NRC FORM 374
(7-94)

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

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

Licensee	
1. Department of the Army Cold Regions Research and Engineering Laboratory (CRREL) 2. 72 Lyme Road Hanover, New Hampshire 03755-1290	3. License Number 28-07946-07 4. Expiration Date September 30, 2001 5. Docket or Reference No. 030-34215

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Hydrogen 3	A. Any	A. 20 millicuries
B. Carbon 14	B. Any	B. 10 millicuries
C. Sulfur 35	C. Any	C. 10 millicuries

9. Authorized use

A. through C. Research and development as defined in 10 CFR 30.4.

CONDITIONS

10. A. Licensed material may be used only at the licensee's facilities located at Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, New Hampshire.

B. The licensee may not possess and use materials authorized in Items 6, 7, and 8, until: (1) the licensee has constructed the facilities and obtained the equipment described in the application and supporting documentation; and (2) the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406 has been notified in writing that activities authorized by the license will be initiated.

In accordance with the requirements set forth in 10 CFR 30.36(b), 40.42(b), and 70.38(b), the licensee shall promptly notify the Nuclear Regulatory Commission, in writing, of a decision not to complete the facility, acquire equipment, or possess and use authorized material.

11. A. Licensed material shall be used by, or under the supervision of, Charles M. Reynolds, Ph.D..

B. The Radiation Safety Officer for this license is Charles M. Reynolds, Ph.D..

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

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 28-07946-07

Docket or Reference Number: 030-34215

13. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

14. The licensee is authorized to hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash, provided:

    A. Waste to be disposed of in this manner shall be held for decay a minimum of ten half-lives.

    B. Before disposal as ordinary trash, the waste shall be surveyed at the container surface with the appropriate survey instrument set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

    C. A record of each such disposal permitted under this License Condition shall be retained for three years. The record must include the date of disposal, the date on which the byproduct material was placed in storage, the radionuclides disposed, the survey instrument used, the background dose rate, the dose rate measured at the surface of each waste container, and the name of the individual who performed the disposal.

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

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

    A. Letter dated July 12, 1996
    B. Letter dated August 16, 1996
    C. Letter dated September 10, 1996

Date SEP 21 1996

For the U.S. Nuclear Regulatory Commission
Original Signed By:
By Kathleen Dolce

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

SEP 21 1996

License No. 28-07946-07
Docket No. 030-34215
Control No. 123520

Mr. Robert S. Sletten, Chief
Environment, Safety and Security
Department of the Army
Cold Regions Research and
Engineering Laboratory (CRREL)
72 Lyme Road
Hanover, New Hampshire 03755-1290

Dear Mr. Sletten:

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

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Until your license is terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.

2. Not possess and use materials authorized in Items 6, 7, and 8, on the license until:

   a. you have constructed the facilities and obtained the equipment described in the license application and supporting documentation, and

   b. you have notified the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406 in writing, that activities authorized by the license will be initiated.

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3. Notify NRC, in writing, within 30 days:

   a. when an authorized user or Radiation Safety Officer, permanently discontinues performance of duties under the license or has a name change; or

   b. when the mailing address on the license changes (no fee is required if the location of byproduct material remains the same).

4. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license:

   a. when you decide to terminate all activities involving materials authorized under the license; or

   b. if you decide not to complete the facility, acquire equipment, or possess and use authorized material.

5. Request and obtain a license amendment before you:

   a. permit anyone to work as an authorized user under the license;

   b. change Radiation Safety Officer;

   c. order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;

   d. add or change the areas of use, or address or addresses of use identified in the license application or on the license; or

   e. change ownership of your organization.

6. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or a certifying official of the licensee rather than the Radiation Safety Officer or a consultant.

You will be periodically inspected by the NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), NUREG 1600.

Since serious consequences to employees and the public can result from failure to comply with NRC requirements, prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Thank you for your cooperation.

