regulation, 29 CFR 1910.120. It also demonstrates compliance with Title 10 Parts 19 and 20 as set forth by the Nuclear Regulatory Commission.

1.1 Applicability

The provisions of this HASP are mandatory for all personnel visiting or working at the DUSA during the course of the investigation. The investigation includes, but is not limited to: field investigations, UXO surveys, radiation surveys, surveys for buried objects using EM-61 geophysical instruments (EM-61), and soil sampling.

Personnel include all General Physics employees and its contractors working or visiting the area covered by the HASP.

1.2 Plan Amendments and Review

The HASP and its appendices have been reviewed and approved by the organizations listed in the front of the document. Due to the nature of the work, plan amendments may be required as the project progresses. Changes to the HASP may be initiated by the Project Manager, the Health and Safety Officer, or any concurring organization. All changes are subject to the same review process and concurrence as the original HASP, unless specifically provided for in the HASP.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Key Project Personnel

Program Manager:	Donald L. Urbani, PE	(410) 676-8835
Quality Assurance Officer:	John G. Casana, PE	(410) 290-2558
Safety Officer:	Bruce W. Jacobs, CIH	(410) 676-8835
Project Manager:	Bruce R. Parrish	(410) 290-2512
Field Operations Manager:	Bruce R. Parrish	(410) 290-2512
Alternates:	Don Urbani or	(410) 676-8835
	Robert Lee	(410) 676-8835
Field Health and Safety Officer:	Bruce R. Parrish	(410) 290-2512
Alternates:	Don Urbani or	(410) 676-8835
	Robert Lee	(410) 676-8835

2.2 Project Responsibilities

2.2.1 Program Manager

The Program Manager defines project objectives, allocates resources, assigns project personnel, and evaluates project outcome. The Program Manager:

- provides necessary facilities, equipment, and funding
- provides personnel and time resources to conduct activities safely
- supports efforts of the Project Safety Officer, Project Quality Assurance Officer, and Project Manager

2.2.2 Quality Assurance (QA) Officer

The QA Officer advises the Project Manager on all aspects of quality assurance/quality control (QA/QC) to assure the quality of work performed. Specifically, the QA Officer:

- reviews all project plans
- conducts scheduled and spot audits of work (including subcontractors)

The QA Officer will report immediately to the Project Manager any deficiencies encountered during an audit.

2.2.3 Safety Officer

The Safety Officer advises the Project Manager on all aspects of health and safety at the site. The Safety Officer has the authority to stop work if any operation threatens worker or public health or safety. Specifically, the Safety Officer:

- specifies necessary monitoring and protective equipment for the project
- monitors safety performance of all project personnel in compliance with the project HASP
- advises Field Health and Safety Officer in correcting unsafe work practices or conditions and documenting these corrections
- reviews the results of site monitoring and recommends additional monitoring or changes in protective equipment as specified in the contingencies of the HASP
- provides ongoing review of the protective level needs as project work is performed

2.2.4 Project Manager

The Project Manager reports to the Program Manager and directs project activities. The Project Manager assumes control over project activities. Specifically, the Project Manager:

- coordinates all activities with appropriate officials
- obtains all necessary permits
- ensures work plan is completed on schedule
- briefs project personnel on specific assignments
- serves as liaison between General Physics Corporation, the U.S. Army, and all contractors

2.2.5 Field Health and Safety Officer

The Field Health and Safety Officer reports to the Project Safety Officer through the Field Operations Manager. The Field Health and Safety Officer oversees all aspects of field safety. Specifically, the Field Health and Safety Officer:

- enforces safety procedures
- performs site monitoring as required by the HASP
- coordinates with the Safety Officer in determining protection levels
- enforces site controls
- verifies that all project personnel have current medical authorizations and have received appropriate training
- determines that equipment is used properly and is calibrated in accordance with manufacturer's instructions or other standard protocols and that the results are properly recorded and filed
- documents field activities related to safety

The Field Health and Safety Officer responds to all emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. The Field Health and Safety Officer implements, or oversees the implementation of, corrective measures and notifies appropriate authorities.

2.2.6 Field Operations Manager

The Field Operations Manager reports directly to the Project Manager. The Field Operations Manager directs all field activities. Specifically, the Field Operations Manager:

- directs site activities
- executes work plan and schedule
- documents field activities and sample collection

The Field Operations Manager may serve as the Field Health and Safety Officer.

3.0 SAFETY AND HEALTH RISK ANALYSIS

3.1 Site Description and Historical Background

APG lies along the western shore of the Chesapeake Bay in Harford and Baltimore Counties, Maryland, approximately 15 miles northeast of Baltimore (Figure 1). APG covers a total of 79,000 acres and consists of two distinct areas: the northern portion of APG, referred to as the Aberdeen Area (AA); and the southern portion of APG, referred to as the Edgewood Area (EA).

Established as the Ordnance Proving Ground in 1917, the AA became a formal military post, designated as APG, in 1919. From its establishment, APG's primary mission involves the testing and development of weapon systems, munitions, vehicles, and a wide variety of military support materiel. (Figure 2).

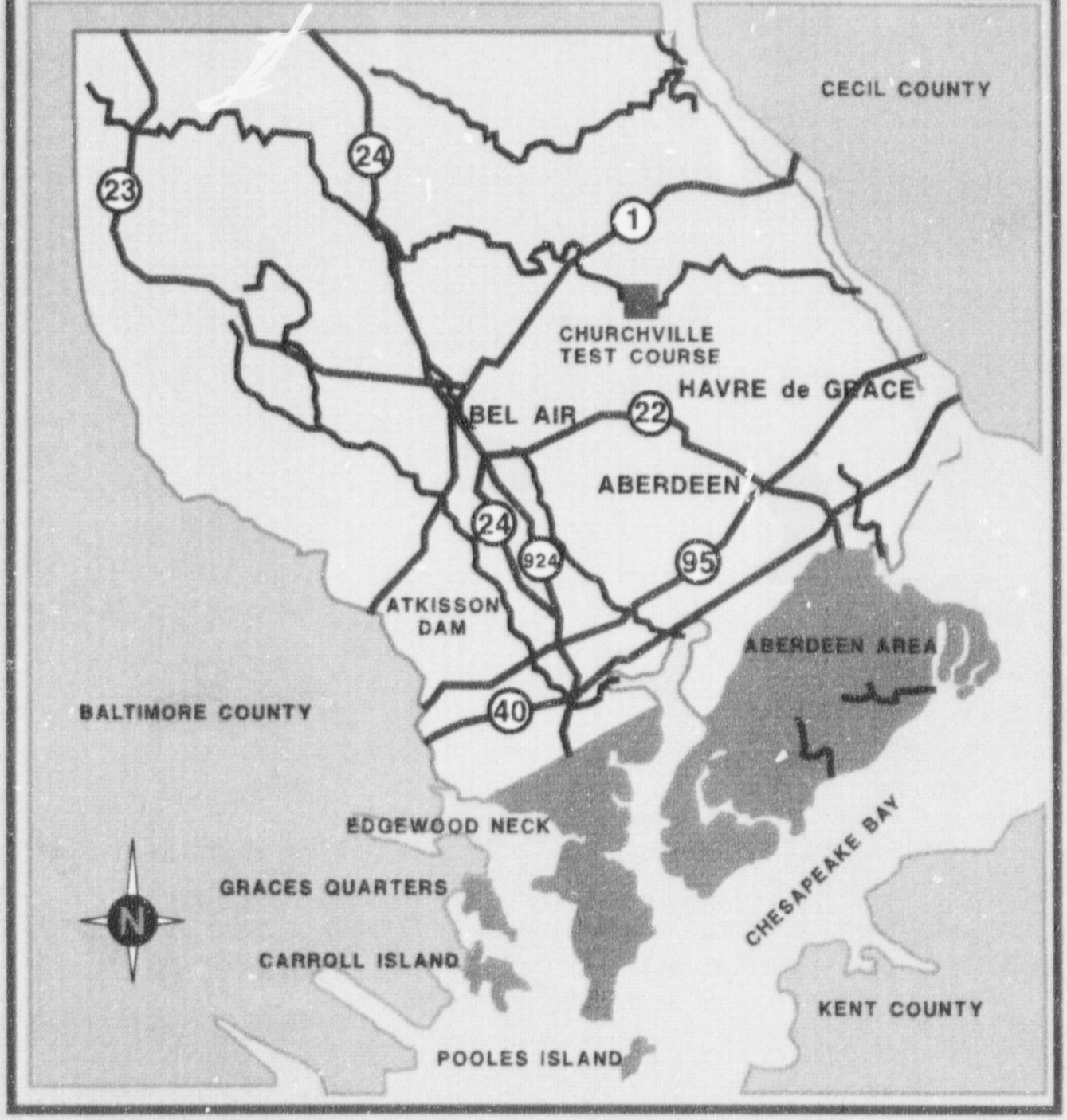
The EA (formerly Edgewood Arsenal) lies adjacent to the towns of Edgewood and Joppatowne in the southern part of Harford County. The EA was appropriated by Presidential Proclamation in 1917. Historically, all of the military chemical research, development, and related activities occurred at the EA. The EA was placed on the National Priorities List (NPL) on February 21, 1990. In March 1990 the U.S. Environmental Protection Agency (EPA) Region III, APG and U.S. Department of the Army entered into a Federal Facility Agreement for the EA and sections of the AA that established a procedural framework and schedule for developing and implementing appropriate Remedial Investigations (RI) actions including radiological characterizations.

As shown in Figure 3, the DUSA is located on the southern portion of the Transonic Range and was known as "Lower X-ray" south and east of Building 740A at the end of the paved access road in the Transonic Range Area The site is 12 acres in area. Approximately half of the site is cleared and used for testing. The remaining area is wooded and covered by undergrowth.

The DUSA was used for hard-impact testing of depleted uranium (DU) penetrators. DU penetrators were gun launched against armor targets to test their effectiveness. DU turned molten on impact and either partially or completely penetrated the target and scattered into the surrounding area or was vaporized. DU is depleted of the natural percentage of U-235, and contains U-238, U-235 and U-234 all of which are radioactive. Thus, the DU penetrator testing contaminated the target material, and potentially contaminated surrounding structures and soil.

DU testing began at the DUSA in 1973 and ceased in the summer of 1979. The site environmental surveillance program indicates levels of activity in excess of the current regulatory site limit of 35 pico-Curies per gram (pCi/g) for DU.

This Page is Intentionally Blank



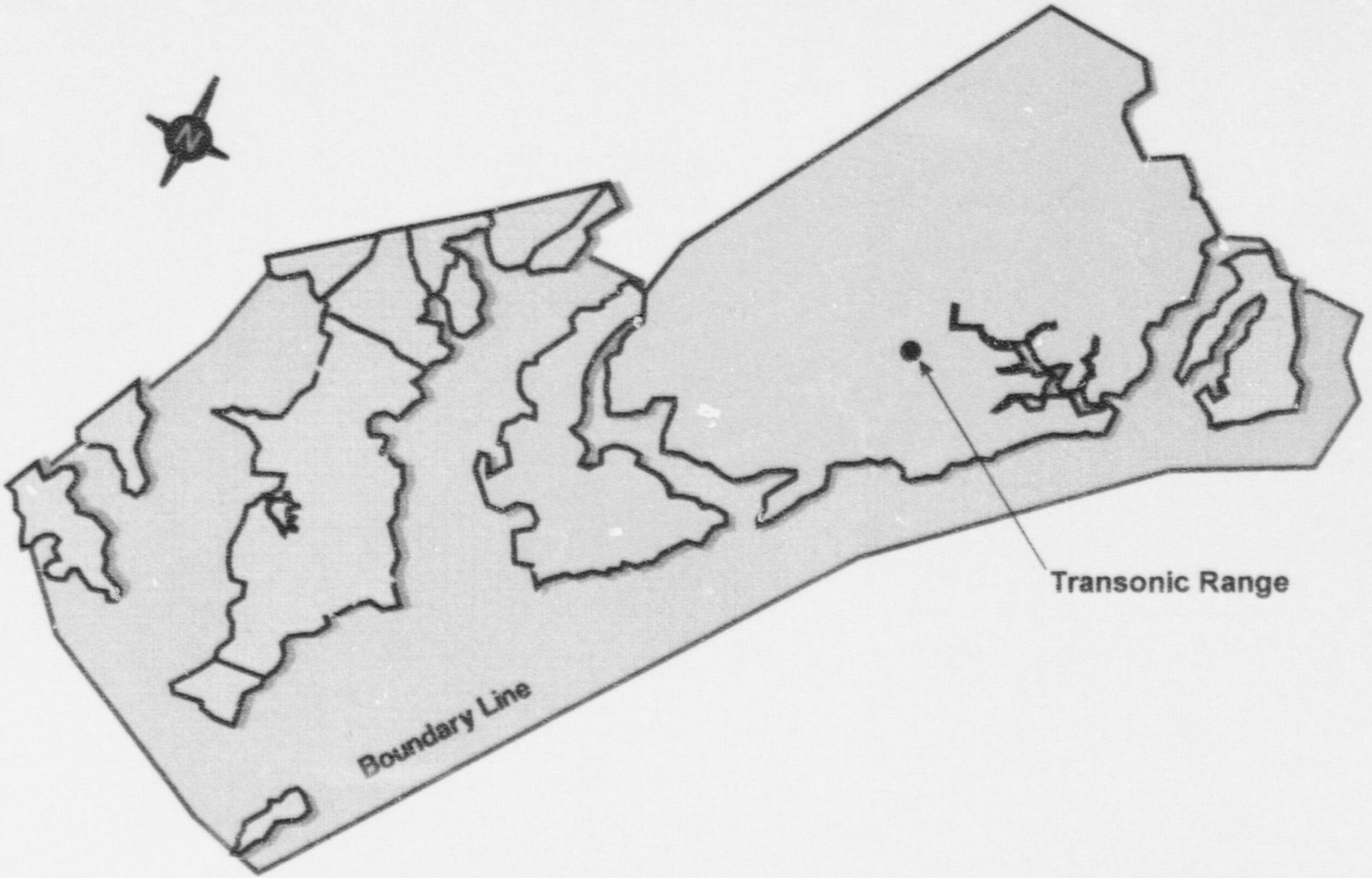
NOT TO SCALE

ABERDEEN PROVING GROUND

GENERAL PHYSICS CORPORATION

LOCATION OF APG

DATE: 10/24/94 | | FIGURE: 1



1 2 3 4 5
SCALE (MILES)

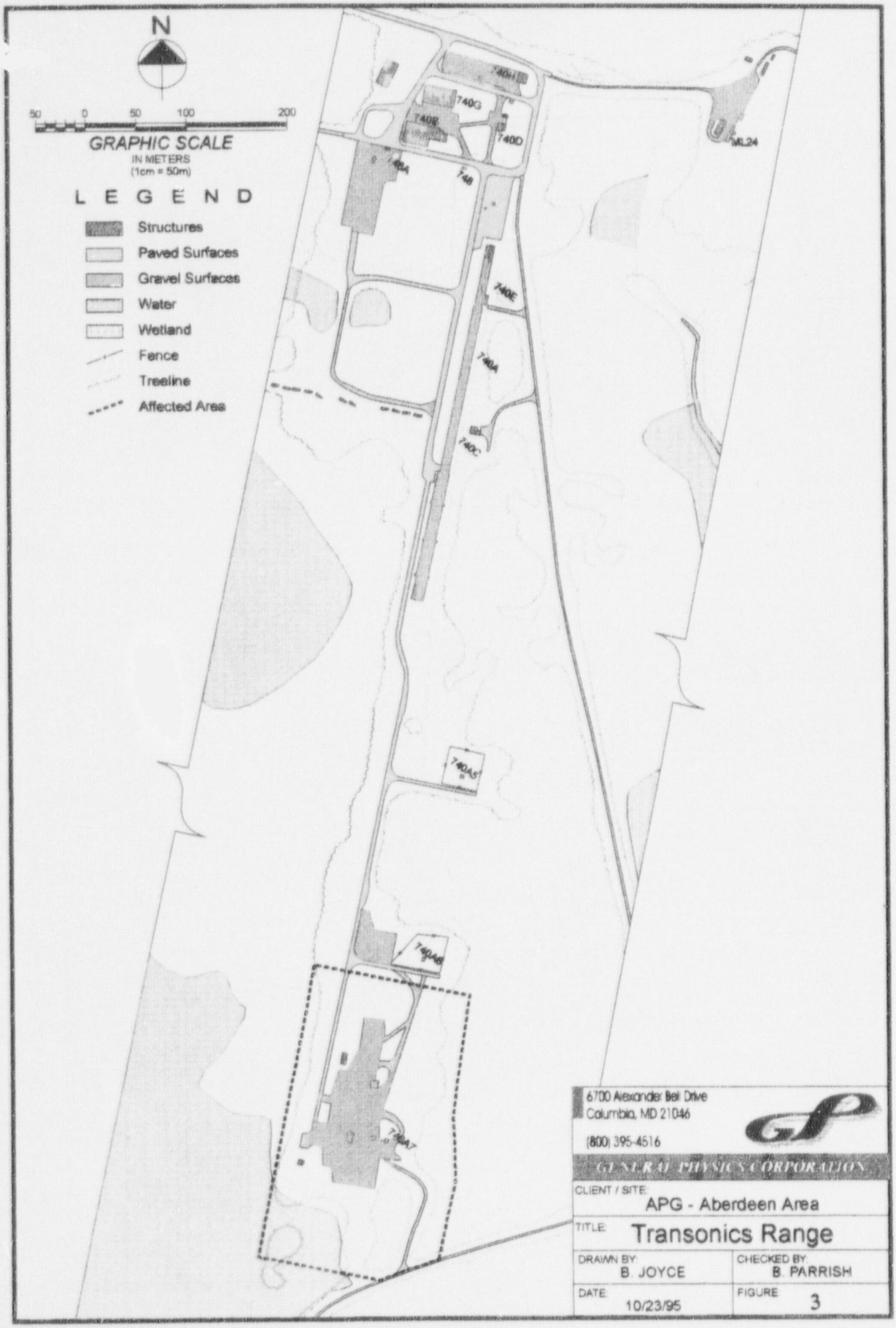
ABERDEEN AREA

GENERAL PHYSICS CORPORATION

APG - ABERDEEN AREA

STUDY AREA ON APG

DATE: 10/12/95		FIGURE: 2



6700 Alexander Bell Drive
Columbia, MD 21046
(800) 395-4516

GENERAL PHYSICS CORPORATION

CLIENT / SITE: APG - Aberdeen Area	
TITLE: Transonics Range	
DRAWN BY: B. JOYCE	CHECKED BY: B. PARRISH
DATE: 10/23/95	FIGURE: 3

This limit is published in the Nuclear Regulatory Commission's (NRC) Branch Technical Position (BTP) "Disposal of Onsite Storage of Thorium or Uranium Wastes from Past Operations" (FR volume 46, No. 205, 10/23/81). Since site operations using DU ceased, several areas have undergone remediation at DUSA. These include areas where shot target was stored temporally and contaminated areas around structures.

The goal of this radiological characterization is to survey the entire site to identify areas above 35 pCi/g and to locate areas where contaminated target may still remain. Additionally, five structures associated with the DU testing remain on-site and require characterization to document radiological status.

3.2 Site Hazard Identification and Assessment

The principal hazards at the DUSA investigation sites include exposure to radioactive material, detonation of unexploded ordnance (UXO), and physical hazards associated with field activities (such as tripping, falling, and cuts). UXO, radiation, and physical hazards are discussed in the following sections. Mitigation measures for each of the hazards are also described in the following sections. Figure 4 shows the DUSA site and features.

3.3 Task Specific Hazards

3.3.1 Identification

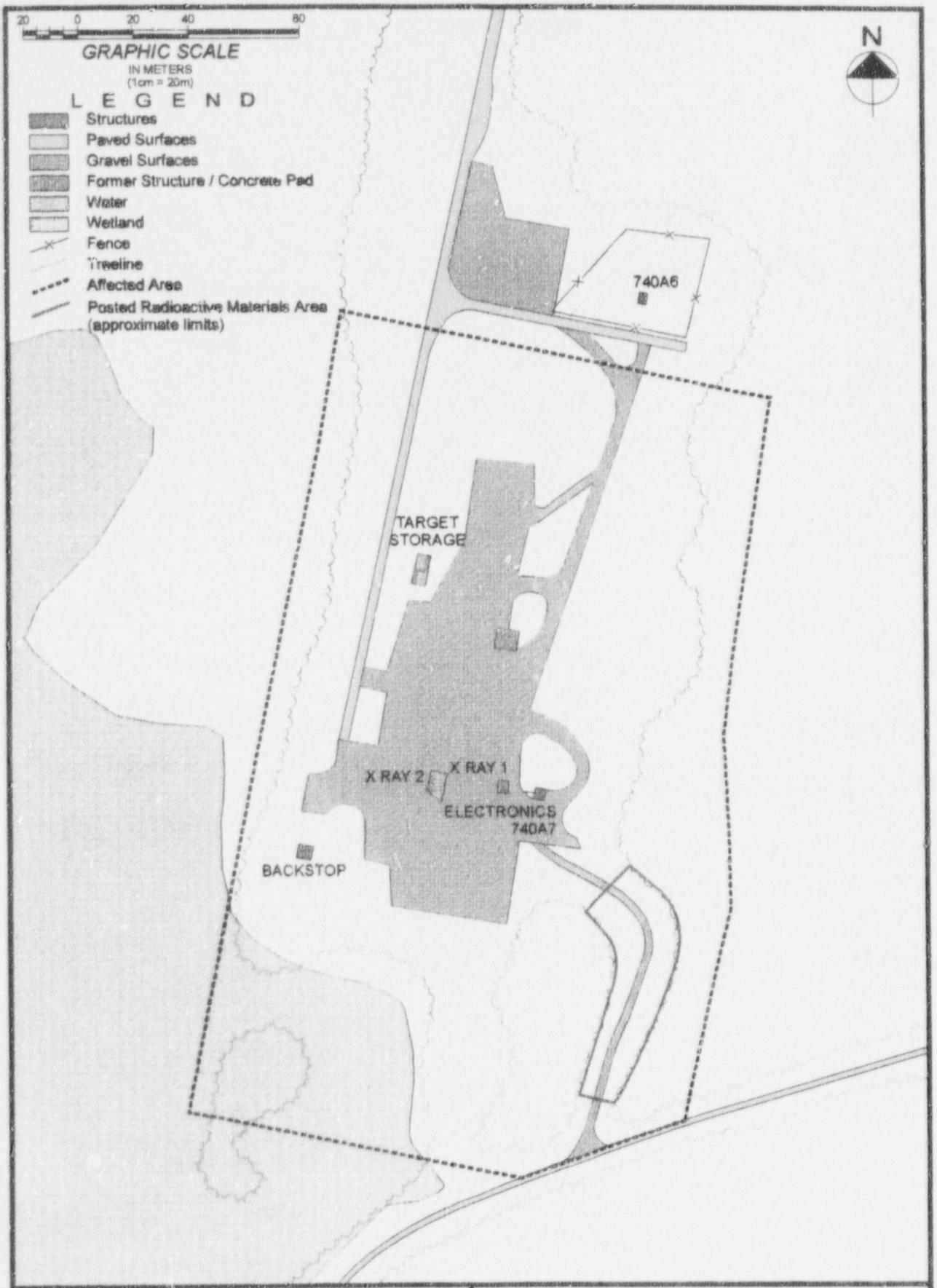
The major contaminants known to be on site include uranium isotopes and their progeny. These contaminants are a result of DU testing. The radionuclides of concern include U-234, U-235 and U-238. Analytical results for soil samples collected from several areas showed levels in excess of the NRC release criteria of 35 pCi/g for unrestricted use. Most of the soil contamination was found in an area posted as a Radioactive Materials Area on the southeast side of the site. The roped area bounds a known shot target storage site, from which target was packaged and shipped to a licensed disposal site. Of the 165 soil samples collected from this area, 37 were greater than the 35 pCi/g limit. Concentrations above the release limit ranged from 36 to 520 pCi/g.

The areas behind the backstops show soil concentrations below the limit for free release with few exceptions. Soil samples collected in and around remaining site structures are below the release limit.

3.3.2 General Assessment and Mitigation

Periodic monitoring for radioactivity has been conducted in the past. No significant levels of contamination that pose a hazard to workers has been identified. Radioactivity has not migrated off of the site. Army Research Laboratory (ARL) and Army Test Center (ATC) personnel use the area for testing without concern for the residual levels of DU or

This Page is Intentionally Blank



6700 Alexander Bell Drive Columbia, MD 21046 (800) 395-4516	TITLE: Transonic Range - DU Study Area	
GENERAL PHYSICS CORPORATION	DRAWN BY: B. JOYCE	CHECKED BY: B. PARRISH
CLIENT / SITE: APG - Aberdeen Area	DATE: 10/24/95	FIGURE: 4

deleterious effects of the radioactive material. Radiation levels are below that requiring monitoring workers for exposure to ionizing radiation.

Work practices, protective clothing and decontamination procedures preclude the intake of these compounds via the oral or skin absorption routes.

Although it is not anticipated that field personnel will encounter significant quantities of the DU mentioned above, Table 1 presents general information on the symptoms of acute exposure to ionizing radiation. The levels anticipated and the work at the DUSA are less than those that would be typical of chronic low level occupational exposure to ionizing radiation. Chronic exposure to ionizing radiation over a lifetime is associated with increased genetic effects in off-spring and some forms of cancer. Other chronic effects include non-specific life-shortening.

A variety of precautions will be implemented during site activities. These are described in depth within the pertinent sections of this HASP and are listed in summary form below.

- Magnetometry surveys are performed prior to the initiation of all initial intrusive activities to check for the presence of UXO or other metallic objects. HFA will be responsible for conducting this activity. Their HASP is included in Appendix A.

- Radiological monitoring instruments will be used during all site work including initial intrusive work to monitor for the presence of radiological activity and contamination.

Table 1 Physical Properties and Symptoms of Exposure

Hazard Name	Symptoms of Acute Exposure to High Concentrations
Radionuclides associated with DU	Skin burns, nausea, vomiting, diarrhea, cancer, genetic effects.

3.3.3 DUSA UXO Hazards

A variety of ordnance types may been found in DUSA. The DUSA was a known impact area for DU penetrators and kinetic energy projectiles.

The exposure hazard associated with UXO items is related to unexpected disturbance causing leakage of contents or detonation. Hazards include the explosive and chemical hazards near the point of detonation, and the downwind hazard associated with the release of a potentially toxic material from the UXO.

Hazards of this nature will be minimized by the completion of magnetometry surveys, prior to the initiation of all intrusive field work at DUSA which consist of placing grid markers for survey reference, radiation surveys, geophysical surveys, and soil sampling.

3.3.4 DUSA Radiation Hazards

The DUSA is a known radiological testing and material handling area at APG. Radioactive work included DU penetrator testing, waste packaging and storage.

Historical research and previous field investigations have not found any supporting evidence for immediate radiological concerns in the DUSA; however, due to the degree of uncertainty associated with the area, all initial intrusive field work will be monitored for the presence of radiological materials. The probability of a radiation hazard in DUSA is thought to be small.

Radiological materials represent an external exposure potential and an internal exposure potential. Inhalation, ingestion, and dermal contact hazards may exist. Due to past activities, the DUSA has radiological contamination present. During all initial intrusive work, health and safety monitoring will be performed using a gamma scintillometer (μR meter) and a thin window GM detector (pancake style) or gas flow proportional counter. Equipment and personnel will be surveyed in the contamination reduction zone. Equipment will also be given a baseline frisk to compare with subsequent frisk results in order to determine whether contamination of the pieces has occurred.

Radiation levels exceeding two times background levels via frisking will result in all work ceasing in the area and investigation as to the nature and source of the contamination.

3.3.5 DUSA Physical Hazards

Physical hazards associated with the DUSA RC activities include light equipment operation (e.g. generators, etc.), traversing undeveloped areas, adverse weather conditions, possible wildlife encounters and water hazards in marshes and creeks. Light equipment operation associated with field activities is of little concern due to the fact that safety is easily controlled. Mitigation measures include common sense; safe field practices; safe lifting techniques; and adhering to approved plans, SOPs, and manufacturer's specifications.

No unique physical hazards exist in the developed portions of DUSA. Generally, the undeveloped portions of DUSA are characterized by small hills and valleys and flat areas. Hazards associated with the undeveloped areas may be characterized as tripping hazards (e.g., underbrush, covered holes, etc.). Mitigation measures implemented when leaving the undeveloped areas include employing the "buddy system," adhering to PPE requirements, and maintaining a high level of alertness.

The planned field activities associated with the DUSA RC will take place over approximately a 3-month period and temperature extremes may be a factor. Hazards are mitigated by appropriate clothing; work and rest schedules; shelter; and hot or cold non-caffeinated beverages (See Appendix B for additional guidance).

what's background?

Wildlife common to the area includes snakes, small rodents, and insects. Poisonous plants such as poison ivy, oak, and sumac may also exist. The hazards most likely to be encountered include bites, stings, dermatitis, and biological hazards such as tick and mosquito borne diseases. (See Appendix C for specific details and guidance on Lyme Disease). Wildlife encounters are not anticipated to be a problem.

3.3.6 DUSA Task Specific Hazards

Field operations will primarily consist of field investigations, UXO sweeps, gridding the site, radiation surveys, geophysical surveys using EM-61, and soil sampling. Each operation is slightly different and the potential hazards differ for each operation. Specific details are found in the Work Plan.

3.3.6.1 Field Investigations

Field investigations (also known as site reconnaissance) involve project personnel performing visual inspections of the DUSA area. Personnel performing field inspections do not intrusively sample, enter existing structures and fixtures, or operate equipment. Only ambient radiation monitoring is performed.

The principal hazards include physical hazards, weather related stresses, and the presence of UXO (potential for detonation and/or leakage). The physical hazards are mitigated by the measures detailed in paragraph 3.3.5. Potential UXO hazards are mitigated by the procedures described in paragraph 3.3.4.

3.3.6.2 UXO Sweeps

The UXO contractor will conduct visual sweeps for UXO in the DUSA. Magnetometers will also be used to determine the potential presence of buried UXO prior to the initiation of all intrusive activities such as soil sampling and installation of grid points.

The principal hazards with this operation include detonation of UXO and physical hazards. Mitigation measures include the use of magnetometry itself and avoidance of areas where use of magnetometry has determined the potential for buried UXO.

3.3.6.3 Gridding the Site

A geodetic surveyor will identify grid points in the DUSA at 200 foot intervals. Each point will be identified with a stake. These points will be used to locate transponders during the radiation and geophysical surveys described in section 3.3.6.4 and 3.3.6.5.

The principal hazards with this operation include detonation of UXO and physical hazards. Mitigation measures include the use of magnetometry during this operation and avoidance of areas where use of magnetometry has determined the potential for buried UXO.

3.3.6.4 Radiation Surveys

Chemrad will conduct walkover radiation surveys using a gas flow proportional counter mounted on a wheeled cart. Hazards during radiation surveys include UXO detonation/leakage, and physical hazards. Mitigation measures include adherence to safe field practices, approved plans and SOPs, and maintaining a high level of alertness. HFA will provide additional UXO and safety expertise during this phase.

3.3.6.5 Geophysical Surveys Using EM-61

Chemrad will conduct a geophysical survey using EM-61 for buried objects. The survey will graphically demonstrate the shape and dimensions of the objects. The radar device is mounted on a robot and operated in an area located at a distance great enough such that if a UXO with a proximity fuze or other type of fuze that would be detonated by an electronic pulse from the Geonics EM-61 (rated at 50 watts at 75 Hz) the operator and onsite personnel would not be affected. The safe distance is 345 meters from the robot.

Hazards using EM-61 include UXO detonation/leakage and physical hazards. Mitigation measures include adherence to operating the robot at a safe distance, approved plans and SOPs, and maintaining a high level of alertness. HFA will provide additional UXO and safety expertise during this phase.

3.3.6.6 Soil Sampling

At the completion of the walkover surveys the radiation levels will be demonstrated on a site map. At the direction of the APG HPO, soil samples will be collected at specific locations to confirm high readings, low readings and boundaries where levels are greater than 35 pCi/g.

Sampling team personnel will collect surface soil samples from various locations within the DUSA area. Surface soil samples will be collected at various depths from the borings and transferred to containers. Samples will be collected using an auger, split-spoon sampler, or other means.

Hazards include skin contact with contaminated soil, detonation/leakage of UXO, and physical hazards. Physical hazards are mitigated as described in paragraph 3.3.5. Exposure hazards are mitigated by use of proper PPE as delineated in Section 6.0. UXO hazards are mitigated as described in paragraph 3.3.3, using HFA to determine if a UXO hazard exists at the sampling location.

3.3.6.7 Building and Structure Surveys

Several single story structures located on DUSA have the potential to be contaminated with DU. Radiation surveys of floors, walls, ceilings and roofs will be conducted.

Hazards conducting structure surveys include physical hazards. Mitigation measures include adherence to safe field practices, approved plans and SOPs, and maintaining a high level of alertness.

Health Physics Office

4.0 TRAINING

All personnel working within the DUSA in connection with RC activities will have received hazardous waste worker training in accordance with 29 CFR 1910.120(e). The training includes 40-hour initial training and 8-hour refresher training for all site workers, as well as 8-hour supervisor/manager training for the Program Manager, Project Manager, Field Health and Safety Officer, Field Operations Manager, and UXO Contractor Leader.

Personnel training records are maintained at the offices of the various project participants. Copies of personnel training records which verify workers' training and dates, will be provided to the Field Health and Safety Officer prior to the start of the project and maintained on site at all times during the study. Copies maintained on site will include, as a minimum, the dates of initial training and the most recent refresher training. The Field Health and Safety Officer is responsible for ensuring that all project personnel have received their annual training and qualify to work on the project.

Appendix D summarizes the current training status for General Physics field personnel. All GP personnel involved in the project have received radiation protection awareness training. GP's contractors will be given a radiological briefing by the HPO prior to starting work at DUSA.

5.0 MEDICAL SURVEILLANCE

All personnel will be included in a medical surveillance program consistent with the regulations and guidelines set forth in 29 CFR 1910.120(t) and 29 CFR 1910.134.

Personnel medical records are maintained at the offices of the various project participants or contracted medical providers. Copies of medical documentation, certifying that each worker is medically qualified to wear a respirator and work with hazardous materials, will be provided to the Field Operations Manager prior to the start of the project. These copies will be maintained on site at all times during the study. The on-site copies will include the date of the individual's last exam, a statement certifying the individual is medically qualified, and a physician's signature. The Field Health and Safety Officer is responsible for ensuring that all project personnel have received their annual exam and are currently medically qualified to work on the project.

Appendix D summarizes the current medical status for General Physics field employees.

6.0 PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) protects employees from the hazards and potential hazards they are likely to encounter. PPE consists of a combination of protective clothing and respiratory protection equipment. Selection of PPE is based on an evaluation of the performance characteristics of the PPE relative to the known hazards of the site and the task specific conditions and duration. The level of protection is upgraded when site monitoring or conditions indicate that increased protection is necessary to reduce an employee's potential for exposure.

6.1 General Site Working Uniform

Based on available information assessing the current condition of the DUSA, minimal skin protection is required for general site access and non-intrusive work. The prescribed working uniform for all personnel engaged in activities related to the project at the DUSA sites is a modified EPA level D and will consist of:

- Long-sleeved shirt and full-length pants
- Steel-toe boots or shoes
- Eye protection and hearing protection (carried)
- Hard hat (available when needed)
- Latex Gloves (soil sampling only)

No respiratory protection equipment is required. At the present time, based on available information, the atmosphere contains no known hazards.

6.2 Task-Specific PPE Requirements

PPE is selected based on the characteristics of the site and the tasks to be performed. PPE is employed when the tasks cannot be modified, or engineering controls cannot be applied or are inadequate. The individual components of clothing and equipment are selected to protect the worker from site-specific and task-specific hazards and minimize the drawbacks of the PPE itself. Specific PPE requirements are established for the different task areas and presented in Table 2.

The Field Health and Safety Officer is responsible for ensuring that adequate supplies of PPE are maintained on site; that they are properly stored, used, and disposed of or returned to service after use; and that equipment is maintained in proper working condition while on site.

Table 2 Task-Specific PPE Requirements	
Task	**PPE Requirements**
UXO, Radiation Surveys, EM-51 Surveys, and Field Investigations	General site working uniform as described in Section 6.1
Soil Sampling	Gloves, latex Steel-toe boots or shoes Eye protection

6.3 Reassessment of PPE Requirements

The levels of PPE presented above are based on indications of conditions that are expected or likely to be encountered. The protection program requires area radiation monitoring (as discussed in Section 7.0) to ensure the protection of project workers. When a significant change in activity or working conditions occur, the hazards will be reassessed. Some indicators of the need for reassessment are:

- change in job tasks during a work phase
- increase in level of radiation and/or contamination
- change in scope of work which affects the degree of contact with contaminants
- commencement of a new work phase that begins on a portion of the site not anticipated by this plan
- unusual odors or visual evidence of contamination

Any observation of a condition that may affect the effectiveness of prescribed PPE will be reported to the Field Operations Manager immediately. The Field Health and Safety Officer, in consultation with the Safety Officer and the Field Operations Manager, is responsible for reassessing the PPE requirements and making appropriate changes. Without modification of this HASP, changing PPE requirements based on monitoring activities will be limited to one upgrade to EPA Level C if contamination levels over significant portions of the site are encountered. DSHE's Installation Safety will be notified telephonically of any PPE upgrade.

EPA Personal Protective Equipment Modified Level D will consist of the following:

- Tyvek™ coveralls (or equivalent)
  Tyvek™ will be used depending upon the hazard presented. Tyvek™ is appropriate for hazards associated with particulates, including radioactive material.
- Inner gloves (Latex™ or equivalent) and outer gloves (Nitrile™ or equivalent)
- Tyvek™ or plastic boot or shoe covers

The levels of personal protection specified are adequate to prevent or substantially reduce contact with the contaminants expected to be encountered, based on the scope of the investigation. Should activities or conditions change so that workers would be subject to an increased potential for exposure to hazardous substances beyond that described in this plan, the appropriate sections of the Health and Safety Plan will be revised to address the new conditions and be approved by all original concurring activities as outlined in Section 1.2.

7.0 MONITORING

Monitoring is performed to identify potential hazardous substances in the work place. Monitoring is also used to quantify the hazards in the atmosphere to ensure the proper selection of personal protective equipment and work practices necessary to prevent or minimize worker exposure.

7.1 Monitoring Instruments

Monitoring instruments used during the investigation include use of radiation detection equipment. Monitoring equipment will be calibrated (or response checked as appropriate) daily to ensure reliability in the results. The Field Health and Safety Officer is responsible for carrying out the monitoring requirements, and will ensure the required monitoring equipment is on site, calibrated, and in proper working condition each day. All maintenance and calibration will be recorded in a permanent bound log book.

7.2 Monitoring Procedures

7.2.1 Site Radiation Monitoring

Background readings for radiation will be taken upon arrival at each site prior to commencing work activities. Readings will be obtained using μR Meter, a GM detector, or gas flow proportional counter. The μR Meter is used to determine the need for incorporating radiation dosimetry, while the GM detector or gas flow proportional counter will detect low levels of contamination and the potential contamination of equipment and individuals.

Monitoring results will be recorded in a field notebook. Results recorded will include, as a minimum, the date and time of the survey, the radiation levels observed, and the purpose of monitoring (e.g., initial background check, routine monitoring, etc.).

7.2.2 Task-Specific Monitoring

Task-specific monitoring and action levels are presented in Table 3; procedures and guidelines are described in the subsequent paragraphs.

Table 3 Task Monitoring and Actions		
Instrument	Readings	Action
Micro R Meter	>2 mrem/hr.	Evacuate area; notify APG HPO and Installation Safety; dosimetry is required
GM Detector or Gas Flow Proportional Counter	>2 x background	Access area to determine source of contamination or radiation. Determine if decontamination is necessary based on levels

During site activities and intrusive work, the media, personnel and equipment will be screened for the presence of radiological activity. Radiological materials represent an external exposure potential and an internal exposure potential. Inhalation, ingestion, and dermal contact hazards may exist. Monitoring will be performed using a gamma scintillometer (μR meter) and a thin window GM detector (pancake style) or gas flow proportional counter. Equipment and personnel will be surveyed prior to leaving the site, using a thin window, pancake style GM detector or gas flow proportional counter. Equipment will also be given a baseline survey to compare with subsequent survey results in order to determine whether contamination of the pieces has occurred. Contamination levels exceeding two times background levels will result in work ceasing in the area until the source and the nature of the activity is determined. If the levels exceed 2 mrem per hour or the potential exists that workers could receive 100 mrem over the duration of the project, the APG Radiation Protection Officer, the Installation Safety Division and GP Safety Officer will be notified for further assessment.

8.0 SITE CONTROL

The purpose of site control is to minimize the potential exposure or contamination of employees. This section includes descriptions of work zones, security, work practices, and site maps.

8.1 Site Work Zones

At this time the use of site work zones is not necessary. However if conditions change, the Project Manager, Field Operations Manager of the Field Health and Safety Officer can require use of the following zones. This section is presented here for completeness and if necessary, implementation.

To reduce the accidental spread of substances by workers from potentially contaminated areas to clean areas, zones will be delineated where different types of operations will occur. Generally, work sites will be divided into three zones:

- The *Exclusion Zone* (EZ) represents the area where contamination is either known or likely to be present or, because of activity, will provide a potential to cause harm to personnel. The exclusion zone is separate from the contamination reduction zone and is defined by a "hotline." The exclusion zone must be physically secured, fenced, or well-defined by landmarks.

- The *Contamination Reduction Zone* (CRZ) serves as a buffer between the Exclusion Zone and the Support Zone and is used for decontamination, sample preparation, temporary rest area, and emergency response.

- The *Support Zone* (SZ) is considered a non-contaminated or clean area. Non-contaminated support equipment is located in this zone, and traffic is restricted to authorized personnel. Contaminated clothing, equipment or samples are not allowed in the support zone, but are left in the contamination reduction zone until they are decontaminated or properly prepared for disposal.

The delineation of the zones will vary from site-to-site based on the type of sampling to be conducted and conditions encountered around the area. The zones will be established by the Field Health and Safety Officer or Senior Team Member prior to each sampling event. An appropriate CRZ will be established adjacent to the EZ, based on the amount of activity to take place and the conditions of the site (e.g., wind direction). All personnel will sample from the EZ.

The CRZ will be of sufficient size to cover the activities to take place and should be covered with plastic sheeting when appropriate. No unauthorized personnel will be allowed

in the EZ or CRZ, nor will any authorized person remain unnecessarily in the EZ. All access to the EZ will be via the CRZ.

8.2 Site Access/Site Security

The nature of the work conducted during this task requires notification of Range Control and Transonic Range personnel. All contractors will stay within the DUSA. Range Controls and Transonic Range personnel will be notified prior to arrival and leaving at the end of the day.

8.3 Site Communications

The primary means of external communication during field activities will be mobile and Post telephones. Internal communications among field personnel will include field radios and mobile telephones. Section 10.0 discusses communications during emergency situations.

8.4 Safe Work Practices

8.4.1 General

- At the beginning of each field work day, the Field Operations Manager will hold a field briefing. During the briefing potential hazards, PPE and other related site safety and operations issues will be discussed.
- In the event of a fire or explosion, the Emergency Operations Center shall be notified immediately by dialing 911. If 911 fails to respond, dial 272-0960.
- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area, or where there is a possibility for the transfer of contamination.
- Contact with potentially contaminated substances will be avoided by not walking through puddles, mud, etc. and not kneeling, leaning, or sitting on equipment or the ground. Monitoring equipment will not be placed on a potentially contaminated surface.
- Spillage and splashing of contaminated materials should be avoided, and prevented as far as humanly possible.

8.4.2 Buddy System

The purpose of the buddy system is to provide quick assistance to other employees in the event of an emergency. Site activities will be conducted with a buddy who is able to:

- provide the partner with assistance
- observe the partner for signs of chemical or physical stress
- periodically check the integrity of the partner's protective clothing
- notify others if emergency help is needed

8.5 Site Mapping

Figure 4 depicts the DUSA.

9.0 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. This section describes the minimum policy of decontamination for the proposed project. Requirements are based on the EPA Standard Operating Safety Guides, June, 1992. It is not anticipated that personnel or equipment will be contaminated. If contamination is detected dry methods of decontamination will be used.

Personal protective clothing (e.g., gloves) and other solid waste (e.g., disposable equipment) generated by field activities will be surveyed for contamination and disposed as radioactive waste if found contaminated. If not contaminated, articles and PPE will be bagged for disposal prior to exiting the DUSA at the end of each work day. Contaminated articles will be bagged and turned in to the APG HPO for disposal.

10.0 EMERGENCY RESPONSE PLAN

The nature of the activities (i.e., walking the site and soil sampling) and the historical use of the site makes emergencies involving UXO a concern. Emergencies, by their nature, occur quickly, unexpectedly and require immediate response. During sampling activities at a hazardous waste site, such as the DUSA site, an emergency may be as limited as a worker experiencing protective equipment failure or as large as an explosion involving hazardous materials. The complexity of these potential emergencies means that advanced planning and thorough preparation is essential to protect worker health and safety.

This section of the HASP addresses the planning and response to potential emergencies that could occur during the investigations at the site.

10.1 Emergency Personnel and Telephone Numbers

During the investigation, the Field Operations Manager will serve as the on-site emergency coordinator and will be responsible for responding to and correcting emergency situations. Off-site organizations are available to provide assistance during a site emergency. Off-site support organizations include those listed in Table 4.

Table 4. Emergency Organizations and Numbers

Organization	Telephone Number
Fire, Police, Ambulance	"911", or 272-0960 from a commercial/cellular phone if 911 fails to respond.
Administrative Numbers	
APG Health Physics Office	278-9025
Kirk U.S. Army Health Clinic, Aberdeen Area	278-3332
Installation Safety Division	278-4756, 4757
Range Control	278-2246, 2256
Transonic Range	278-2242

10.2 Emergency Recognition and Prevention

All personnel involved in the investigation will read the HASP prior to commencing work. Since the investigation team is small, emergency response procedures must be fully understood by all project personnel because there is not a dedicated response team. Personnel will be familiar with potential hazards and their recognition, communication procedures and signals, evacuation routes, and routes to the nearest medical facility.

A briefing, informing project personnel of site-specific field operations and potential hazards, will be conducted at the start of each work day by the Field Operations Manager. All visitors to the DUSA site will be briefed by the Field Operations Manager concerning emergency procedures and site hazards prior to entering the site and will sign the HASP.

10.3 Emergency Equipment

Large pieces of emergency equipment (e.g., fire engines, rescue equipment, etc.) are maintained at various locations around APG and may be summoned through the numbers listed in Section 10.1. Smaller pieces of equipment to control fires and other emergencies will be conspicuously maintained on site. This equipment will include:

- one adequately stocked first-aid kit
- one emergency eyewash kit or portable eyewash station
- one B/C type dry chemical fire extinguisher, minimum rating 2A-10

10.4 Emergency Communications

The primary means of off-site communications by field personnel during field activities will be by mobile telephone which will be kept on site.

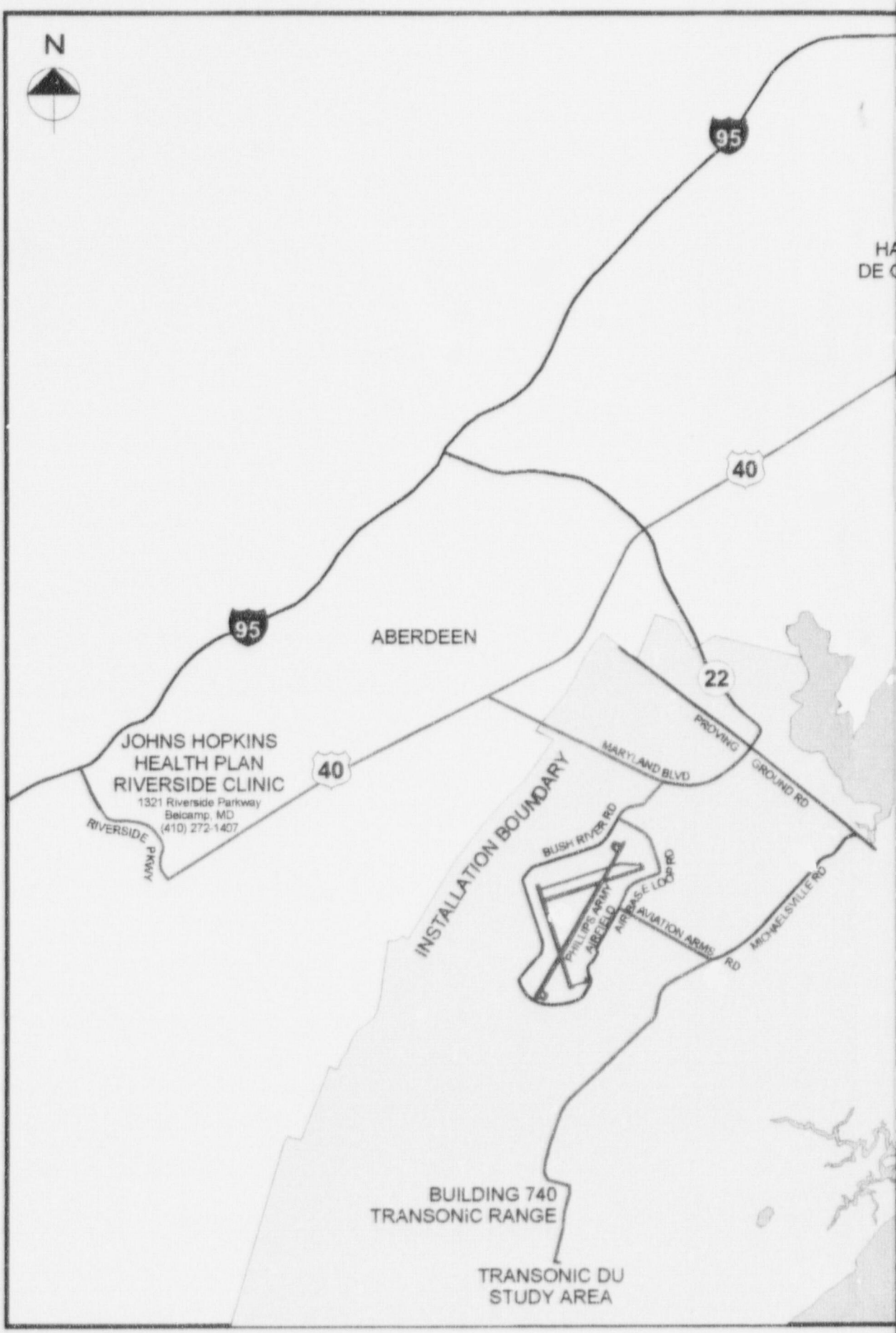
Internal communications by field personnel will include verbal communication; a whistle or car horn will be used as a backup system or in case of an emergency. Notification to field personnel that an emergency is in progress will be given by voice, radio, three blasts on a whistle, or air or vehicle horn. Upon hearing the emergency notification, personnel will immediately and safely cease operations and proceed to the designated assembly point at building 740G.

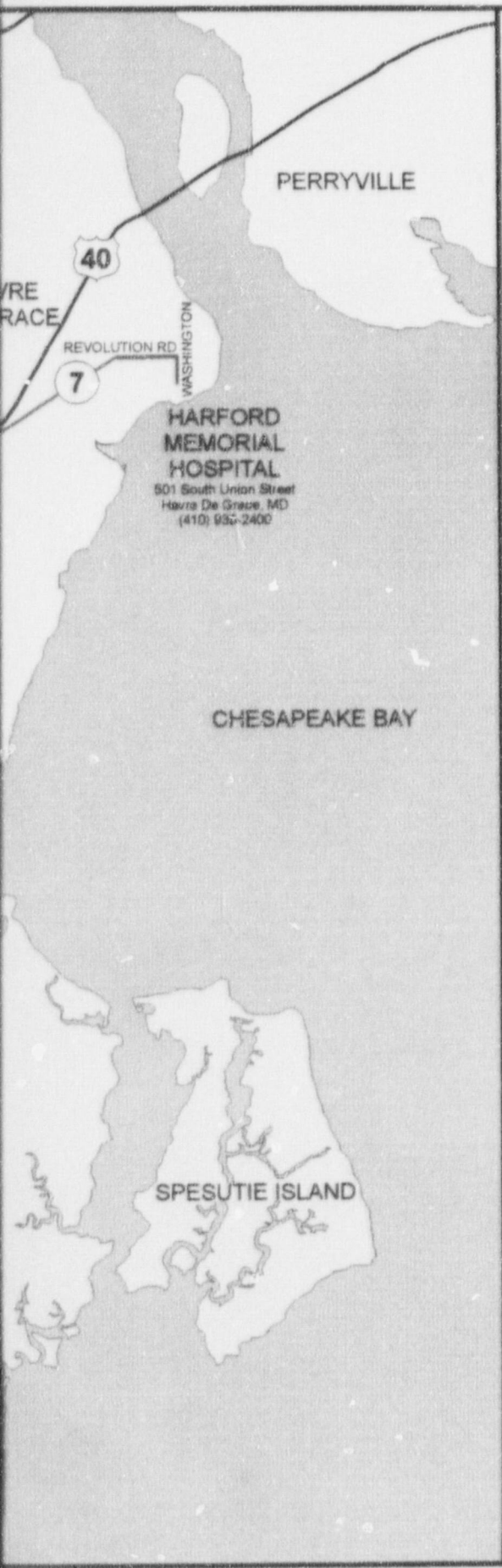
10.5 Evacuation Routes

Evacuation procedures for any emergency will be by vehicle using the paved roads. Figure 5 shows the evacuation routes from the DUSA.

Personnel requiring a doctor's care will be transported immediately to one of the medical facilities listed in Table 5. Figure 5 illustrates the most direct routes to the clinic and hospital. Johns Hopkins Riverside is open Monday through Friday, 8:30 a.m. - 4:30 p.m. and should be called in advance. Emergencies during off hours, i.e., early morning and weekends, should go directly to Harford Memorial Hospital.

This Page is Intentionally Blank


N
95
40
95
ABERDEEN
22
JOHNS HOPKINS
HEALTH PLAN
RIVERSIDE CLINIC
1321 Riverside Parkway
Belcamp, MD
(410) 272-1407
40
RIVERSIDE PKWY
MARYLAND BLVD
PROVING GROUND RD
INSTALLATION BOUNDARY
BUSH RIVER RD
PHILLIPS ARMY AIRFIELD
AIRBASE LOOP RD
AVIATION ARMS RD
MICHAELSVILLE RD
BUILDING 740
TRANSONIC RANGE
TRANSONIC DU
STUDY AREA



L E G E N D

- Aberdeen Proving Ground
- Major Roads
- Evacuation Route

APERTURE
CARD

Also Available on
Aperture Card

9903160350-01

6700 Alexander Bell Drive
Columbia, MD 21046

(800) 395-4516

GENERAL PHYSICS CORPORATION

CLIENT / SITE: Aberdeen Proving Ground
Aberdeen Area

TITLE:

Evacuation Routes

DRAWN BY:	CHECKED BY:	DATE:	FIGURE:
B. JOYCE	B. PARRISH	10/24/95	5

Table 5. Local Area Medical Facilities	
Medical Facility	**Directions**
Johns Hopkins Health Services at Riverside 1321 Riverside Parkway Belcamp, Maryland 21017 (410) 272-1407	Exit area, turn right onto Michaelsville Rd. Left on Aviation Arms Rd. Right on Airbase Loop Rd. Right on Bush River Rd. Left onto Maryland Blvd exit post. South on Route 40 to Riverside Parkway West; Right into Riverside Plaza - Clinic on right at end of Plaza On weekends Gate 25 is closed (Bush River Road), or if Gate 25 is otherwise closed. Exit area, turn right onto Michaelsville Rd. Left onto West Berry Rd. Left onto Colleran Rd. Left onto Aberdeen Rd. Left onto Maryland Blvd exit post. South on Route 40 to Riverside Parkway West; Right into Riverside Plaza - Clinic on right at end of Plaza
Harford Memorial Hospital 501 South Union St. Havre De Grace, Maryland 21078 (410) 939-2400	Exit area, turn right onto Michaelsville Rd. Left on Aviation Arms Rd. Right on Airbase Loop Rd. Right on Bush River Rd. Left onto Maryland Blvd exit post. Exit north onto Route 40 to Havre De Grace. Follow Route 7 into Havre De Grace onto Route 7. Right on Revolution. Right on Union St.- Hospital on left between Union and Washington On weekends Gate 25 is closed (Bush River Road), or if Gate 25 is otherwise closed. Exit area, turn right onto Michaelsville Rd. Left onto West Berry Rd. Left onto Colleran Rd exit Gate 13. Left onto Aberdeen Rd. Left onto Maryland Blvd exit post. Exit north onto Route 40 to Havre de Grace. Follow Route 7 into Havre de Grace. Right on Revolution St. Right on Union St. Hospital on left between Union and Washington

10.6 Emergency Procedures

10.6.1 Life-Threatening Emergencies and Injuries Requiring Ambulance Transport

For life-threatening medical emergencies, injuries requiring ambulance transport and suspected contamination by an unknown chemical or biological agent, APG ambulance and emergency personnel will be notified immediately (dial 911, if no response, dial 272-0960 on a commercial phone). If the patient's condition permits, they will be moved upwind from any known contaminated sites, while awaiting response personnel. Decontamination procedures may be implemented as appropriate. Response personnel will be provided with clear communication regarding the nature of any injuries and the type of contamination, if known.

10.6.2 Personal Injury in the Exclusion Zone or the Contamination Reduction Zone

Upon an injury in the EZ or CRZ, other workers in the area will be signaled for evacuation (three blasts). Personnel will assemble upwind in the CRZ and await instructions. The victim will be removed to the "hotline" (physical condition permitting) and decontaminated to the extent possible prior to movement to the SZ. Emergency response personnel will be notified as needed and initiate first-aid procedures. No personnel will re-enter the CRZ or EZ until the cause of the injury has been determined and the hazard removed, if appropriate. The Field Operations Manager will notify personnel when re-entry is allowed.

10.6.3 Personal Injury in the Support Zone

Injuries in the SZ will receive appropriate first aid or medical attention. If needed, emergency response personnel will be notified. The Project Manager and Field Health and Safety Officer will be notified to evaluate the effect of the injury on site operations and take action. At least 2 personnel on site will be first aid/cpr qualified.

10.6.4 Fire or Explosion

The evacuation signal will be sounded upon notification of a fire or explosion and all personnel will assemble at the CRZ or other designated area. The APG fire department will be notified (dial 911; if no response, dial 272-0960 on a commercial phone). If the fire is small and does not involve any additional hazards (e.g., toxic chemicals), the fire will be extinguished using the portable fire extinguisher. If the fire is large, the site will be evacuated. If in doubt, evacuate site.

10.6.5 Protective Equipment Failure

If protective equipment is necessary and a failure or alteration of protective equipment is noticed, all work will be stopped immediately and the area will be evacuated (with your buddy, if "buddy" system is in use). Re-entry will not be permitted until the equipment has been repaired or replaced and permission is obtained from the Field Operations Manager.

10.6.6 UXO Discovery

If UXO is discovered during on site work, all work will be stopped immediately and all personnel will be evacuated to a remote location upwind, if possible. Emergency response personnel will be notified immediately (dial 911; if no response, dial 272-0960 on a commercial phone).

APG emergency response units (i.e., Fire Department) will assume control of the incident upon their arrival. If calls are made to 911, the 911 operator will route the call to the

proper switchboard once the site has been identified. If UXO is found in an Army Test Center (ATC) area, contact Range Control at 278-2246 or 2256.

10.7 Emergency Reporting

All emergencies shall be logged by the Field Operations Manager in the project field logbook. Additionally, all work-related injuries and illnesses will be immediately reported to the Installation Safety Division at 278-4756 or 4757.

11.0 HAZARD COMMUNICATION

Employees engaged in activities that have the potential for exposure to chemical substances will participate in a comprehensive education and training program consistent with the requirements of the Hazard Communication Standard, 29 CFR 1910.1200. The program will present employees engaged in these operations with the knowledge required to work safely in these environments. The program will be designed to ensure that employees are knowledgeable about the hazards and appropriate safety precautions.

General Physics' Hazard Communication Program is documented in the company's Safety and Health Program Plan. A copy of this plan is maintained on post with the Installation Safety Division.

APPENDIX A

UXO CONTRACTOR SITE OPERATIONS AND SAFETY PLAN
AND
SITE SPECIFIC ADDENDUM

Rec. 17 OCT 95

HUMAN FACTORS APPLICATIONS, INC
ORDNANCE & EXPLOSIVE WASTE REMEDIATION

UNEXPLODED ORDNANCE (UXO) SITE OPERATIONS

WORK PLAN

AND

SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

CONTRACT # DAAD05-93-D-7053

CLIENT NAME: U.S. ARMY, ABERDEEN PROVING GROUND, MARYLAND

PRIME CONTRACTOR: GENERAL PHYSICS CORPORATION

PROJECT TITLE: UXO SUPPORT FOR TRANSONIC RANGE, ENVIRONMENTAL SERVICES PROJECT SITE

PROJECT LOCATION: ABERDEEN AREA OF ABERDEEN PROVING GROUND

DATE PREPARED: 10-16-95 PREPARED BY: Marcus T. Reed
Marcus T. Reed

SAFETY REVIEW DATE: 17 OCT 95 APPROVED BY: For Robert L. Crowe
17 OCT 95
Chief, Installation Safety Division
Directorate of Safety, Health,
and Environment

PROPRIETARY DATA NOTICE

PROPRIETARY INFORMATION - This document contains Human Factors Applications, Inc. proprietary information. The information contained in this document includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed -- in whole or part -- for any purpose other than to evaluate this document. In conjunction with the contract award for this project, the Government shall have the right to duplicate, use, or disclose their data to the extent provided in the contract. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. Disclosure or distribution of the information contained in this document to other private corporations or individuals is prohibited by law. All of the information in this document is subject to this restriction. (1988 DEC)

TABLE OF CONTENTS

SECTION 1. WORK PLAN

1.0 INTRODUCTION I-1

1.1 PROJECT I-1

1.2 BACKGROUND I-1

2.0 SITE CONDITIONS II-1

2.1 PHYSICAL SETTING II-1

2.2 RESULTS OF PREVIOUS INVESTIGATIONS II-1

3.0 UXO OPERATIONS III-1

3.1 UXO SITE SURVEY III-1

3.2 FOLLOW-ON UXO SERVICES III-5

3.3 UXO DENSITY REPORT III-5

4.0 MANAGEMENT IV-1

4.1 STAFFING IV-1

4.2 PROJECT SCHEDULE IV-1

SECTION 2. SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

5.0 SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP) V-1

5.1 REGULATORY REQUIREMENTS V-1

5.2 SAFETY AND HEALTH POLICY V-1

5.3 RESPONSIBILITIES V-1

5.4 TRAINING V-3

5.5 MEDICAL SURVEILLANCE V-4

5.6 DOCUMENTATION V-5

5.7 PERSONNEL PROTECTIVE CLOTHING V-6

5.8 GENERAL SAFE WORK PRACTICES V-6

5.9 EMERGENCY SERVICES V-8

5.10 EMERGENCY SITE RESOURCES V-9

5.11 AMMUNITION COLOR CODING V-12

SECTION 3. DETECTION EQUIPMENT

6.0 DETECTOR CAPABILITIES VI-1

6.1 DETECTORS VI-1

SECTION 4. ENVIRONMENTAL PLAN

7.0 ENVIRONMENTAL PLAN VII-1

7.1 OVERVIEW VII-1

7.2 SITE CONDITION SURVEY VII-1

7.3 ENVIRONMENTAL PROTECTION VII-2

7.4 CONTAMINATION CONTROL MEASURES VII-3

7.5 SPILL CONTROL VII-3

7.6 POSTUXO OPERATIONS CLEANUP VII-3

SECTION 5. QUALITY CONTROL PLAN

8.0 QUALITY CONTROL PLAN VIII-1

8.1 QUALITY CONTROL VIII-1

8.2 EQUIPMENT VIII-1

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

8.3 ON-SITE INSPECTIONS VIII-1

8.4 EXCAVATIONS VIII-1

8.5 POSTDETONATION CRATER INSPECTIONS VIII-1

8.6 RANDOM SITE UXO QC CHECKS VIII-2

SECTION 1.

WORK PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1.0 INTRODUCTION

1.1 Project - Human Factors Applications, Inc. (HFA), has been contracted by General Physics Corporation, to provide unexploded ordnance (UXO) services for the Transonic Range environmental project site on the Aberdeen Area of Aberdeen Proving Ground (APG), Maryland. In support of this project, HFA will provide the following services:

A. UXO Surface/ Subsurface Survey Searches - Prior to any environmental activities taking place on the Transonic Range Project Site, HFA will perform a surface/ subsurface search of approximately 12.5 acres.

B. Follow-On UXO Services - The follow-on services listed below will be performed after the UXO Surface Survey search has been completed.

- All excavations (trenches, man holes, footers, auger holes, monitoring wells, soil sampling, etc.) will be rechecked with magnetometers at each 2-foot increment of excavation, i.e. at the 2', 4', 6', 8', 10' levels.

This UXO Work Plan (WP) and Safety, Health, and Emergency Response Plan (SHERP) describes the overall scope of the project and the general methodology to be used.

1.2 Aberdeen Area Background - The Aberdeen Area is the main Aberdeen Proving Ground complex. This area has been used extensively for testing of both foreign and domestic conventional munitions. As a result of the munitions testing, this area is heavily contaminated with unexploded ordnance (UXO). A number of tenant organizations employing both civilian and military personnel are located on the Aberdeen Area. The installation facilities include office/administrative areas, military family housing areas, military school facilities, laboratories, training areas and range/test areas. Many different military operations are presently carried out on the Aberdeen Area.

1.2.1 Project Site Background - The Transonic Range is used for testing of high velocity weapons.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

2.0 SITE CONDITIONS

2.1 Physical Setting - The Transonic Range is located within the active firing ranges on the Aberdeen Area of Aberdeen Proving Ground. The Transonic Range consist of mixed woods, brush, and grass. The Government has assigned hazard Category II to this site. There is a possibility that UXO/HTRW could be encountered on this site.

2.2 Results of Previous Investigations - HFA previously searched sites throughout the Aberdeen Area. All types and sizes of UXO have been found to include mortars, projectiles, and WWI bombs. It is virtually impossible to predetermine the types or quantities of UXO or non-UXO materials that could be located during HFA UXO operations on the project site.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

3.0 UXO OPERATIONS

3.1 UXO Site Survey - The following is a general outline of the HFA UXO services that may be required to support the Transonic Range Project.

A. All HFA UXO activities will be coordinated with the following organizations and activities:

1. General Physics Corporation (Mr. Bruce Parrish, [410] 290-2512)
2. Aberdeen Area Environmental Project Sites - DSHE Edgewood Safety Office (Ms. Pat Barber / Mr. Randy Rexrode, [410] 671-4839/3660)
3. U.S. Army Tech Escort (EOD Section, [410] 671-4381/4383)
4. Ordnance & Explosive Waste Remediation, Human Factors Applications, Inc. (Mr. Sam Hooper, [301] 705-5044)

B. Only qualified U.S. Military Explosive Ordnance Disposal (EOD) personnel and HFA UXO personnel will be permitted in the project area during UXO search or excavation activities. When and if required, temporary barricades will be used to control access to the project site. The dates and time of restricted access to the project area in conjunction with the placement of the barricades will be coordinated through the APG Safety Offices.

1. The Aberdeen Area Safety Office has issued instructions that all UXO services on the Aberdeen Area are to be performed in accordance with the following ordnance avoidance requirements:

   a. Construction Sites - All areas of disturbance on a construction site are to receive a surface and subsurface search for UXO. Because the building site and all of the associated construction areas are in fixed locations, there is no latitude for moving the area to avoid ordnance.

   b. Utility Routes, Trenches, and Fencing Projects - These projects follow preestablished lines that have been surveyed. These projects will receive a surface and subsurface search for UXO as they are laid out.

   c. Designated Access Routes - On some projects, the access routes selected by the Contracting Officer (CO) or Contracting Officers Representative (COR) will have to be searched as they are laid out. If heavy surface and subsurface contamination is encountered on the designated route and a less contaminated route is available, this alternative can be submitted to the CO or COR. If the CO or COR states that the designated route cannot be moved to the less contaminated route, the more heavily contaminated route will have to be searched.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

d. Undesignated Access Routes - Some projects will allow for selection of less contaminated access routes. The access route may be for a footpath or for vehicle access.

(1) Vehicle Access Routes - Vehicle access routes are 15 feet in width. This allows for most vehicles to have access to the site. Using the method of selecting the least contaminated access route involves several considerations.

(a) Turning Radius of the Vehicle - In some cases, the turning radius of the vehicle may be very narrow and a route with tight turns may be acceptable. If the vehicle requires a wide turning radius, sharps turns in the access route may not be acceptable.

(b) Terrain Features - Some ares may have gullies, streams, or fallen trees which will restrict the access route selection.

(2) Footpaths - The footpath is the easiest access route to meet the ordnance avoidance requirements. The paths must be well marked and all personnel using them must be advised that they are not to enter areas outside of the marked footpath.

(3) Due to the time constraints for each project, on the sites where the access routes are undesignated, a quick visual and magnetometer scan will be performed to identify which route is the best route into the site. If the site is uniformly contaminated with surface and subsurface objects, the most direct route into the site will be searched.

e. Monitoring Well/Soil Boring Sites - Due to the size of the drill rigs used to augur the monitoring wells/soil boring sites, a radius of 50 feet around the drill location most be searched and cleared of UXO to allow the rig to maneuver on the site.

f. If while searching an access route or any other type of UXO search area, a UXO is observed on the surface in an area that is inside or outside of the search area, ***this items must be marked and immediately reported.***

NOTE: ***The 100 meter exclusion area may not be obtainable due to occupied buildings or other structures where the government has elected not to shut down operations. If the 100 meter exclusion area cannot be obtained, it will be noted in the Daily Operations Journal.***

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

C. In accordance with 29 CFR Part 1910.120, paragraph (d)(2) "Buddy System,", the HFA UXO search/excavation team (consisting of two UXO Specialists of which one holds a Master EOD rating) will conduct electronic surface and subsurface search of the project site. During UXO operations a 100 meter radius exclusion area will be in effect during intrusive UXO activities. During intrusive UXO activities, no UXO/non-EOD personnel will be permitted within the 100 meter exclusion area. If anyone enters the exclusion area, all UXO intrusive activities will be halted. In conjunction with the UXO search, the HFA UXO team will perform the following steps:

1. Identify and mark the boundaries of the project site areas within which the UXO Surface Survey search will be performed. The boundaries will be marked with orange survey markers.

2. Using visual \ electronic surface and electronic subsurface location techniques, and excavation as required, locate and identify UXO within the boundaries of the project sites. When a UXO is located, (depending on the UXO category, the following actions will be carried out:

   a. Explosive, Chemical, Propellant, or Pyrotechnic Loaded UXO - The location of the UXO will be marked with a yellow survey marker. The client project manager and on-site Government representative will be notified of the presence of UXO. The following UXO reporting procedures will be utilized for each of the designated areas:

      (1) All UXO will be immediately reported to the Aberdeen Area Emergency Center by dialing 911 from a Government, commercial, or cellular telephone. If 911 is dialed from a commercial telephone or cellular phone, the call will go into the Harford County Emergency Center, the area of UXO services must be identified (e.g. Aberdeen Area of APG) and the Harford County 911 operator will reroute call to the proper switchboard. The location of the UXO will be provided, and HFA personnel will standby until such time as the Aberdeen Area authorities assume responsibility of the site.

NOTE: ***If the project site is on an ATC range/test area, the APG Emergency Center will not be notified. All UXO located in ATC areas will be reported to ATC Range Control.***

ATC Range Control - Notify by radio or by dialing Government 3-2792 or Commercial 278-2792

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

An administrative telephone call will be made to the APG Safety Office Government 3-4756/4757 or commercial 278-4756/4757 and the Edgewood Safety Office Government 5-3660/3157 or commercial 671-3660/3157.

b. Nonexplosive loaded ordnance components - These items will be collected and stored in a designated location for pick up by U.S. Army Tech Escort EOD personnel at their convenience. Items in this category would include but not be limited to the following types of ordnance/residue:

(1) Armor Piercing (AP) projectiles
(2) Empty ejection munitions
(3) Spent rocket motors (when found separated from warheads)
(4) Nonexplosive loaded training munitions

c. Miscellaneous metallic debris - These items will be collected and stored in a designated location for pick up by Government personnel at a later date.

3. Record the location of all UXO and UXO components in a log book.

D. All necessary "ground penetrating" magnetometry & electromagnetic pulse induction search equipment (29 CFR Part 1910.120, paragraph (j)(1)(ix), "Ground Penetrating System"), hand excavation equipment, and other materials required to conduct a surface/subsurface UXO survey will be provided by HFA.

E. HFA UXO personnel requirements:

NOTE: During all hazardous operations related to searching for UXO or any hazardous UXO/explosive-related service, a minimum of two (2) qualified UXO Specialists (29 CFR 1910.120, paragraph (d)(2) "Buddy System"); one (1) of whom is a Master rated EOD technician will be required to perform these services.

NOTE: Most of the projects performed by HFA UXO on the Aberdeen Area of APG are performed by a two (2) person UXO team. The Project Leader also acts as the UXO Site safety Officer. If requested or directed to do so by the Government or prime project contractor, additional teams will be provided to work on site. If due to circumstance beyond the control of HFA the scope of the project is increased and the hazards associated with the site are also heightened, a full time UXO Site Safety Officer may be required.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1. Search and marking operations - Two teams consisting of one (1) Project Leader/UXO Site Safety Officer (Master EOD rated) and three (3) UXO specialist
2. UXO excavation operations - Two teams consisting of one (1) Project Leader/UXO Site Safety Officer (Master EOD Rated) and three (3) specialist

3.2 **Follow-On UXO Services** - The following HFA UXO services are required to support the soil sampling requirements in this areas.

- Perform magnetometer subsurface checks for UXO at each of the sampling sites.
- Assist in the collecting of the soil samples at each of the sampling sites
- Other services as deemed necessary by General Physics or the Government

3.3 **UXO Density Report** - Upon completion of the basic UXO search operation, a copy of the UXO Density Report will be provided to the client and the Aberdeen Safety Office.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 2.

SAFETY, HEALTH AND EMERGENCY RESPONSE PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

4.0 MANAGEMENT

4.1 **Staffing** - This section contains a listing of project staff personnel as related to this project.

Director of Operations - Samuel J. Hooper Sr.: Mr. Hooper is responsible for the effective day-to-day management of the project staff; direct communication and liaison with client; technical approach and review of deliverables; management of resources, schedules, and budgets; and coordination among the general and technical support functions.

Project Leader - To Be Determined: This individual is responsible for the on-site management of UXO services and site UXO safety. His responsibilities include coordination and direction of all UXO site operations.

4.2 **Project Schedule** - UXO services will be performed in accordance with the posted client's schedule of operations.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

5.0 Safety, Health, and Emergency Response Plan (SHERP)

5.1 Regulatory Requirements - Occupational Safety and Health Administration (OSHA) standards 29 Code of Federal Regulations (CFR) 1910 and 1926 apply to work performed under this Safety, Health, and Emergency Response Plan (SHERP). Specific sections of 29 CFR part 1910 that apply include 1910.120, Hazardous Waste Operations and Emergency Response; 1910.134, Respiratory Protection; 1910.1000, Air Contaminants; 1926.602, Material handling equipment; and 1926.652, Specific Trenching Requirements. Additional U.S. Army requirements governing this work are included in the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385-1-1) and the U.S. Army Material Command (USAMC) Safety Manual, AMC-R 385-100.

5.2 Safety and Health Policy - The purpose of this SHERP is to protect workers and other on-site personnel, the public, and the environment from hazards associated with site activities and potential site contaminants. This SHERP includes preventive and protective measures against health, physical, fire, and explosion hazards that may exist or occur during UXO search operations. It is the policy of HFA management and a contract requirement that all work be performed according to this SHERP. All HFA personnel and subcontractors will be familiar with the SHERP and will adhere to the SHERP at all times.

5.3 Responsibilities - Responsibilities of the Director of Operations, HFA UXO Safety Officer, UXO Project Leader, and UXO crew will be in accordance with HFA standard practices. Other contractors for this project are subject to the same requirements and responsibilities as field team members.

5.3.1 Director of Operations - Samuel J. Hooper, Sr. - The Director of Operations is responsible for overall project safety. The responsibilities of the Director of Operations include:

A. An effective and comprehensive SHERP is prepared for the project;
B. Adequate and appropriate safety training and equipment are available for project personnel; and
C. Project personnel are medically monitored and qualified for their involvement in the project.
D. Categorizing and identifying the hazards and associated risks for the conditions and activities to be encountered on-site; and
E. Reviewing reports of incidents related to project activities.

5.3.2 UXO Safety Officer - (To be determined) (additional duty for UXO Project Leader on this project) - The UXO Safety Officer is responsible to the Director of Operations for the health and safety of personnel during site activities. Responsibilities of the UXO Safety Officer include:

A. Implementing all safety procedures and operations on-site;
B. Updating equipment or procedures based upon new information gathered during the

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

site inspection;

C. Upgrading or downgrading the levels of personnel protection based upon-site observations;

D. Determining and posting locations and routes to medical facilities (including poison control centers) and arranging emergency transportation to medical facilities (as required);

E. Notifying (as required) local public emergency officers (i.e., police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members;

F. Ensuring that at least one member of the field team is available to stay behind and notify emergency services if the UXO Project Leader must enter an area of maximum hazard, or entering this area only after notifying emergency services (Emergency Center);

G. Observing work party members for symptoms of on-site exposure or stress; and

H. Arranging for the availability of on-site emergency medical care and first aid as necessary.

The UXO Safety Officer has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace or causes significant adverse impact to the environment.

The UXO Safety Officer has experience supervising personnel and functioning as an UXO Safety Officer at hazardous waste sites. He has completed the site supervisor training required under 29 CFR 1910.120

5.3.3 **UXO Project Leader - To Be Determined** - The UXO Project Leader is responsible to the Director of Operations for all operational activities on-site, as well as for all safety and health practices by site personnel. The responsibilities of the UXO Project Leader include:

A. Ensuring and enforcing compliance with the SHERP;

B. Controlling site entry of unauthorized personnel or coordinating with local law enforcement agencies or state authorities to limit site access;

C. Coordinating site activities so that they are performed in an efficient and safe manner consistent with the SHERP;

D. Enforcing the buddy system on-site; and

E. Ensuring the ready access and availability of all safety equipment.

5.3.4 **UXO Crew Member(s) - To Be Determined** - HFA employees are responsible to the UXO Project Leader and the UXO Safety Officer for all activities on-site. The responsibilities of UXO survey crew member(s) include:

A. Complying with all aspects of the SHERP, including strict adherence to the buddy system;

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

B. Obeying the orders of the UXO Project Leader and the UXO Safety Officer; and
C. Notifying the UXO Project Leader or UXO Safety Officer of hazardous or potentially hazardous incidents or working situations.

5.3.5 Site Visitors - Visitors and governmental agency representatives are required to comply with all provisions of the SHERP and may be responsible to the UXO Project Leader and UXO Safety Officer. The responsibilities of site visitors include:

A. Complying with all aspects of the SHERP, including strict adherence to the buddy system; and
B. Obeying the orders of the UXO Project Leader and UXO Safety Officer.