Sincerely,

Original Signed By:
Kathleen Dolce

Kathleen Dolce
Division of Nuclear Materials Safety

License No. 28-07946-07
Docket No. 030-34215
Control No. 123520

Enclosures:
1. License No. 28-07946-07
2. 10 CFR Parts 2, 19, 20, 30, 71 and 170
3. NRC Forms 3 and 313

DOCUMENT NAME: R:\WPS\MLTR\L2807946.01
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	Dolce\kdl							
DATE	09/19/96		09/ /96		09/ /96		09/ /96	

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DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755-1290

M516
P-3

September 10, 1996

United States Nuclear Regulatory Commission
Region I
475 Allentown Road
King of Prussia, PA 19406

Dears Sirs:

Reference my letter of July 12, 1996 requesting an amendment to our NRC license No. 28-07946-06:

As discussed on the phone with Ms. Kathleen Dulce of your staff, we understand that a separate license can be issued for the use of C14, H3, and S35 and that Dr. Mike Reynolds will be the RSO and only authorized user under this license. We also understand that we will need to conduct basic radiation safety training for all personnel who will be working under Dr. Reynolds' supervision and any other personnel who may have occasion to enter spaces where the sources will be used. Such training will be conducted prior to obtaining or using sources. In addition, we recognize the requirement to conduct refresher training for users and ancillary personnel annually after the initial training. Finally, we will seek a Radiation Safety Officer training course for Dr. Reynolds who in his capacity as RSO for this license will be responsible for maintaining all required records.

If there are any other questions regarding this information, please contact me at 603/646-4443 or Dr. Reynolds at 603/646-4394.

Sincerely,

R S Sletten

Robert S. Sletten
Chief, Environment, Safety
and Security

cf: Mr. Bob Stout, HQUSACE SO
Mr. Luke McCormick, COE HTRW CTX
Dr. Mike Reynolds

123520

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SEP 16 1996

TELEPHONE CONVERSATON RECORD	Date: 8/28/96	Time: 1 PM
Mail Control No.: 123520	**License No.:** new	**Docket No.:** 030-34215
Person Called: Bob Sletten	**Licensee:Army-Cold Regions Lab**	**Telephone No.:** 603.646.4443
Person Calling: Kathleen Dolce / (610) 337-5251		
Subject: telephone deficiency		
Summary: I informed Mr. Sletten that we could only authorize H-3, C-14 and S-35 and would not authorize the use of P-32 or I-125 because of Dr. Reynolds' limited experience. I told him that Dr. Reynolds could be the RSO and would also be the sole Authorized User because the other candidates have no experience. Mr. Sletten will provide a commitment for annual refresher training. He will also confirm that the RSO will maintain records of waste, receipt and transfer, training, surveys and audits.		
Action Required/Taken: Wait for fax		
Signature: K. Dolce	**Date:** 8/28/96	

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755-1290

M516
P-3

August 16, 1996

United States Nuclear Regulatory Commission
Region I
475 Allentown Road
King of Prussia, PA 19406

Dears Sirs:

Reference my letter of July 12, 1996 requesting an amendment to our NRC license No. 28-07946-06.

As discussed on the phone with Ms. Kathleen Dulce of your staff, we understand that a separate license will be issued for the unsealed sources requested in the referenced letter. Accordingly, it is requested that all references to sealed sources in the July 12 application be deleted.

As requested by Ms. Dulce, a resume for each of the authorized users of unsealed sources is attached. In addition, Dr. Reynolds, who is the proposed RSO for the unsealed source license has let a contract with Wester & Associates to conduct training for both the authorized users and ancillary personnel who may have occasion to be in the labs where the unsealed sources will be used. This training will be conducted prior to obtaining and using the sources. A copy of the scope of work for this training is attached.

If there are any other questions regarding this request, please contact me at 603/646-4443 or Dr. Reynolds at 603/646-4394.

Sincerely,

RSSletten

Robert S. Sletten
Chief, Environment, Safety
and Security

attachments: as
cf: Mr. Bob Stout, HQUSACE SO
Mr. Luke McCormick, COE HTRW CTX
Dr. Mike Reynolds

123520

AUG 22 1996

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RESUME

(Abbreviated form for NRC, Aug. 1996)

Charles Michael (Mike) Reynolds
CRREL (Cold Regions Research and Engineering Laboratory)
72 Lyme Road
Hanover, NH 03755
603-646-4394 Fax 603-646-4644

Position :
Research Scientist, US Army Cold Regions Research and Engineering Laboratory, Hanover New Hampshire

Radiation Safety Training:
Radiation Safety Course, Univ. of Arkansas, 1982 (24 hrs)
Radiation Safety Refresher Course, Univ. of Arkansas, 1986 (4 hrs).
Canberra Nuclear, Basics of Liquid Scintillation, Sep. 1994 (16 hrs).
Radiation Safety Lecture, 1996 CRREL- Luke McCormick - Health Physicist, Corps of Engineers (1.5 hrs)

Experience with labeled compounds:
^{14}C labeled organic compounds in tracer studies.
University of Arkansas, 1982-1986

RESUME

(Abbreviated form for NRC, Aug. 1996)

Lawrence B. Perry
CRREL (Cold Regions Research and Engineering Laboratory)
72 Lyme Road
Hanover, NH 03755
603-646-4394 Fax 603-646-4644

Position :
Research Physical Science Technician, US Army Cold Regions Research and Engineering Laboratory, Hanover New Hampshire

Radiation Safety Training:
Troxler Electronics Laboratories on Radiation (for sealed sources), 1991 CRREL Radiation Safety Lecture, 1996 CRREL- Luke McCormick - Health Physicist, Corps of Engineers (1.5 hrs)

Experience with labeled compounds:
None

RESUME

(Abbreviated form for NRC, Aug. 1996)

Chad S. Pidgeon
CRREL (Cold Regions Research and Engineering Laboratory)
72 Lyme Road
Hanover, NH 03755
603-646-4394 Fax 603-646-4644

Position :
Research Physical Science Technician, US Army Cold Regions Research and Engineering Laboratory, Hanover New Hampshire

Radiation Safety Training:
Radiation Safety Lecture, 1996 CRREL- Luke McCormick - Health Physicist, Corps of Engineers (1.5 hrs)

Experience with labeled compounds:
None

Dr. Debra Meese
Research Physical Scientist
PI on radionuclide freezing experiments
2 day radiation safety course
Experience with non-licensable quantities of same nuclides to be used in similar experiments.

John Govoni
Technician
Developed equipment for freezing experiment and in charge of sampling.
Experience with non-licensable quantities of same nuclides to be used in similar experiments.

Nancy Perron
Technician
In charge of ice structural work and any chemical analyses to be completed.
Experience with non-licensable quantities of same nuclides to be used in similar experiments.

R.M. WESTER & ASSOCIATES, INC.
215 INDACOM DRIVE • ST. PETERS, MISSOURI 63376
(314) 928-9628 • FAX 928-9857

August 14, 1996

Dr. Mike Reynolds
U.S.A. C.R.R.E.L.
72 Lyme Rd.,
hanover, New Hampshire 03755-1290

Dear Dr. Reynolds,

its was good talking to you this morning and hearing that our joint project is on track and proress is being made. The following discriptions are for the courses you have requested to meet your projected licensing :equirements, based on our phone converation this morning.

ANCILLARY TRAINING

Radiation Safety Awareness introduces non-radiation workers to the basic concepts in radiation safety and provides refresher training for ancillary personnel through lectures/demonstrations on the origin and types of radiation, where it occurs in our environment, and personal protection. price per student $160.00 ea.