5.3.6 Client Contacts - (see paragraph 3.1.A.) - The client contacts are the individuals serving as the primary liaison between the clients and the HFA Director of Operations/UXO Project Leader. All HFA project personnel and subcontractors are directly or indirectly responsible to the client. However, the client contact must comply with all applicable portions of the SHERP when in areas covered by its provisions. In case of immediate on-site difficulties, the Ordnance & Explosive Waste Remediation Office (Telephone (301) 705-5044) will be contacted.

5.4 Training - In accordance with HFA standard practices, all HFA site personnel will have completed training required by 29 CFR 1910.120. All HFA site personnel working on the site investigation will have completed an extensive training course and have worked at least three (3) days at a hazardous waste site. The course, designed to meet training requirements of 29 CFR 1910.120, is taught using in-house expertise. The course consists of an initial 40-hour session and annual refresher courses of eight (8) hours. The UXO Project Leader will have completed an additional eight (8) hours of waste site management training. The following topics are covered in the HFA Hazardous Waste/Materials Site Investigations Training, Annual Refresher, and Supervisor Training Courses:

<u>Hazardous Waste/Materials Site Investigations Training Course</u>

Safety plans
Fundamentals of industrial hygiene
Properties of hazardous materials/compatibility testing, shipping, and handling of samples/chain of custody
Levels of personnel protection
Hotline systems
Decontamination operation
Emergency response
Air-purifying respirators and fit-testing air-supplying respirators
Field exercise, air-purifying respirators, and self-contained breathing apparatus (SCBA), levels A, B, and C
Field exercises (site zones and sampling operations)

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

Confined space entry
Review of regulations
Engineering controls

Annual Refresher

Regulations review
Properties of hazardous materials
Safety plans
Levels of protection
Review of instruments
Transportation
Respiratory protection
Site control/decontamination
Emergency preparedness/prevention
Review and quiz

Supervisor Training Course

Site safety requirements and responsibility
Medical monitoring program
Respiratory protection program
Air monitoring
Regulations--OSHA/Resource Conservation and Recovery Act (RCRA)/Superfund Amendments and Reauthorization Act (SARA), and Hazard Communication
Shipping and handling
Costs of hazardous site work
Problems encountered during site work

Site-specific training will be given by the UXO Project Leader or HFA UXO Safety Officer to inform the UXO team members of site-specific hazards and hazardous activities. Training will be provided prior to site entry, each morning before work begins, and after all project field activity has been completed.

Specific UXO related site safety training will be provided by HFA to all other contractor personnel working on this site. No personnel will be permitted to work on this project site until they have received this training.

5.5 **Medical Surveillance** - All HFA site personnel will be subject to the HFA medical surveillance program for hazardous waste site workers. This program was designed in accordance with the recommendations found in the National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Operations, and meets the requirements of 29 CFR 1910.120. Physician

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

statements of findings are kept in employees' personnel files and will be available for review. The following examinations are covered in the Medical Examination and Monitoring Program.

A. Basic physical exam
B. Heart status and functions (electrocardiogram {EKG})
C. Chest X-ray (Roentgenogram posterior-anterior)
D. Pulmonary function-forced vital capacity, forced expiratory volume at 1 second and reserve volume
E. Blood-full SMAC Series

    1. Hemoglobin-cell counts, protein levels
    2. Acetylcholinesterase activity
    3. Heavy metals
    4. PCB in serum

F. Liver function-full enzyme profile
G. Renal function-blood, urea, nitrogen (BUN), creatinine, creatine/ Creatinine ratio, lipoprotein count and differential, uric acid
H. Urinalysis
I. Audiometry-audio spectrum response of ear
J. Eye-physical condition, visual acuity.

5.6 Documentation - Personnel and environmental monitoring will be made part of the permanent project record. Monitoring records will be kept in accordance with 29 CFR 1910.20 and standard HFA practices. Training and medical records for HFA personnel are available for inspection as required. Subcontractors are required to have training and medical records available for inspection as required by HFA and client representatives.

5.6.1 Acknowledgement - All workers and site visitors must read, understand, and agree to comply with all provisions of this WP/SHERP prior to entering into the exclusion zone during intrusive UXO activities. Each worker and site visitor must be briefed and have read this document before they will be allowed on the site. Acknowledgement and compliance with this requirement is indicated by each individual's signature on the HFA "ON-SITE SAFETY MEETING" form in the Daily Operations Journal. ***NO ONE WILL BE ALLOWED ON ANY HFA UXO WORK SITE DURING INTRUSIVE OPERATIONS WHO HAS NOT MET WITH THESE REQUIREMENTS.*** The following guidance will be used to determine who is required to read and comply with this WP / SHERP:

A. All personnel entering the work site exclusion area (100 meter radius of the intrusive activity) where intrusive UXO activities are taking place, must have reviewed the WP / SHERP and must sign the HFA "ON-SITE SAFETY MEETING FORM" in the Daily Operations Journal. Examples of personnel required to do so are listed below:

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1. All HFA UXO technicians.
2. Well drillers or environmental technicians taking samples in conjunction with bore hole magnetometer operations.
3. Industrial health personnel monitoring UXO excavations.
4. Any personnel such as, Government inspectors, safety personnel, environmental personnel, Government personnel, contractor or subcontractor personnel, etc., who have a valid need for entry on to the site.

NOTE: ***If someone insists on entry to the work site exclusion area and refuses to comply with this requirement, all site operations will be halted. For sites on the Aberdeen Area, the APG Safety Office will be notified by calling 278- 4756/4757. UXO intrusive operations will not be resumed until such time this issue is resolved.***

B. Personnel with a valid need to enter the site during magnetometer search and marking operations, during which no intrusive UXO activities are being performed, may enter the site without being required to comply with the WP / SHERP requirements, however, they should be briefed and escorted while on the site.

C. Government emergency personnel responding to the site for a UXO incident or some other type of emergency, will assume responsibility for the site and HFA will no longer be responsible for entry control to the site.

5.7 Personnel Protective Clothing - For the miscellaneous environmental and construction project sites, the HFA UXO team will normally work in a modified Level D PPE during the performance of the basic UXO site search. The equipment listed below comprises the HFA PPE Level D for this project.

A. Normal work clothes (long pants and shirt)
B. Gloves (leather)
C. Boots (leather, non-steel toe) - Due to sensitivity of magnetometers steel toed boots will not be worn during UXO search operations.
D. Hard hat (optional, as required) - Hard hats will not be worn while performing UXO services except for when these services are being performed in conjunction with heavy equipment (backhoes, excavators, bull dozers, etc.), in which case, hard hats will be worn by HFA UXO personnel.

5.8 General Safe Work Practices - The following general safety requirements are based on standard UXO precautions and/or specific requirements of the APG/ Edgewood Safety Offices.

Use or disclosure of document data is subject to the restrictions on Title Page of this document

These safety requirements were established during previous HFA UXO operations on the Aberdeen and Edgewood Areas of APG.

A. Only qualified U.S. Army EOD personnel and HFA UXO personnel will be permitted on the site during HFA UXO search and excavation operations.

B. Use of CB radios or other radio communication devices rated above 5 watts will not be permitted during UXO search or excavation operations.

C. All safety precautions related to UXO will be observed.

D. The UXO Project Leader will be in charge of all UXO operations conducted by HFA. Safety responsibilities of the UXO Project Leader and UXO Safety Officer are as follows:

1. When and if required, ensures that all barricades are in place prior to the start of any UXO operations.
2. Ensures that all personnel in the area of UXO operations are qualified UXO personnel.
3. Ensures that adequate emergency fire/rescue, medical, and security support is available.
4. Has absolute authority to stop all operations and order the immediate evacuation of the project site in the event that UXO or suspected UXO is located.

E. General UXO Safety Precautions and Rules - The following safety precautions and rules will be observed by all personnel present on a UXO survey site:

1. Do not go souvenir hunting.
2. Do not pick up or disturb unidentified items.
3. Report all UXO or unidentified objects.
4. Do not excavate any areas until you are sure they have been checked.
5. Do not go outside the boundaries of the access routes or work sites.
6. Do not enter the uncleared areas of the site.
7. Do not carry fire or spark producing devices into the site.
8. Do not smoke except in areas specifically designated for smoking.
9. Avoid inhalation and skin contact with explosives.
10. Remove from the area any person showing evidence of explosive poisoning or dermatitis.
11. Do not allow one person to work alone during any operations in areas contaminated with explosives or related hazardous materials.
12. Prohibit unnecessary personnel from visiting the operations site.
13. Observe static electric precautions when sampling and processing samples.
14. Suspend all operations immediately upon approach of an electrical storm.
15. Do not attempt to extinguish burning explosives or any fire which might involve explosive materials.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

16. If explosive materials are burning or their ignition is eminent, immediately evacuate the area.
17. Have a vehicle in the area in case of an accident or emergency.
18. Have communications equipment in the area in case of an accident or emergency.

5.9 **Emergency Services** - The following emergency services are available on the Aberdeen Area.

Fire Department	Emergency Medical Services
Ambulance	U.S. Army Technical Escort EOD Support
Military Police	Emergency Decontamination Services

A. Emergency Medical Care for Life Threatening or Unknown Situations-As a contractor employee working on APG, emergency medical care for life threatening or unknown medical situations is available at the APG Area Kirk Army Health Clinic. The following procedures will be utilized to request emergency services:

Aberdeen Area - To obtain emergency services on the Aberdeen Area, dial 911from a government, commercial or cellular telephone. If 911 is dialed from a commercial telephone or cellular phone, the call will go into the Harford County Emergency Center, the area of services must be identified (e.g. Aberdeen Area of APG) and the Harford County 911 operator will reroute call to the proper switchboard.

B. Non-Emergency Medical Care - For job related injuries of a non-emergency nature which require a doctors care, the injured person will be transported to Physicians Prompt Care, 2953 Emmorton Road,
Abington, Maryland 21009; telephone no. (410) 569-1919; hours of operation are 8:00 AM to 12:00 PM.

- The clinic is at the intersection of Emmorton Road and Singer Road, in the Boxhill Shopping Center behind the 7-11 Store. (see Figure 5-1. Medical Emergency Routes, block B)
  - From the Aberdeen Area, depart through the Harford Gate, via Route 22 to the Route 95 cloverleaf.
  - Take Route 95 south to Exit 77.
  - Take Exit 77 onto route 24 west (towards Bel Air).
  - Turn east onto Singer Road to Route 924 (Emmorton Road).

If hospital treatment appears more appropriate, Fallston General Hospital and

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

Harford Memorial Hospital are within easy driving distance. Both provide 24-hour service, 7 days a week.

Fallston General Hospital	Harford Memorial Hospital
200 Milton Avenue	501 South Union Street
Fallston, Maryland	Havre De Grace, Maryland
(410) 877-3700	(410) 939-2400

- To Fallston General Hospital (see Figure 5-1. Medical Emergency Routes, block A):

  * From the Aberdeen Area, depart through the Maryland Gate, via Route 715 to the intersect with Route 40.
  * Take Route 40 west to Route 152 (Magnolia Road).
  * Turn right (north) onto Route 152 until it intersects with Route 1.
  * Turn east onto Route 1 and continue for approximately 1 mile to Milton Avenue.
  * Turn left onto Milton Avenue and hospital entrance.

- To Harford Memorial Hospital (see Figure 5-1. Medical Emergency Routes, block C):

  * From the Aberdeen Area, depart through the Harford Gate, via Route 22 to the intersect with Route 40.
  * Go east on Route 40 until it intersects with Old Post Road, Route 7 (Havre De Grace).
  * Exit onto Old Post Road and follow it to until it intersects with Union Street.
  * Harford Memorial Hospital is on the southeast corner of the intersection of Route 7 (Revolution) and Union Street.

C. First Aid - For minor cuts, abrasions, or other minor injuries deemed by the HFA Site Supervisor or Team Leader to be treatable on-site by first aid, will be treated using the site first aid kit.

5.10 Emergency Site Resources - The following on-site emergency equipment will be maintained by HFA.

A. One (1) fire extinguisher, rated at least 1A, 10BC
B. One (1) standard industrial first aid kit

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

C. One (1) emergency eye wash kit

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

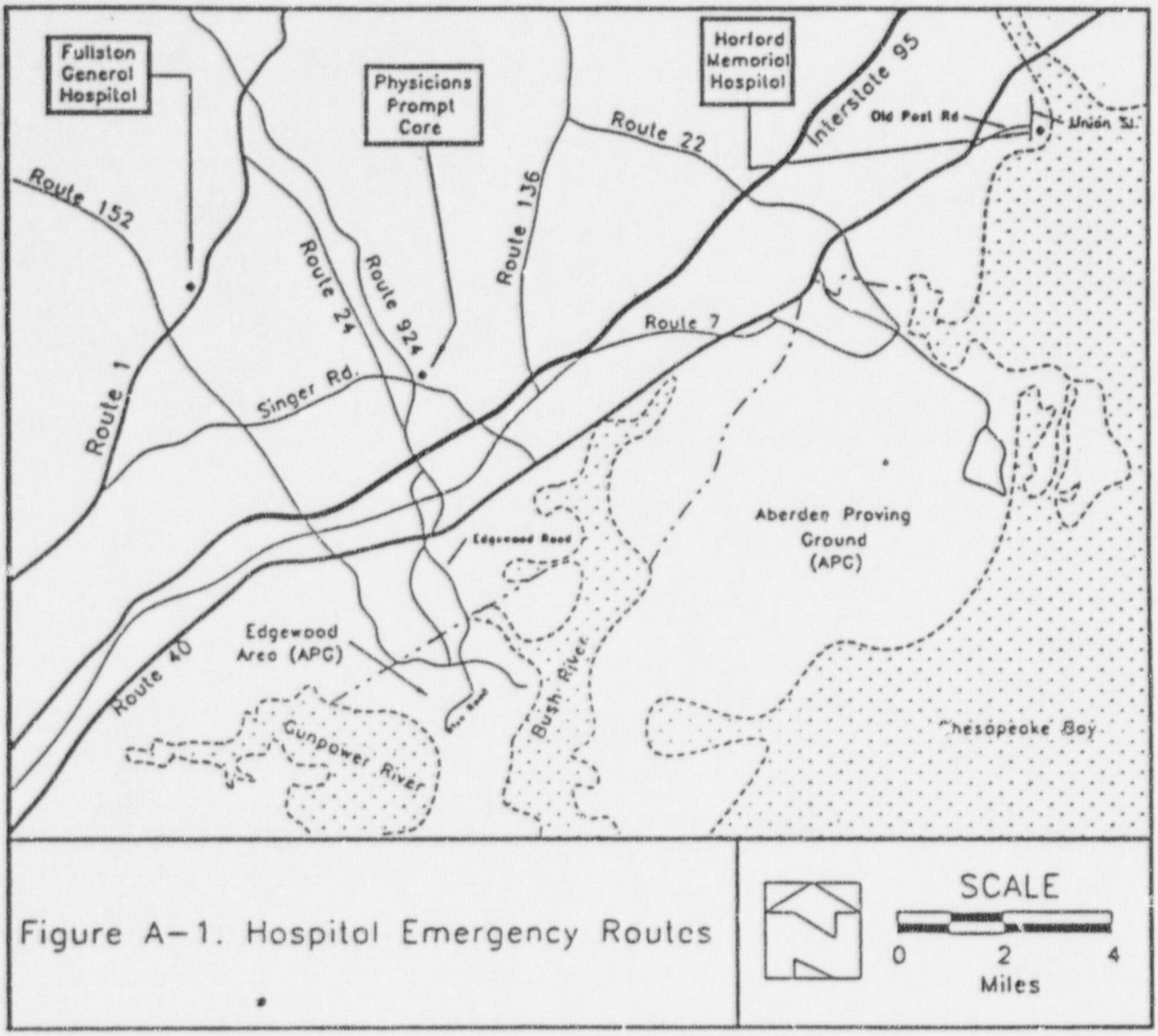


Figure A–1. Hospitol Emergency Routes

Figure 5-1. Medical Emergency Routes

A. Fallston General Hospital
B. Physicians Prompt Care
C. Harford Memorial Hospital

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

5.11 Ammunition Color Coding - The color codes listed below are commonly used to identify ammunition. In most instances due to weathering, the colors will no longer be visible. However on recently fired UXO the markings may still be clear enough for identification of the UXO.

NOTE: ***These color codes are not 100 % reliable. In some cases for testing or experimentation, munitions may have been loaded with hazardous materials. Ammunition may also be encountered which has been incorrectly marked by the manufacturer.***

A. One green band and green printing on a gray background

1. Old color code system - GB, CG, AC, and CK
2. New color code system - CG, AC, and CK

B. Two green bands and green printing on a gray background

1. Old color code system - VX, L, HL, HD, H, and HT
2. New color code system - HD, H, and HT

C. Three green bands and green printing on a gray background - New color code system - G and V Series

D. One red band and red printing on a gray background

1. Old color code system - CN, DM, CS, CN1, DM1, and CS1
2. New color code system - CN, DM, CS, CN1, DM1, and CS1

E. Two red bands and red printing on a gray background - New color code system - BZ AND CS2

F. One purple band and purple letters on a gray background - Old color code system - (Incendiaries) TH, NP, PT1, and PTV

G. One yellow band and yellow letters on a gray background - Old color code system - (Smoke) HC, WP, and PWP

H. One white band and white letters on a gray or olive drab background - Old and New color code system - Illuminating

I. One black band and black letters on a white background - New color code system - Illuminating

J. All printing and markings in black on a light red background - New color code system - (Incendiary) TH, NP, PT1, and PTV

K. All printing and markings in black on a light green background - New color code system - (Smoke) HC

L. All printing and markings in red on a light green background - New color code

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

system - (Smoke) WP and PWP

M. One yellow band and yellow printing on a olive drab background - High Explosive

N. One brown band and brown printing on an olive drab background - Low Explosive

O. White diamonds on an olive drab background - Flechettes

P. Yellow diamonds on an olive drab background - ICM (Submunitions)

Q. Yellow, brown, or white markings on a blue background - High Explosive, Low Explosive, or empty practice munitions

R. Black markings on an orange background - track and recovery munition

S. Any combination of the markings and colors listed above or any strangely painted and marked objects.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 3.

DETECTION EQUIPMENT

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

6.0 DETECTOR CAPABILITIES

6.1 Detectors - In accordance with 29 CFR Part 1910.120, paragraph (j)(1)(x), "ground penetrating systems", HFA will provide all necessary ground penetrating magnetometry and electromagnetic pulse induction search equipment required to conduct a surface/subsurface survey for OEW and UXO. HFA will be using an active all-metals detector and a passive ferrous metals detector on this project for the electronic subsurface search. Based on current state-of-the-art magnetometer technologies, HFA does not guarantee that 100% of UXO will be located on this or any other site.

6.1.1. Electromagnetic (Active All-Metals) Induction Detectors - Active locators, as a class, generate a magnetic field. Their detection ranges are determined by the strength of their magnetic field, the attenuation of the field in the soil, the size and makeup of the items being sought, and the amount of conductive clutter in the search area. These factors tend to limit active detection ranges to two (2) feet or less, depending on the search instrument. A major advantage to this type of detector is its all-metals capabilities. These instruments are capable of detecting ordnance constructed of both ferrous and nonferrous metals. Active locators can affect influence fuzing; therefore, it is necessary to have some knowledge of the types of ordnance and their fuzing systems that may be encountered within the search area. The U.S. Military currently utilizes locators that employ the multiple-coil, balanced bridge, and phase-imbalance types of active locators. The active all-metals detectors listed below are currently used by HFA:

6.1.1.1 White's Eagle II SL 90 - The Eagle II is a multiple-coil active all-metals detector. Additional features include a programmable memory system and a digital display which provides a readout of the items being located and the status of the instrument.

A. Typical Sounding Depth (Detection Capabilities) - Active detectors as a class have very limited detection ranges of three (3) feet or less, depending on the search instrument. Experience has shown that the Eagle II under average conditions will be able to detect a 75 to 81 mm projectile at a depth of 1.5 to 2 feet.

B. Range of Operation - The Eagle II is normally used in its all metals (Prospecting and Relic Hunting Mode) with a sensitivity range of 1 to 7, with 7 being the most sensitive setting. The Eagle II is very unique in that it can be programmed to search for one (1) type of metal. HFA has used this feature on a number of occasions to locate specific types of UXO such as the M72 LAW rocket (all aluminum).

C. Limitations - The same limitations listed below for the Mk 26 Ordnance Locator also effect the performance of the Eagle II.

6.1.1.2 Fisher 1266XB - This is a multiple-coil active all-metals detector. This instrument is similar to the Eagle II with all controls being operated manually.

A. Typical Sounding Depth (Detection Capabilities) - Same as Eagle II

B. Range of Operation - Principle of operation is same as Eagle II, however, instrument

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

settings are different.

C. Limitations - The same limitations listed below for the Mk 26 Ordnance Locator also effect the performance of the Fisher 1266XB.

6.1.2. PASSIVE FERROUS METAL DETECTORS - Passive magnetic locators detect anomalies in the earth's magnetic field which are produced by ferromagnetic (ferrous metal) targets. Generally passive locators respond to either: 1) the magnitude of the magnetic field strength (Proton-Precession) or 2) the gradient or rate of change of the field (Fluxgate). The detection ranges of passive locators are dependent on not only the resolution of the device, but also the magnetic features of both the search area and the item being located. Within the UXO community the standard passive magnetometers in use today are of the Fluxgate and the Proton-Precession types. The passive ferrous metal magnetometers listed below are currently used by HFA:

6.1.2.1. Mk 26 Mod 0 Ordnance Locator (Förster Ferex® 4.021) - This is a Fluxgate type ferrous metals passive magnetometer. HFA has both Ferex L 4.021.03 (Land Version) and Ferex K 4.021.02 (Land, Underwater, and Borehole Version) magnetometers in our equipment inventory. This magnetometer will only detect ferrous metal UXO.

NOTE: The capabilities listed below have been extracted from the Förster Ferex® 4.021 technical manual and are based on clean area laboratory testing procedures and these conditions are rarely encountered in the field. As indicated below in paragraphs 6.1.2.1.B. through C., actual field conditions can and do reduce the depth detection capabilities of the magnetometer.

A. Typical Sounding Depth (Detection Capabilities Under Laboratory Clean Conditions)

1. 13 mm projectile - .25 m (9.8 inches)
2. Mills-bomb - .6 m (23.6 inches)
3. Anti-personnel mine - 1.1 m (43.3 inches)
4. Flat anti-tank mine - 1.5 m (59.1 inches)
5. 88 mm projectile - 3 m (118.1 inches)
6. 100 mm projectile - 3.3 m (129.9 inches)
7. 250 kg (550 lb) bomb - 4.5 m (177.2 inches)
8. 500 kg (1,100 lb) bomb - 6 m (236.2 inches)

B. Range of Operation - The Förster Ferex® 4.021 Search Instrument has four (4) modes of operation. Each mode selected by rotation of the Operating Mode Switch.

1. Operating Mode 1 (switch position 1) - General search tasks for small and large ferrous objects in a relatively clean area. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 1. This is the most sensitive and desirable operating mode; however, when heavy small item metallic contamination such as UXO/target fragments are present, this

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

mode cannot be used. To date, HFA has never performed UXO related services on a project site that was clean enough to allow operation in this mode.

2. Operating Mode 2 (switch position 2) - General search tasks, but primarily to avoid confusion between two magnetic influences where one is much greater than the other. In this mode the larger influence is selected and the smaller is dampened out. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 2. This is the second most sensitive operating mode and is used for search operations when site conditions preclude the use of Operating Mode 1. To date, HFA has performed UXO related services on a limited number of project sites that were clean enough to allow operation in this mode.
3. Operating Mode 3 (switch position 3) - Used when searching in the vicinity of ferrous fences, underground ferrous pipes, or areas heavily contaminated with ferrous objects. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 3. Thjs is the least sensitive operating mode and is used for search operations when site conditions preclude the use of Operating Modes 1 and 2. This is the most often used mode used by HFA when performing UXO services.
4. Operating Mode 4 (switch position 4) - Used to find magnetic north. There are no search capabilities in this mode.

C. Limitations - There are many environmental considerations that can limit the depth of detection (magnetic signatures), i.e., soil characteristics (minerals and salts present), type of metal being detected, size of the metal object, orientation of the object (vertical or horizontal to the linear axis of the object), metallic contamination of the site (widespread fragmentation), and the capabilities of the detector. Activities such as earth removal and tree grubbing can also change the magnetic signatures in the earth. ***With all factors taken into consideration, there are no iron clad measurements regarding the sizes of UXO or depths at which they can be detected.***

6.1.2.2. **Schonstedt Model GA-52B** - This is a Fluxgate type passive ferrous metals magnetometer. HFA has used the Model GA-52B with a great deal of success for the location of buried UXO. As with the Mk 26 Mod 0, the Model GA-52B will only detect ferrous metal UXO.

A. Typical Sounding Depth (Detection Capabilities) - The Model GA-52B is a commercially available magnetometer with detection depth capabilities comparable to the Förster Ferex® 4.021 Search Instrument listed above.

B. Range of Operation - The Model GA-52B is a very simple instrument to use. Operation of the instrument is governed by an ON-OFF switch and a Sensitivity Control Knob.

C. Limitations - The same limitations listed above for the Förster Ferex® 4.021 Search Instrument also effect the performance of the Model GA-52B.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

6.1.2.3 Schonstedt Model GA-72CV - This instrument is a reconfigured GA-52B with several design upgrades which are described below. All principles of operations and capabilities are the same as those described above for the GA-52B.

A. The GA-72CV has a new plastic case with a handle grip attached.

B. A meter has been added to the instrument which reads in the "+" and "-" ranges during operation. This added feature aids in determining the orientation of subsurface objects which are in a horizontal or near horizontal position.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 4.

ENVIRONMENTAL PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

7.0 ENVIRONMENTAL PLAN

7.1 **Overview** - All of the UXO services performed by HFA will have very minimal impact on the site environment. The temporary disturbance of the site during UXO field activities is not expected to produce adverse effects on the surrounding down gradient areas due to increased storm water runoff, nor adversely affect the ecological resources in the area. All work in the area will be performed in a manner that will minimize the release of contaminants and control dust and noise to within reasonable limits. The proposed UXO services will affect only a very small area of APG and will not adversely affect any area beyond APG. Site-specific environmental controls, which will be employed as needed during UXO services, are as follows:

- Minimizing disturbed soil surface areas (all excavations will be performed using shovels, picks, and hand trowels). All excavations performed by HFA will be filled and tamped.

- Avoiding disturbance to trees, shrubs, and ground cover wherever possible.

NOTE: ***In most instances, HFA is on-site with other contractors/subcontractors over whom HFA has no operational control other than UXO safety. HFA is not liable for environmental damages caused by the other contractors/subcontractors. All contractor/subcontractor damages observed by HFA will be duly noted and recorded in the Daily Operations Journal.***

7.2 **Site Condition Survey** - The HFA Project Leader will perform a site condition survey prior to commencing UXO operations. During this survey, the project site area, access route and adjacent areas will be visually examined to note utilities, site improvements, fences, trees, shrubs and other features. The conditions of the items will be noted and included on a hand drawn sketch of the site during the survey of the site. Specific items of interest are:

A. Trees - The physical condition of the trees to include existing damage will be noted.
B. Shrubs and Grassed Areas - The physical condition of the shrubs and grassed areas to include existing damage will be noted.
C. On-Site and Immediate Off-Site Drainage - Existing drainage patterns will be noted, especially areas undergoing active erosion/sedimentation.
D. Access Roads and Haul Routes - The access roads and haul routes will be examined for signs of deterioration and wear, such as potholes, muddy stretches, obstructing debris, and clogged drainage ditches.
E. Drain Culverts - Drain culverts will be checked for crushed sections and blocked openings, and their location will be noted.
F. Fencing - Damaged or missing sections of fencing will be noted.
G. Preexisting Refuse/Debris Accumulations - The location of accumulated refuse or other debris within or adjacent to the project site will be noted.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

A copy of the site condition survey will be provided to the contracting officer (CO) or the designated contracting officer's representative (COR)

7.3 **Environmental Protection** - All land areas on-site and outside of specifically assigned UXO work areas, storage areas, and access routes will be preserved in their original condition during the course of UXO operations. UXO work activities will be confined to the areas defined in the Work Plan. Trucks and equipment will be confined to the designated haul and access routes, and the project work area. During site UXO operations, every effort will be made to prevent damage to the roads, culverts, trees shrubs and grassed areas.

7.3.1 **Protection of Landscaping** - All landscaping outside of the specifically assigned UXO work area shall be preserved in its original condition with the following restrictions observed:

A. No trees, shrubs, turf, or crops will be removed, cut, or disturbed unless specifically designated for clearing on the plans, or special authority is given by the CO or COR.
B. All public and private easements used for site access will be restored to the original condition.
C. No ropes, cables, or guys will be fastened to any nearby trees for anchorage.
D. If it becomes necessary to erect barrier cable for site security, waste segregation, or equipment staging areas, posts will be placed on anchorages.

NOTE: ***It is very common in UXO project areas containing second and subsequent generations of tree growth to find UXO in the tree root systems. In most cases, the damage to the root system during the UXO access process is very extensive and irreparable. Due to the circumstances involved, HFA is not liable for the damage to the root system or replacement of the tree.***

E. Appropriate measures will be taken during excavation of UXO to prevent root damage to trees that are to remain alive.

F. During excavation of suspected UXO sites, the boundaries will be marked to ensure that all UXO operations are restricted to the limits of the project area.
G. Collection of miscellaneous metallic debris and nonhazardous UXO components will be consolidated in predetermined holding areas awaiting disposal.

7.3.2 **Protection of Water Resources** - As a rule, all UXO services are limited to surface searches and hand excavation of suspected UXO. Little to no waste is generated by these services that could result in contaminated waste from entering surface waters. The individual UXO excavations performed by HFA usually involve a total surface area of only 2 to 4 square feet. Each hole is immediately filled in after excavation and tamped. Due to the minimal intrusive soil activities runon/runoff control measures as outlined in EM 385-1-1 are not required.

7.4 **Contamination Control Measures** - This plan focuses on the minimization of contaminant

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

generation resulting from UXO operations on APG. There are 2 primary areas in which contaminant generation could occur, which are, airborne contaminants of potentially toxic vapors and via spills. HFA's UXO services do not include remediation of hazardous toxic waste (HTW). In the event that HTW is encountered, HFA's personnel will withdraw from the site and report the suspected HTW to the CO or COR.

7.4.1 **Waste Disposal** - HFA will maintain appropriate project on-site house keeping practices during the course of the UXO services project. All waste generated by HFA will be collected and properly disposed of.

7.4.2 **Burning** - No burning of any sort will occur on-site.

7.4.3 **Dust Control** - HFA's UXO services will not generate any significant amounts of dust which would require dust control measures.

7.5 **Spill Control** - As outlined above in paragraph 7.4, HFA's UXO services do not include handling HTW or chemical agent materials. If a spill resulting from a ruptured UXO or some other type of container filled with chemical agent or HTW should occur, HFA and all other personnel on site shall evacuate in an upwind direction. The Emergency Center will be notified that a spill has occurred.

7.6 **Post UXO Operations Cleanup** - HFA will maintain a clean and unobstructed working environment at all times. No tools, equipment, materials (except as noted below), or rubbish will remain on-site following completion of UXO operations. With the exception of the boundary marker flags used to identify the limits of the UXO services performed by HFA, all rubbish and other materials brought on to the project site by HFA will be removed.

7.6.1 **Site Walkover** - The HFA UXO Project Leader will perform a site walkover inspection to ensure that all of the UXO excavations have been filled and tamped. The Project Leader will also ensure that all of the rubbish and materials brought on site by HFA have been collected and properly disposed of.

NOTE: ***HFA is not responsible for other contractor/subcontractor or Government generated rubbish or materials that may be left on site.***

NOTE: ***HFA is not responsible for filling of craters generated by Military EOD personnel when UXO are detonated in place on the project site.***

NOTE: ***HFA is not responsible for filling other contractor/ subcontractor excavations or auger holes.***

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

personnel when UXO are detonated in place on the project site.

NOTE: *HFA is not responsible for filling other contractor/ subcontractor excavations or auger holes.*

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 5.

QUALITY CONTROL PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

8.0 QUALITY CONTROL PLAN

8.1 **Quality Control** - To ensure that effective UXO services are being performed, the quality control (QC) procedures outlined below will be in effect on all UXO services projects.

8.2 **Equipment** - All equipment will be inspected by the Project Leader and/or Safety Officer prior to departing from Indian Head, Maryland to the project site.

8.2.1 **Magnetometers and Metal Detectors** - Inspect the magnetometer(s) and metal detector(s) to ensure that they are in calibration and operating within specifications. The items will also be inspected to ensure that they are not in need of repair and all required accessories are present.

8.2.2 **Emergency Equipment** - Inspect the required emergency equipment to include first aid kit, eye wash kit, bleach, fire extinguishers, and any other emergency items to ensure that they are in good repair and complete.

8.2.3 **Hand Tools** - Inspect the UXO tool kit to include shovels, picks, hand trowels, probes, machetes, etc. to ensure that they are in good repair.

8.2.4 **Project Specific Items** - Individual projects may require items that are not normally included in the site equipment inventory. These items could include PPE, special tools, power cutters, etc.. All of the site specific items must also be inspected to ensure that they are in good repair.

8.3 **On-Site Inspections** - All tools and equipment will be inspected by the Project Leader and/or Site Safety Officer on a daily basis.

8.3.1 **Operational Checks** - The magnetometer(s) and metal detector(s) will be tested before starting UXO operations in the morning and when operations are resumed after lunch. Spot checks will also be performed during daily operations to ensure that the magnetometers and metal detectors are operating properly.

8.4 **Excavations** - All excavations will be rechecked with a magnetometer and metal detector after the previously located UXO or metallic object has been removed.

8.5 **Post detonation Crater Inspection** - After a UXO has been detonated in place, the crater will be rechecked with a magnetometer and metal detector to ensure that no other UXO are present.

8.6 **Random Site UXO QC Checks** - The Project Leader and/or Site Safety Officer will perform a random QC inspection of each project site to ensure the effectiveness of the UXO search being performed. A minimum of 10 % of each site will be rechecked with a magnetometer

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

and metal detector. The QC check shall be random in nature with all areas of the project site being checked, however, areas that included heavy UXO or metallic contamination should receive emphasis during the QC check. If a UXO is detected during the QC check, the entire project site will be researched to ensure that no other UXO is present. If more than 2 significant nonUXO metallic objects are located during the QC check, the QC inspection area will be increased to 20 %. If additional significant nonUXO metallic objects are located in the added QC inspection area, the entire project site will be researched to ensure that no UXO are present.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

APPENDIX B

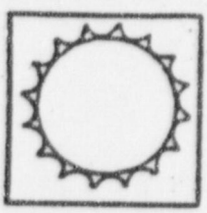
HEAT STRESS AND COLD EXTREMES INFORMATION AND GUIDELINES

CHAPTER 8 HEAT STRESS AND COLD EXPOSURE

8.0 INTRODUCTION

Temperature extremes pose a hazard of particular concern to the health, safety, and comfort of personnel involved in hazardous waste site activities. Site health and safety personnel must consider the two most common dangers, heat stress and cold exposure, when making decisions regarding PPE selection and work mission duration, when establishing standard operating procedures for site activities, and when conducting medical monitoring.

8.1 HEAT STRESS



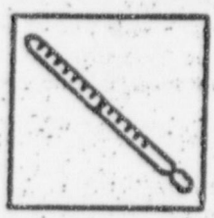
Heat stress is one of the most common and potentially serious illnesses at hazardous waste sites and, therefore, warrants regular monitoring and other preventive measures. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly -- within as little as 15 minutes -- and can pose as great a danger to worker health as chemical exposure. In its early stages, heat stress can cause rashes, cramps, and drowsiness. This can result in impaired functional ability that threatens the safety of both the individual and co-workers. Continued heat stress can lead to heat stroke and death.

8.1.1 Heat Stress and PPE

Heat stress is a major health hazard for workers wearing PPE because the same protective materials that shield the body from chemical exposure also limit the dissipation of body heat and moisture. Thus, personal protective clothing can create a hazardous condition.

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. The added weight and bulk of PPE severely reduces the body's access to normal heat exchange mechanisms and increases energy expenditure. When selecting PPE, therefore, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. After PPE has been selected, the safe duration of work/rest periods should be determined based on the anticipated work rate, the ambient temperature and other environmental factors, the type of protective ensemble, and the individual worker characteristics and fitness.

8.1.2 Monitoring for Heat Stress



All workers, even those not wearing protective equipment, should be monitored, because the incidence of heat stress depends on a variety of factors and can affect any worker. Monitoring should be initiated before initial entry and should be continued during each break cycle. Some general guidelines include:

- For workers wearing [illegible]eable clothing, monitor for signs of hea[illegible]ss and follow established work/rest schedules.
- For workers wearing semipermeable or impermeable encapsulating ensembles, workers should also be monitored when the temperature in the work area is above 70°F (21°C). Below 70°F, monitoring is considered on a case-by-case basis.

To conduct personnel monitoring, measure the heart rate and body temperature, as follows:

Heart Rate. Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

Oral Temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If

EXHIBIT 8-1
Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F (32.2°) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°- 90°F (30.8°- 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°- 87.5°F (28.1°- 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°- 82.5°F (25.3°- 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

[a] For work levels of 250 kilocalories/hour.
[b] Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 X % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)
[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Source: *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA, 1985).

oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

Initially, the length of the work cycle should be governed by the frequency of the required physiological monitoring. The frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Exhibit 8-1, above).

8.1.3 Preventing Heat Stress

To protect against heat stress, it is important to choose the appropriate level of protection, to provide careful training for workers and site personnel, and to monitor frequently personnel who wear protective clothing. It is also important to ensure that work and rest periods are scheduled regularly, and that workers frequently replace lost fluids (it is not uncommon for workers to lose as many as 6 to 8 quarts of water in a hot shift).

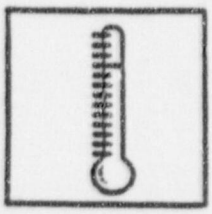
Proper training and preventive measures will help avert serious illness and loss of work productivity caused by heat stress. Preventing heat stress is particularly important because one incident of heat stress will increase the likelihood of future incidences. The site health and safety officer should take the following steps to prevent heat stress:

- Adjust work and rest schedules as needed;
- Provide shelter or shaded areas to protect personnel during rest periods;
- Maintain workers' body fluids at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must equal the approximate amount of water lost in sweat;
- Encourage workers to maintain an optimal level of physical fitness. Fit individuals may acclimatize more readily to temperatures;
- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Effective devices

include field showers or hose-down areas, as well as cooling jackets, vests, or suits;

- Train workers to recognize and treat heat stress, and to identify the signs and symptoms of heat stress (e.g., muscle spasms, dizziness, lack of perspiration). Refer to Exhibit 8-2 for more detail on the signs and symptoms of heat stress.

8.2 COLD EXPOSURE



Exposure to cold temperatures can cause frostbite and hypothermia as well as impair the ability to work. Extremely low temperatures are not necessary to suffer cold exposure -- a strong wind combined with a cold temperature can chill the body to the point where frostbite and hypothermia are a risk. Maintaining body temperature and recognizing the early signs and symptoms can help prevent illness and injury due to cold exposure.

Cold injury is generally classified as local (e.g., frostbite or frostnip) or general (e.g., hypothermia). The main factors contributing to cold injury are exposure to humidity and high winds, contact with wetness or metal, inadequate clothing, age, and general health. Physical conditions that worsen the effects of cold include allergies, vascular disease, excessive smoking and drinking, and use of specific drugs and medicines.

8.2.1 PPE And Cold Exposure

The correct PPE depends on the specific cold stress situation. It is important to preserve the air space between the body and the outer layer of clothing in order to retain body heat. The more air pockets each layer of clothing has, the better the insulation. However, the insulating effect is negated if the clothing interferes with the evaporation of sweat, or if the skin or clothing is wet.

The most important parts of the body to protect are the feet, hands, head, and face. Hands and feet are the farthest from the heart, and become cooled most easily. Keeping the head covered is important, because as much as 40 percent of body heat can be lost when the head is exposed.

Workers should wear several layers of clothing instead of a single heavy outer garment. In addition to offering better insulation, layers of clothing can be removed as needed to keep the worker from overheating. The outer layer should be windproof as well as waterproof, because body heat is lost quickly in even light winds.

8.2.2 Monitoring for Cold Exposure

Recognizing the early signs and symptoms of cold stress can help prevent serious injury. Described below are the most common types of cold injury and their monitoring signals.

Hypothermia. The first symptoms of hypothermia are uncontrollable shivering and the sensation of cold; the heartbeat slows and sometimes becomes irregular, the pulse weakens, and the blood pressure changes. Severe shaking or rigid muscles may be caused by bursts of body energy and changes in the body's chemistry. Uncontrollable fits of shivering, vague or slow slurred speech, memory lapses, incoherence and drowsiness are some of the symptoms that can occur. Other symptoms that can be seen before complete collapse are cool skin, slow and irregular breathing, low blood pressure, apparent exhaustion, and fatigue after rest.

As the core body temperature drops, the victim may become listless, confused, and make little or no attempt to keep warm. Pain in the extremities can be the first warning of dangerous exposure to cold. Severe shivering must be taken as a sign of danger. If the body core temperature reaches about 85°F, significant and dangerous drops in blood pressure, pulse rate, and respiration can occur. In some cases, the victim may die.

Frostbite. Frostbite can occur without hypothermia when the extremities do not receive sufficient heat from central body stores. This can occur because of inadequate circulation and/or insulation. Frostbite occurs when there is freezing of the fluids around the cells of the body tissues due to extremely low temperatures. Frostbite may result in damage to and loss of tissue, and usually affects the nose, cheeks, ears, fingers, and toes. Damage from frostbite can be serious (e.g., scarring, tissue death resulting in amputation, and permanent loss of movement in the affected parts).

EXHIBIT 8-2
Classification, Medical Aspects, and Prevention of Heat Illness

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbance	Treatment	Prevention
Temperature Regulation Heatstroke				
Heatstroke: (1) Hot, dry skin; usually red, mottled, or cyanotic; (2) rectal temperature 40.5°C (104°F) and over; (3) confusion, loss of consciousness, convulsions, rectal temperature continues to rise; fatal if treatment is delayed	(1) Sustained exertion in heat by unacclimatized workers; (2) lack of physical fitness and obesity; (3) recent alcohol intake; (4) dehydration; (5) individual susceptibility; and (6) chronic cardiovascular disease	Failure of the central drive for sweating (cause unknown) leading to loss of evaporative cooling and an uncontrolled accelerating rise in t_{re}; there may be partial rather than complete failure of sweating	Immediate and rapid cooling by immersion in chilled water with massage or by wrapping in wet sheet with vigorous fanning with cool dry air; avoid overcooling; treat shock if present	Medical screening of workers, selection based on health and physical fitness; acclimatization for 5-7 days by graded work and heat exposure; monitoring workers during sustained work in severe heat
Circulatory Hypostasis Heat Syncope				
Fainting while standing erect and immobile in heat	Lack of acclimatization	Pooling of blood in dilated vessels of skin and lower parts of body	Remove to cooler area; rest in recumbent position; recovery prompt and complete	Acclimatization; intermittent activity to assist venous return to heart
Water and/or Salt Depletion				
(a) Heat Exhaustion				
(1) Fatigue, nausea, headache, giddiness; (2) skin clammy and moist; complexion pale, muddy, or hectic flush; (3) may faint on standing with rapid thready pulse and low blood pressure; (4) oral temperature normal or low, but rectal temperature usually elevated (37.5-38.5°C or 99.5-101.3°F); water restriction type: urine volume small, highly concentrated; salt restriction type: urine less concentrated chlorides less than 3 g/L	(1) Sustained exertion in heat; (2) lack of acclimatization; and (3) failure to replace water lost in sweat	(1) Dehydration from deficiency of water; (2) depletion of circulating blood volume; (3) circulatory strain from competing demands for blood flow to skin and to active muscles	Remove to cooler environment; rest in recumbent position; administer fluids by mouth; keep at rest until urine volume indicates that water balances have been restored	Acclimatize workers using a breaking-in schedule for 5-7 days; supplement dietary salt only during acclimatization; ample drinking water to be available at all times and to be taken frequently during work day
(b) Heat Cramps				
Painful spasms of muscles used during work (arms, legs, or abdominal); onset during or after work hours	(1) Heavy sweating during hot work; (2) drinking large volumes of water without replacing salt loss	Loss of body salt in sweat, water intake dilutes electrolytes; water enters muscles, causing spasm	Salted liquids by mouth, or more prompt relief by IV infusion	Adequate salt intake with meals; for unacclimatized workers, supplement salt intake at meals.

EXHIBIT 8-2 (continued)
Classification, Medical Aspects, and Prevention of Heat Illness

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbance	Treatment	Prevention
Skin Eruptions				
(a) Heat Rash (*miliaria rubra*, or "prickly heat")				
Profuse tiny raised red vesicles (blister-like) on affected areas; pricking sensations during heat exposure	Unrelieved exposure to humid heat with skin continuously wet from unevaporated sweat	Plugging of sweat gland ducts with sweat retention and inflammatory reaction	Mild drying lotions; skin cleanliness to prevent infection	Cool sleeping quarters to allow skin to dry between heat exposures
(b) Anhidrotic Heat Exhaustion (*miliaria profunda*)				
Extensive areas of skin which do not sweat on heat exposure, but present gooseflesh appearance, which subsides with cool environments; associated with incapacitation in heat	Weeks or months of constant exposure to climatic heat with previous history of extensive heat rash and sunburn	Skin trauma (heat rash; sunburn) causes sweat retention deep in skin; reduced evaporative cooling causes heat intolerance	No effective treatment available for anhidrotic areas of skin; recovery of sweating occurs gradually on return to cooler climate	Treat heat rash and avoid further skin trauma by sunburn; provide periodic relief from sustained heat
Behavioral Disorders				
(a) Heat Fatigue - Transient				
Impaired performance of skilled sensorimotor, mental, or vigilance tasks, in heat	Performance decrement greater in unacclimatized and unskilled worker	Discomfort and physiologic strain	Not indicated unless accompanied by other heat illness	Acclimatization and training for work in the heat
(b) Heat Fatigue - Chronic				
Reduced performance capacity; lowering of self-imposed standards of social behavior (e.g., alcoholic over-indulgence); inability to concentrate, etc.	Workers at risk come from temperate climates for long residence in tropical latitudes	Psychosocial stresses probably as important as heat stress; may involve hormonal imbalance but no positive evidence	Medical treatment for serious causes; speedy relief of symptoms on returning home	Orientation on life in hot regions (customs, climate, living conditions, etc.)

The freezing point of the skin is about 30°F (-1°C). As wind velocity increases, heat loss is greater and frostbite will occur more rapidly. If skin comes into contact with objects colder than freezing (e.g., tools or machinery), frostbite may develop at the point of contact, even in warmer environments.

There are three degrees of frostbite: first degree, which is freezing without blistering or peeling; second degree, which is freezing with blistering or peeling; and third degree, which is freezing with tissue death. Exhibit 8-3 lists the symptoms of frostbite. It is important to remember that the victim is often unaware of the frostbite until someone else observes the symptoms.

EXHIBIT 8-3
Symptoms of Frostbite

- The first symptom of frostbite is an uncomfortable sensation of coldness, followed by numbness. There may be tingling, stinging, aching, or cramping.
- The skin changes color to white or grayish-yellow, then to reddish-violet, and finally turns black as the tissue dies.
- Pain may be felt at first, but subsides.
- Blisters may appear.
- The affected part is cold and numb.
- When frostbite of the outer layer of skin occurs, the skin has a waxy or whitish look and is firm to the touch.
- In cases of deep frostbite, the tissues are cold, pale, and solid. Injury is severe.

8.2.3 Preventing Cold Exposure

In preventing cold stress, health and safety professionals must consider factors relating both to the individual and to the environment. Acclimatization, water and salt replacement, medical screening, continuing medical supervision, proper work clothing, and training and education will contribute to the prevention of cold stress and injury related to working in a cold environment. Control of the environment involves engineering controls, work practices, work-rest schedules, environmental monitoring, and considerations of windchill temperature.

Acclimatization. Some degree of acclimatization may be achieved in cold environments. With sufficient exposure to cold, the body undergoes some changes that increase comfort and reduce the risk of cold injury. However, these physiological changes are usually minor and require repeated uncomfortably cold exposures to induce them. People who are physically unfit, older, obese, taking medication, or using alcohol or drugs may not acclimatize too readily.

Dehydration. Working in cold areas causes significant water losses through the skin and lungs as a result of the dryness of the air. Increased fluid intake is essential to prevent dehydration, which affects the flow of blood to the extremities and increased the risk of cold injury. Warm, sweet, caffeine-free, non-alcoholic drinks and soup should be available at the work-site for fluid replacement and caloric energy.

Salt. The body needs a certain amount of salt and other electrolytes to function properly. However, using salt tablets is not recommended. Salt tablets cause stomach irritation, which may include nausea and vomiting. A normal, balanced diet should take care of salt needs. Anyone with high blood pressure or who is on a restricted sodium diet should consult a physician for advice on salt intake.

Windchill. Air temperature alone is not sufficient to judge the cold hazard of a particular environment, because even a light wind can blow away the thin layer of air that insulates the body against the cold air temperature. The "windchill factor" is the cooling effect of any combination of temperature and air movement. The windchill index (Exhibit 8-4) should be consulted to estimate the equivalent temperature felt by personnel working in cold and windy environments. Remember, however, that the windchill index does not take into account: (1) the body part exposed to the cold; (2) the level of activity and the resulting heat produced; or (3) the amount of clothing worn.

Continuous exposure of skin should not be permitted when the windchill factor results in an equivalent temperature of -32°C (-26°F). Workers exposed to air temperatures of 2°C (35.6°F) or lower who become immersed in water or whose

EXHIBIT 8-4
Windchill Index[1]

	ACTUAL THERMOMETER READING (F)									
	50	40	30	20	10	0	-10	-20	-30	-40
Wind speed in mph	EQUIVALENT TEMPERATURE (F)									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	Little Danger (for properly clothed person)				Increasing Danger (Danger from freezing of exposed flesh)			Great Danger		

[1]Source: *Fundamentals of Industrial Hygiene, Third Edition.* Plog, B.A., Benjamin, G.S., Kerwin, M.A., National Safety Council, 1988.

clothing gets wet should be given dry clothing and be treated for hypothermia.

Special Considerations. Older workers and workers with circulatory problems need to be extra careful in the cold. Additional insulating clothing and reduced exposure time should be considered for these workers. Obese and chronically ill people need to make a special effort to follow preventive measures. Sufficient sleep and good nutrition are important for maintaining a high level of tolerance to cold. If possible, the most stressful tasks should be performed during the warmer parts of the day. Double shifts and overtime should be avoided. Rest periods should be extended to cope with increases in cold stress.

Workers should immediately go to warm shelter if any of the following symptoms are spotted: the onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, and/or euphoria. The outer layer of clothing should be removed when entering a heated shelter. If possible, a change of dry work clothing should be provided to prevent workers from returning to work with wet clothing. If this is not feasible, the remaining clothing should be loosened to permit sweat to evaporate.

Alcohol should not be consumed while in the warmer environment. Anyone on medication such as blood pressure control or water pills should consult a physician about possible side effects from cold stress. It is strongly recommended that workers suffering from diseases or taking medication that interferes with normal body temperature regulation, or that reduces tolerance of cold, not be permitted to work in temperatures of -1°C (30°F) or below.

To guard against cold exposure, provide workers with appropriate clothing, have warm shelter available at all times, carefully schedule work and rest periods, and monitor workers' physical conditions. Under no circumstances should a person be given an alcoholic beverage "to keep warm." Alcohol causes the body to release heat more quickly and will therefore increase the risk of cold exposure. Fruits can help warm the body by creating increased energy and metabolism.

8.2.4 A Control Program for Cold Stress

A control program for preventing cold stress at hazardous waste sites should include the following elements:

- **Medical supervision of workers** including pre-placement physicals that evaluate fitness, weight, the cardiovascular system, and other conditions that might make workers susceptible to cold stress. Medical evaluation during and after cold illnesses and a medical release for returning to work should be required.
- **Employee orientation and training** on cold stress, cold-induced illnesses and their symptoms, water and alt replacement, proper clothing, work practices, and emergency first aid procedures.
- **Work-rest regimens**, with heated rest areas and enforced rest breaks.
- **Scheduled drink breaks** for recommended fluids.
- **Environmental monitoring**, using the air temperature and wind speed indices to determine wind chill and adjust work/rest schedules accordingly.
- **Reduction of cold stress** through engineering and administrative controls, and the used of personal protective equipment.

FURTHER GUIDANCE: For additional information on recognizing, preventing, and controlling heat and cold stress, see:

1. Plog, Barbara A., Benjamin, G.S., and M.A. Kerwin. *Fundamentals of Industrial Hygiene, Third Edition.* National Safety Council, 1988.
2. *Pocket Guide to Cold Stress.* National Safety Council, 1985.
3. *Pocket Guide to Heat Stress.* National Safety Council, 1985.
4. *1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* American Conference of Governmental Industrial Hygienists, 1991.

APPENDIX C

LYME DISEASE
INFORMATION AND GUIDELINES

U. S. Army Environmental Hygiene Agency
Entomological Sciences Division
Aberdeen Proving Ground, MD 21010-5422



FACT SHEET - PROTECTION FROM TICKS AND LYME DISEASE

WHAT IT'S ALL ABOUT

Soldiers and other personnel and dependents who live, train, work, or play in the field, share their environment with many forms of animal and insect life. Ticks may be abundant in both wooded and grassy areas. Several tick species are vectors or "transmitters" of Lyme disease. They include the deer tick, Ixodes dammini, in the Northeast and Midwest, and the western black-legged tick, Ixodes pacificus, in the West. Two other species, the Lone Star tick, Amblyomma americanum, and the black-legged tick, Ixodes scapularis, are prevalent across the South, and are potential vectors of Lyme disease. BE CONCERNED - BUT NOT ALARMED. Not all ticks carry Lyme disease, so a tick bite does not necessarily mean that disease will follow. In addition, prompt removal of a tick will lessen the chance of disease transmission.

BUDDY UP

When in the field, buddy up and routinely check for ticks every few hours or as frequently as possible. After returning indoors, remove your clothing and check your body carefully. Pay special attention to the hairy and/or warm, moist parts of the body.

WEAR CLOTHING PROPERLY

You can greatly reduce your chance of tick bite by following the DOD REPELLENT SYSTEM of wearing proper clothing and using both skin and clothing repellents:

Blouse or tuck your uniform legs into your boots and wear your sleeves down. Civilians should tuck their pant legs into their socks, and their shirt into their pants. Light colored clothing makes it easier to spot ticks.

USE REPELLENTS

Apply deet repellent, NSN 6840-01-284-3982, to any exposed skin surfaces, and apply permethrin repellent spray, NSN 6840-01-278-1336, to your uniform or field clothing. Remember that permethrin is only for use on clothing, NEVER on skin. This combined use of repellents and proper wearing of clothing will provide nearly complete protection from tick bites.

IF YOU ARE BITTEN

If you find a tick embedded in your skin, DO NOT SQUASH OR BURN IT. Report to medical personnel to have the tick removed, or follow these guidelines: Use tweezers to grasp the tick's mouthparts as close to the skin as possible, and pull it straight outward. Pull slowly, firmly, and steadily. Be patient. The ticks central mouthpart called the hypostome is long and covered with barbs. This can make it difficult to remove. Wash the wound site and apply an antiseptic. Save the tick either in alcohol or frozen in a pill vial or plastic bag in case symptoms arise and identification of the tick becomes necessary.

BE AWARE

Be aware of the symptoms of Lyme disease. IF YOU HAVE BEEN IN AN AREA WHERE TICKS ARE FOUND AND YOU DEVELOP A RASH AROUND THE SITE OF THE TICK BITE OR FLU-LIKE SYMPTOMS (ACHES AND PAINS, HEADACHE, FEVER, EXTREME FATIGUE), ESPECIALLY DURING THE PERIOD FROM MAY THROUGH EARLY FALL, PROMPTLY SEE A PHYSICIAN FOR EVALUATION.

REMEMBER...

Wear trousers inside boots and sleeves down; use skin (deet) and clothing (permethrin) repellents; check your clothing and body as frequently as possible; remove attached ticks as soon as they are discovered; seek medical attention if symptoms develop.

FOR FURTHER INFORMATION CALL _____

APPENDIX D

TRAINING AND MEDICAL DOCUMENTATION

Summary of General Physics Personnel Training and Medical History					
	Medical		Training		
Name	Annual Physical (most recent date)	Baseline Cholinesterase[1]	Initial	Supervisor	Latest Refresher
Adams, Barry	11/18/94	07/26/94	12/21/90	01/24/91	1/24/95
Allen, Kim	12/27/94	02/01/95	01/20/95	01/26/95	
Burgoon, Scott	01/11/95		01/12/90	04/15/93	4/19/94
Caudill, Jane	11/11/94	09/28/94	12/21/90	01/24/91	1/24/95
Cavallo, Robert	09/29/94		08/24/90	10/25/90	1/24/95
DeReamer, Tom	12/08/94	07/26/94	03/07/88	1/26/95	1/24/95
Dunkerly, Mickey	12/29/94	07/26/94	06/02/88	01/27/92	4/19/95
Dr. [illegible]ren	01/06/95		12/21/90	05/13/91	1/24/95
F[illegible]	04/07/94		03/01/91	03/26/91	4/19/95
[illegible]	12/27/94	02/01/95	01/20/95	01/26/95	
[illegible]	12/06/94	07/26/94	02/25/94	09/09/94	1/24/95
[illegible]san	06/15/94	09/08/94	10/19/90	12/02/91	1/24/95
H[illegible], John	12/21/94	09/29/94	02/25/94	10/24/94	1/24/95
Jacobs, Bruce	12/21/93		08/24/90	10/24/94	1/24/95
Kramer, Bill	09/29/94	10/06/94	08/24/90	02/18/92	1/24/95
Lee, Bob	10/07/94	2/07/95	04/30/91		2/14/95
Lew, Dennis	10/07/94		08/24/90	01/27/92	1/24/95
Leckron, Daryl	07/13/94		05/18/92		1/24/95
Lewis, Mark	03/23/94		06/28/91	01/27/92	4/19/94
McComas, Tim	09/06/94		07/08/90	10/24/94	1/24/95
Mosca, Joe	06/27/94		06/24/91	12/02/91	1/24/95
Myers-Paligo, Laura	04/01/94	10/05/94	01/27/89	02/18/92	2/14/95
Nolan, Patrick	11/0[illegible]94		11/18/94		
Parrish, Bruce	1/19/96		06/25/89	12/02/91	1/24/95
Schaefer, Jennifer	06/29/94	07/26/94	10/25/91	01/27/92	1/24/95
Shackelford, Ronie	10/27/94	1/05/95	09/28/84	10/24/94	10/25/94
Smith, Jennifer	11/21/94	11/23/94	11/18/94	01/26/95	
Thomas, Ed					
Tome, Jeff	09/02/94				
Twilley, Dan	05/25/94		11/08/91	10/24/94	1/24/95
Urbani, Don	05/06/94		12/21/90	04/14/93	4/19/94
Vocelka, Robert	04/28/94	11/23/94	04/12/91	05/13/90	4/19/94
Weeks, Tara			2/17/95		

Notes: [1] Government Baseline Cholinesterase Test Category "C"

Memorandum

February 12, 1996
GP-M-71196024

TO: Bruce Jacobs, CIH

FROM: Bruce R. Parrish

SUBJECT: Dates of Annual Physical and Annual Refresher Training

---

Please be informed that I received my annual physical on January 19, 1996. I also completed "Hazardous Waste Operations and Emergency Response Annual Refresher Training" in full compliance with the training requirements of 29 CFR 1910.120(e) on February 1, 1996. Please have my records updated accordingly.

12 Feb 96

126170

TRANSONIC RANGE
DEPLETED URANIUM STUDY AREA

Work Plan
for
Radiological Characterization

Prepared For:

U.S. Army Directorate of Safety,
Health and Environment,
Health Physics Office
Aberdeen Proving Ground, Maryland

Contract No.: DAAD-05-93-D-7053

Delivery Order No.: 0058

Prepared By:



General Physics Corporation
6700 Alexander Bell Drive
Columbia, Maryland 21046

APR 12 1996

DEPARTMENT OF ARMY
Directorate of Safety, Health, and Environment
Aberdeen Proving Ground, Maryland

Transonic Range
Depleted Uranium Study Area

Work Plan

Radiological Characterization Activities

January 1996

CONCURRENCE:

APGSA, Chief,
Installation Safety Office
Directorate of Safety, Health and Environment — Richard D. Altman 12 Feb 96 Date

APGSA
Radiation Protection Officer — Ralph Claudet 1/19/96 Date

Program Manager,
General Physics Corporation — 1/19/96 Date

Quality Assurance Officer,
General Physics Corporation — 1/19/96 Date

Project Safety Officer,
General Physics Corporation — 1/19/96 Date

Chief, Industrial Hygiene Branch,
Kirk U.S. Army Health Clinic — 2/7/96 Date

Copies Provided to ATC Safety, ARL Safety

TABLE OF CONTENTS

SECTION 1 INTRODUCTION

1.1 PURPOSE AND SCOPE 1
1.2 DEPLETED URANIUM STUDY AREA 1
1.3 DUSA HISTORY 1
1.4 REGULATORY REQUIREMENTS 4
1.5 GIS FILE 4
1.6 FIELD EXAMINATION 4
1.7 DATA OBJECTIVES 4

SECTION 2 AREAS FOR REMEDIAL INVESTIGATION

2.1 GENERAL 6
2.2 SITE DESCRIPTION 6

SECTION 3 PLANNED WORK

3.1 GENERAL 8
3.2 SITE CLEARANCE 8
3.3 SURFACE SURVEY FOR UXO 8
3.4 REFERENCE GRID 9
3.5 RADIATION SURVEYS 9
3.6 ELECTROMAGNETIC SURVEYS 9
3.7 STRUCTURE SURVEYS 9
3.8 SOIL SAMPLING 11

Appendix A HFA Work Plan
Appendix B Chemrad Work Plan
Appendix C Structure Survey Procedure
Appendix D Soil Sampling Procedure

FIGURES

Figure 1. Transonic Range 2

Figure 2. DUSA and Affected Area 3

Figure 3. DUSA Survey Locations 10

SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This detailed cluster work plan presents site-specific details of work to be accomplished during the radiological characterization (RC) of the Depleted Uranium (DU) Study Area at Transonic Range, Aberdeen Area (AA), Aberdeen Proving Ground (APG).

The planned work includes conducting surface sweeps for unexploded ordnance (UXO), surface radiation surveys for depleted uranium, electromagnetic (EM) surveys for buried objects, soil sampling and radiation surveys of structures potentially contaminated with DU.

1.2 DEPLETED URANIUM STUDY AREA

The location of the Depleted Uranium Study Area (DUSA) within the Transonic Range is shown in Figure 1. Figure 2 shows the DUSA surface features and boundaries of the characterization study.

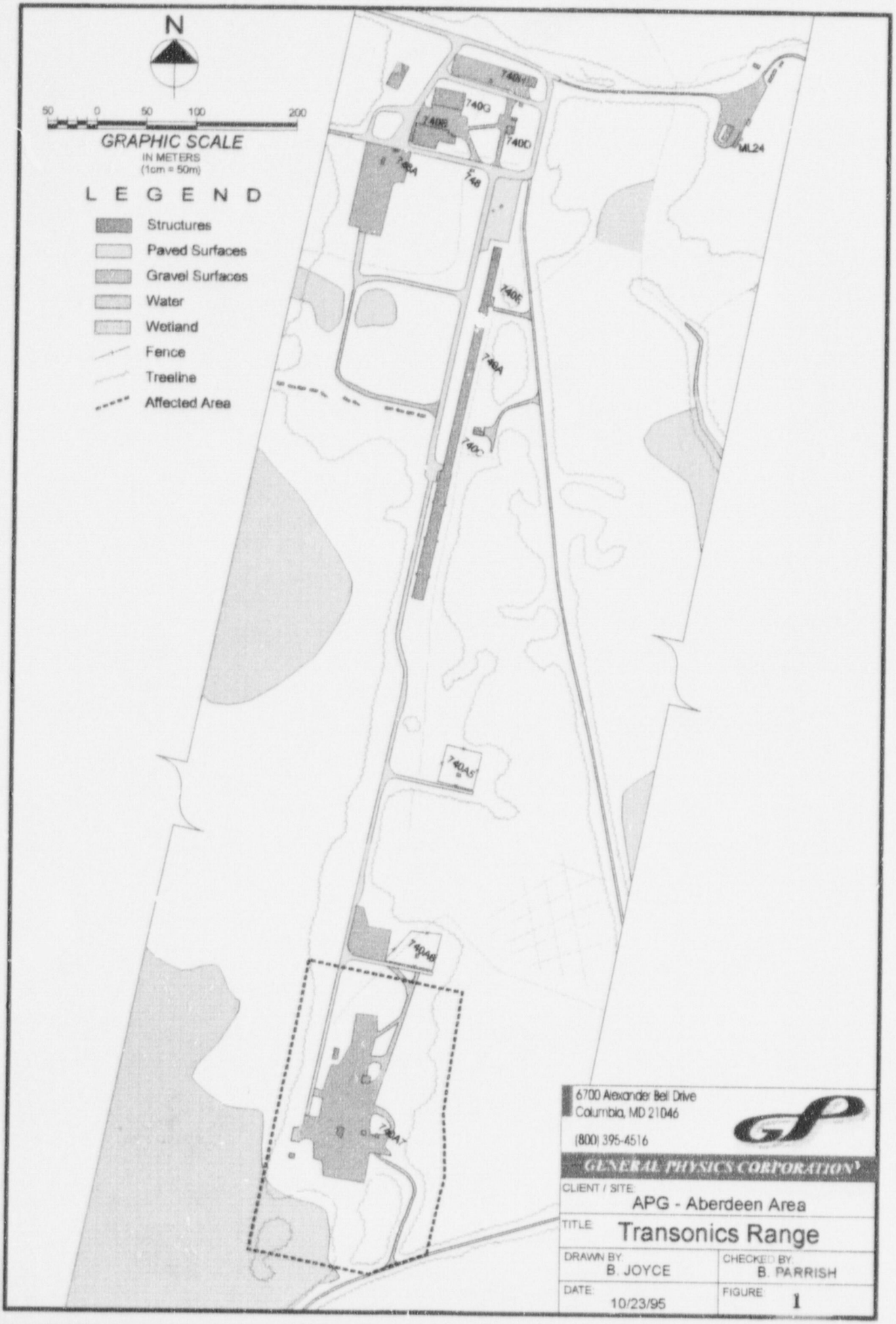
1.3 DUSA HISTORY

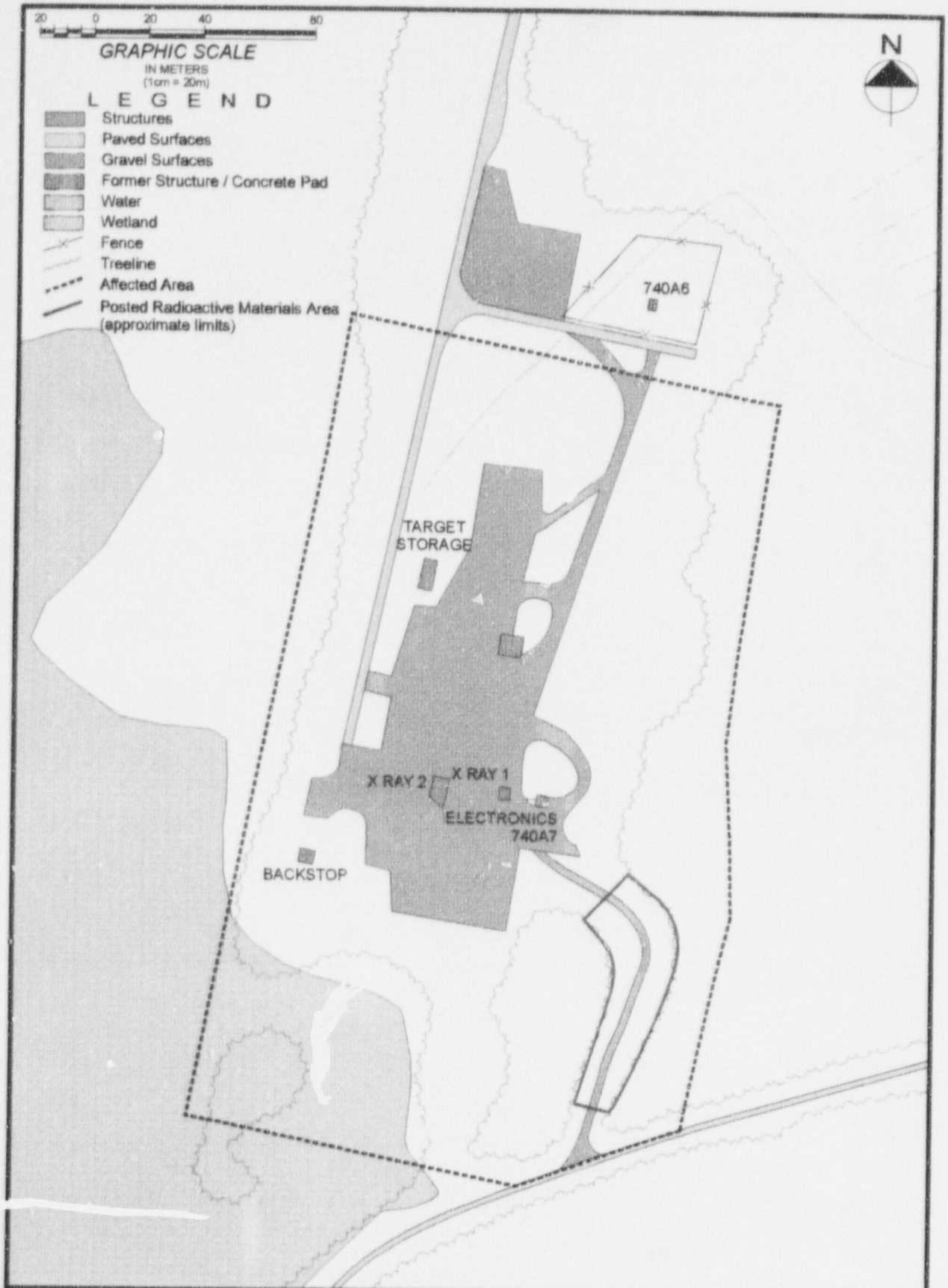
The DUSA is located in the southern portion of the Transonic Range and was known as "Lower X-ray". The DUSA was used for hard-impact testing of DU penetrators. DU penetrators were gun launched against armor targets to test their effectiveness. DU being pyrophoric, turned molten on impact and either partially or completely penetrated the target and scattered into the surrounding area, or vaporized and was dispersed with the wind. DU is depleted of the natural percentage of U-235 and contains U-238, U-235 and U-234, all of which are radioactive material. Thus, the DU from testing contaminated the target and potentially contaminated surrounding structures and soil.

Testing began at the DUSA in 1973 and ceased in the summer of 1979. The site environmental surveillance program indicates levels of activity in excess of the site release limit of 35 pico-Curies per gram (pCi/g) for DU. The release limit of 35 pCi/g is the most restrictive limit for DU published in the Nuclear Regulatory Commission's (NRC) Branch Technical Position (BTP) "Disposal of On-site Storage of Thorium or Uranium Wastes from Past Operations" published in the Federal Register (FR Volume 46, No. 205, 10/23/81) for release of sites contaminated with DU for unrestricted use by licensees.

Since site operations using DU ceased, several areas have undergone remediation by Army Research Laboratory to meet BTP requirements for unrestricted use. These include areas where shot target was stored temporally and contaminated areas around structures.

This Page is Intentionally Blank


N
50 0 50 100 200
GRAPHIC SCALE
IN METERS
(1cm = 50m)
LEGEND
Structures
Paved Surfaces
Gravel Surfaces
Water
Wetland
Fence
Treeline
Affected Area
740H
740G
740B
740D
ML24
740A
740
740E
740A
740C
740A5
740A8
740A7
6700 Alexander Bell Drive
Columbia, MD 21046
(800) 395-4516
GENERAL PHYSICS CORPORATION
CLIENT / SITE:
APG - Aberdeen Area
TITLE:
Transonics Range
DRAWN BY:
B. JOYCE
CHECKED BY:
B. PARRISH
DATE:
10/23/95
FIGURE:
1



6700 Alexander Bell Drive Columbia, MD 21046 (800) 395-4516	TITLE: Transonic Range - DU Study Area
GENERAL PHYSICS CORPORATION	DRAWN BY: B. JOYCE / CHECKED BY: B. PARRISH
CLIENT / SITE: APG - Aberdeen Area	DATE: 10/24/95 / FIGURE: 2

This Page is Intentionally Blank

1.4 REGULATORY REQUIREMENTS

The need to perform a RC of DUSA is found in the Nuclear Regulatory Commission's (NRC), Branch Technical Position (BTP) "When to Remediate Inadvertent Contamination of the Terrestrial Environment." According to the BTP, licensee sites which are no longer used to conduct licensed activities should be remediated to unrestricted use levels within two years of last licensed activity to preclude migration of the radioactivity. Thus, the site should be characterized and released for unrestricted use. The RC will ascertain present levels of radioactivity in order to effectively plan release of the site for unrestricted use. Release criteria for DU is 35 pCi/g for soils. The RC will determine the extent to which the site is contaminated above this level. The initial survey will be limited to the boundaries of affected area shown in Figure 2. However, the survey may extend beyond the site if the boundary levels exceed 35 pCi/g.

1.5 GIS FILE

Base maps shown in the figures in this work plan come from the APG Geographical Information System (GIS). Please note that the maps in this work plan reflect the historical data rather than current site conditions. Some changes to the maps were made based on visual observation, interviews, and review of site documents.

1.6 FIELD EXAMINATION

In preparation for this work plan, a preliminary field examination was conducted in July 1995. This examination was conducted to visually check ground conditions at suspect areas and sampling locations, locate areas needing investigation, and to verify site conditions.

1.7 DATA OBJECTIVES

Data quality objectives are detailed in the sample analysis plan (GWP, Section 8). Specific objectives which will be met by data collected during the RC are summarized below:

- Determine whether radiological contamination of soils and structures exists at DUSA.
- Acquire data to be used by the APG HPO to determine if remediation is required.
- Integrate data into a comprehensive GIS database which may be used to facilitate the feasibility study and license termination.

- Determine the volume of soil requiring remediation, if DUSA is found to be contaminated.

- Determine the extent of structure contamination and, if contaminated, determine possible remediation strategies.

SECTION 2
AREAS FOR REMEDIAL INVESTIGATION

2.1 GENERAL

The Transonic Range DUSA, located on the southeast end of the Transonic Range was used for DU testing from 1973 through 1979. DU penetrators were gun launched from two areas north of X-ray 1 and 2 and struck targets adjacent to the X-ray units. Backstops were located behind the targets. Materials, soils and structures may be contaminated from the testing. Storage activities of shot target and other contaminated material may have spread the contamination to areas beyond the initial storage site.

2.2 SITE DESCRIPTION

Figure 2 shows site details collected from GIS, interviews with range personnel and review of site documents. The 12 acre site contains the following:

- X-ray 1 Structure and Supports
- X-ray 2 Structure and Supports
- Backstops behind X-ray 1 and 2
- Building 740 A7 (Electronics)
- Target Supports
- Stripper Plates
- Bomb Safe
- Backstop for the Transonic Range
- Security Container

Each of the structures known as X-ray 1 and 2 contain a U.S. Army equipment trailer. The walls and roof of the structures are constructed of plate steel, two inches thick. The floors are gravel.

The ground below the target support structures and the backstops is also gravel. There is sufficient space underneath support structures to collect soil samples.

DU was stored in a metal structure. Since operations have ceased, the metal structure used for DU target storage has been moved to a location west of the Transonic Range Building (740 C). Previously, the DU target storage building was situated near the current location of the Security Container. The Security Container is an unaffected structure.

The Catch Box, Backstops, Stripper Plates and Target Supports are not thought to be contaminated; however, site work will involve scoping surveys to determine future needs. The Catch Box for the Transonic Range should be classed as an unaffected structure. Interviews indicate that DU penetrators were not fired from the Transonic Range into the Catch Box. The original Backstops are thought to have been disposed at a licensed facility.

Approximately seven years ago the Range Chief had black plastic laid on the east side of the site from 740 A7 to the tree line to the east, to the Bomb Safe to the north, and to the path for X-ray 1 to the west. A 4 to 8 inch layer of gravel was laid over the plastic. Weathering and erosion has caused grass to grow over the area.

Also about 7 years ago, the swampy area to the north of the firing positions was covered with 2 to 4 feet of soil to allow guns to be moved further away from the targets.

Previously, ARL conducted soil sampling from 1973 to 1978, and in 1991. Analytical results for soil samples collected from several areas showed levels in excess of the release criteria for unrestricted use of 35 pCi/g. Most of the soil contamination was found in an area posted as a Radioactive Materials Area on the southeast side of the site. A roped area bounds a known shot target storage site from which target was packaged and shipped to a licensed disposal site. Of the 165 soil samples collected from this area, 37 were greater than the 35 pCi/g limit. Concentrations ranged from background to 520 pCi/g.

The areas behind the backstops show soil concentrations below the limit for free release with few exceptions. Soil samples collected in and around remaining site structures are below the release limit.

SECTION 3
PLANNED WORK

3.1 GENERAL

This section describes the details of planned work for the RC. The results of the RC will be used to determine if remediation is required of the soil or structures. Work will proceed as follows at the 12-acre site.

- Site clearance of test debris and foliage.
- Surface survey for unexploded ordnance (UXO).
- Establishment of a 200-foot by 200-foot grid.
- Surface survey for radioactive contamination to delineate areas >35 pCi/g.
- Geophysical survey using EM 61 survey of site to identify locations of buried objects.
- Radiation survey of five structures to determine extent of contamination.
- Soil sampling to delineate boundaries of areas >35 pCi/g.

3.2 SITE CLEARANCE

Numerous metallic and wood articles and debris litter the DUSA. In order to delineate surface objects from buried objects, it is necessary to move materials and equipment so that the site can be effectively characterized. It will also be necessary to cut foliage as close as possible to the ground. This will enable the greatest sensitivity for radiation surveys. Site clearance will be the responsibility of ARL.

3.3 SURFACE SURVEY FOR UXO

The 12-acre site was used to test projectiles containing DU. Therefore, the potential exists that UXO may reside at the site. In addition, the DUSA is located in an area where munitions testing continues. Therefore, it is likely that UXO lie within the DUSA.

UXO surveys will be conducted of the entire site by Human Factors Applications (HFA), a General Physics subcontractor. HFA will use hand held magnetometry instruments to complete the survey. Duration of the surveys for UXO is expected to last 10-12 days. HFA's work plans and procedures for conducting the surface surveys for UXO are found in Appendix A.

HFA will also be subcontracted for all intrusive work. Intrusive work includes establishing a reference grid and the collection of soil samples.

3.4 REFERENCE GRID

Following UXO surface surveys, KLS Consultants, Inc. (KLS) will locate 24 grid points at the site. These points will be established at 200-foot by 200-foot intervals throughout the 12-acre site. Stakes will be driven at each node. HFA will survey each node location to verify the stake will not impact underlying UXO. Node points will be recorded and placed on the site map for future reference. KLS will use the map in Figure 3 to establish the grid for the site.

3.5 RADIATION SURVEYS

The RC will commence with a surface survey for DU contamination. Survey sweeps of the site will be conducted at approximate intervals of 18 inches with a field tested gas flow proportional counter by a General Physics subcontractor, Chemrad. Data regarding count rate is to be communicated to an on-site computer that will plot count rate from the detector in the x and y direction. Chemrad will conduct the radiation surveys of the ground. Chemrad's work plan, QA/QC and Health and Safety Plan are found in Appendix B. The duration of the radiation survey is anticipated to last 10 to 12 working days. Chemrad's procedure is found in Appendix B.