BASIC RADIATION SAFETY

Basic Radiation Safety examines basic concepts in radiation safety and provides refresher training through lectures, worksheets, and other written material. Lectures are accompanied by computer-animated illustrations of the following topics:

. Radiation physics - what radiation is and where it originates.
. Radiation biology - effects on living systems and personal protection.
. Working with radiation - safety in the workplace.
. Waste-handling procedures - waste minimization and waste disposal.

Worksheets are provided on topics such as conversion between units of radioactivity and dose, types of radiation, reducing exposure, and distinguishing between radioactive material, radioactivity and contamination. price per student $275.00 ea.

RADIATION SAFETY OFFICER TRAINING

Radiation Safety Officer Training continues in much more depth with the discussions of Basic Radiation Safety, license applications and amendments, developing safety programs and procedures in response to the new 10CFR Part 20 regulations, and surveys of radiation areas. Discussions will be tailored to predominant needs of class members.

price per student $275.00 ea.

Note: As before, this quotation does not include travel, lodging or local transportation.
All instruction to be scheduled during same trip, back to back(to help control cost).

Again my thanks for you business and cooperation, we look farward to helping you meet your needs.

Sincerely,

Tjaden L. Meyer (CHAD)

TELEPHONE CONVERSATON RECORD	Date: 8/2/96	Time: 10:15 AM
Mail Control No.: ~~122729~~ 123520	License No.: new	Docket No.:
Person Calling: Bob Sletten	Licensee: US Army	Telephone No.: 603.646.4443
Person Called: Kathleen Dolce / (610) 337-5251		
Subject: TELEPHONE DEFICICENY		

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ML 10

Summary: This is in reference to your letter dated July 12, 1996 requesting to amend License No. 28-07946-06. License No. 28-07946-06 is a gauge license. Because your request is to use unsealed radioactive materials, we will issue you a new license for use of unsealed radioactive material for research and development (R&D). Since this action will result in the issuance of a new R&D license, please delete all references to sealed sources and other requirements that are related to License 28-07946-06.

A broad scope license authorizes a Radiation Safety Committee in which the committee approves users. This license will not authorize such activties. The NRC will approve Authorized Users. Provide a brief resume of the training and experience of each person who will directly supervise the use of material, who will use material without supervision, or who will have responsibility for radiological safety. The resume should include the type (on-the-job or formal course work), location, and duration of the training. Training should cover (a) principles and practices of radiation protection, (b) radioactivity measurements, standardization, and monitoring techniques and instruments, (c) mathematics and calculations basic to the use and measurement of radioactivity, and (d) biological effects of radiation. The description of the use of licensed materials should include the specific isotopes handled, the maximum quantities of materials handled, where the experience was gained, the duration of experience, and the type of use.

In your application, you designate Dr. Charle M. Reynolds as the Radiation Protection Officer. Please describe the specific isotopes handled, the maximum quantities of materials handled, where the experience was gained, the duration of experience, and the type of use for Dr. Reynolds.

In your application, you didn't describe a training program for ancillary personnel (maintenance, security, etc.) and personnel involved in radionuclide work. Please describe a program that will:

a. be of sufficient scope to ensure that all personnel using licensed materials, or frequenting areas where licensed materials are used, receive proper instruction in accordance with 10 CFR 19.12 (enclosed);
b. assure that personnel are instructed before assuming duties with, or in the vicinity of, licensed materials with retraining as necessary;
c. specify a frequency for retraining.

The training given to each group should be commensurate with the duties and responsibilities of the group and need not be the same for each group.

Please confirm that the Iodine-125 requested will be bound and not volatile.

Confirm that you will maintain records of radiation safety training, results of audits, results of surveys, waste records, receipt and transfer of licensed material.