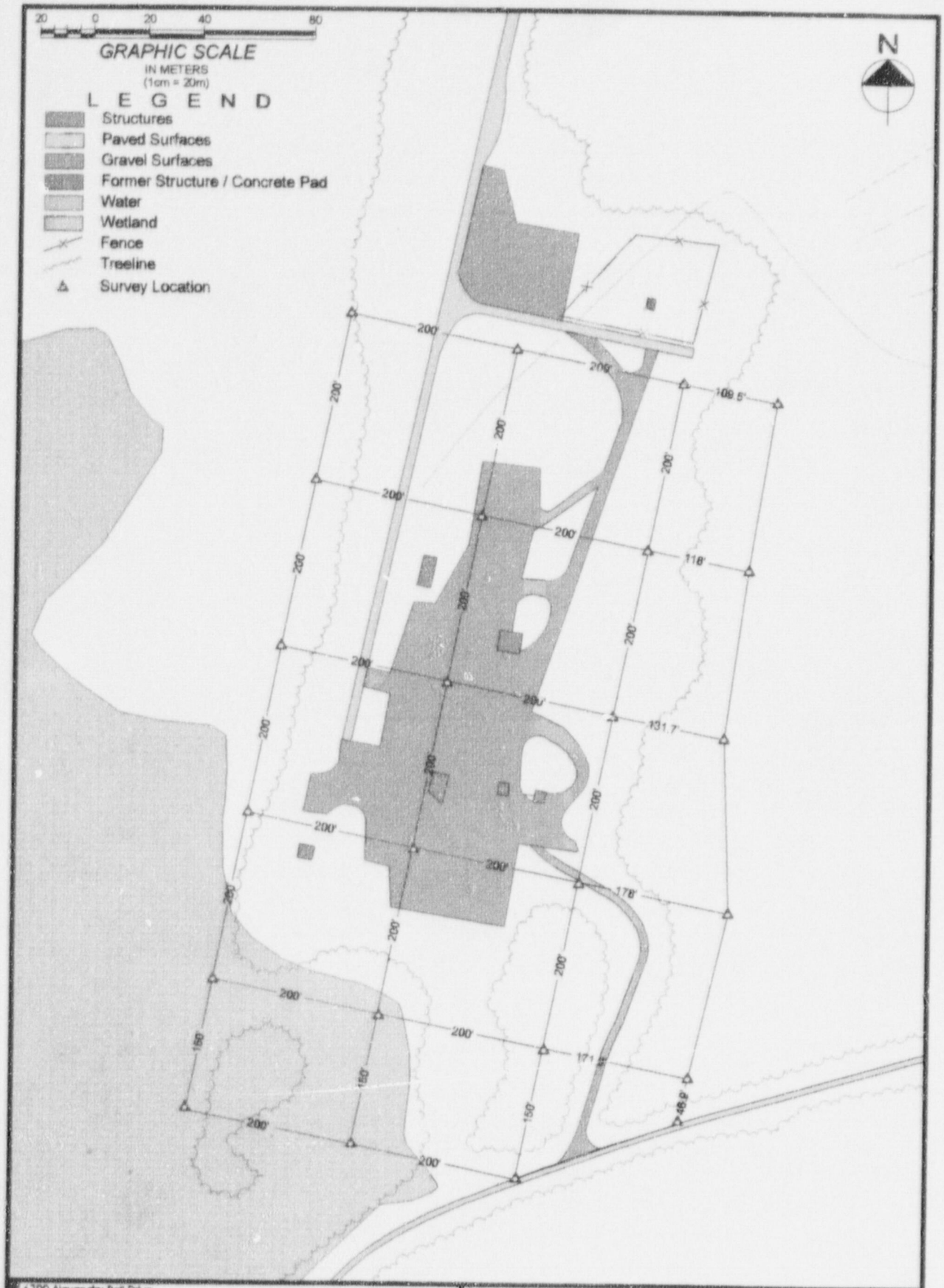
3.6 ELECTROMAGNETIC SURVEYS

Chemrad will also conduct an electromagnetic radiation survey for buried target. The method of choice to detect buried metallic objects is EM 61. Chemrad will be conducting the EM 61 survey. The procedure is found in Appendix B. Their work plan, QA/QC plan and Health and Safety Plan are included in Appendix B. The EM 61 survey will be conducted in areas where radioactive contamination is confirmed during Radiation Surveys. The EM 61 Survey will be conducted remotely at a distance of 345 meters in order to protect the operator from UXO hazards.

3.7 STRUCTURE SURVEYS

A total of five structures were used during DU testing. These structures are X-ray 1, X-ray 2, Electronics in 740 A7, Bomb Safe and Target Storage. These structures will be surveyed for fixed and removable contamination using the procedure found in Appendix C. General Physics and Chemrad will perform the surveys. The planned duration is five working days.

This Page is Intentionally Blank



6700 Alexander Bell Drive Columbia, MD 21046 (800) 395-4516 GENERAL PHYSICS CORPORATION	TITLE: Transonic Range - DU Study Area Survey Locations
CLIENT / SITE: APG - Aberdeen Area	DRAWN BY: B. JOYCE CHECKED BY: B. PARRISH DATE: 10/24/95 FIGURE: 3

3.8 SOIL SAMPLING

Once the surface radiation surveys of site and structures are completed, confirmatory soil samples will be collected to verify boundaries of areas greater than 35 pCi/g. Soil sample locations will be biased based on the results of Chemrad's radiation survey of the soils. Up to 100 soil samples will be collected to characterize the site. Workers will conduct radiation surveys of soil sample locations, collected soils, and personnel during the collection process to reduce the possibility of contamination. The soil sampling procedure is found in Appendix D.

Appendix A
HFA Work Plan

REC. 17 OCT 95

HUMAN FACTORS APPLICATIONS, INC
ORDNANCE & EXPLOSIVE WASTE REMEDIATION

UNEXPLODED ORDNANCE (UXO) SITE OPERATIONS

WORK PLAN

AND

SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

CONTRACT # DAAD05-93-D-7053

CLIENT NAME: U.S. ARMY, ABERDEEN PROVING GROUND, MARYLAND

PRIME CONTRACTOR: GENERAL PHYSICS CORPORATION

PROJECT TITLE: UXO SUPPORT FOR TRANSONIC RANGE, ENVIRONMENTAL SERVICES PROJECT SITE

PROJECT LOCATION: ABERDEEN AREA OF ABERDEEN PROVING GROUND

DATE PREPARED: 10-16-95 PREPARED BY: Marcus T. Reed

SAFETY REVIEW DATE: 17 Oct 95 APPROVED BY: For [signature]
17 Oct 95
Chief, Installation Safety Division
Directorate of Safety, Health,
and Environment

PROPRIETARY DATA NOTICE

PROPRIETARY INFORMATION - This document contains Human Factors Applications, Inc. proprietary information. The information contained in this document includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed -- in whole or part -- for any purpose other than to evaluate this document. In conjunction with the contract award for this project, the Government shall have the right to duplicate, use, or disclose their data to the extent provided in the contract. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. Disclosure or distribution of the information contained in this document to other private corporations or individuals is prohibited by law. All of the information in this document is subject to this restriction. (1966 DEC)

TABLE OF CONTENTS

SECTION 1. WORK PLAN

1.0 INTRODUCTION I-1

1.1 PROJECT I-1

1.2 BACKGROUND I-1

2.0 SITE CONDITIONS II-1

2.1 PHYSICAL SETTING II-1

2.2 RESULTS OF PREVIOUS INVESTIGATIONS II-1

3.0 UXO OPERATIONS III-1

3.1 UXO SITE SURVEY III-1

3.2 FOLLOW-ON UXO SERVICES III-5

3.3 UXO DENSITY REPORT III-5

4.0 MANAGEMENT IV-1

4.1 STAFFING IV-1

4.2 PROJECT SCHEDULE IV-1

SECTION 2. SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

5.0 SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP) V-1

5.1 REGULATORY REQUIREMENTS V-1

5.2 SAFETY AND HEALTH POLICY V-1

5.3 RESPONSIBILITIES V-1

5.4 TRAINING V-3

5.5 MEDICAL SURVEILLANCE V-4

5.6 DOCUMENTATION V-5

5.7 PERSONNEL PROTECTIVE CLOTHING V-6

5.8 GENERAL SAFE WORK PRACTICES V-6

5.9 EMERGENCY SERVICES V-8

5.10 EMERGENCY SITE RESOURCES V-9

5.11 AMMUNITION COLOR CODING V-12

SECTION 3. DETECTION EQUIPMENT

6.0 DETECTOR CAPABILITIES VI-1

6.1 DETECTORS VI-1

SECTION 4. ENVIRONMENTAL PLAN

7.0 ENVIRONMENTAL PLAN VII-1

7.1 OVERVIEW VII-1

7.2 SITE CONDITION SURVEY VII-1

7.3 ENVIRONMENTAL PROTECTION VII-2

7.4 CONTAMINATION CONTROL MEASURES VII-3

7.5 SPILL CONTROL VII-3

7.6 POSTUXO OPERATIONS CLEANUP VII-3

SECTION 5. QUALITY CONTROL PLAN

8.0 QUALITY CONTROL PLAN VIII-1

8.1 QUALITY CONTROL VIII-1

8.2 EQUIPMENT VIII-1

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

8.3 ON-SITE INSPECTIONS VIII-1

8.4 EXCAVATIONS VIII-1

8.5 POSTDETONATION CRATER INSPECTIONS VIII-1

8.6 RANDOM SITE UXO QC CHECKS VIII-2

SECTION 1.

WORK PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1.0 INTRODUCTION

1.1 Project - Human Factors Applications, Inc. (HFA), has been contracted by General Physics Corporation, to provide unexploded ordnance (UXO) services for the Transonic Range environmental project site on the Aberdeen Area of Aberdeen Proving Ground (APG), Maryland. In support of this project, HFA will provide the following services:

A. UXO Surface/ Subsurface Survey Searches - Prior to any environmental activities taking place on the Transonic Range Project Site, HFA will perform a surface/ subsurface search of approximately 12.5 acres.

B. Follow-On UXO Services - The follow-on services listed below will be performed after the UXO Surface Survey search has been completed.

- All excavations (trenches, man holes, footers, auger holes, monitoring wells, soil sampling, etc.) will be rechecked with magnetometers at each 2-foot increment of excavation, i.e. at the 2', 4', 6', 8', 10' levels.

This UXO Work Plan (WP) and Safety, Health, and Emergency Response Plan (SHERP) describes the overall scope of the project and the general methodology to be used.

1.2 Aberdeen Area Background - The Aberdeen Area is the main Aberdeen Proving Ground complex. This area has been used extensively for testing of both foreign and domestic conventional munitions. As a result of the munitions testing, this area is heavily contaminated with unexploded ordnance (UXO). A number of tenant organizations employing both civilian and military personnel are located on the Aberdeen Area. The installation facilities include office/administrative areas, military family housing areas, military school facilities, laboratories, training areas and range/test areas. Many different military operations are presently carried out on the Aberdeen Area.

1.2.1 Project Site Background - The Transonic Range is used for testing of high velocity weapons.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

2.0 SITE CONDITIONS

2.1 Physical Setting - The Transonic Range is located within the active firing ranges on the Aberdeen Area of Aberdeen Proving Ground. The Transonic Range consist of mixed woods, brush, and grass. The Government has assigned hazard Category II to this site. There is a possibility that UXO/HTRW could be encountered on this site.

2.2 Results of Previous Investigations - HFA previously searched sites throughout the Aberdeen Area. All types and sizes of UXO have been found to include mortars, projectiles, and WWI bombs. It is virtually impossible to predetermine the types or quantities of UXO or non-UXO materials that could be located during HFA UXO operations on the project site.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

3.0 UXO OPERATIONS

3.1 UXO Site Survey - The following is a general outline of the HFA UXO services that may be required to support the Transonic Range Project.

A. All HFA UXO activities will be coordinated with the following organizations and activities:

1. General Physics Corporation (Mr. Bruce Parrish, [410] 290-2512)
2. Aberdeen Area Environmental Project Sites - DSHE Edgewood Safety Office (Ms. Pat Barber / Mr. Randy Rexrode, [410] 671-4839/3660)
3. U.S. Army Tech Escort (EOD Section, [410] 671-4381/4383)
4. Ordnance & Explosive Waste Remediation, Human Factors Applications, Inc. (Mr. Sam Hooper, [301] 705-5044)

B. Only qualified U.S. Military Explosive Ordnance Disposal (EOD) personnel and HFA UXO personnel will be permitted in the project area during UXO search or excavation activities. When and if required, temporary barricades will be used to control access to the project site. The dates and time of restricted access to the project area in conjunction with the placement of the barricades will be coordinated through the APG Safety Offices.

1. The Aberdeen Area Safety Office has issued instructions that all UXO services on the Aberdeen Area are to be performed in accordance with the following ordnance avoidance requirements:

   a. Construction Sites - All areas of disturbance on a construction site are to receive a surface and subsurface search for UXO. Because the building site and all of the associated construction areas are in fixed locations, there is no latitude for moving the area to avoid ordnance.
   b. Utility Routes, Trenches, and Fencing Projects - These projects follow preestablished lines that have been surveyed. These projects will receive a surface and subsurface search for UXO as they are laid out.
   c. Designated Access Routes - On some projects, the access routes selected by the Contracting Officer (CO) or Contracting Officers Representative (COR) will have to be searched as they are laid out. If heavy surface and subsurface contamination is encountered on the designated route and a less contaminated route is available, this alternative can be submitted to the CO or COR. If the CO or COR states that the designated route cannot be moved to the less contaminated route, the more heavily contaminated route will have to be searched.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

d. Undesignated Access Routes - Some projects will allow for selection of less contaminated access routes. The access route may be for a footpath or for vehicle access.

(1) Vehicle Access Routes - Vehicle access routes are 15 feet in width. This allows for most vehicles to have access to the site. Using the method of selecting the least contaminated access route involves several considerations.

(a) Turning Radius of the Vehicle - In some cases, the turning radius of the vehicle may be very narrow and a route with tight turns may be acceptable. If the vehicle requires a wide turning radius, sharps turns in the access route may not be acceptable.

(b) Terrain Features - Some ares may have gullies, streams, or fallen trees which will restrict the access route selection.

(2) Footpaths - The footpath is the easiest access route to meet the ordnance avoidance requirements. The paths must be well marked and all personnel using them must be advised that they are not to enter areas outside of the marked footpath.

(3) Due to the time constraints for each project, on the sites where the access routes are undesignated, a quick visual and magnetometer scan will be performed to identify which route is the best route into the site. If the site is uniformly contaminated with surface and subsurface objects, the most direct route into the site will be searched.

e. Monitoring Well/Soil Boring Sites - Due to the size of the drill rigs used to augur the monitoring wells/soil boring sites, a radius of 50 feet around the drill location most be searched and cleared of UXO to allow the rig to maneuver on the site.

f. If while searching an access route or any other type of UXO search area, a UXO is observed on the surface in an area that is inside or outside of the search area, ***this items must be marked and immediately reported.***

NOTE: ***The 100 meter exclusion area may not be obtainable due to occupied buildings or other structures where the government has elected not to shut down operations. If the 100 meter exclusion area cannot be obtained, it will be noted in the Daily Operations Journal.***

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

C. In accordance with 29 CFR Part 1910.120, paragraph (d)(2) "Buddy System,", the HFA UXO search/excavation team (consisting of two UXO Specialists of which one holds a Master EOD rating) will conduct electronic surface and subsurface search of the project site. During UXO operations a 100 meter radius exclusion area will be in effect during intrusive UXO activities. During intrusive UXO activities, no UXO/non-EOD personnel will be permitted within the 100 meter exclusion area. If anyone enters the exclusion area, all UXO intrusive activities will be halted. In conjunction with the UXO search, the HFA UXO team will perform the following steps:

1. Identify and mark the boundaries of the project site areas within which the UXO Surface Survey search will be performed. The boundaries will be marked with orange survey markers.

2. Using visual \ electronic surface and electronic subsurface location techniques, and excavation as required, locate and identify UXO within the boundaries of the project sites. When a UXO is located, (depending on the UXO category, the following actions will be carried out:

   a. Explosive, Chemical, Propellant, or Pyrotechnic Loaded UXO - The location of the UXO will be marked with a yellow survey marker. The client project manager and on-site Government representative will be notified of the presence of UXO. The following UXO reporting procedures will be utilized for each of the designated areas:

      (1) All UXO will be immediately reported to the Aberdeen Area Emergency Center by dialing 911 from a Government, commercial, or cellular telephone. If 911 is dialed from a commercial telephone or cellular phone, the call will go into the Harford County Emergency Center, the area of UXO services must be identified (e.g. Aberdeen Area of APG) and the Harford County 911 operator will reroute call to the proper switchboard. The location of the UXO will be provided, and HFA personnel will standby until such time as the Aberdeen Area authorities assume responsibility of the site.

NOTE: ***If the project site is on an ATC range/test area, the APG Emergency Center will not be notified. All UXO located in ATC areas will be reported to ATC Range Control.***

ATC Range Control - Notify by radio or by dialing Government 3-2792 or Commercial 278-2792

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

An administrative telephone call will be made to the APG Safety Office Government 3-4756/4757 or commercial 278-4756/4757 and the Edgewood Safety Office Government 5-3660/3157 or commercial 671-3660/3157.

b. Nonexplosive loaded ordnance components - These items will be collected and stored in a designated location for pick up by U.S. Army Tech Escort EOD personnel at their convenience. Items in this category would include but not be limited to the following types of ordnance/residue:

(1) Armor Piercing (AP) projectiles
(2) Empty ejection munitions
(3) Spent rocket motors (when found separated from warheads)
(4) Nonexplosive loaded training munitions

c. Miscellaneous metallic debris - These items will be collected and stored in a designated location for pick up by Government personnel at a later date.

3. Record the location of all UXO and UXO components in a log book.

D. All necessary "ground penetrating" magnetometry & electromagnetic pulse induction search equipment (29 CFR Part 1910.120, paragraph (j)(1)(ix), "Ground Penetrating System"), hand excavation equipment, and other materials required to conduct a surface/subsurface UXO survey will be provided by HFA.

E. HFA UXO personnel requirements:

NOTE: ***During all hazardous operations related to searching for UXO or any hazardous UXO/explosive-related service, a minimum of two (2) qualified UXO Specialists (29 CFR 1910.120, paragraph (d)(2) "Buddy System"); one (1) of whom is a Master rated EOD technician will be required to perform these services.***

NOTE: ***Most of the projects performed by HFA UXO on the Aberdeen Area of APG are performed by a two (2) person UXO team. The Project Leader also acts as the UXO Site safety Officer. If requested or directed to do so by the Government or prime project contractor, additional teams will be provided to work on site. If due to circumstance beyond the control of HFA the scope of the project is increased and the hazards associated with the site are also heightened, a full time UXO Site Safety Officer may be required.***

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1. Search and marking operations - Two teams consisting of one (1) Project Leader/UXO Site Safety Officer (Master EOD rated) and three (3) UXO specialist
2. UXO excavation operations - Two teams consisting of one (1) Project Leader/UXO Site Safety Officer (Master EOD Rated) and three (3) specialist

3.2 **Follow-On UXO Services** - The following HFA UXO services are required to support the soil sampling requirements in this areas.

- Perform magnetometer subsurface checks for UXO at each of the sampling sites.
- Assist in the collecting of the soil samples at each of the sampling sites
- Other services as deemed necessary by General Physics or the Government

3.3 **UXO Density Report** - Upon completion of the basic UXO search operation, a copy of the UXO Density Report will be provided to the client and the Aberdeen Safety Office.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 2.

SAFETY, HEALTH AND EMERGENCY RESPONSE PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

4.0 MANAGEMENT

4.1 Staffing - This section contains a listing of project staff personnel as related to this project.

Director of Operations - Samuel J. Hooper Sr.: Mr. Hooper is responsible for the effective day-to-day management of the project staff; direct communication and liaison with client; technical approach and review of deliverables; management of resources, schedules, and budgets; and coordination among the general and technical support functions.

Project Leader - To Be Determined: This individual is responsible for the on-site management of UXO services and site UXO safety. His responsibilities include coordination and direction of all UXO site operations.

4.2 Project Schedule - UXO services will be performed in accordance with the posted client's schedule of operations.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

5.0 Safety, Health, and Emergency Response Plan (SHERP)

5.1 Regulatory Requirements - Occupational Safety and Health Administration (OSHA) standards 29 Code of Federal Regulations (CFR) 1910 and 1926 apply to work performed under this Safety, Health, and Emergency Response Plan (SHERP). Specific sections of 29 CFR part 1910 that apply include 1910.120, Hazardous Waste Operations and Emergency Response; 1910.134, Respiratory Protection; 1910.1000, Air Contaminants; 1926.602, Material handling equipment; and 1926.652, Specific Trenching Requirements. Additional U.S. Army requirements governing this work are included in the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 385-1-1) and the U.S. Army Material Command (USAMC) Safety Manual, AMC-R 385-100.

5.2 Safety and Health Policy - The purpose of this SHERP is to protect workers and other on-site personnel, the public, and the environment from hazards associated with site activities and potential site contaminants. This SHERP includes preventive and protective measures against health, physical, fire, and explosion hazards that may exist or occur during UXO search operations. It is the policy of HFA management and a contract requirement that all work be performed according to this SHERP. All HFA personnel and subcontractors will be familiar with the SHERP and will adhere to the SHERP at all times.

5.3 Responsibilities - Responsibilities of the Director of Operations, HFA UXO Safety Officer, UXO Project Leader, and UXO crew will be in accordance with HFA standard practices. Other contractors for this project are subject to the same requirements and responsibilities as field team members.

5.3.1 Director of Operations - Samuel J. Hooper, Sr. - The Director of Operations is responsible for overall project safety. The responsibilities of the Director of Operations include:

A. An effective and comprehensive SHERP is prepared for the project;
B. Adequate and appropriate safety training and equipment are available for project personnel; and
C. Project personnel are medically monitored and qualified for their involvement in the project.
D. Categorizing and identifying the hazards and associated risks for the conditions and activities to be encountered on-site; and
E. Reviewing reports of incidents related to project activities.

5.3.2 UXO Safety Officer - (To be determined) (additional duty for UXO Project Leader on this project) - The UXO Safety Officer is responsible to the Director of Operations for the health and safety of personnel during site activities. Responsibilities of the UXO Safety Officer include:

A. Implementing all safety procedures and operations on-site;
B. Updating equipment or procedures based upon new information gathered during the

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

site inspection;

C. Upgrading or downgrading the levels of personnel protection based upon-site observations;
D. Determining and posting locations and routes to medical facilities (including poison control centers) and arranging emergency transportation to medical facilities (as required);
E. Notifying (as required) local public emergency officers (i.e., police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members;
F. Ensuring that at least one member of the field team is available to stay behind and notify emergency services if the UXO Project Leader must enter an area of maximum hazard, or entering this area only after notifying emergency services (Emergency Center);
G. Observing work party members for symptoms of on-site exposure or stress; and
H. Arranging for the availability of on-site emergency medical care and first aid as necessary.

The UXO Safety Officer has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace or causes significant adverse impact to the environment.

The UXO Safety Officer has experience supervising personnel and functioning as an UXO Safety Officer at hazardous waste sites. He has completed the site supervisor training required under 29 CFR 1910.120

5.3.3 **UXO Project Leader - To Be Determined** - The UXO Project Leader is responsible to the Director of Operations for all operational activities on-site, as well as for all safety and health practices by site personnel. The responsibilities of the UXO Project Leader include:

A. Ensuring and enforcing compliance with the SHERP;
B. Controlling site entry of unauthorized personnel or coordinating with local law enforcement agencies or state authorities to limit site access;
C. Coordinating site activities so that they are performed in an efficient and safe manner consistent with the SHERP;
D. Enforcing the buddy system on-site; and
E. Ensuring the ready access and availability of all safety equipment.

5.3.4 **UXO Crew Member(s) - To Be Determined** - HFA employees are responsible to the UXO Project Leader and the UXO Safety Officer for all activities on-site. The responsibilities of UXO survey crew member(s) include:

A. Complying with all aspects of the SHERP, including strict adherence to the buddy system;

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

B. Obeying the orders of the UXO Project Leader and the UXO Safety Officer; and
C. Notifying the UXO Project Leader or UXO Safety Officer of hazardous or potentially hazardous incidents or working situations.

5.3.5 Site Visitors - Visitors and governmental agency representatives are required to comply with all provisions of the SHERP and may be responsible to the UXO Project Leader and UXO Safety Officer. The responsibilities of site visitors include:

A. Complying with all aspects of the SHERP, including strict adherence to the buddy system; and
B. Obeying the orders of the UXO Project Leader and UXO Safety Officer.

5.3.6 Client Contacts - (see paragraph 3.1.A.) - The client contacts are the individuals serving as the primary liaison between the clients and the HFA Director of Operations/UXO Project Leader. All HFA project personnel and subcontractors are directly or indirectly responsible to the client. However, the client contact must comply with all applicable portions of the SHERP when in areas covered by its provisions. In case of immediate on-site difficulties, the Ordnance & Explosive Waste Remediation Office (Telephone (301) 705-5044) will be contacted.

5.4 Training - In accordance with HFA standard practices, all HFA site personnel will have completed training required by 29 CFR 1910.120. All HFA site personnel working on the site investigation will have completed an extensive training course and have worked at least three (3) days at a hazardous waste site. The course, designed to meet training requirements of 29 CFR 1910.120, is taught using in-house expertise. The course consists of an initial 40-hour session and annual refresher courses of eight (8) hours. The UXO Project Leader will have completed an additional eight (8) hours of waste site management training. The following topics are covered in the HFA Hazardous Waste/Materials Site Investigations Training, Annual Refresher, and Supervisor Training Courses:

<u>Hazardous Waste/Materials Site Investigations Training Course</u>

Safety plans
Fundamentals of industrial hygiene
Properties of hazardous materials/compatibility testing, shipping, and handling of samples/chain of custody
Levels of personnel protection
Hotline systems
Decontamination operation
Emergency response
Air-purifying respirators and fit-testing air-supplying respirators
Field exercise, air-purifying respirators, and self-contained breathing apparatus (SCBA), levels A, B, and C
Field exercises (site zones and sampling operations)

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

Confined space entry
Review of regulations
Engineering controls

Annual Refresher

Regulations review
Properties of hazardous materials
Safety plans
Levels of protection
Review of instruments
Transportation
Respiratory protection
Site control/decontamination
Emergency preparedness/prevention
Review and quiz

Supervisor Training Course

Site safety requirements and responsibility
Medical monitoring program
Respiratory protection program
Air monitoring
Regulations--OSHA/Resource Conservation and Recovery Act (RCRA)/Superfund
mendments and Reauthorization Act (SARA), and Hazard Communication
Shipping and handling
Costs of hazardous site work
Problems encountered during site work

Site-specific training will be given by the UXO Project Leader or HFA UXO Safety Officer to inform the UXO team members of site-specific hazards and hazardous activities. Training will be provided prior to site entry, each morning before work begins, and after all project field activity has been completed.

Specific UXO related site safety training will be provided by HFA to all other contractor personnel working on this site. No personnel will be permitted to work on this project site until they have received this training.

5.5 **Medical Surveillance** - All HFA site personnel will be subject to the HFA medical surveillance program for hazardous waste site workers. This program was designed in accordance with the recommendations found in the National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Operations, and meets the requirements of 29 CFR 1910.120. Physician

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

statements of findings are kept in employees' personnel files and will be available for review. The following examinations are covered in the Medical Examination and Monitoring Program.

A. Basic physical exam
B. Heart status and functions (electrocardiogram {EKG})
C. Chest X-ray (Roentgenogram posterior-anterior)
D. Pulmonary function-forced vital capacity, forced expiratory volume at 1 second and reserve volume
E. Blood-full SMAC Series

1. Hemoglobin-cell counts, protein levels
2. Acetylcholinesterase activity
3. Heavy metals
4. PCB in serum

F. Liver function-full enzyme profile
G. Renal function-blood, urea, nitrogen (BUN), creatinine, creatine/ Creatinine ratio, lipoprotein count and differential, uric acid
H. Urinalysis
I. Audiometry-audio spectrum response of ear
J. Eye-physical condition, visual acuity.

5.6 **Documentation** - Personnel and environmental monitoring will be made part of the permanent project record. Monitoring records will be kept in accordance with 29 CFR 1910.20 and standard HFA practices. Training and medical records for HFA personnel are available for inspection as required. Subcontractors are required to have training and medical records available for inspection as required by HFA and client representatives.

5.6.1 **Acknowledgement** - All workers and site visitors must read, understand, and agree to comply with all provisions of this WP/SHERP prior to entering into the exclusion zone during intrusive UXO activities. Each worker and site visitor must be briefed and have read this document before they will be allowed on the site. Acknowledgement and compliance with this requirement is indicated by each individual's signature on the HFA "ON-SITE SAFETY MEETING" form in the Daily Operations Journal. ***NO ONE WILL BE ALLOWED ON ANY HFA UXO WORK SITE DURING INTRUSIVE OPERATIONS WHO HAS NOT MET WITH THESE REQUIREMENTS.*** The following guidance will be used to determine who is required to read and comply with this WP / SHERP:

A. All personnel entering the work site exclusion area (100 meter radius of the intrusive activity) where intrusive UXO activities are taking place, must have reviewed the WP / SHERP and must sign the HFA "ON-SITE SAFETY MEETING FORM" in the Daily Operations Journal. Examples of personnel required to do so are listed below:

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

1. All HFA UXO technicians.
2. Well drillers or environmental technicians taking samples in conjunction with bore hole magnetometer operations.
3. Industrial health personnel monitoring UXO excavations.
4. Any personnel such as, Government inspectors, safety personnel, environmental personnel, Government personnel, contractor or subcontractor personnel, etc., who have a valid need for entry on to the site.

NOTE: ***If someone insists on entry to the work site exclusion area and refuses to comply with this requirement, all site operations will be halted. For sites on the Aberdeen Area, the APG Safety Office will be notified by calling 278- 4756/4757. UXO intrusive operations will not be resumed until such time this issue is resolved.***

B. Personnel with a valid need to enter the site during magnetometer search and marking operations, during which no intrusive UXO activities are being performed, may enter the site without being required to comply with the WP / SHERP requirements, however, they should be briefed and escorted while on the site.

C. Government emergency personnel responding to the site for a UXO incident or some other type of emergency, will assume responsibility for the site and HFA will no longer be responsible for entry control to the site.

5.7 Personnel Protective Clothing - For the miscellaneous environmental and construction project sites, the HFA UXO team will normally work in a modified Level D PPE during the performance of the basic UXO site search. The equipment listed below comprises the HFA PPE Level D for this project.

A. Normal work clothes (long pants and shirt)
B. Gloves (leather)
C. Boots (leather, non-steel toe) - Due to sensitivity of magnetometers steel toed boots will not be worn during UXO search operations.
D. Hard hat (optional, as required) - Hard hats will not be worn while performing UXO services except for when these services are being performed in conjunction with heavy equipment (backhoes, excavators, bull dozers, etc.), in which case, hard hats will be worn by HFA UXO personnel.

5.8 General Safe Work Practices - The following general safety requirements are based on standard UXO precautions and/or specific requirements of the APG/ Edgewood Safety Offices.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

These safety requirements were established during previous HFA UXO operations on the Aberdeen and Edgewood Areas of APG.

A. Only qualified U.S. Army EOD personnel and HFA UXO personnel will be permitted on the site during HFA UXO search and excavation operations.

B. Use of CB radios or other radio communication devices rated above 5 watts will not be permitted during UXO search or excavation operations.

C. All safety precautions related to UXO will be observed.

D. The UXO Project Leader will be in charge of all UXO operations conducted by HFA. Safety responsibilities of the UXO Project Leader and UXO Safety Officer are as follows:

1. When and if required, ensures that all barricades are in place prior to the start of any UXO operations.
2. Ensures that all personnel in the area of UXO operations are qualified UXO personnel.
3. Ensures that adequate emergency fire/rescue, medical, and security support is available.
4. Has absolute authority to stop all operations and order the immediate evacuation of the project site in the event that UXO or suspected UXO is located.

E. General UXO Safety Precautions and Rules - The following safety precautions and rules will be observed by all personnel present on a UXO survey site:

1. Do not go souvenir hunting.
2. Do not pick up or disturb unidentified items.
3. Report all UXO or unidentified objects.
4. Do not excavate any areas until you are sure they have been checked.
5. Do not go outside the boundaries of the access routes or work sites.
6. Do not enter the uncleared areas of the site.
7. Do not carry fire or spark producing devices into the site.
8. Do not smoke except in areas specifically designated for smoking.
9. Avoid inhalation and skin contact with explosives.
10. Remove from the area any person showing evidence of explosive poisoning or dermatitis.
11. Do not allow one person to work alone during any operations in areas contaminated with explosives or related hazardous materials.
12. Prohibit unnecessary personnel from visiting the operations site.
13. Observe static electric precautions when sampling and processing samples.
14. Suspend all operations immediately upon approach of an electrical storm.
15. Do not attempt to extinguish burning explosives or any fire which might involve explosive materials.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

16. If explosive materials are burning or their ignition is eminent, immediately evacuate the area.
17. Have a vehicle in the area in case of an accident or emergency.
18. Have communications equipment in the area in case of an accident or emergency.

5.9 **Emergency Services** - The following emergency services are available on the Aberdeen Area.

Fire Department	Emergency Medical Services
Ambulance	U.S. Army Technical Escort EOD Support
Military Police	Emergency Decontamination Services

A. Emergency Medical Care for Life Threatening or Unknown Situations-As a contractor employee working on APG, emergency medical care for life threatening or unknown medical situations is available at the APG Area Kirk Army Health Clinic. The following procedures will be utilized to request emergency services:

Aberdeen Area - To obtain emergency services on the Aberdeen Area, dial 911from a government, commercial or cellular telephone. If 911 is dialed from a commercial telephone or cellular phone, the call will go into the Harford County Emergency Center, the area of services must be identified (e.g. Aberdeen Area of APG) and the Harford County 911 operator will reroute call to the proper switchboard.

B. Non-Emergency Medical Care - For job related injuries of a non-emergency nature which require a doctors care, the injured person will be transported to Physicians Prompt Care, 2953 Emmorton Road,
Abington, Maryland 21009; telephone no. (410) 569-1919; hours of operation are 8:00 AM to 12:00 PM.

- The clinic is at the intersection of Emmorton Road and Singer Road, in the Boxhill Shopping Center behind the 7-11 Store. (see Figure 5-1. Medical Emergency Routes, block B)

  * From the Aberdeen Area, depart through the Harford Gate, via Route 22 to the Route 95 cloverleaf.
  * Take Route 95 south to Exit 77.
  * Take Exit 77 onto route 24 west (towards Bel Air).
  * Turn east onto Singer Road to Route 924 (Emmorton Road).

If hospital treatment appears more appropriate, Fallston General Hospital and

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

Harford Memorial Hospital are within easy driving distance. Both provide 24-hour service, 7 days a week.

Fallston General Hospital
200 Milton Avenue
Fallston, Maryland
(410) 877-3700

Harford Memorial Hospital
501 South Union Street
Havre De Grace, Maryland
(410) 939-2400

- To Fallston General Hospital (see Figure 5-1. Medical Emergency Routes, block A):
  - From the Aberdeen Area, depart through the Maryland Gate, via Route 715 to the intersect with Route 40.
  - Take Route 40 west to Route 152 (Magnolia Road).
  - Turn right (north) onto Route 152 until it intersects with Route 1.
  - Turn east onto Route 1 and continue for approximately 1 mile to Milton Avenue.
  - Turn left onto Milton Avenue and hospital entrance.

- To Harford Memorial Hospital (see Figure 5-1. Medical Emergency Routes, block C):
  - From the Aberdeen Area, depart through the Harford Gate, via Route 22 to the intersect with Route 40.
  - Go east on Route 40 until it intersects with Old Post Road, Route 7 (Havre De Grace).
  - Exit onto Old Post Road and follow it to until it intersects with Union Street.
  - Harford Memorial Hospital is on the southeast corner of the intersection of Route 7 (Revolution) and Union Street.

C. First Aid - For minor cuts, abrasions, or other minor injuries deemed by the HFA Site Supervisor or Team Leader to be treatable on-site by first aid, will be treated using the site first aid kit.

5.10 **Emergency Site Resources** - The following on-site emergency equipment will be maintained by HFA.

A. One (1) fire extinguisher, rated at least 1A, 10BC
B. One (1) standard industrial first aid kit

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

C. One (1) emergency eye wash kit

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

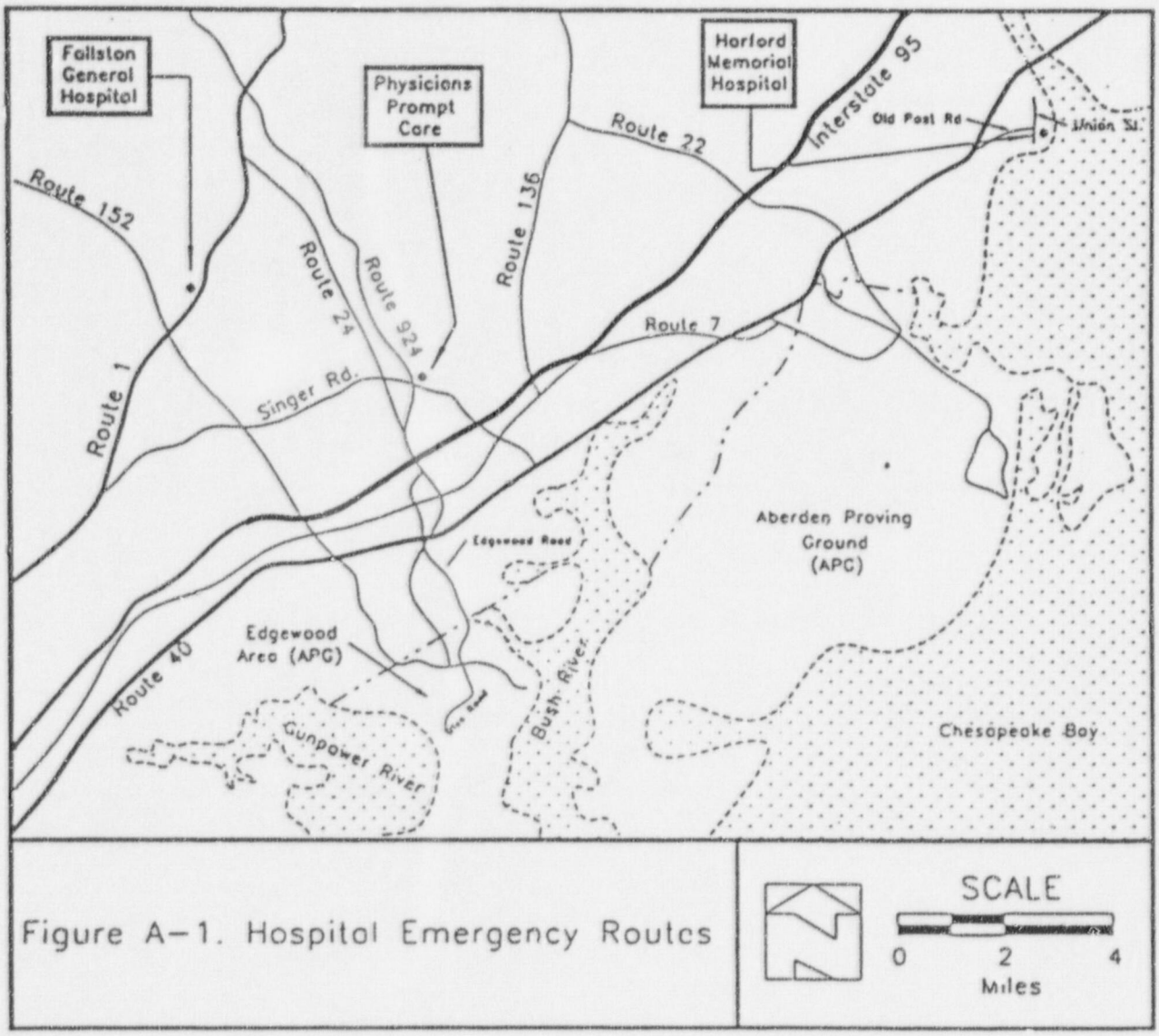


Figure A–1. Hospitol Emergency Routes

Figure 5-1. Medical Emergency Routes

A. Fallston General Hospital
B. Physicians Prompt Care
C. Harford Memorial Hospital

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

5.11 Ammunition Color Coding - The color codes listed below are commonly used to identify ammunition. In most instances due to weathering, the colors will no longer be visible, however on recently fired UXO the markings may still be clear enough for identification of the UXO.

NOTE: ***These color codes are not 100 % reliable. In some cases for testing or experimentation, munitions may have been loaded with hazardous materials. Ammunition may also be encountered which has been incorrectly marked by the manufacturer.***

A. One green band and green printing on a gray background

1. Old color code system - GB, CG, AC, and CK
2. New color code system - CG, AC, and CK

B. Two green bands and green printing on a gray background

1. Old color code system - VX, L, HL, HD, H, and HT
2. New color code system - HD, H, and HT

C. Three green bands and green printing on a gray background - New color code system - G and V Series

D. One red band and red printing on a gray background

1. Old color code system - CN, DM, CS, CN1, DM1, and CS1
2. New color code system - CN, DM, CS, CN1, DM1, and CS1

E. Two red bands and red printing on a gray background - New color code system - BZ AND CS2

F. One purple band and purple letters on a gray background - Old color code system - (Incendiaries) TH, NP, PT1, and PTV

G. One yellow band and yellow letters on a gray background - Old color code system - (Smoke) HC, WP, and PWP

H. One white band and white letters on a gray or olive drab background - Old and New color code system - Illuminating

I. One black band and black letters on a white background - New color code system - Illuminating

J. All printing and markings in black on a light red background - New color code system - (Incendiary) TH, NP, PT1, and PTV

K. All printing and markings in black on a light green background - New color code system - (Smoke) HC

L. All printing and markings in red on a light green background - New color code

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

system - (Smoke) WP and PWP

M. One yellow band and yellow printing on a olive drab background - High Explosive

N. One brown band and brown printing on an olive drab background - Low Explosive

O. White diamonds on an olive drab background - Flechettes

P. Yellow diamonds on an olive drab background - ICM (Submunitions)

Q. Yellow, brown, or white markings on a blue background - High Explosive, Low Explosive, or empty practice munitions

R. Black markings on an orange background - track and recovery munition

S. Any combination of the markings and colors listed above or any strangely painted and marked objects.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 3.

DETECTION EQUIPMENT

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

6.0 DETECTOR CAPABILITIES

6.1 Detectors - In accordance with 29 CFR Part 1910.120, paragraph (j)(1)(x), "ground penetrating systems", HFA will provide all necessary ground penetrating magnetometry and electromagnetic pulse induction search equipment required to conduct a surface/subsurface survey for OEW and UXO. HFA will be using an active all-metals detector and a passive ferrous metals detector on this project for the electronic subsurface search. Based on current state-of-the-art magnetometer technologies, HFA does not guarantee that 100% of UXO will be located on this or any other site.

6.1.1. Electromagnetic (Active All-Metals) Induction Detectors - Active locators, as a class, generate a magnetic field. Their detection ranges are determined by the strength of their magnetic field, the attenuation of the field in the soil, the size and makeup of the items being sought, and the amount of conductive clutter in the search area. These factors tend to limit active detection ranges to two (2) feet or less, depending on the search instrument. A major advantage to this type of detector is its all-metals capabilities. These instruments are capable of detecting ordnance constructed of both ferrous and nonferrous metals. Active locators can affect influence fuzing; therefore, it is necessary to have some knowledge of the types of ordnance and their fuzing systems that may be encountered within the search area. The U.S. Military currently utilizes locators that employ the multiple-coil, balanced bridge, and phase-imbalance types of active locators. The active all-metals detectors listed below are currently used by HFA:

6.1.1.1 White's Eagle II SL 90 - The Eagle II is a multiple-coil active all-metals detector. Additional features include a programmable memory system and a digital display which provides a readout of the items being located and the status of the instrument.

A. Typical Sounding Depth (Detection Capabilities) - Active detectors as a class have very limited detection ranges of three (3) feet or less, depending on the search instrument. Experience has shown that the Eagle II under average conditions will be able to detect a 75 to 81 mm projectile at a depth of 1.5 to 2 feet.

B. Range of Operation - The Eagle II is normally used in its all metals (Prospecting and Relic Hunting Mode) with a sensitivity range of 1 to 7, with 7 being the most sensitive setting. The Eagle II is very unique in that it can be programmed to search for one (1) type of metal. HFA has used this feature on a number of occasions to locate specific types of UXO such as the M72 LAW rocket (all aluminum).

C. Limitations - The same limitations listed below for the Mk 26 Ordnance Locator also effect the performance of the Eagle II.

6.1.1.2 Fisher 1266XB - This is a multiple-coil active all-metals detector. This instrument is similar to the Eagle II with all controls being operated manually.

A. Typical Sounding Depth (Detection Capabilities) - Same as Eagle II

B. Range of Operation - Principle of operation is same as Eagle II, however, instrument

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

settings are different.

C. Limitations - The same limitations listed below for the Mk 26 Ordnance Locator also effect the performance of the Fisher 1266XB.

6.1.2. PASSIVE FERROUS METAL DETECTORS - Passive magnetic locators detect anomalies in the earth's magnetic field which are produced by ferromagnetic (ferrous metal) targets. Generally passive locators respond to either: 1) the magnitude of the magnetic field strength (Proton-Precession) or 2) the gradient or rate of change of the field (Fluxgate). The detection ranges of passive locators are dependent on not only the resolution of the device, but also the magnetic features of both the search area and the item being located. Within the UXO community the standard passive magnetometers in use today are of the Fluxgate and the Proton-Precession types. The passive ferrous metal magnetometers listed below are currently used by HFA:

6.1.2.1. Mk 26 Mod 0 Ordnance Locator (Förster Ferex® 4.021) - This is a Fluxgate type ferrous metals passive magnetometer. HFA has both Ferex L 4.021.03 (Land Version) and Ferex K 4.021.02 (Land, Underwater, and Borehole Version) magnetometers in our equipment inventory. This magnetometer will only detect ferrous metal UXO.

NOTE: The capabilities listed below have been extracted from the Förster Ferex® 4.021 technical manual and are based on clean area laboratory testing procedures and these conditions are rarely encountered in the field. As indicated below in paragraphs 6.1.2.1.B. through C., actual field conditions can and do reduce the depth detection capabilities of the magnetometer.

A. Typical Sounding Depth (Detection Capabilities Under Laboratory Clean Conditions)

1. 13 mm projectile - .25 m (9.8 inches)
2. Mills-bomb - .6 m (23.6 inches)
3. Anti-personnel mine - 1.1 m (43.3 inches)
4. Flat anti-tank mine - 1.5 m (59.1 inches)
5. 88 mm projectile - 3 m (118.1 inches)
6. 100 mm projectile - 3.3 m (129.9 inches)
7. 250 kg (550 lb) bomb - 4.5 m (177.2 inches)
8. 500 kg (1,100 lb) bomb - 6 m (236.2 inches)

B. Range of Operation - The Förster Ferex® 4.021 Search Instrument has four (4) modes of operation. Each mode selected by rotation of the Operating Mode Switch.

1. Operating Mode 1 (switch position 1) - General search tasks for small and large ferrous objects in a relatively clean area. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 1. This is the most sensitive and desirable operating mode; however, when heavy small item metallic contamination such as UXO/target fragments are present, this

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

mode cannot be used. To date, HFA has never performed UXO related services on a project site that was clean enough to allow operation in this mode.

2. Operating Mode 2 (switch position 2) - General search tasks, but primarily to avoid confusion between two magnetic influences where one is much greater than the other. In this mode the larger influence is selected and the smaller is dampened out. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 2. This is the second most sensitive operating mode and is used for search operations when site conditions preclude the use of Operating Mode 1. To date, HFA has performed UXO related services on a limited number of project sites that were clean enough to allow operation in this mode.
3. Operating Mode 3 (switch position 3) - Used when searching in the vicinity of ferrous fences, underground ferrous pipes, or areas heavily contaminated with ferrous objects. There are eight (8) sensitivity levels (0.3 to 1000 gamma) that can be selected in Operating Mode 3. This is the least sensitive operating mode and is used for search operations when site conditions preclude the use of Operating Modes 1 and 2. This is the most often used mode used by HFA when performing UXO services.
4. Operating Mode 4 (switch position 4) - Used to find magnetic north. There are no search capabilities in this mode.

C. Limitations - There are many environmental considerations that can limit the depth of detection (magnetic signatures), i.e., soil characteristics (minerals and salts present), type of metal being detected, size of the metal object, orientation of the object (vertical or horizontal to the linear axis of the object), metallic contamination of the site (widespread fragmentation), and the capabilities of the detector. Activities such as earth removal and tree grubbing can also change the magnetic signatures in the earth. ***With all factors taken into consideration, there are no iron clad measurements regarding the sizes of UXO or depths at which they can be detected.***

6.1.2.2. Schonstedt Model GA-52B - This is a Fluxgate type passive ferrous metals magnetometer. HFA has used the Model GA-52B with a great deal of success for the location of buried UXO. As with the Mk 26 Mod 0, the Model GA-52B will only detect ferrous metal UXO.

A. Typical Sounding Depth (Detection Capabilities) - The Model GA-52B is a commercially available magnetometer with detection depth capabilities comparable to the Förster Ferex® 4.021 Search Instrument listed above.

B. Range of Operation - The Model GA-52B is a very simple instrument to use. Operation of the instrument is governed by an ON-OFF switch and a Sensitivity Control Knob.

C. Limitations - The same limitations listed above for the Förster Ferex® 4.021 Search Instrument also effect the performance of the Model GA-52B.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

6.1.2.3 Schonstedt Model GA-72CV - This instrument is a reconfigured GA-52B with several design upgrades which are described below. All principles of operations and capabilities are the same as those described above for the GA-52B.

A. The GA-72CV has a new plastic case with a handle grip attached.

B. A meter has been added to the instrument which reads in the "+" and " " ranges during operation. This added feature aids in determining the orientation of subsurface objects which are in a horizontal or near horizontal position.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 4.

ENVIRONMENTAL PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

7.0 ENVIRONMENTAL PLAN

7.1 **Overview** - All of the UXO services performed by HFA will have very minimal impact on the site environment. The temporary disturbance of the site during UXO field activities is not expected to produce adverse effects on the surrounding down gradient areas due to increased storm water runoff, nor adversely affect the ecological resources in the area. All work in the area will be performed in a manner that will minimize the release of contaminants and control dust and noise to within reasonable limits. The proposed UXO services will affect only a very small area of APG and will not adversely affect any area beyond APG. Site-specific environmental controls, which will be employed as needed during UXO services, are as follows:

- Minimizing disturbed soil surface areas (all excavations will be performed using shovels, picks, and hand trowels). All excavations performed by HFA will be filled and tamped.

- Avoiding disturbance to trees, shrubs, and ground cover wherever possible.

NOTE: ***In most instances, HFA is on-site with other contractors/subcontractors over whom HFA has no operational control other than UXO safety. HFA is not liable for environmental damages caused by the other contractors'subcontractors. All contractor/subcontractor damages observed by HFA will be duly noted and recorded in the Daily Operations Journal.***

7.2 **Site Condition Survey** - The HFA Project Leader will perform a site condition survey prior to commencing UXO operations. During this survey, the project site area, access route and adjacent areas will be visually examined to note utilities, site improvements, fences, trees, shrubs and other features. The conditions of the items will be noted and included on a hand drawn sketch of the site during the survey of the site. Specific items of interest are:

A. Trees - The physical condition of the trees to include existing damage will be noted.
B. Shrubs and Grassed Areas - The physical condition of the shrubs and grassed areas to include existing damage will be noted.
C. On-Site and Immediate Off-Site Drainage - Existing drainage patterns will be noted, especially areas undergoing active erosion/sedimentation.
D. Access Roads and Haul Routes - The access roads and haul routes will be examined for signs of deterioration and wear, such as potholes, muddy stretches, obstructing debris, and clogged drainage ditches.
E. Drain Culverts - Drain culverts will be checked for crushed sections and blocked openings, and their location will be noted.
F. Fencing - Damaged or missing sections of fencing will be noted.
G. Preexisting Refuse/Debris Accumulations - The location of accumulated refuse or other debris within or adjacent to the project site will be noted.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

A copy of the site condition survey will be provided to the contracting officer (CO) or the designated contracting officer's representative (COR)

7.3 **Environmental Protection** - All land areas on-site and outside of specifically assigned UXO work areas, storage areas, and access routes will be preserved in their original condition during the course of UXO operations. UXO work activities will be confined to the areas defined in the Work Plan. Trucks and equipment will be confined to the designated haul and access routes, and the project work area. During site UXO operations, every effort will be made to prevent damage to the roads, culverts, trees shrubs and grassed areas.

7.3.1 **Protection of Landscaping** - All landscaping outside of the specifically assigned UXO work area shall be preserved in its original condition with the following restrictions observed:

A. No trees, shrubs, turf, or crops will be removed, cut, or disturbed unless specifically designated for clearing on the plans, or special authority is given by the CO or COR.
B. All public and private easements used for site access will be restored to the original condition.
C. No ropes, cables, or guys will be fastened to any nearby trees for anchorage.
D. If it becomes necessary to erect barrier cable for site security, waste segregation, or equipment staging areas, posts will be placed on anchorages.

NOTE: ***It is very common in UXO project areas containing second and subsequent generations of tree growth to find UXO in the tree root systems. In most cases, the damage to the root system during the UXO access process is very extensive and irreparable. Due to the circumstances involved, HFA is not liable for the damage to the root system or replacement of the tree.***

E. Appropriate measures will be taken during excavation of UXO to prevent root damage to trees that are to remain alive.

F. During excavation of suspected UXO sites, the boundaries will be marked to ensure that all UXO operations are restricted to the limits of the project area.
G. Collection of miscellaneous metallic debris and nonhazardous UXO components will be consolidated in predetermined holding areas awaiting disposal.

7.3.2 **Protection of Water Resources** - As a rule, all UXO services are limited to surface searches and hand excavation of suspected UXO. Little to no waste is generated by these services that could result in contaminated waste from entering surface waters. The individual UXO excavations performed by HFA usually involve a total surface area of only 2 to 4 square feet. Each hole is immediately filled in after excavation and tamped. Due to the minimal intrusive soil activities runon/runoff control measures as outlined in EM 385-1-1 are not required.

7.4 **Contamination Control Measures** - This plan focuses on the minimization of contaminant

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

generation resulting from UXO operations on APG. There are 2 primary areas in which contaminant generation could occur, which are, airborne contaminants of potentially toxic vapors and via spills. HFA's UXO services do not include remediation of hazardous toxic waste (HTW). In the event that HTW is encountered, HFA's personnel will withdraw from the site and report the suspected HTW to the CO or COR.

7.4.1 **Waste Disposal** - HFA will maintain appropriate project on-site house keeping practices during the course of the UXO services project. All waste generated by HFA will be collected and properly disposed of.

7.4.2 **Burning** - No burning of any sort will occur on-site.

7.4.3 **Dust Control** - HFA's UXO services will not generate any significant amounts of dust which would require dust control measures.

7.5 **Spill Control** - As outlined above in paragraph 7.4, HFA's UXO services do not include handling HTW or chemical agent materials. If a spill resulting from a ruptured UXO or some other type of container filled with chemical agent or HTW should occur, HFA and all other personnel on site shall evacuate in an upwind direction. The Emergency Center will be notified that a spill has occurred.

7.6 **Post UXO Operations Cleanup** - HFA will maintain a clean and unobstructed working environment at all times. No tools, equipment, materials (except as noted below), or rubbish will remain on-site following completion of UXO operations. With the exception of the boundary marker flags used to identify the limits of the UXO services performed by HFA, all rubbish and other materials brought on to the project site by HFA will be removed.

7.6.1 **Site Walkover** - The HFA UXO Project Leader will perform a site walkover inspection to ensure that all of the UXO excavations have been filled and tamped. The Project Leader will also ensure that all of the rubbish and materials brought on site by HFA have been collected and properly disposed of.

NOTE: ***HFA is not responsible for other contractor/subcontractor or Government generated rubbish or materials that may be left on site.***

NOTE: ***HFA is not responsible for filling of craters generated by Military EOD personnel when UXO are detonated in place on the project site.***

NOTE: ***HFA is not responsible for filling other contractor/ subcontractor excavations or auger holes.***

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

personnel when UXO are detonated in place on the project site.

NOTE: *HFA is not responsible for filling other contractor/ subcontractor excavations or auger holes.*

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

SECTION 5.

QUALITY CONTROL PLAN

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

8.0 QUALITY CONTROL PLAN

8.1 **Quality Control** - To ensure that effective UXO services are being performed, the quality control (QC) procedures outlined below will be in effect on all UXO services projects.

8.2 **Equipment** - All equipment will be inspected by the Project Leader and/or Safety Officer prior to departing from Indian Head, Maryland to the project site.

8.2.1 **Magnetometers and Metal Detectors** - Inspect the magnetometer(s) and metal detector(s) to ensure that they are in calibration and operating within specifications. The items will also be inspected to ensure that they are not in need of repair and all required accessories are present.

8.2.2 **Emergency Equipment** - Inspect the required emergency equipment to include first aid kit, eye wash kit, bleach, fire extinguishers, and any other emergency items to ensure that they are in good repair and complete.

8.2.3 **Hand Tools** - Inspect the UXO tool kit to include shovels, picks, hand trowels, probes, machetes, etc. to ensure that they are in good repair.

8.2.4 **Project Specific Items** - Individual projects may require items that are not normally included in the site equipment inventory. These items could include PPE, special tools, power cutters, etc.. All of the site specific items must also be inspected to ensure that they are in good repair.

8.3 **On-Site Inspections** - All tools and equipment will be inspected by the Project Leader and/or Site Safety Officer on a daily basis.

8.3.1 **Operational Checks** - The magnetometer(s) and metal detector(s) will be tested before starting UXO operations in the morning and when operations are resumed after lunch. Spot checks will also be performed during daily operations to ensure that the magnetometers and metal detectors are operating properly.

8.4 **Excavations** - All excavations will be rechecked with a magnetometer and metal detector after the previously located UXO or metallic object has been removed.

8.5 **Post detonation Crater Inspection** - After a UXO has been detonated in place, the crater will be rechecked with a magnetometer and metal detector to ensure that no other UXO are present.

8.6 **Random Site UXO QC Checks** - The Project Leader and/or Site Safety Officer will perform a random QC inspection of each project site to ensure the effectiveness of the UXO search being performed. A minimum of 10 % of each site will be rechecked with a magnetometer

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

and metal detector. The QC check shall be random in nature with all areas of the project site being checked, however, areas that included heavy UXO or metallic contamination should receive emphasis during the QC check. If a UXO is detected during the QC check, the entire project site will be researched to ensure that no other UXO is present. If more than 2 significant nonUXO metallic objects are located during the QC check, the QC inspection area will be increased to 20 %. If additional significant nonUXO metallic objects are located in the added QC inspection area, the entire project site will be researched to ensure that no UXO are present.

Use or disclosure of document data is subject to the restrictions on Title Page of this document.

Appendix B
Chemrad Work Plan

PROCEDURE FOR CONDUCTING SURFACE RADIATION SURVEYS FOR DU AND GEOPHYSICAL SURVEYS FOR BURIED OBJECTS

1.0 Scope

This procedure describes Chemrad's general process for conducting surface radiation surveys and surveys for buried objects.

2.0 Responsibilities

2.1 Prerequisites will be performed by the parties mentioned at the prearranged scheduled times.

2.2 Site surface surveys will be conducted by trained employees of Chemrad. Verification will be conducted by the Project Manager.

3.0 Equipment and Materials

3.1 Ludlum Model 12 ratemeter and Model 43-37 gas flow proportional counter for radiation survey.

3.2 EM-61.

4.0 Prerequisites

4.1 Representatives of the US Army will cut the vegetation and undergrowth at the site and under trees to be surveyed to the shortest length possible.

4.2 The area to be surveyed will be surface swept for UXO prior to surface surveys by the approved UXO contractor.

4.3 The site will be gridded at 200 by 200 foot intervals by a geophysical surveyor.

4.4 Chemrad will set up their survey equipment as follows:

4.4.1 Chemrad will setup the base station, start-up the base station, perform functionality checks on the USRADS System, and deploy the Stationary Receivers (SR's).

4.4.2 After the USRADS System is verified to be working properly, an SR will be placed at each end of the baseleg. Chemrad will then place additional SR's

throughout the grid dependent on the number of obstructions on the site. (The USRADS System can determine the location of each of the SR's within an accuracy of +/- four inches.)

4.4.3 A two person team will conduct the USRADS survey and EM-61 survey. One person will monitor the display of the field computer system to verify that the survey is being performed to the protocol, that the detectors are providing reasonable results, and that the surveyor is not entering a high radiation area.

4.5 Daily Response Check

4.5.1 The radiation detectors will receive a daily response check to a radiation source in the field. A Tc-99 source or other suitable radiation source will be used to verify operation. The source will be held close to the detector. Source strength will be low enough to avoid dead time loses.

4.5.2 The same radiation response check will be performed at the same location on the same detector at the end of each survey day to verify measurement consistency over the course to that day's surveys. Records of these checks will be recorded in a Daily Activity Log at the project site, as well as maintained in a permanent project file. The maximum acceptable variation between the two measurements is 20 percent.

4.5.3 The EM-61 will be response checked at the same location at the beginning and end of each survey day to assure consistency in readings.

5.0 Performance Steps

5.1 Radiation Surveys

5.1.1 The surveyor will conduct the survey by walking the area in parallel transects spaced approximately three feet apart at a speed of approximately three feet per second. The surveyors' location and data from the detector will be automatically recorded each second and displayed in real time of the field computer's monitor.

5.1.2 The detector will be spaced such that every other lane is surveyed.

5.1.3 A one minute quality check will be made of the survey instrument at a field location prior to initiating the survey of each grid. An equivalent redundancy check is made at the same location at the end of each survey.

(Note:These reading document that no significant changes have occurred in the detector's responses during the course of the survey. The readings may also be used as background information provided that the location is known to be outside a contaminated area.)

5.1.4 Stationary Systematic and Biased Sampling will be conducted as follows.

5.1.4a Once the walkover survey is completed, a sixty second systematic stationary count will be made near the center of each survey grid. The surveyor will note the coordinates of the location as displayed on the USRADS handheld terminal and write these coordinates on a pin flag that will be inserted at the counting location.

5.1.4b Biased sampling locations will be identified as the points of local maximums within areas above the threshold of concern.

(Note: One definition of this threshold can be two times the mean for the detector over that survey grid. While this definition differs from the conventional concept of "background", it recognizes that the background count rate may vary with the geology and the effects of "shine" from nearby contaminated areas. It also takes into consideration that the primary purpose of a walkover survey is just to identify those areas of possible contamination. The stationary systematic and biased sampling samples are used to discriminate whether the area is contaminated and to what degree.)

5.1.4c The USRADS System will determine areas that are above the threshold immediately upon completion of surveying a grid and display them on the field computer screen. The surveyor will be directed to the coordinates of the locations of biased sampling.

5.1.4d The surveyor will place a pin flag at each biased sampling location and write the coordinates of the location of the flag.

5.1.5 All of the survey data, i.e., location coordinates and detector readouts, will be automatically recorded digitally in the field computer. These raw data will be delivered in electronic media as a part of the final report.

5.2 Geophysical Survey

5.2.1 Chemrad will test the EM-61 each day of the surveys to note consistent performance as a daily response check.

5.2.2 The surveyor will set up the EM-61 to survey the grid for buried objects.

5.2.3 The surveyor will set the robot at a distance of 345 meters and operate the EM 61 robot remotely over the area of interest in parallel transects spaced approximately three fee apart. The robot's location and data from the detector will be automatically recorded each second and displayed in real time on the field computer's monitor.

5.2.4 Data from the EM 61 will be transmitted to the fie'd computer as described previously.

Appendix C
Structure Survey Procedure

CHARACTERIZATION SURVEYS FOR STRUCTURES

1.0 Scope

This procedure describes establishing parameters for conducting radiation surveys of buildings and structures and the conduct of surveys for the characterization of site structures.

2.0 Responsibilities

2.1 This procedure applies to all project personnel conducting characterization surveys of site structures.

2.2 The Project Manager or designee is responsible for administering and implementing this procedure.

2.3 Health Physics personnel are responsible for performing this procedure.

3.0 Equipment and Materials

3.1 Ludlum Model 19 or equivalent micro roentgen (μR) meter

3.2 Survey instrument and alpha scintillation probe

3.3 Survey instrument and Geiger Mueller (GM) detector (pancake probe) or gas proportional detector

3.4 Smears

3.5 Paint or other suitable marking materials

3.6 Tools and Sampling Apparatus

4.0 Prerequisites

4.1 The Project Manager or designee, in conjunction with the site health and safety personnel, shall determine if work activities require a Radiation Work Permit (RWP) and the safety and radiological protection requirements needed to perform survey activities.

5.0 Precautions and Limitations

5.1 Ensure personnel performing radiological measurements are qualified in the use of the instruments.

5.2 Ensure instrumentation has been calibrated in accordance with approved procedures and has recieved an operability check.

5.3 Prior to surveying any area more than 8 feet above the floor, install and use approved scaffolding or an appropriate lifting device.

6.0 Performance Steps

6.1 Background Determinations for Site Structures

6.1.1 Background is determined by measurements and sampling at locations on the site, or in the vicinity of the site, which were unaffected by site operations.

6.1.2 It may be necessary to group the background readings to match the structural differences of the site. For example, a site composed of concrete buildings and lightweight steel buildings should have a background developed for each type of structure.

6.1.3 Select the points to be surveyed for each type of structure. A minimum of 10 is recommended for adjacent structures as long as the agregate is 30 points.

6.1.4 Perform a direct radiation measurement at 1 meter using a the micro R meter or equivalent. Collect background readings for each type of instrument used for the survey.

6.1.5 Record the measurement locations and results on a Survey Data Form.

6.1.2 Test the background measurements for direct beta-gamma contamination and direct radiation using the following statistical test. The objective for background determination is that the average level should accurately represent the true background average to within $\pm$ 20% at the 95% confidence level.

$$N = \left(\frac{tS}{r\bar{x}}\right)^2$$

Where:

N	=	required number of measurements
t	=	the "student 't' statistic" (for example, the value for 't' at 95% confidence and 29 degrees of freedom is 1.699).
s	=	standard deviation of initial background measurements
r	=	acceptable relative error (0.20) for the determination of the population mean
$\bar{x}$	=	the average of the measurements

6.1.2.1 If $N < n$, then no further measurements will be required.

6.1.2.2 If $N > n$, then N must be increased by N minus n, the number of additional randomly distributed measurements that may need to be taken per the direction of the Project Manager or designee.

6.1.3 Record the background and the results of the test on Attachment 2 Survey Form.

6.2 Survey Documentation and Data Collection

6.2.1 Before conducting characterization surveys for site structures, determine the number of samples required and the survey locations for each survey area. Refer to the the criteria in Attachment 1 for determining the number and locations to be surveyed. Attachment 2 contains the required documentation for each type of structure. Deviations from the data collection scheme are allowable with approval from the Project Manager as long as the reasons are documented.

6.2.2 Define the survey areas for the site. A survey area may be a single room or group of similar rooms, a level in a structure, or any other identifiable area with the same operating history and radiological conditions.

6.2.3 Define the following for each survey area.

6.2.3.1 Survey Units

a. Survey units are a division of the survey area which would be expected to have similar contamination deposition patterns. A survey unit also may be designated to identify special sampling or quality control (QC) surveys to provide ease in cross-referencing the data. The following are typical survey units.

- Floors
- Walls (below 2 meters)
- Ceiling and Upper Walls
- Horizontal Surfaces
- Penetrations of Piping, Ducts or Conduits
- Special Samples

b. Identify the location codes for each survey unit in the survey package.

6.2.3.2 Sample Points

6.2.3.2.a Designate the type and locations of radiological samples or measurements for each survey unit and identify if any reference grids are to be used.

6.2.3.2.b The number of points to be surveyed in the survey unit based upon the guidance in Attachment 1, Radiological Criteria for Structures. The location of sample points for surveys of the upper walls, ceilings, horizontal surfaces and equipment is decided by the Project Manager or designee unless specifically designated.

6.2.3.3 Physical Measurements and Data

6.2.3.3.a Determine the physical data to be collected for each survey unit.

6.2.3.3.b The type of data and level of detail to be collected is related to the client's objectives for the site characterization and if a cost analysis is to be performed for decommissioning.

6.2.3.3.c The data requirements shall be determined by the Project Manager or designee, with consultation with the client as necessary.

6.2.4 Determination of Counting Times

6.2.4.1 Determine the minimum counting time for direct measurement of beta-gamma and depleted uranium alpha contamination (or thorium alpha if thorium contamination is known to have been present) which provides a minimum detectable activity (MDA) that is less than or equal to 75% of the applicable termination surface contamination limit.

Determine the minimum counting times for beta-gamma or alpha contamination using the following.

$$MDA = \frac{\frac{2.69}{t_s} + 3.28\sqrt{\frac{R_B}{t_B}\left(1 + \frac{t_B}{t_s}\right)}}{E \bullet \frac{A}{100}}$$

Where:

MDA	=	activity level in dpm/100 cm^2
R_B	=	background rate in counts/minute
t_B	=	background counting time in minutes
t_s	=	sample counting time in minutes
E	=	detector efficiency in counts/disintegration
A	=	active probe area in cm^2

a. If the MDA exceeds 75% of the release guideline, then increase the counting time and recalculate the MDA until the MDA is 75% or less of the release limit.

b. For beta-gamma contamination measurements, verify there will be a minimum of 20 counts measured during the counting cycle by dividing the background (R_B) by the count time (t). Increase the count time as required to ensure a minimum of 20 counts.

6.2.4.2 For alpha contamination measurements, use a counting time of 1 minute unless otherwise directed by the Project Manager or designee.

6.2.5 Prepare the survey diagrams for each survey area.

6.2.5.1 Sketch the structure on Attachment 2. Include references to direction, including compass direction for north.

6.2.5.2 Complete the Description of the Structure on Attachment 2.

6.2.5.3 Mark the survey locations on the structure diagram.

a. Specify the number of sample points and any specific points to be surveyed (horizontal surfaces, ceilings, upper walls, etc.).

b. Identify which types of the following samples or measurements are to be taken for each survey unit.

- Direct beta-gamma, including the minimum count time.
- Direct alpha, including the minimum count time.
- Removable beta-gamma and alpha.
- Direct gamma (μR/hr) at 1 meter

6.3 Characterization Surveys

6.3.1 If required establish reference grids for the survey unit. Reference grids for survey units may be laid out using any means that provides a reference point for the surveyor.

6.3.2 Ensure the necessary equipment is staged for access to the survey unit (ladders, scaffolding, etc.).

6.3.4 Verify that the area and reference grid match the survey diagram. Make any corrections necessary and record the grid identification on the survey diagram.

6.3.5 Label the survey diagram with the reference grid and note the location of any reference points (large equipment, windows, etc.).

6.3.6 Project personnel shall perform characterization surveys using the survey equipment as follows.

6.3.6.1 Set up the survey instrument and detector combination for the survey to be performed in accordance with the instrument operating procedure and as follows.

a. Select the detector for the survey to be performed.

- Characterization surveys for direct beta-gamma and alpha contamination should be performed with a 100 cm^2 detector or

larger. Smaller detectors may be used if approved.

b. Perform a pre-operational check on all detectors and enter the detector parameters.

6.3.6.2 Proceed to the survey unit and take background readings as follows. (Background readings are not required for direct gamma radiation surveys.)

a. Background readings for the gas proportional detector shall be taken with approximately a 300 mg/cm^2 cover over the detector face.

b. The background count times for beta-gamma surface contamination measurements and alpha surface contamination measurements are 1 minute and 5 minutes, respectively, unless alternate count times are specified by the Project Manager or designee.

c. Take a minimum of 3 background counts.

6.3.6.3 Perform the survey for the survey unit.

6.3.7 Project personnel shall perform smear surveys of the survey unit as follows.

6.3.7.1 Take smears as specified on the survey package worksheet and label using unique structure, grid or other reference number.

6.3.7.2 Perform a field count of the smears for beta-gamma and alpha contamination. Note high readings above twice background.

6.3.7.3 After the smears results have been field counted, and results recorded, review and sign the Survey Form and turn it in to the Project Manager or designee for review.

7.0 References

7.1 NUREG/CR-5849 (DRAFT), Manual for Conducting Radiological Surveys in Support of License Termination, June 1992.

7.2 USNRC, Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials, May 1987.

ATTACHMENT 1
RADIOLOGICAL CRITERIA FOR STRUCTURES

A. Floors

- Direct Beta-Gamma Radioactivity
  - Affected Area: 50% scan or 1 measurement per 100 sq. ft. of floor space
  - Unaffected area: 1 measurement per 2000 sq. ft. of floor space
- Direct Alpha Radioactivity
  - Affected Area: 50% scan or 1 measurement per 100 sq.ft. of floor space if the scoping survey shows alpha to be present
  - Unaffected area: None
- Direct Gamma Radiation
  - Affected Area: 50% scan or 1 measurement per 200 sq.f.t of floor space
  - Unaffected Area: 1 measurement per 2000 sq.ft. of floor space
- Transferable Radioactivity
  - Affected Area: 1 smear per 200 sq.ft. of floor space and composite of smears for isotopic analysis
  - Unaffected Area: None
- Structure Surface
  - Affected Area: 1 sample per 500 sq.ft. of floor space for areas where direct beta-gamma or alpha measurements are not possible due to dose rates
  - Unaffected Area: None

B. Walls (Below 2 meters)

- Direct Beta-Gamma Radioactivity
  - Affected area: 25% scan or 1 measurement per 200 sq.ft. of floor space
  - Unaffected area: None
- Direct Alpha Radioactivity
  - Affected Area: 50% scan or 1 measurement per 200 sq.ft. of floor space if the scoping survey shows alpha to be present
  - Unaffected area: None

- Direct Gamma Radiation
  - Affected Area; None
  - Unaffected Area: None

- Transferable Radioactivity
  - Affected Area: 1 smear per 200 sq. ft. of floor space
  - Unaffected Area: None

- Structure Surface
  - Affected Area: 1 sample per 500 sq.ft. of floor space for areas where direct beta-gamma or alpha measurements are not possible due to dose rates.
  - Unaffected Area: None

C. Ceiling, Upper Walls and Horizontal Surfaces

- Direct Beta-Gamma Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the overhead areas due to the processes performed in the area.
  - Unaffected Area: None

- Direct Alpha Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the overhead areas due to the processes performed in the area.
  - Unaffected Area: None

- Direct Gamma Radiation
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the overhead areas due to the processes performed in the area.
  - Unaffected Area: None

- Transferable Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the overhead areas due to the processes performed in the area.
  - Unaffected Area: None

- Structure Surfaces
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the overhead areas due to the processes performed in the area.
  - Unaffected Area: None

D. Penetrations

- Direct Beta-Gamma Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the penetrations due to the processes performed in the area.
  - Unaffected Area: None
- Direct Alpha Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the penetrations due to the processes performed in the area.
  - Unaffected Area: None
- Direct Gamma Radiation
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the penetrations due to the processes performed in the area.
  - Unaffected Area: None
- Transferable Radioactivity
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the penetrations due to the processes performed in the area.
  - Unaffected Area: None
- Structure Surfaces
  - Affected Area: None, except a spot check based upon the potential for radioactivity being present only in the penetrations due to the processes performed in the area.
  - Unaffected Area: None

ATTACHMENT 2
CHARACTERIZATION SURVEY FORM

BUILDING INTERIOR SURVEY

Building No. _____

Performed By _____

Date _____

Instruments Used Bkg. Bat. Response

_____

_____

_____

_____

_____

_____

_____

Weather Conditions _____

_____

_____

Time _____

Observations/Comments

_____

_____

_____

_____

_____

_____

Location

Grid Point Designation

Sample Number	Point	Grid Designation	Gross Alpha (cpm)	Gross Beta (cpm)	Gross Gamma (cpm)	Micro-R-Meter (μR/hr)

BUILDING INTERIOR SURVEY (Cont'd)

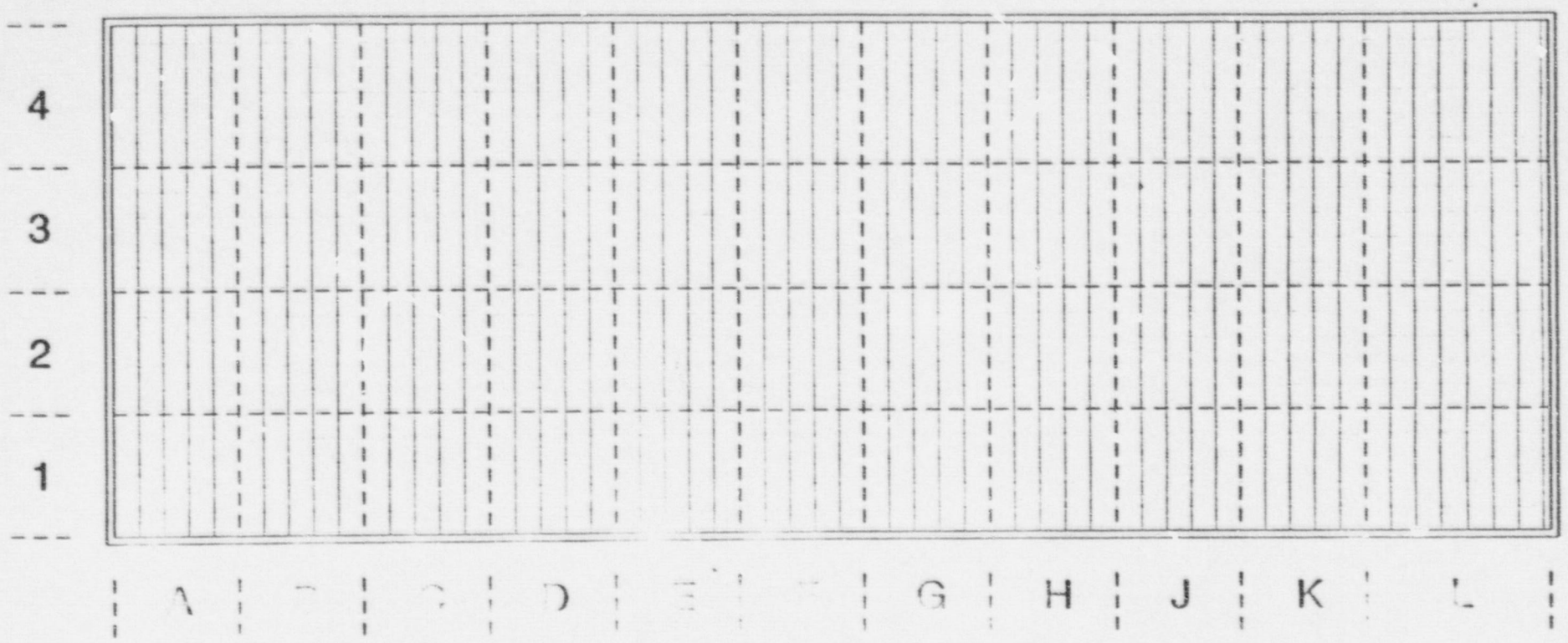
Page___of___

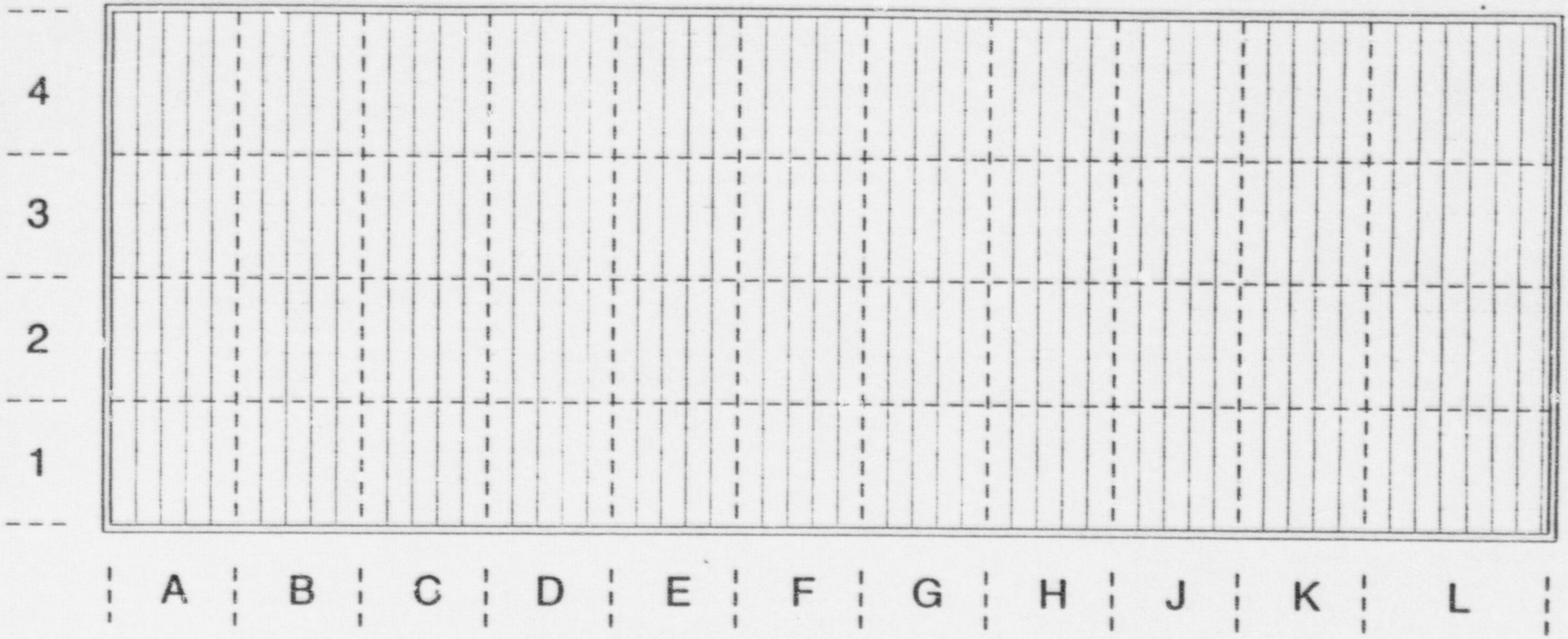
Sample Number	Point	Grid Designation	Gross Alpha (cpm)	Gross Beta (cpm)	Gross Gamma (cpm)	Micro-R-Meter (μR/hr)