Action Required/Taken: Wait for licensee's response

Signature: K. Orta **Date:** 8/2/96

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755-1290

July 12, 1996

L 07946
030-34215
03620

United States Nuclear Regulatory Commission
Region I
475 Allentown Road
King of Prussia, PA 19406

Dears Sirs:

Reference our NRC license No. 28-07946-06:

Request our license be ammended in accordance with the enclosed application to reflect the use of unsealed sources in addition to those sealed sources already covered by the license. The enclosed application was prepared by Mr. Luke McCormick, Health Physicist from the Corps of Engineers Hazardous, Toxic, and Radiological Waste Center of Expertise after an on-site visit and review of facilities, equipment, and proposed use of the unsealed sources. Any required fees in conjunction with this application will be remitted under separate cover.

Sincerely,

Mark C. Nelson
LTC EN
COMMANDER

attachment: as
cf: Mr. Bob Stout, HQUSACE SO
Mr. Luke McCormick, COE HTRW CTX
Dr. Mike Reynolds

CONTROLLED AS 123520
PULLED OUT OF ~~123729~~
8/2/96

OFFICIAL RECORD COPY ML 10 JUL 17 1996

1. APPLICATION FOR: Amendment to License Number 28-07946-06.

2. APPLICANTS NAME: Department of the Army
Cold Regions Research and
Engineering Laboratory (CRREL)
(603) 646-4443

3. APPLICANTS MAILING ADDRESS:
72 Lyme Road
Hanover, New Hampshire 03755-1290

4. NAME OF PERSON TO BE CONTACTED CONCERNING THIS APPLICATION:
Mr. Robert Sletten
Telephone Number: (603) 646-4443

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED:
Department of the Army
Cold Regions Research and
Engineering Laboratory
72 Lyme Road
Hanover, New Hampshire 03755-1290

6. INDIVIDUALS WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL:* (this amendment proposes to add the following personnel as authorized users)

a. Charles M.'Mike' Reynolds, Ph.D., Research Physical Scientist

7. RADIATION PROTECTION OFFICER: Dr. Charles M. 'Mike' Reynolds, Ph.D. for use of unsealed sources requested in this amendment, and Robert S. Sletten for sealed sources presently used at CRREL. Duties of the RSO are described in EM 385-1-80 'USACE Radiation Safety Manual'; applicable sections are included in CRREL Radiation Safety Program. (Reasoning for separating the RPO function between two individuals is that the sealed sources are primarily used on remote locations, and Mr. Sletten has served as RPO for the Sealed sources for two years, and has three years experience with the sealed sources used in instruments at remote location, but has had little experience with unsealed sources. Dr. Reynolds has experience with unsealed sources of radionuclides for nearly 15 years, but has not worked extensively with the instruments containing the sealed sources used in the remote locations.)

*resume outlining training and experience for Dr. Reynolds is attached at Appendix A

8. LICENSED MATERIAL:
(This amendment proposes to add the following radioisotopes, physical forms and uses)

Line No	ELEMENT AND MASS NUMBER A	CHEMICAL AND/OR PHYSICAL FORM B	(NO SEALED SOURCES ADDED IN AMENDMENT) C	MAXIMUM NUMBER OF MILLICURIES POSSESSED AT ANY ONE TIME (mCi.) D
(1)	Hydrogen 3	any unsealed form	N/A	20.0
(2)	Carbon 14	any unsealed form	N/A	10.0
(3)	Phosphorus 32	any unsealed form	N/A	1.0
(4)	Sulfur 35	any unsealed form	N/A	10.0
(5)	Iodine 125	any unsealed form	N/A	0.5

E USE OF LICENSED MATERIAL:

Lines 1 through 5 are to be used in basic research. There is no animal research allowed. Research is proposed to include, but is not limited to plant uptake studies, contaminant degradation studies, bench top environmental transport studies, etc...