BUILDING INTERIOR SURVEY (Cont'd)

Page___of___

Sample Number	Point	Grid Designation	Gross Alpha (cpm)	Gross Beta (cpm)	Gross Gamma (cpm)	Micro-R-Meter (μR/hr)


4
3
2
1
A
D
G
H
J
K
L

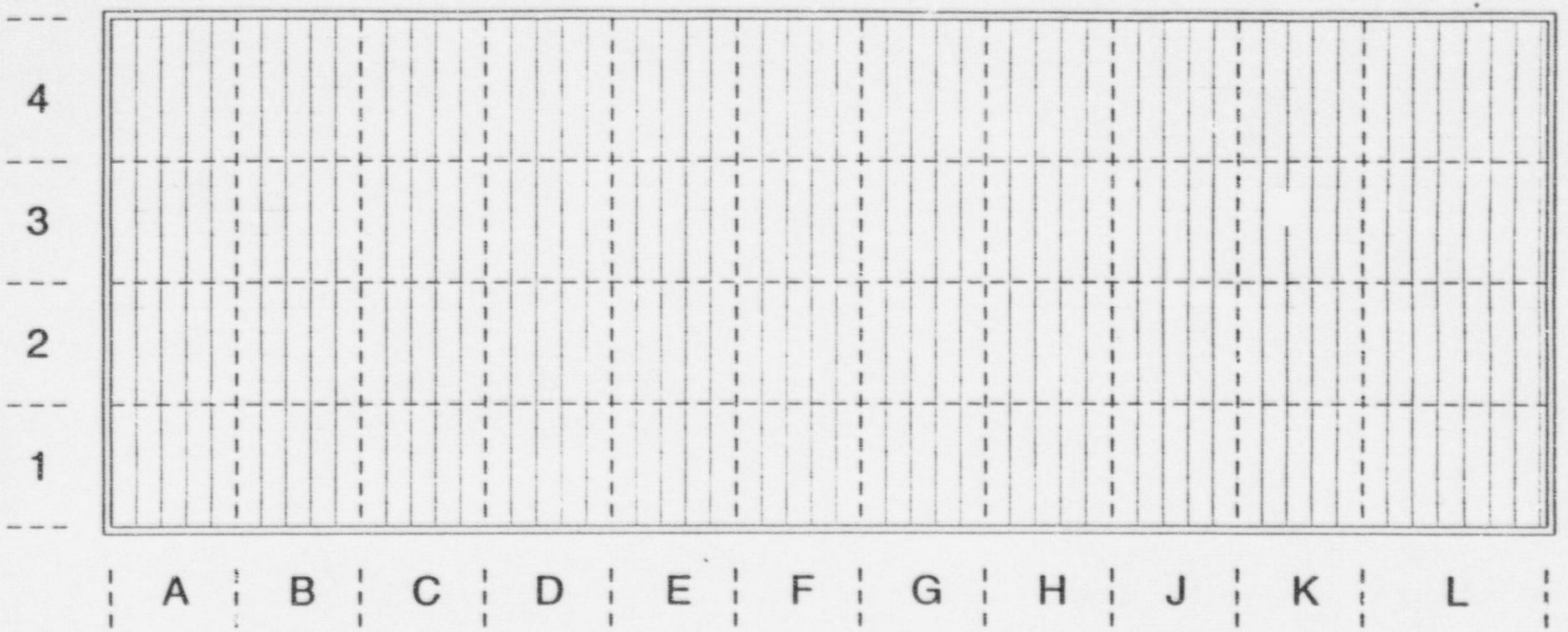


VIEW _____

(Top, Wall, Ceiling, Floor)

BUILDING/STRUCTURE _____

DATE _____



VIEW _____

(Top, Wall, Ceiling, Floor)

BUILDING/STRUCTURE _____

DATE _____

Appendix D
Soil Sampling Procedure

PROCEDURE FOR SOIL SAMPLING

1.0 Scope and Applicability

Instructions presented in this Standard Operating Procedure are for collecting representative soil samples. Soil sampling can be classified into two primary types: surficial and subsurface. Instructions for sampling surficial and subsurface soils by the following techniques are included in this SOP: spade and scoop, hand auger and tube sampler, or other appropriate sampling device.

2.0 Responsibilities

2.1 The Field Supervisor is responsible for ensuring that techniques for obtaining representative samples are properly implemented.

2.2 Field sampling personnel are responsible for complying with the requirements of this SOP and appropriate site-specific safety and health, field sampling, and quality assurance plans.

3.0 Equipment and Materials

Each sampling technique has various advantages and disadvantages for its application. Subsurface soil conditions will restrict the application of certain samplers. The following list provides a selection of equipment that may be used to sample soil.

3.1 Personal Protective Equipment (as required)

3.2 Sample Containers and sturdy plastic or metal coolers

3.3 Sample I.D. Labels

3.4 Chain-of-Custody Forms

3.5 Sampling Devices

3.5.1 Spade and Scoop

3.5.2 Hand Auger and Tube Sampler

3.6 Monitoring Equipment (as required)

3.7 Decontamination equipment (as required)

3.8 Radiation monitoring equipment to include a Micro R Meter, and a survey instrument with either a gas flow proportional counter or pancake Gieger Mueller (GM) detector.

4.0 Prerequisites

4.1 Sampling Strategies

Sampling strategies must be designed for the type of contaminants anticipated to be encountered, the stage of the investigation, and the Data Quality Objectives required for the project.

4.2 Sample Types

The sample types will have been determined during the planning stages of the project. Information about the types of samples to be obtained will be provided in the site-specific Field Sampling Plan.

4.3 Sample Volumes and Other Requirements

Sample volume requirements must be verified with the laboratory. Sample bottles should be prelabeled.

4.4 Worker Certification

Workers conducting sampling shall be trained and medically certified to perform hazardous materials work.

4.5 Additional Guidance Documents

This SOP shall not be used alone, but is to be used in conjunction with a site-specific safety and health plan (SSHP) and a field sampling plan.

4.6 Site Access

Access has been granted to the sampling areas. The sampling area must be readily accessible. Other site specific requirements must be identified (*e.g.*,

keys, access requirements, hunting precautions).

5.0 Precautions and Limitations

5.1 Sample Homogenization and Compositing

Soil samples should be collected using a clean stainless steel scoop, spoon, or trowel and placed into clean stainless steel or other appropriate homogenization containers. The sample should be mixed thoroughly to obtain a homogeneous, representative sample prior to placement into the sample container. When compositing samples from different locations or at different times is desired, all components of the composite sample are mixed in the homogenization container before the composite is placed in the sample container. Because of the low analytical detection limits that are required for certain data uses, care must be taken when collecting the sample to avoid the loss of any contaminants. They should be transferred carefully directly from the sample collection device to the sample container in order to minimize contaminant loss through agitation/volatilization or adherences to another container.

5.2 Sampling Order

Samples should be collected in the container that is required for that analysis or set of compatible parameters. Care must be taken when collecting the samples to avoid the loss of any contaminants. Samples for volatile analysis should not be composited due to contaminant loss from volatilization. These samples should be transferred directly from the sampling equipment to sample containers.

5.3 Special Precautions for Trace Contaminant Sampling

Contaminants can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination. The following general precautions should be observed:

5.4.1 A clean pair of new disposable gloves should be worn each time a different location is sampled and gloves should be donned immediately prior to sampling.

5.4.2 All sample containers should be placed in separate plastic bags immediately after collecting, preserving, labeling, etc.

5.4.3 If possible, one member of the field team should take all the notes, fill out sample tags, field sheets, etc., while the other members collect all of the samples.

5.4.4 Sample collection activities should proceed progressively from the suspected least contaminated area to the suspected most contaminated area.

5.4.5 Field personnel should use equipment constructed of PTFE, stainless steel, or glass that has been properly precleaned. PTFE or glass is preferred for collecting samples where trace metals are of concern.

6.0 Performance Steps

Presented below are sampling instructions for the most common techniques of collecting soil samples. Prior to sample collection, the soil sampling location and characteristics (soil type, depth) should be recorded in the field logbook. Selection of soil sampling equipment is usually based on the depth of the samples. Manual techniques are usually selected for surface or shallow, subsurface soil sampling. At greater depths, mechanically driven equipment is usually required to overcome torque induced by soil resistance and depth. Additional information on collecting soil samples is presented in EPA/625/R-93/003.

6.1 General Procedures

6.1.1 Verify personal protective equipment, monitoring and other requirements specified in the project-specific plans.

6.1.2 Set up and organize the equipment.

a. Cut a section of plastic sheeting asa lay-down area. Place the sheet on the up-gradient side of the sampling area.

b. Place the pre-labeled sample containers and equipment on the plastic sheet.

c. Set up decontamination equipment and materials (if required).

6.1.3 Don personal protective equipment if required.

6.2 Spade and Scoop

6.2.1 Applicability

The spade and scoop method is a very accurate, representative method for collecting surface and shallow subsurface soil samples. This method is usually limited to sample depths less than 1 ft.

6.2.2 Method Summary and Equipment

The simplest, most direct method of collecting surface soil samples is to use a spade and stainless steel scoop. A typical garden spade can be used to remove the top cover of soil to the required depth, and the smaller stainless steel scoop can be used to collect the sample. Typical "garden type" scoops are many times plated with chrome or other metals and would therefore be inappropriate for sampling when analyzing for metals.

6.2.3 Sampling Procedure

a. Carefully remove the top layer of soil to the desired sample depth with a precleaned or decontaminated spade.

b. Using a precleaned or decontaminated stainless steel scoop or trowel, collect the sample aliquot for VOC analysis first, then homogenize enough soil in a stainless steel bowl for the remaining sample containers.

c. Transfer sample into the appropriate prelabeled sample bottle with a stainless steel lab spoon or equivalent.

d. Secure the cap tightly. Survey the sample with the Micro R Meter and the radiation survey instrument. Record readings in the field log book.

f. Survey self and equipment for contamination.

e. Place filled sample containers in zipseal bags.

f. Complete all chain-of-custody documents and record in the field logbook.

6.3 Hand Auger and Tube Sampler

6.3.1 Applicability

Equipment for the hand auger is portable and easy to use. Discrete subsurface soil samples can be collected efficiently without the use of a drill rig. Disadvantages of the hand auger include its limited sampling depth. The tube sampler may not penetrate gravelly or rocky soils.

6.3.2 Method Summary and Equipment

Hand augers are the simplest and most direct method for collecting subsurface soil samples. Although the maximum sampling depth for the hand auger is typically 5 ft, greater depths can be sampled depending on the soil type. Hand augers come in various diameters and various types. The auger bit is used to bore a hole to the desired sampling depth and then withdrawn. The auger tip is then replaced with the tube corer, lowered into the borehole, and forced into the soil at the completion depth. The corer is then withdrawn and the sample is collected.

6.3.3 Sampling Procedure

a. Attach the auger bit to a drill rod extension and further attach the "T" handle to the drill rod.

b. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 8 to 15 cm of surface soil with a spade for an area approximately 15 cm in radius around the boring location.

c. Begin drilling, periodically removing accumulated soils. This prevents accidentally brushing loose material into the borehole when removing the auger or adding drill rods.

d. After reaching desired depth, slowly and carefully remove auger from boring.

e. Remove auger tip from drill rods and replace with a precleaned or decontaminated thin-wall tube sampler. Install proper cutting tip. If non-cohesive materials (i.e., sands) are being sampled, then it may be necessary to use a bucket hand auger.

f. Carefully lower corer down borehole. Gradually force corer

into soil. Take care to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring because the vibrations may cause the boring wall to collapse.

g. Remove corer by twisting to prevent losing core, and detach drill rods.

h. Remove cutting tip and remove core from device.

i. Discard top of core (approximately 2.5 cm), which represents any material collected by the corer before penetration of the desired layer. Place remaining core into sample container or stainless steel bowl for homogenizing.

j. Secure the cap tightly. Survey the sample with the Micro R Meter and the radiation survey instrument. Record readings in the field log book.

k. Survey self and equipment for contamination.

l. Place filled, pre-labeled sample containers in zipseal bags and immediately put on ice.

m. Complete all chain-of-custody documents and record information in the field logbook.

n. Decontaminate sampling equipment after use and between sampling locations.

7.0 Documentation

7.1 Field logbook with required sampling information recorded.

7.2 Sample form or pre-printed sampling log sheet (in lieu of a field logbook).

7.3 Completed chain-of-custody form.

8.0 References

8.1 EPA/540/P-87/001, 1987. A Compendium of Superfund Field Operations Methods.

8.2 USACE, 1994. Requriements for the Preparation of Sampling and Analysis Plans (Draft). EM 200-1-3.

8.3 EPA/625/R-93/003, 1993. Subsurface Field Screening, Characterization and Monitoring Techniques.

126170

This is to acknowledge the receipt of your letter/application ~~dated~~ postmarked 10-01-98, and to inform you that the initial processing which includes an administrative review has been performed. SMD-141/40-06394

☒ There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information. Amend.

☐ Please provide to this office within 30 days of your receipt of this card

_____.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 126170. When calling to inquire about this action, please refer to this control number. You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(8-96)

Sincerely,
Licensing Assistance Team Leader

040-06384

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

REPLY TO
THE ATTENTION OF

Risk Management

Director
Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, Pennsylvania 19405

Gentlemen:

In a letter, dated January 1, 1996, the US Army Research Laboratory (USARL) expressed an intent to decontaminate/decommission an area (Transonic Range) covered by License Number SMB-141. A follow-up letter. dated July 1, 1998, USARL indicated that USARL had funded Argon National Laboratory to prepare a dose assessment and decommissioning plan for the facility. This letter is to forward a copy of the dose assessment and inform your office of future plans for the site.

The USARL Radiation Protection Committee has reviewed the dose assessment. The committee, together with USARL management, in coordination with the US Army Industrial Operations Command (IOC) Radioactive Waste Division has decided that the third option, as discussed in the assessment (cleaning of all hotspots), is the best option (ALARA). This option will result in a worst-case dose of less than 5.1 mrem/yr for a resident farmer or a more realistic dose of 1.5 mrem/yr for the industrial worker. Both of these doses are well below the suggested 25 mrem/yr (NRC) or 15 mrem/yr (EPA).

Funding for the clean-up is expected in FY99 with decommissioning work expected to commence in the spring of 1999. Copies of the decommissioning plan and the results of the termination surveys will be forwarded when available.

The USARL invites the Nuclear Regulatory Commission to participate in the planning of the clean-up. Representatives of the USARL and IOC are available to meet with the NRC at your convenience.

The point of contact for this action is Mr. Richard A. Markland, who can be reached at 410-278-6354.

Sincerely,

David W. Ore
Site Manager, APG Site Operations

Enclosure

126170

OFFICIAL RECORD COPY ML 10

REC'D IN LAT OCT 13 1998

OCT - 5 1998

Dose Assessment for the Depleted Uranium Study Area of the Transonic Range Aberdeen Proving Ground, Maryland

September 1998

prepared by

Environmental Assessment Division, Argonne National Laboratory

prepared for

Commander, U.S. Army Headquarters, Industrial Operations Command

CONTENTS

1 INTRODUCTION 1

2 OBJECTIVE 1

3 DESCRIPTION OF CONTAMINATION 1

3.1 Soil 3
3.2 Structures 7

4 METHODOLOGY 8

4.1 Exposure Scenarios 8
4.2 Dose Calculations 10
4.3 Exposure-Point Concentrations 10

5 RESULTS 11

6 SUMMARY 12

7 REFERENCES 13

APPENDIX: Summary of RESRAD Output 14

FIGURES

1 The Depleted Uranium Study Area 2

2 Soil Sampling Locations 4

TABLES

1 Soil Sampling Results for the Depleted Uranium Study Area 5

2 Exposure Parameters Used to Model Resident-Farmer and Industrial Worker Scenarios 9

3 Radiological Doses Estimated Using Current Soil Contamination Levels 11



This report is printed on recycled paper.

DOSE ASSESSMENT FOR THE DEPLETED URANIUM STUDY AREA OF THE TRANSONIC RANGE

1 INTRODUCTION

The Depleted Uranium Study Area (the site) is located within the boundaries of the Transonic Range in the Aberdeen Area of Aberdeen Proving Ground (APG). APG lies along the western shore of the Chesapeake Bay in Harford and Baltimore Counties, Maryland, approximately 15 miles northeast of Baltimore. The site occupies approximately 12 acres on the southeast end of the Transonic Range and became contaminated as a result of depleted uranium (DU) testing activities that were performed at the site between 1973 and 1979.

Testing consisted of gun launching DU penetrators from two locations in the northern portion of the site at targets mounted adjacent to x-ray units to the south. Plates between the launch or shooting locations and the targets were designed to strip or deflect the sabot away from the penetrator while in flight. Penetrators were either stopped at the target or penetrated the target and lodged in a backstop close behind the targets.

2 OBJECTIVE

This report presents an estimate of potential radiological doses associated with contaminated soil and structures at the site for the hypothetical industrial worker and resident-farmer. There is no contamination in the groundwater beneath the site. Therefore, dose calculations include the contribution from soil only. However, dose estimates for the future scenario include contribution from the groundwater pathway due to leaching. The estimated doses should provide an adequate range reflecting current and reasonably foreseeable future land use (industrial worker scenario) to worst-case conditions (resident-farmer scenario). The results presented in this report could be used to support management decisions for the site.

3 DESCRIPTION OF CONTAMINATION

A layout of the site depicting the major structures is shown in Figure 1. Contamination at the site consists of fixed radiological contamination in some of the structures, DU contamination in soil, and potential unexploded ordnance.

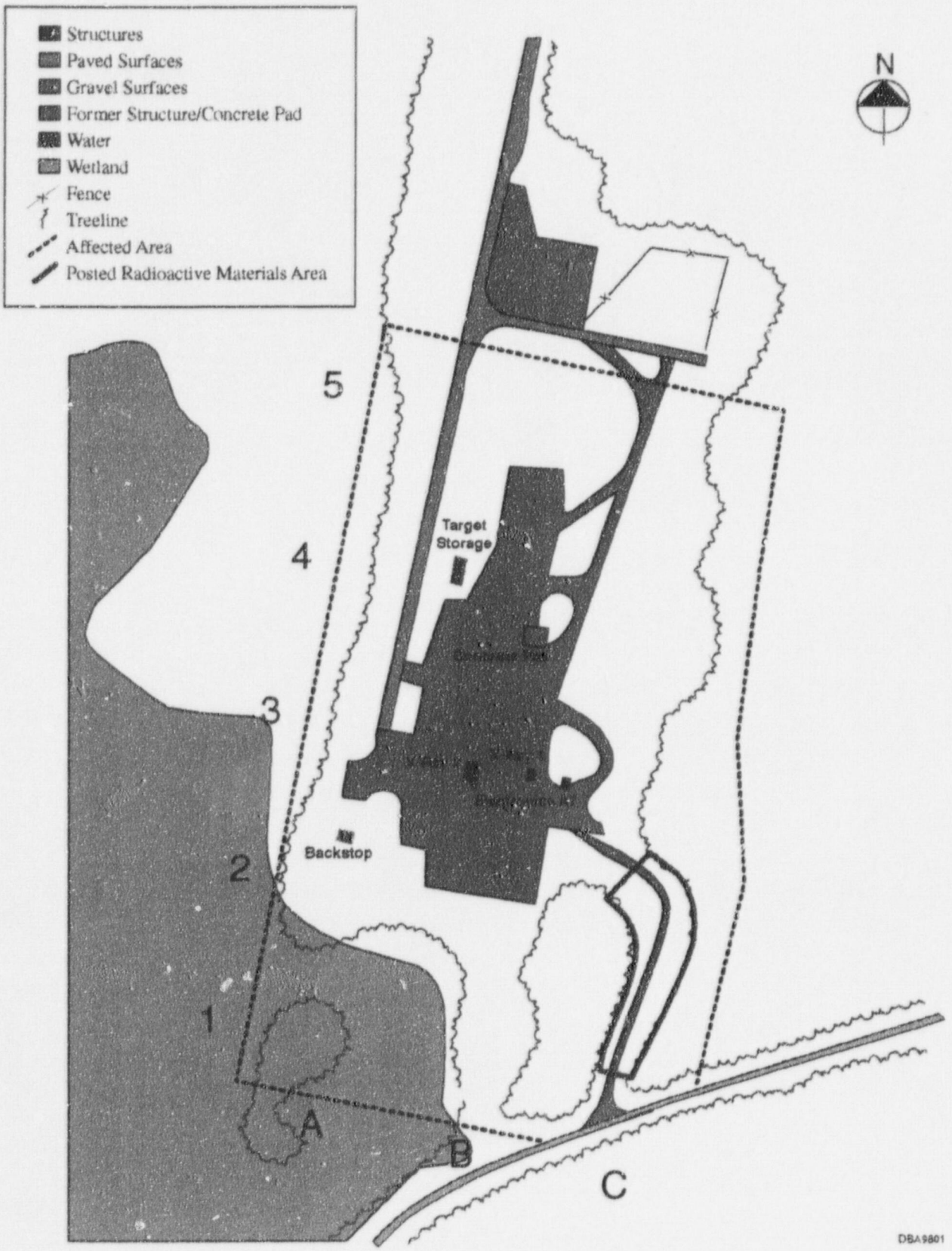


FIGURE 1 The Depleted Uranium Study Area

During the active DU testing phase, waste was managed by maintaining a waste storage area east of the impact zone in the southeastern portion of the site. Shot target was stored in this designated area.

When DU testing was discontinued in 1979, a site survey and cleanup were conducted by the U.S. Army Research Laboratory to reduce the radioactive waste inventory and to allow other nonradiological testing to be conducted at the site. Materials from the storage area were disposed of as part of an initial site cleanup; the area is currently roped off and posted as a radioactive materials area (Figure 1).

A comprehensive radiological characterization of the site was performed from December 1995 through May 1996 (General Physics Corp. 1996). The characterization included a beta and gamma radiation survey of the site, collection and analysis of soil samples from biased locations, and assessment of fixed and removable contamination on site structures.

3.1 SOIL

The soil survey was conducted using a gas-flow proportional counter and a sodium iodide detector mounted on a mobile cart. The detectors were positioned approximately 3 in. above the ground surface. Beta and gamma count rates were transmitted to a computer along with position of the cart. The correlation between counts per minute and total uranium concentration (in pCi/g) was assessed for both gamma and beta radiation survey results.

Soil samples were collected at 45 biased locations determined from the results of the survey, and 5 random locations (Figure 2). The site was surveyed using a 200- by 200-ft (66- by 66-m) grid; at least two samples were collected from each grid. For each sampling location, soil was collected from 1- to 3-in. (3- to 8-cm) and 3- to 6-in. (8- to 17-cm) depth intervals. Direct-reading exposure measurements (in μR/hr) were also taken on contact and at a height of 3 ft (1 m) at every sampling location. Samples were analyzed for U-234, U-235, and U-238. Results for each sampling location are presented in Table 1.

Results of the radiological survey and soil sampling indicated low-level contamination across the site, with localized higher concentrations. The distribution of uranium isotopes was indicative of DU: in general, higher levels of uranium were detected in the uppermost 1- to 3-in. (3- to 8-cm) interval. Total uranium ranged from background to 430,000 pCi/g. The maximum concentration reported for U-238 (370,000 pCi/g) is questionable, given that it exceeds the specific activity of DU (360,000 pCi/g). Four other locations also had total uranium concentrations ranging from 102,000 pCi/g to 305,000 pCi/g. These hotspots are depicted in Figure 2.



FIGURE 2 Soil Sampling Locations

TABLE 1 Soil Sampling Results for the Depleted Uranium Study Area[a]

Grid	Sample[b]	Concentration in Soil (pCi/g) Uranium-234	Uranium-235	Uranium-238
A1	TRB27A	17	3.1	120
	TRB27B	2.2	0.18	10
	TRB47A	1.1	0.16	7.5
	TRB47B	0.74	0.10	4.6
	TRB48A	1.6	0.30	11
	TRB48B	1.12	0.10	3.5
A2	TRB28A	49,000	8,300	370,000
	TRB28B	1.4	0.12	5.5
	TRB29A	220	49	1,500
	TRB29B	16,000	2,800	87,000
	TRB31A	0.94	0.065	1.4
	TRB31B	0.74	0.037	0.96
	TRQ02A	0.75	0.091	2.6
	TRQ02B	23	6.2	180
A3	TRQ03A	1.7	0.30	12
	TRQ03B	0.89	0.075	3.8
	TRB32A	0.60	0.015	1.6
	TRB32B	0.36	0.058	1.5
	TRB33A	0.85	0.0055	1.1
	TRB33B	0.67	0.041	1.0
A4	TRB52A	3.7	0.74	26
	TRB52B	1.4	0.22	6.9
	TRB53A	9.6	1.4	66
	TRB53B	2.7	0.39	17
	TRB54A	2.1	0.32	13
	TRB54B	5.9	0.86	44
A5	TRB34A	1.4	0.14	4.6
	TRB34B	1.1	0.043	2.0
	TRB35A	0.33	0.0022	0.33
	TRB35B	0.19	0.0093	0.19
	TRB36A	0.50	0.027	1.3
	TRB36B	0.57	0.028	1.1
	TRB50A	0.95	0.099	3.8
	TRB50B	0.86	0.061	2.1
	TRB51A	0.87	0.092	2.7
	TRB51B	1.7	0.19	7.8
B1	TRB12A	5.0	0.70	30
	TRB12B	2.0	0.13	4.6
	TRB13A	2.3	0.34	11
	TRB13B	0.83	0.026	1.5
	TRQ05A	1.8	0.27	9.2
	TRQ05B	4.2	0.71	27

TABLE 1 (Cont.)

Grid	Sample[b]	Concentration in Soil (pCi/g) Uranium-234	Uranium-235	Uranium-238
B2	TRB08A	8,100	2,400	40,000
	TRB08B	36	7.1	230
	TRB09A	9,700	1,800	49,000
	TRB09B	10	1.6	63
	TRB10A	13,000	1,400	88,000
	TRB10B	40	4. 9	250
	TRB11A	220	33	1,600
	TRB11B	16	2.9	120
B3	TRB03A	9.4	1.6	61
	TRB03B	4.0	0.86	30
	TRB04A	17	2.6	120
	TRB04B	21	2.9	140
	TRB05A	11	1.8	76
	TRB05B	12	1.8	96
	TRB06A	110	23	840
	TRB06B	72	8.6	590
B4	TRB00A	39,000	4,900	260,000
	TRB00B	3.0	0.34	16
	TRB01A	9.4	1.7	67
	TRB01B	3.3	0.46	22
	TRB02A	0.36	0.0067	0.91
	TRB02B	0.32	0.0034	1.7
B5	TRB14A	0.57	0.012	2.2
	TRB14B	0.5	0.0047	1.2
C1	TRB26A	1.0	0 13	2.7
	TRB26B	1.2	0.11	1.3
	TRB45A	1.4	0.18	5.0
	TRB45B	1.1	0.091	1.7
	TRB46A	11	1.7	77
	TRB46B	1.3	0.064	1.5
C2	TRQ10A	1.5	0.18	10
	TRQ10B	0.32	0.011	1.4
	TRB22A	28	4.4	190
	TRB22B	10	1.6	65
	TRB23A	4,400	520	3,300
	TRB23A[c]	17	2.4	140
	TRB24A	200	26	1,500
	TkB24B	160	41	900
	TRB25A	5,800	1,000	44,000
	TRB25B	6.7	1.2	45

TABLE 1 (Cont.)

Grid	Sample[b]	Concentration in Soil (pCi/g) Uranium-234	Uranium-235	Uranium-238
C3	TRB21A	3.6	0.74	22
	TRB21B	1.2	0.026	2.5
	TRQ11A	4.3	0.75	21
	TRQ11B	0.66	0.025	1.1
C4	TRB18A	0.87	0.12	1.8
	TRB18B	0.94	0.0010	1.6
	TRB19A	46	6.3	290
	TRB19B	0.87	0.028	2.1
C5	TRB16A	0.51	0.027	0.80
	TRB16B	0.56	0.027	0.62
	TRB17A	5.6	0.91	41
	TRB17B	0.82	0.095	3.5
	TRB49A	0.94	0.10	2.5
	TRB49B	3.0	0.39	19
Z2	TRB39A	20,000	3,000	130,000
	TRB39B	10,000	3,100	63,000
	TRQ14A	1.1	0.083	2.2
	TRQ14B	0.62	0.0019	0.90

[a] Source: General Physics Corporation (1996). Activity concentrations are rounded to two significant figures.

[b] Samples ending with "A" are from the 0- to 3-in. sampling depth; samples ending with "B" are from the 3- to 6-in. sampling depth.

[c] A steel plate prevented collection from the 3- to 6-in. sampling depth at location TRB23. An additional sample was collected from the 0- to 3-in. depth 1 ft west of the first location.

3.2 STRUCTURES

The site contains five small industrial-type structures (Figure 1). The two x-ray buildings, 265 ft^2 (25 m^2) and 630 ft^2 (59m^2), are constructed of steel plate welded together. They house U.S. Army trailers containing electronic equipment to control x-ray tubes. Building A7, constructed of concrete, was used for storage of electronic equipment in support of range projects. The building is 13 ft wide by 17 ft long and 10 ft high (4.3 × 5.6 × 3.3 m). The other two structures on site functioned as security boxes. Security box 1 is 36 ft long by 16 ft wide and 12 ft high (12 × 5.3 × 4 m), and security box 2 is 25 ft long by 12 ft wide and 12 ft high (8.3 × 4 × 4 m). Both buildings are constructed of 1-in. steel.

A radiological survey and sampling of the structures was conducted using direct radiation readings to assess the total (removable and fixed) contamination levels on buildings. A total of 20 smear samples was collected from each building to test for removable gross alpha and beta-gamma contamination. Fixed contamination on building surfaces was measured using an alpha scintillation detector for alpha levels and a Geiger Mueller detector for beta-gamma levels. Results are reported in disintegrations per minute (dpm) per 100 cm^2.

Results of the radiation survey were compared with U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 (AEC 1974), which outlines the criteria used by the NRC to terminate nuclear reactor operating licenses. The guidelines contain a table of residual activity contamination levels that the NRC has determined to be acceptable on surfaces of property being released for unrestricted use. For uranium isotopes, the concentration limits specify an average of 5,000 dpm per 100 cm^2, and a maximum level of 15,000 dpm per 100 cm^2. A limit of 1,000 dpm per 100 cm^2 is applied for removable contamination. The radiation survey found very low levels of removable contamination on the structures: gross alpha and gross beta levels were less than 5 dpm/100 cm^2 for all samples. Fixed radiation levels were also low compared with the guidelines for most of the surfaces scanned. However, localized areas in the x-ray buildings and building A7 did exceed the criteria. Gross beta levels as high as 460,000 dpm per 100 cm^2 were measured. No measurements for isotopic data were collected.

4 METHODOLOGY

4.1 EXPOSURE SCENARIOS

APG is a U.S. Army installation that is accessible only to authorized personnel. Access is controlled at several checkpoints. Future land use is likely to be similar to current land use due to safety hazards at the site (e.g., unexploded ordnance deposits). Site personnel are allowed to freely access APG, except for the radioactive waste storage area, which is roped off to prevent entry. The storage area contains localized DU contamination as well as potential unexploded ordnance.

In order to support the development of a strategy for management (e.g., release) of the site, dose calculations were performed for two scenarios representing current and reasonably foreseeable future land use. For a worst-case estimate, doses were calculated based on the assumption that the land would be developed for residential use. Although this assumption is unrealistic given the location of the site, it is presented to provide an upper-bound estimate associated with the current contaminant concentrations. The hypothetical future resident was assumed to spend 6 hours outdoors and 12 hours indoors each day of the year. The resident was also assumed to have a small farm on the property. Exposure pathways evaluated for the resident-farmer include external irradiation; inhalation of radioactive particulates and radon; ingestion of plants, meat, and milk grown on the property; ingestion of groundwater; and incidental ingestion of soil.

An industrial worker scenario was assumed to represent current and reasonably foreseeable future land use. This worker was assumed to spend 6 hours outdoors on the site and 2 hours indoors, 5 days/week, 50 weeks/year. The worker was assumed to be in contact with contaminated soil.

The exposure pathways evaluated and exposure parameters assumed in the calculations represent those that are considered standard and appropriate by U.S. Environmental Protection Agency and NRC protocols for risk and dose assessments. Site-specific data, where available, were incorporated into the analysis. A summary of the exposure parameters used for calculating doses in this assessment is provided in Table 2.

TABLE 2 Exposure Parameters Used to Model Resident-Farmer and Industrial Worker Scenarios

		Scenario		
Parameter	Unit	Resident-Farmer	Industrial Worker	Reference/Rationale
Area	m^2	48,000	48,000	General Physics Corp. (1996)
Length parallel to aquifer flow	m	220	220	Square root of area
Cover depth	m	0	0	General Physics Corp. (1996)
Contaminated zone thickness	m	0.15	0.15	General Physics Corp. (1996)
Density of contaminated zone	g/cm^3	1.5	1.5	RESRAD default
Exposure time	hr/d			
Indoor		12	2	EPA
Outdoor		6	6	EPA
Exposure frequency	d/yr	365	250	EPA
Ingestion rate				
Soil	g/d	0.1	0.1	RESRAD default
Meat	kg/yr	63	NA[a]	RESRAD default
Plant	kg/yr	160	NA	RESRAD default
Water	L/yr	510	NA	RESRAD default
Inhalation rate	m^3/hr	0.96	0.96	RESRAD default
Uranium distribution coefficient	cm^3/g	200	200	Erikson et al. (1990)
Porosity	--	0.49	NA	Tomasko and Yin (1997)
Hydraulic conductivity	m/yr	110	NA	Tomasko and Yin (1997)
Hydraulic gradient	--	0.27	NA	Tomasko and Yin (1997)

[a] NA = not applicable.

4.2 DOSE CALCULATIONS

Exposure to radioactive contaminants is expressed in terms of the 50-year committed effective dose equivalent (CEDE). This concept, developed for assessing internal exposures by the International Commission on Radiological Protection (ICRP 1977), is the weighted sum of the dose equivalent in various organs. The weighting factors for the organs are proportional with the potential risk associated with irradiation of those organs. The CEDE considers the variable radiosensitivities of different organs, the different biological effectivenesses of radiation types and the distinct retention times in the body for different radionuclides.

The concept of the committed dose applies only to internal pathways. For external pathways there is no long-term residence of radionuclides, and the appropriate measure of dose is the effective dose equivalent (EDE). The sum of the CEDE and the EDE is termed the total committed effective dose equivalent (TEDE). The TEDE is expressed in units of rem.

The RESRAD computer code, Version 5.782 (Yu et al. 1993), was used to calculate the dose to an on-site resident-farmer and an industrial worker from exposure to contaminated soil. The RESRAD code is a pathway analysis code that implements the methodology prescribed in DOE Order 5400.5 (DOE 1990) for determining residual radioactive soil guidelines. Doses are projected over 1,000 years. The source is adjusted over time to account for radioactive decay and ingrowth, leaching, erosion, and mixing.

Doses from external exposure to contaminated structures were approximated using the dose coefficients contained in Federal Guidance Report 12 for exposure to soil contaminated to an infinite depth (EPA 1993). The calculations assumed that contamination consisted only of DU.

According to the decay schemes for uranium isotopes, the ratio of alpha to beta decays should be about equal; this assumption was supported by the results of the smear analysis. The fixed survey indicated much higher levels of gross beta than gross alpha contamination. Due to the difficulties associated with obtaining accurate measurements of gross alpha contamination (e.g., absorption), the dose calculations were based on gross beta measurements. A screening-level estimate of dose from gamma exposure was based on the maximum gross beta measurement recorded on any surface (i.e., 460,000 dpm/100 cm^2) and the exposure factors listed in Table 2 for the industrial worker. Doses were estimated for external radiation only: because removable contamination levels were well below the guidance levels, other exposure pathways would not come into play.

4.3 EXPOSURE-POINT CONCENTRATIONS

The soil sampling data collected from the site (see Table 1) were used to derive the estimated exposure-point concentration for soil. Data from all sampling locations were

aggregated as one exposure unit to represent the likelihood that an individual would not preferentially visit one area over another. The exposure-point concentration was estimated as the one-tailed 95% upper confidence limit of the arithmetic average (UCL). Data from the two sampling depth intervals were averaged together to estimate the concentration in the top layer. Due to the large degree of uncertainty associated with the maximum concentration detected (i.e., 370,000 pCi/g U-238; 430,000 pCi/g total uranium), this location was not included in calculating a representative exposure-point concentration for the site.

Several additional calculations were performed in order to provide a range of options for managing soil contamination at the site. The first option considered reducing risk by managing (i.e., remediating) the two most contaminated locations (TRB-00 and 39). The second option focused only on hotspots inside the waste storage area. Risk reduction was evaluated for cleanup of hotspots represented by samples TRB-10, 11, 23, 24, and 25. Option 3 considered all hotspots identified for the site (TRB-00, 06, 08, 09, 10, 11, 23, 24, 25, 28, 29, and 39). A sample was designated a hotspot when the uranium concentration exceeded the mean plus two standard deviations.