9. STORAGE OF SEALED SOURCES: (There are no additional sealed sources proposed under this amendment.)

10. RADIATION DETECTION INSTRUMENTS:

LINE NO.	TYPE OF INSTRUMENT	MANUFACTURER'S NAME	MODEL NUMBER	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE
(1)	GM/BF_3 Survey Meter	Ludlum	15 w/ 44-9 thin window pancake GM detector	1 available 1 ordered	beta/ gamma/ neutron	0-500,000 cpm*
(2)	Liquid Scintillation Counter	Packard	1900 TR	1	beta/ gamma	0-2,000,000 cpm*
(3)	GM Survey Meter (proposed)	US Army Issue	AN/PDR 77 w/ thin end window GM detector	1 (requisi-tioned)	beta/ gamma/ alpha	0-1,000,000 cpm*

*According to manufacturer's specifications, both GM survey meters can detect C-14, S-35 and P-32 with efficiencies exceeding 20%, and can detect I-125 with efficiencies of near 10%. The Packard Liquid Scintillation Counter (LSC) is capable of detecting H-3, P-32 and I-125 with efficiencies of near 60% and C-14 and S-35 with efficiencies nearing 95%.

11. CALIBRATION OF INSTRUMENTS LISTED IN ITEM 10.

(1) The Ludlum model 15 will be returned to the manufacturer for calibration.

Ludlum Instrument Corp.
501 Oak St.
Sweetwater, TX 79556

Calibrations will be performed at least annually, and whenever service or repair is performed on the instrument. Calibrations will be made to an NIST traceable source. Battery changes are not considered service or repair. Instrument will be operationally checked to a dedicated check source prior to each use. Calibration procedures are available from the manufacturer.

(3) The AN/PDR 77 is US Army issued equipment and will be returned to the US Army Test Measurements and Diagnostic Equipment (TMDE) Calibration Facility at Redstone Arsenal. AL. TMDE is NRC licensed and participates in the NVLAP program. Calibrations will be performed at least annually, and whenever service or repair is performed on the instrument. Calibrations will be made to an NIST traceable source. Battery changes are not considered service or repair. Instrument will be operationally checked to a dedicated check source prior to each use. Calibration procedures are available from TMDE

(2) The Packard 1900 TR uses a Carbon-14 standard and an internal algorithm to calibrate the energy calibration and the efficiency calibration for the 0 to 2000 keV range radiations. Quenching is compensated for using an external standard inside the instrument. The spectrum analyzer allows identification of unknown radionuclides. The LSC will be used to analyze smears for removable contamination. Calibration counting of background and the C-14 standard will be performed with each batch of samples/smears counted. Calibration standard will be NIST traceable.

12. PERSONNEL MONITORING DEVICES.

For external exposure:

TYPE: Thermo Luminescence Dosimeter (TLD) (includes chip for neutron exposure)

SUPPLIER: US Army Ionizing Radiation Dosimetry Center, Redstone Arsenal, AL (Note that the AIRDC was previously located at the Bluegrass Army Depot in Lexington, KY and has moved to Redstone Arsenal, AL). USAIRDC participates in the NVLAP program and is NVLAP Accredited.

EXCHANGE FREQUENCY: Quarterly.

Extremity dosimeters were considered for experiments involving P-32 and I-125, but the quantity involved in each individual experiment (10 μCi per experiment) would not present a significant hazard. Extremity dosimeters may be made available to a radiation worker upon request.

For internal exposure:

Evaluation of potential internal exposure was made using the following conservative assumptions:

Maximum possession limits were chosen based on total of 100 experiments expected to be performed.
With the exception of I-125, the quantity of radionuclides used in each experiment is less than 10% of an ALI. For I-125 the quantity used in each experiment will be about 25% of an ALI. Barring a major accident or gross violation of all laboratory safety procedures it is unlikely that a radiation worker would uptake more that 1% of a radionuclide used in an experiment. Due to the small quantities of radionuclides used in each procedure, routine bioassays are not considered necessary.

In the event of a suspected uptake of more than 10% of an ALI, an emergency bioassay will be arranged through the US Army Medical Command. Computations related to this consideration are included at Appendix C.