5 RESULTS

Radiological doses estimated for a resident-farmer and industrial worker from exposures to soil are presented in Table 3 and the appendix. Doses are estimated on the basis of current data. Under baseline conditions, the calculated UCLs for U-238, U-235, and U-234 are 14,400, 370, and 2,300 pCi/g, respectively. The maximum annual doses estimated at time zero are 1,800 mrem/yr for the resident, and 53 mrem/yr for the industrial worker. For both scenarios, the external gamma pathway is the dominant exposure route, accounting for 60% and 80% of the total dose for the resident-farmer and industrial worker, respectively. The dose contribution from ingestion of groundwater is insignificant. Because of the high retardation value for uranium, migration into groundwater is a slow process. After 1,000 years, the dose from groundwater ingestion is estimated to be 23 mrem.

TABLE 3 Radiological Doses Estimated Using Current Soil Contamination Levels

Pathway	Estimated Dose (mrem/yr) Resident-Farmer	Industrial Worker
External gamma	1,200	420
Inhalation	150	66
Ingestion		
Plant	170	NA[a]
Meat	50	NA
Milk	130	NA
Soil	130	39
TEDE	1,800	530

[a] NA = not applicable.

pCi/g
U-234 2300
U-235 370
U-238 14,400
How calculated

As a check, direct exposure readings provided in the General Physics Report (1996) were also used to estimate the dose from external radiation. Doses were estimated using the same exposure parameters as listed in Table 2 and a conversion factor of 0.95 mrem/mR. A shielding factor of 0.8 was applied in calculating indoor exposures to account for shielding afforded by the structure. Doses were calculated using net exposure rate measurements taken at a height of 1 m; calculations were performed using the maximum exposure level (20 µR/hr), and the UCL of all measurements (7.1 µR/hr). On the basis of the UCL, the annual doses calculated for the resident-farmer and industrial worker were 37 and 13 mrem, respectively. For the hotspot analysis, the maximum exposure level was 20 µR/hr. The annual doses calculated for the resident-farmer and industrial worker were 110 and 36 mrem, respectively.

Three options were evaluated to estimate dose reduction achieved by cleanup of various portions of the site. Option 1, which evaluated cleanup of the two most contaminated areas of the site, achieved a dose reduction of about 50%. The estimated doses to a resident-farmer and industrial worker, minus the two hotspots, were 840 and 240 mrem/yr, respectively. Option 2, which evaluated hotspots within the waste storage area only, was not effective in reducing the estimated dose for the site as a whole because the UCL concentrations for the site did not effectively change. Dose estimates based on all data minus the 12 hotspots (Option 3) resulted in an estimated residual dose of 5.1 mrem/yr for the resident-farmer and 1.5 mrem/yr for the industrial worker.

The maximum potential dose associated with an industrial worker exposed to contaminated structures was estimated to be on the order of 1 mrem/yr. This dose was approximated on the basis of the maximum gross beta measurement found on the structures. The dose is only an estimate because isotopic data are not available and direct-reading exposure measurements were not taken in the buildings. It is, however, a conservative approximation and could be used to support management decisions for the structures.

6 SUMMARY

This assessment provides potential radiological doses associated with contamination in site soil and structures. Soil dose estimates could be biased high compared with direct gamma exposure readings obtained. Field measurements indicate that the dose estimates could be as much as a factor of 10 higher than what a receptor could actually receive. Nevertheless, this assessment does show that contamination levels detected in a few locations at the site contribute to potential doses greater than 25 mrem/yr for both the industrial worker and the resident-farmer scenarios. Dose estimates associated with potential exposures to contamination in structures indicate very low doses, on the order of 1 mrem/yr, largely received from external gamma radiation.

7 REFERENCES

AEC: see U.S. Atomic Energy Commission

DOE: see U.S. Department of Energy

EPA: see U.S. Environmental Protection Agency

Erikson, R.L., et al., 1990, *Measured and Theoretical Behavior of Depleted Uranium Corrosion Products in Soil Systems*, TD 2761, Pacific Northwest Laboratory, Richland, Wash.

General Physics Corporation, 1996, *Transonic Range Depleted Uranium Study Area, Radiological Characterization Report*, prepared by General Physics Corporation, Columbia, Md., for Aberdeen Proving Ground Directorate of Safety, Health and Environment, Aberdeen Proving Ground, Md., Oct.

International Commission on Radiological Protection, 1977, Recommendations of the Commission on Radiological Protection (Adopted January 17, 1977), ICRP Publication 26, *Annals of the ICRP* 1(3)

Tomasko, D., and S. Yin, 1997, *Cumulative Impact Assessment of Aberdeen Proving Ground Operational Activities, Volume VI: Hydrology and Water Resources Analysis*, prepared by Argonne National Laboratory, Environmental Assessment Division, Argonne, Ill., for Aberdeen Proving Ground Directorate of Safety, Health and Environment, Aberdeen Proving Ground, Md., Nov.

U.S. Atomic Energy Commission (now the Nuclear Regulatory Commission), 1974, Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," Washington, D.C., June.

U.S. Department of Energy, 1990, Order 5400.5, "Radiation Protection of the Public and the Environment."

U.S. Environmental Protection Agency, 1993, Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water, and Soil," Office of Radiation and Indoor Air, Washington, D.C.

Yu, C., et al., 1993, *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, Ill.

APPENDIX:

SUMMARY OF RESRAD OUTPUT

OFFICIAL RECORD COPY ML 10 126170

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary ... 4
Summary of Pathway Selections ... 8
Contaminated Zone and Total Dose Summary ... 9
Total Dose Components
Time = 0.000E+00 ... 10
Time = 1.000E+00 ... 11
Time = 3.000E+00 ... 12
Time = 1.000E+01 ... 13
Time = 3.000E+01 ... 14
Time = 1.000E+02 ... 15
Time = 3.000E+02 ... 16
Time = 1.000E+03 ... 17
Dose/Source Ratios Summed Over All Pathways ... 18
Single Radionuclide Soil Guidelines ... 18
Dose Per Nuclide Summed Over All Pathways ... 19
Soil Concentration Per Nuclide ... 20

Dose Conversion Factor (and Related) Parameter Summary

File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(3)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	U-234	1.320E-01	1.320E-01	DCF2(6)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(7)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(8)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(3)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	U-234	2.830E-04	2.830E-04	DCF3(6)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(7)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(8)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L) (pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)

File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.856E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	2.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	3.000E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-234	2.300E+03	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-235	3.700E+02	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-238	1.440E+04	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.900E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	4.900E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.100E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.700E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.426E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.217E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.100E+01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.100E+01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	1.000E+00	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12C2
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	1.500E-01	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	2.400E+00	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	1.000E-01	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	3.000E-02	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	3.000E-07	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	5.000E-01	5.000E-01	---	REXG
R021	Height of the building (room) (m)	2.500E+00	2.500E+00	---	HRM
R021	Building interior area factor	0.000E+00	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	-1.000E+00	-1.000E+00	code computed (time dependent)	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	active
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	46560.00 square meters	U-234	2.300E+03
Thickness:	0.15 meters	U-235	3.700E+02
Cover Depth:	0.00 meters	U-238	1.440E+04

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 30 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.834E+03	1.808E+03	1.757E+03	1.586E+03	1.175E+03	3.268E+02	5.275E-01	2.614E+01
M(t):	6.114E+01	6.027E+01	5.855E+01	5.288E+01	3.915E+01	1.089E+01	1.758E-02	8.714E-01

Maximum TDOSE(t): 1.834E+03 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	5.419E-01	0.0003	2.281E+01	0.0124	0.000E+00	0.0000	2.368E+01	0.0129	7.372E+00	0.0040	1.880E+01	0.0103	1.782E+01	0.0097
U-235	1.588E+02	0.0866	3.419E+00	0.0019	0.000E+00	0.0000	3.593E+00	0.0020	1.119E+00	0.0006	2.853E+00	0.0016	2.704E+00	0.0015
U-238	1.040E+03	0.5672	1.277E+02	0.0696	0.000E+00	0.0000	1.409E+02	0.0768	4.387E+01	0.0239	1.119E+02	0.0610	1.060E+02	0.0578
Total	1.200E+03	0.6541	1.539E+02	0.0839	0.000E+00	0.0000	1.682E+02	0.0917	5.236E+01	0.0285	1.335E+02	0.0728	1.266E+02	0.0690

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.101E+01	0.0496
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.725E+02	0.0941
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.571E+03	0.8563
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.834E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	5.358E-01	0.0003	2.241E+01	0.0124	1.151E-04	0.0000	2.327E+01	0.0129	7.250E+00	0.0040	1.847E+01	0.0102	1.750E+01	0.0097
U-235	1.569E+02	0.0868	3.359E+00	0.0019	0.000E+00	0.000	3.544E+00	0.0020	1.115E+00	0.0006	2.803E+00	0.0016	2.659E+00	0.0015
U-238	1.027E+03	0.5680	1.254E+02	0.0694	6.817E-10	0.0000	1.385E+02	0.0766	4.314E+01	0.0239	1.099E+02	0.0608	1.042E+02	0.0576
Total	1.185E+03	0.6551	1.512E+02	0.0836	1.151E-04	0.0000	1.653E+02	0.0914	5.151E+01	0.0285	1.312E+02	0.0726	1.243E+02	0.0688

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.944E+01	0.0495
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.704E+02	0.0943
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.548E+03	0.8563
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.808E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	5.241E-01	0.0003	2.162E+01	0.0123	9.984E-04	0.0000	2.246E+01	0.0128	6.995E+00	0.0040	1.782E+01	0.0101	1.689E+01	0.0096
U-235	1.532E+02	0.0872	3.243E+00	0.0018	0.000E+00	0.0000	3.441E+00	0.0020	1.104E+00	0.0006	2.705E+00	0.0015	2.570E+00	0.0015
U-238	1.001E+03	0.5699	1.210E+02	0.0689	1.776E-08	0.0000	1.336E+02	0.0761	4.163E+01	0.0237	1.061E+02	0.0604	1.005E+02	0.0572
Total	1.155E+03	0.6575	1.459E+02	0.0830	9.984E-04	0.0000	1.595E+02	0.0908	4.973E+01	0.0283	1.266E+02	0.0721	1.200E+02	0.0683

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.631E+01	0.0491
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.663E+02	0.0947
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.504E+03	0.8562
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.757E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.0000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	4.861E-01	0.0003	1.905E+01	0.0120	9.743E-03	0.0000	1.979E+01	0.0125	6.164E+00	0.0039	1.570E+01	0.0099	1.489E+01	0.0094
U-235	1.408E+02	0.0888	2.864E+00	0.0018	0.000E+00	0.0000	3.092E+00	0.0019	1.049E+00	0.0007	2.384E+00	0.0015	2.278E+00	0.0014
U-238	9.146E+02	0.5765	1.066E+02	0.0672	5.807E-07	0.0000	1.178E+02	0.0742	3.669E+01	0.0231	9.347E+01	0.0589	8.858E+01	0.0558
Total	1.056E+03	0.6656	1.285E+02	0.0810	9.743E-03	0.0000	1.406E+02	0.0887	4.390E+01	0.0277	1.116E+02	0.0703	1.057E+02	0.0667

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.610E+01	0.0480
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.525E+02	0.0961
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.358E+03	0.8559
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.586E+03	1.0000

*Sum of all water independent and dependent pathways.

OFFICIAL RECORD COPY ML 10

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	3.987E-01	0.0003	1.309E+01	0.0111	6.042E-02	0.0001	1.359E+01	0.0116	4.233E+00	0.0036	1.078E+01	0.0092	1.022E+01	0.0087
U-235	1.098E+02	0.0935	1.977E+00	0.0017	0.000E+00	0.0000	2.202E+00	0.0019	8.178E-01	0.0007	1.637E+00	0.0014	1.582E+00	0.0013
U-238	6.999E+02	0.5959	7.321E+01	0.0623	1.091E-05	0.0000	8.086E+01	0.0688	2.519E+01	0.0214	6.417E+01	0.0546	6.081E+01	0.0518
Total	8.102E+02	0.6897	8.827E+01	0.0752	6.043E-02	0.0001	9.665E+01	0.0823	3.024E+01	0.0257	7.659E+01	0.0652	7.262E+01	0.0618

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.237E+01	0.0446
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.180E+02	0.1005
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.004E+03	0.8549
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.175E+03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = [illegible]02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.953E-01	0.0006	2.515E+00	0.0077	1.511E-01	0.0005	2.612E+00	0.0080	8.127E-01	0.0025	2.066E+00	0.0063	1.964E+00	0.0060
U-235	3.684E+01	0.1127	3.810E-01	0.0012	0.000E+00	0.0000	4.370E-01	0.0013	1.747E-01	0.0005	3.137E-01	0.0010	3.068E-01	0.0009
U-238	2.197E+02	0.6724	1.[illegible]3E+01	0.0429	8.972E-05	0.0000	1.550E+01	0.0474	4.830E+00	0.0148	1.230E+01	0.0376	1.165E+01	0.0357
Total	2.568E+02	0.7857	1.692E+01	0.0518	1.512E-01	0.0005	1.855E+01	0.0568	5.818E+00	0.0178	1.468E+01	0.0449	1.392E+01	0.0426

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.032E+01	0.0316
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.845E+01	0.1177
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.780E+02	0.8508
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.268E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E-02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.689E-01	0.8890	2.188E-02	0.0415	0.000E+00	0.0000	3.602E-02	0.0683	1.993E-04	0.0004	4.383E-04	0.0008	5.275E-01	1.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.689E-01	0.8890	2.188E-02	0.0415	0.000E+00	0.0000	3.602E-02	0.0683	1.993E-04	0.0004	4.383E-04	0.0008	5.275E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.953E-01	0.0006	2.515E+00	0.0077	1.511E-01	0.0005	2.612E+00	0.0080	8.127E-01	0.0025	2.066E+00	0.0063	1.964E+00	0.0060
U-235	3.684E+01	0.1127	3.810E-01	0.0012	0.000E+00	0.0000	4.370E-01	0.0013	1.747E-01	0.0005	3.137E-01	0.0010	3.068E-01	0.0009
U-238	2.197E+02	0.6724	1.403E+01	0.0429	8.972E-05	0.0000	1.550E+01	0.0474	4.830E+00	0.0148	1.230E+01	0.0376	1.165E+01	0.0357
Total	2.568E+02	0.7857	1.692E+01	0.0518	1.512E-01	0.0005	1.855E+01	0.0568	5.818E+00	0.0178	1.468E+01	0.0449	1.392E+01	0.0426

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.032E+01	0.0316
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.845E+01	0.1177
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.780E+02	0.8508
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.268E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	4.689E-01	0.8890	2.188E-02	0.0415	0.000E+00	0.0000	3.602E-02	0.0683	1.993E-04	0.0004	4.383E-04	0.0008	5.275E-01	1.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	4.689E-01	0.8890	2.188E-02	0.0415	0.000E+00	0.0000	3.602E-02	0.0683	1.993E-04	0.0004	4.383E-04	0.0008	5.275E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	2.078E-01	0.0079	1.440E-02	0.0006	8.514E-03	0.0003	1.605E-02	0.0006	3.751E-03	0.0001	4.346E-03	0.0002	2.549E-01	0.0098
U-235	2.273E+01	0.8694	8.719E-01	0.0334	0.000E+00	0.0000	1.748E+00	0.0669	5.225E-01	0.0200	1.791E-02	0.0007	2.589E+01	0.9902
U-238	1.195E-04	0.0000	8.247E-06	0.0000	4.875E-06	0.0000	9.188E-06	0.0000	2.148E-06	0.0000	2.488E-06	0.0000	1.459E-04	0.0000
Total	2.293E+01	0.8773	8.863E-01	0.0339	8.519E-03	0.0003	1.764E+00	0.0675	5.263E-01	0.0201	2.226E-02	0.0009	2.614E+01	1.0000

*Sum of all water independent and dependent pathways

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	3.957E-02	3.889E-02	3.752E-02	3.308E-02	2.273E-02	4.388E-03	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	4.520E-07	1.311E-06	3.993E-06	9.235E-06	9.238E-06	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	6.268E-08	5.448E-07	5.331E-06	3.329E-05	8.645E-05	0.000E+00	2.575E-05
U-234	Pb-210	1.000E+00	0.000E+00	3.893E-11	8.699E-10	2.459E-08	3.567E-07	1.431E-06	0.000E+00	8.507E-05
U-234	ΣDSR(j)		3.957E-02	3.889E-02	3.753E-02	3.308E-02	2.277E-02	4.485E-03	0.000E+00	1.108E-04
U-235	U-235	1.000E+00	4.663E-01	4.605E-01	4.492E-01	4.115E-01	3.179E-01	1.036E-01	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	7.992E-05	2.309E-04	6.133E-04	9.460E-04	2.831E-04	0.000E+00	1.545E-02
U-235	Ac-227	1.000E+00	0.000E+00	9.478E-07	6.754E-06	4.580E-05	1.290E-04	6.032E-05	1.426E-03	5.451E-02
U-235	ΣDSR(j)		4.663E-01	4.606E-01	4.494E-01	4.121E-01	3.190E-01	1.039E-01	1.426E-03	6.997E-02
U-238	U-238	1.000E+00	1.091E-01	1.075E-01	1.044E-01	9.428E-02	6.973E-02	1.931E-02	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	1.102E-07	3.191E-07	9.377E-07	1.933E-06	1.244E-06	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	6.481E-13	5.569E-12	5.564E-11	3.712E-10	1.073E-09	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	5.922E-14	1.548E-12	5.074E-11	9.600E-10	8.198E-09	0.000E+00	2.355E-09
U-238	Pb-210	1.000E+00	0.000E+00	2.893E-17	1.909E-15	1.801E-13	8.140E-12	1.174E-10	0.000E+00	7.779E-09
U-238	ΣDSR(j)		1.091E-01	1.075E-01	1.044E-01	9.428E-02	6.973E-02	1.931E-02	0.000E+00	1.013E-08

*Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 30 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	7.581E+02	7.715E+02	7.994E+02	9.068E+02	1.317E+03	6.689E+03	*6.245E+09	2.707E+05
U-235	6.434E+01	6.513E+01	6.675E+01	7.279E+01	9.404E+01	2.887E+02	2.104E+04	4.288E+02
U-238	2.751E+02	2.790E+02	2.872E+02	3.182E+02	4.302E+02	1.554E+03	*3.360E+05	*3.360E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
U-234	2.300E+03	0.000E+00	3.957E-02	7.581E+02	3.957E-02	7.581E+02
U-235	3.700E+02	0.000E+00	4.663E-01	6.434E+01	4.663E-01	6.434E+01
U-238	1.440E+04	0.000E+00	1.091E-01	2.751E+02	1.091E-01	2.751E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	9.101E+01	8.944E+01	8.631E+01	7.607E+01	5.228E+01	1.009E+01	0.000E+00	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	1.587E-03	4.596E-03	1.350E-02	2.784E-02	1.992E-02	0.000E+00	0.000E+00
U-234	ΣDOSE(j):		9.101E+01	8.944E+01	8.631E+01	7.609E+01	5.230E+01	1.011E+01	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	1.040E-03	3.015E-03	9.184E-03	2.124E-02	2.125E-02	0.000E+00	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	9.336E-09	8.019E-08	8.012E-07	5.345E-06	1.545E-05	0.000E+00	0.000E+00
Th-230	ΣDOSE(j):		0.000E+00	1.040E-03	3.015E-03	9.185E-03	2.125E-02	2.126E-02	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	1.442E-04	1.253E-03	1.226E-02	7.656E-02	1.988E-01	0.000E+00	5.923E-02
Ra-226	U-238	1.000E+00	0.000E+00	8.528E-10	2.228E-08	7.307E-07	1.382E-05	1.181E-04	0.000E+00	3.392E-05
Ra-226	ΣDOSE(j):		0.000E+00	1.442E-04	1.253E-03	1.226E-02	7.657E-02	1.990E-01	0.000E+00	5.926E-02
Pb-210	U-234	1.000E+00	0.000E+00	8.953E-08	2.001E-06	5.655E-05	8.204E-04	3.291E-03	0.000E+00	1.957E-01
Pb-210	U-238	1.000E+00	0.000E+00	4.166E-13	2.749E-11	2.595E-09	1.172E-07	1.691E-06	0.000E+00	1.120E-04
Pb-210	ΣDOSE(j):		0.000E+00	8.953E-08	2.001E-06	5.655E-05	8.205E-04	3.293E-03	0.000E+00	1.958E-01
U-235	U-235	1.000E+00	1.725E+02	1.704E+02	1.662E+02	1.522E+02	1.176E+02	3.832E+01	0.000E+00	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	2.957E-02	8.542E-02	2.269E-01	3.500E-01	1.047E-01	0.000E+00	5.717E+00
Ac-227	U-235	1.000E+00	0.000E+00	3.488E-04	2.439E-03	1.695E-02	4.773E-02	2.232E-02	5.275E-01	2.017E+01
U-238	U-238	1.000E+00	1.571E+03	1.548E+03	1.504E+03	1.358E+03	1.004E+03	2.740E+02	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g							
			t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	2.300E+03	2.275E+03	2.225E+03	2.058E+03	1.649E+03	7.578E+02	8.227E+01	3.469E-02
U-234	U-238	1.000E+00	0.000E+00	4.037E-02	1.185E-01	3.653E-01	8.178E-01	1.345E+00	4.383E-01	6.165E-04
U-234	∑S(j):		2.300E+03	2.275E+03	2.225E+03	2.059E+03	1.649E+03	7.592E+02	8.271E+01	3.530E-02
Th-230	U-234	1.000E+00	0.000E+00	2.059E-02	6.109E-02	1.959E-01	5.279E-01	1.247E+00	1.780E+00	1.788E+00
Th-230	U-238	1.000E+00	0.000E+00	1.824E-07	1.617E-06	1.707E-05	1.328E-04	9.069E-04	2.501E-03	2.871E-03
Th-230	∑S(j):		0.000E+00	2.059E-02	6.109E-02	1.959E-01	5.280E-01	1.248E+00	1.783E+00	1.791E+00
Ra-226	U-234	1.000E+00	0.000E+00	4.421E-06	3.866E-05	3.891E-04	2.671E-03	1.301E-02	2.359E-02	2.418E-02
Ra-226	U-238	1.000E+00	0.000E+00	2.618E-11	6.479E-10	2.319E-08	4.823E-07	7.722E-06	3.169E-05	3.882E-05
Ra-226	∑S(j):		0.000E+00	4.421E-06	3.866E-05	3.892E-04	2.672E-03	1.301E-02	2.363E-02	2.422E-02
Pb-210	U-234	1.000E+00	0.000E+00	4.536E-08	1.167E-06	3.666E-05	6.311E-04	6.094E-03	1.357E-02	1.413E-02
Pb-210	U-238	1.000E+00	0.000E+00	2.018E-13	1.566E-11	1.668E-09	8.989E-08	3.128E-06	1.765E-05	2.268E-05
Pb-210	∑S(j):		0.000E+00	4.536E-08	1.167E-06	3.666E-05	6.312E-04	6.097E-03	1.359E-02	1.415E-02
U-235	U-235	1.000E+00	3.700E+02	3.659E+02	3.579E+02	3.311E+02	2.652E+02	1.219E+02	1.325E+01	5.596E-03
Pa-231	U-235	1.000E+00	0.000E+00	5.615E-03	2.[illegible]E-02	5.962E-02	1.066E-01	7.495E-02	8.447E-03	3.569E-06
Ac-227	U-235	1.000E+00	0.000E+00	1.167E-04	9.240E-04	6.701E-03	2.107E-02	1.803E-02	2.058E-03	8.694E-07
U-238	U-238	1.000E+00	1.440E+04	1.424E+04	1.393E+04	1.289E+04	1.032E+04	4.746E+03	5.155E+02	2.178E-01

BRF(i) is the branch fraction of the parent nuclide.

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary ... 4
Summary of Pathway Selections ... 8
Contaminated Zone and Total Dose Summary ... 9
Total Dose Components
Time = 0.000E+00 ... 10
Time = 1.000E+00 ... 11
Time = 3.000E+00 ... 12
Time = 1.000E+01 ... 13
Time = 3.000E+01 ... 14
Time = 1.000E+02 ... 15
Time = 3.000E+02 ... 16
Time = 1.000E+03 ... 17
Dose/Source Ratios Summed Over All Pathways ... 18
Single Radionuclide Soil Guidelines ... 18
Dose Per Nuclide Summed Over All Pathways ... 19
Soil Concentration Per Nuclide ... 20

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(3)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	U-234	1.320E-01	1.320E-01	DCF2(6)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(7)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(8)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(3)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	U-234	2.830E-04	2.830E-04	DCF3(6)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(7)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(8)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)

File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.856E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	3.000E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-234	2.300E+03	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-235	3.700E+02	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-238	1.440E+04	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.900E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	4.900E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.100E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.700E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	2.000E+02	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.110E-02	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.099E-01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.426E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.217E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-02	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	1.700E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	--	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	48560.00 square meters	U-234	2.300E+03
Thickness:	0.15 meters	U-235	3.700E+02
Cover Depth:	0.00 meters	U-238	1.440E+04

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 30 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.290E+02	5.218E+02	5.077E+02	4.609E+02	3.466E+02	1.023E+02	0.000E+00	0.000E+00
M(t):	1.763E+01	1.739E+01	1.692E+01	1.536E+01	1.155E+01	3.410E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 5.290E+02 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.915E-01	0.0004	9.833E+00	0.0186	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.464E+00	0.0103
U-235	5.612E+01	0.1061	1.474E+00	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.293E-01	0.0016
U-238	3.675E+02	0.6948	5.503E+01	0.1040	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.252E+01	0.0615
Total	4.239E+02	0.8012	6.634E+01	0.1254	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.881E+01	0.0734

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.549E+01	0.0293
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.842E+01	0.1104
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.551E+02	0.8603
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.290E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.893E-01	0.0004	9.659E+00	0.0185	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.368E+00	0.0103
U-235	5.545E+01	0.1063	1.448E+00	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.154E-01	0.0016
U-238	3.629E+02	0.6954	5.406E+01	0.1036	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.195E+01	0.0612
Total	4.185E+02	0.8020	6.517E+01	0.1249	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.813E+01	0.0731

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.522E+01	0.0292
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.772E+01	0.1106
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.489E+02	0.8602
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.218E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.852E-01	0.0004	9.321E+00	0.0184	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.180E+00	0.0102
U-235	5.414E+01	0.1066	1.398E+00	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.881E-01	0.0016
U-238	3.537E+02	0.6967	5.217E+01	0.1027	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.083E+01	0.0607
Total	4.081E+02	0.8037	6.288E+01	0.1239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.679E+01	0.0725

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.469E+01	0.0289
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.633E+01	0.1109
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.367E+02	0.8601
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.077E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.718E-01	0.0004	8.215E+00	0.0178	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.565E+00	0.0099
U-235	4.976E+01	0.1080	1.235E+00	0.0027	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.985E-01	0.0015
U-238	3.231E+02	0.7011	4.597E+01	0.0997	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.716E+01	0.0589
Total	3.731E+02	0.8094	5.542E+01	0.1202	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.243E+01	0.0704

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.295E+01	0.0281
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.169E+01	0.1121
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.963E+02	0.8598
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.609E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	1.409E-01	0.0004	5.642E+00	0.0163	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.135E+00	0.0090
U-235	3.880E+01	0.1120	8.524E-01	0.0025	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.853E-01	0.0014
U-238	2.473E+02	0.7136	3.156E+01	0.0911	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.865E+01	0.0538
Total	2.863E+02	0.8259	3.805E+01	0.1098	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.227E+01	0.0643

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.918E+00	0.0257
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.014E+01	0.1158
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.975E+02	0.8585
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.466E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	6.699E-02	0.0007	1.084E+00	0.0106	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.022E-01	0.0059
U-235	1.307E+01	0.1272	1.643E-01	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.408E-02	0.0009
U-238	7.764E+01	0.7590	6.048E+00	0.0591	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.574E+00	0.0349
Total	9.072E+01	0.8869	7.296E+00	0.0713	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.270E+00	0.0417

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.756E+00	0.0172
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.327E+01	0.1298
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.726E+01	0.8531
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.023E+02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	6.734E-03	6.616E-03	6.385E-03	5.629E-03	3.873E-03	7.537E-04	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	1.370E-07	4.012E-07	1.226E-06	2.840E-06	2.849E-06	0.000E+00	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	3.866E-09	3.367E-08	3.335E-07	2.164E-06	6.691E-06	0.000E+00	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	1.235E-12	3.138E-11	9.392E-10	1.390E-08	5.729E-08	0.000E+00	0.000E+00
U-234	∑DSR(j)		6.734E-03	6.616E-03	6.385E-03	5.631E-03	3.878E-03	7.633E-04	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	1.579E-01	1.560E-01	1.522E-01	1.397E-01	1.084E-01	3.584E-02	0.000E+00	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	3.432E-06	9.637E-06	2.554E-05	4.027E-05	1.378E-05	0.000E+00	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	2.308E-07	1.813E-06	1.279E-05	3.686E-05	1.824E-05	0.000E+00	0.000E+00
U-235	∑DSR(j)		1.579E-01	1.560E-01	1.522E-01	1.397E-01	1.085E-01	3.588E-02	0.000E+00	0.000E+00
U-238	U-238	1.000E+00	3.160E-02	3.117E-02	3.033E-02	2.752E-02	2.066E-02	6.060E-03	0.000E+00	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	1.876E-08	5.430E-08	1.596E-07	3.294E-07	2.137E-07	0.000E+00	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	1.939E-13	1.697E-12	1.706E-11	1.141E-10	3.309E-10	0.000E+00	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	3.657E-15	9.569E-14	3.175E-12	6.242E-11	6.346E-10	0.000E+00	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	8.778E-19	6.723E-17	6.824E-15	5.163E-13	4.697E-12	0.000E+00	0.000E+00
U-238	∑DSR(j)		3.160E-02	3.117E-02	3.033E-02	2.752E-02	2.066E-02	6.060E-03	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 30 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	4.455E+03	4.534E+03	4.698E+03	5.328E+03	7.737E+03	3.930E+04	*6.245E+09	*6.245E+09
U-235	1.900E+02	1.923E+02	1.971E+02	2.147E+02	2.765E+02	8.362E+02	*2.160E+06	*2.160E+06
U-238	9.492E+02	9.624E+02	9.892E+02	1.090E+03	1.452E+03	4.951E+03	*3.360E+05	*3.360E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
U-234	2.300E+03	0.000E+00	6.734E-03	4.455E+03	6.734E-03	4.455E+03
U-235	3.700E+02	0.000E+00	1.579E-01	1.900E+02	1.579E-01	1.900E+02
U-238	1.440E+04	0.000E+00	3.160E-02	9.492E+02	3.160E-02	9.492E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	1.549E+01	1.522E+01	1.468E+01	1.295E+01	8.907E+00	1.733E+00	0.000E+00	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	2.701E-04	7.819E-04	2.298E-03	4.743E-03	3.077E-03	0.000E+00	0.000E+00
U-234	ΣDOSE(j):		1.549E+01	1.522E+01	1.469E+01	1.295E+01	8.911E+00	1.737E+00	0.000E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	3.152E-04	9.227E-04	2.821E-03	6.532E-03	6.552E-03	0.000E+00	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	2.792E-09	2.443E-08	2.457E-07	1.643E-06	4.765E-06	0.000E+00	0.000E+00
Th-230	ΣDOSE(j):		0.000E+00	3.152E-04	9.227E-04	2.821E-03	6.533E-03	6.556E-03	0.000E+00	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	8.893E-06	7.744E-05	7.671E-04	4.978E-03	1.539E-02	0.000E+00	0.000E+00
Ra-226	U-238	1.000E+00	0.000E+00	5.266E-11	1.378E-09	4.572E-08	8.988E-07	9.138E-06	0.000E+00	0.000E+00
Ra-226	ΣDOSE(j):		0.000E+00	8.893E-06	7.745E-05	7.672E-04	4.979E-03	1.540E-02	0.000E+00	0.000E+00
Pb-210	U-234	1.000E+00	0.000E+00	2.841E-09	7.216E-08	2.160E-06	3.198E-05	1.318E-04	0.000E+00	0.000E+00
Pb-210	U-238	1.000E+00	0.000E+00	1.264E-14	9.681E-13	9.827E-11	4.555E-09	6.764E-08	0.000E+00	0.000E+00
Pb-210	ΣDOSE(j):		0.000E+00	2.841E-09	7.216E-08	2.160E-06	3.199E-05	1.318E-04	0.000E+00	0.000E+00
U-235	U-235	1.000E+00	5.842E+01	5.771E+01	5.632E+01	5.167E+01	4.011E+01	1.326E+01	0.000E+00	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	1.270E-03	3.566E-03	9.448E-03	1.490E-02	5.097E-03	0.000E+00	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	8.540E-05	6.708E-04	4.734E-03	1.364E-02	6.748E-03	0.000E+00	0.000E+00
U-238	U-238	1.000E+00	4.551E+02	4.489E+02	4.367E+02	3.963E+02	2.975E+02	8.726E+01	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	S(j,t), pCi/g							
			t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-234	U-234	1.000E+00	2.300E+03	2.275E+03	2.225E+03	2.058E+03	1.648E+03	7.578E+02	8.227E+01	3.469E-02
U-234	U-238	1.000E+00	0.000E+00	4.037E-02	1.185E-01	3.653E-01	8.778E-01	1.345E+00	4.383E-01	6.165E-04
U-234	∑S(j):		2.300E+03	2.275E+03	2.225E+03	2.059E+03	1.649E+03	7.592E+02	8.271E+01	3.530E-02
Th-230	U-234	1.000E+00	0.000E+00	2.059E-02	6.109E-02	1.959E-01	5.279E-01	1.247E+00	1.780E+00	1.788E+00
Th-230	U-238	1.000E+00	0.000E+00	1.824E-07	1.617E-06	1.707E-05	1.328E-04	9.069E-04	2.501E-03	2.871E-03
Th-230	∑S(j):		0.000E+00	2.059E-02	6.109E-02	1.959E-01	5.280E-01	1.248E+00	1.783E+00	1.791E+00
Ra-226	U-234	1.000E+00	0.000E+00	4.421E-06	3.866E-05	3.891E-04	2.671E-03	1.301E-02	2.359E-02	2.418E-02
Ra-226	U-238	1.000E+00	0.000E+00	2.618E-11	6.879E-10	2.319E-08	4.823E-07	7.722E-06	3.169E-05	3.882E-05
Ra-226	∑S(j):		0.000E+00	4.421E-06	3.866E-05	3.892E-04	2.672E-03	1.301E-02	2.363E-02	2.422E-02
Pb-210	U-234	1.000E+00	0.000E+00	4.536E-08	1.167E-06	3.666E-05	6.311E-04	6.094E-03	1.357E-02	1.413E-02
Pb-210	U-238	1.000E+00	0.000E+00	2.018E-13	1.566E-11	1.668E-09	8.989E-08	3.128E-06	1.765E-05	2.268E-05
Pb-210	∑S(j):		0.000E+00	4.536E-08	1.167E-06	3.666E-05	6.312E-04	6.097E-03	1.359E-02	1.415E-02
U-235	U-235	1.000E+00	3.700E+02	3.659E+02	3.579E+02	3.311E+02	2.652E+02	1.219E+02	1.325E+01	5.596E-03
Pa-231	U-235	1.000E+00	0.000E+00	7.615E-03	2.162E-02	5.962E-02	1.066E-01	7.495E-02	8.447E-03	3.569E-06
Ac-227	U-235	1.000E+00	0.000E+00	1.167E-04	9.240E-04	6.701E-03	2.107E-02	1.803E-02	2.058E-03	8.694E-07
U-238	U-238	1.000E+00	1.440E+04	1.424E+04	1.393E+04	1.289E+04	1.032E+04	4.746E+03	5.155E+02	2.178E-01

BRF(i) is the branch fraction of the parent nuclide.

TO LISA A TURNER

FAX 937-865-3725

FROM _____

LOCATION: _____

REPLY

WILL ATTEND NTSWAC WORKING GROUP FALL MEETING _____

WON'T ATTEND NTSWAC WORKING GROUP FALL MEETING _____

ADDITIONAL ATTENDEES FROM YOUR SITE

_____

_____

_____

_____

_____

HOPE TO SEE YOU THERE!!!!

WASTE MANAGEMENT
Babcock & Wilcox of Ohio, Inc.
Mound Plant
P.O. Box 3030, 1 Mound Rd.
Miamisburg, OH 45343
FAX # (937) 865-3725

FAX COVER SHEET

TO: DISTRIBUTION
FROM: LISA A. TURNER/DOUG HANAHAN
PHONE #: (937) 847-5205/(937) 865-4524
No. Of Pages (excluding cover sheet): 2

MESSAGE: **NTSWAC WORK GROUP CORRESPONDENCE**

I am forwarding this to the WCOs. Please pass the information on to the Member at Large.

This is to inform you that the NTSWAC Work Group Fall Meeting will be held on November 3, 4 and 5 at the DoubleTree Guest Suites, 300 Prestige Place, Miamisburg, OH. (There will be an optional tour of the Mound Plant on the morning of November 5). A list of area hotels & REPLY sheet are attached. Maps & other information will be sent at a later date. Thanks!!

Distribution:

Matthew G. Wiherle	-US Army/APG	Robert Fischer	-LLNL
Dale Brown	-Allied Signal, Inc.-KCD	William Schleyer	-LRRI
Phil Ralphs	-Bechtel Nevada	Patricia Harrington	-MACTEC
Mark Krauss	-Bechtel Nevada	Pam Davis	-Mason&Hanger-Pantex
Ben Bassat	-Boeing/Rocketdyne	Robert Orrin	-Oak Ridge Nat. Lab
Bruce Davis	-Flour Daniel/Fernald	Sandy Dellaverson	-RMI Environmental
Anthony Fudel	-General Atomics	Donn Wright	-SNL/CA
Gregg Geisinger	-Horne Eng./Rocky Flats	Michael Lucas	-SNL/NM
Cheryl Prince	-IT Las Vegas	Martha Gitt	-WASTREN
Elizabeth Bankey	-ITRI		

If you have any questions, please don't hestitate to call Doug or myself.

126170

Area Hotels include:

Double Tree Guest Suites
300 Prestige Place
1-800-222-8733 or 937-436-2400

Marriott Courtyard
100 Prestige Place
1-800-321-2211 or 937-433-3131

Holiday Inn-Dayton Mall
31 Prestige Plaza
937-434-8030

OFFICIAL RECORD COPY ML 10 126170

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

(FOR LFMS USE)
INFORMATION FROM LTS

Program Code: 11220
Status Code: O
Fee Category: EX 2C
Exp. Date: 20010630
Fee Comments: NOT SHIELDING
Decom Fin Assur Reqd: Y

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED
   Applicant/Licensee: ARMY, DEPARTMENT OF THE
   Received Date: 980717
   Docket No: 4006394
   Control No.: ~~125805~~
   License No.: SMB-141
   Action Type: Amendment

VOID & COMBINE W/124 12/10 TO 12/24/98. MM

2. FEE ATTACHED
   Amount: ---/---
   Check No.: ---/---

3. COMMENTS

Signed M. A. Perkins
Date 7/20/98

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 _____

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

(FOR LFMS USE)
INFORMATION FROM LTS

Program Code: 11220
Status Code: O
Fee Category: EX 2C
Exp. Date: 20010630
Fee Comments: NOT SHIELDING
Decom Fin Assur Reqd: Y

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   Applicant/Licensee: ARMY, DEPARTMENT OF THE
   Received Date: 981013
   Docket No: 4006394
   Control No.: 126170
   License No.: SMB-141
   Action Type: Amendment

2. FEE ATTACHED
   Amount: ---/---
   Check No.: ---/---

3. COMMENTS

Signed Brown, Rebecca J.
Date 10/13/98

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 _____