For Declared Pregnant Workers:

Should a radiation worker declare pregnancy, a 'fetus dosimeter' will be issued and worn on the abdomen. The 'fetus dosimeter' will be exchanged monthly. Should cumulative exposure for any part of the gestational period exceed 100 mrem, the RPO will evaluate the source of exposure and reassign work as necessary to menus exposure.

13. FACILITIES AND EQUIPMENT: Drawings of facilities and equipment are attached at Appendix B.

14. WASTE DISPOSAL: Wastes streams will be (1) dry solid waste, and, (2) Aqueous liquid waste. Wastes will be segregated by nuclide. H-3 and C-14 may be commingled.

(1) Dry solid wastes is expected to consist primarily of contaminated paper, gloves and labware. Dry solid wastes contaminated with I-125, P-32 or S-35 will be containerized in 5, 30 or 55 gallon containers, lined with plastic bags, sealed when full and decayed in storage for 10 half-lives (600 days, 150 days and 880 days respectively). After 10 half-lives the plastic bags of waste will be surveyed for radiation. If radiation levels do not exceed background, the waste will be disposed of as normal trash. Dry solid wastes contaminated with C-14 and H-3 will be containerized in 5, 30 or 55 gallon containers, lined with plastic bags, sealed when full and disposed of as radioactive waste through the US Army Materials Command Subordinant, Industrial Operations-Risk Management-Waste Office (AMSIO-DM-W) at a licensed radioactive waste disposal facility. AMSIO-DM-W is the central manager for disposal of all radioactive waste generated within the Department of Defense. Radioactive waste generated under the license issued for this application will be disposed of in accordance with Army Regulation 385-11, and current NRC and DOT regulations, and will meet burial site criteria.

(2) Aqueous Liquid wastes is expected to consist of biodegradable liquid scintillation fluids and water-soluble non-hazardous compounds. Liquid wastes will be checked to ensure that the waste is dispersable in water by adding a few drops of waste liquid to a small container of water and checking if the liquid mixes readily with the water, and does not separate from the water. After the check for dispersability, the waste liquids will be disposed of in the sanitary sewer system, at a rate so as to ensure that the concentration limits in 10 CFR 20 Appendix B are not exceeded. Computations related to this consideration are attached at Appendix C. Each

radionuclide and total activity disposed per day will be recorded in a "Sewer Disposal Log Book". Total annual receipt and use of all radionuclides combined will not exceed 1 Ci, therefore, sewer disposal quantities will not exceed 1 Ci/yr.

15. RADIATION PROTECTION PROGRAM

The radiation safety program is attached at Appendix D.

16. FORMAL TRAINING IN RADIATION SAFETY

Formal training is radiation safety is listed in the researchers resume at Appendix A.

17. EXPERIENCE

Experience with radiation is listed in the researchers resume at Appendix A

18. CERTIFICATE:

The applicant and any official executing this certificate on behalf of the applicant named in item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of out knowledge and belief.

18 USC Section 1001; Act of June 25 1948; 62 Stat 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

a. LICENSE FEE REQUIRED:

(1) LICENSE FEE CATEGORY:

(2) LICENSE FEE ENCLOSED:

b. CERTIFYING OFFICIAL: _____

c. NAME: MARK C. NELSON
LTC, EN

d. TITLE: COMMANDER

e. DATE: 12 July 1996

APPENDIX A. Resume for Charles M.'Mike' Reynolds, Ph.D., Research Physical Scientist

VITAE

(Abbreviated form, June 1996)

Charles Michael (Mike) Reynolds
CRREL (Cold Regions Research and Engineering Laboratory)
72 Lyme Road
Hanover, NH 03755
603-646-4394 Fax 603-646-4644

EDUCATION:

B.S. 1975 University of Maryland, Soil Science
M.S. 1980 University of Maryland, Soil Chemistry
Ph.D. 1986 University of Arkansas, Soil Microbiology
Postdoctoral Research, 1986-1988 North Carolina State University, Numerical Modeling of Soil Processes

LICENSES HELD:

Certified Professional Soil Scientist, American Registry of Certified Professionals in Agronomy, Crops, and Soils (ARCPACS) #02746
Hazardous Waste Operation and Emergency Response License for Site Access and Work

PROFESSIONAL EXPERIENCE:

December 1988 to present

Research Scientist, US Army Cold Regions Research and Engineering Laboratory, Hanover New Hampshire
Primary research focus is in cold region soil processes and includes:
(1) influence of freezing and cold temperatures on microbial, chemical, and physical phenomena that govern chemical fate in soils.
(2) rhizosphere enhanced bioremediation
(3) bioremediation of contaminated soils using low input/natural attenuation strategies

July 1986 to December 1988.

Research Associate, (postdoctoral) North Carolina State University, Raleigh NC.
Research involved N and P modeling is soils.

1981 to July 1986

Research Assistant, University of Arkansas, Fayetteville, AR.
Completed Soil Microbiology class (1 semester + lab. section) that included using radio-nuclides for research.
Completed 1 semester Microbial Physiology course that included the theory of radio-tracer techniques, safety, and calculations.
Conducted research for five years on the fate of organic compounds in soils. Research involved using ^{15}N, ^{14}C, and ^{3}H labeled compounds as tracers in soils.

Team-taught soil microbiology laboratory section for three, 1-semester terms. Laboratory section included the use of ^{14}C compounds in degradation experiments.

1978 to 1981

Supervisor, Maryland Cooperative Extension Service Soil Testing Laboratory, University of Maryland, College Park, MD

1976 to 1978

Graduate Research Assistant, University of Maryland, College Park, MD.

College courses that included radionuclide theory, use, or both for environmental research applications:

*Chemistry, 2 semesters
*Organic Chemistry, 2 semesters
Biochemistry, 2 semesters
Physical Chemistry, 1 semester
*Quantitative Analysis, 1 semester
Chemical Engineering - Chemodynamics, 1 semester
*Microbiology, 2 semesters
Calculus, 3 semesters
Differential Equations, 1 semester
*Plant Physiology, 1 semester
*Expermental Methods for Soils Research, 1 semester
*Soil Chemistry, 1 semester
*Soil Physics, 1 semester
Advanced Soil Chemistry, 1 semester
*Advanced Methods of Soil Investigation, 1 semester
*Soil Fertility, 1 semester
*Advanced Soil Fertility, 1 semester
*Botany, 1 semester
*Soil and Water Pollution, 1 semester
*Soil Biochemistry, 1 semester
Mineral Nutrition of Plants, 1 semester

* included laboratory

Additional Training Courses Completed:

Hazardous Waste Site Operator Refresher 1996 (8 hrs)
Hazardous Waste Site Operator Refresher 1995 (8 hrs)
Canberra Nuclear, Basics of Liquid Scintillation, Sep. 1994 (16 hrs).
Hazardous Waste Site Operator Refresher 1994 (8 hrs)
American Chemical Society, Benchtop GC-MS, June, 1994
Hazardous Waste Site Operator Refresher 1993 (8 hrs)
Bioremediation Workshop, SSSA 1993
Hazardous Waste Site Operator Course, 1992 (40 hrs)

Geostatistical Techniques, SSSA 1992
Soil Bioremediation - Treatability, ASM 1992
Analytical Techniques for Organic Compounds, AEHS 1991
Soil Remediation Technologies, AEHS 1991
Applied Bioremediation Short Course, AEHS 1991
Radiation Safety Refresher Course, Univ. of Arkansas, 1986 (4 hours).
Radiaiton Safety Course, Univ. of Arkansas, 1982 (24 hrs)

PROFFESSIONAL SOCIETIES

American Association for the Advancement of Science
American Society of Agronomy
Soil Science Society of America
American Society for Microbiology
Interr ational Soil Science Society
Assoc'ation for the Environmental Health of Soils

UNIVERSITY ACTIVITIES and PARTICIPATION IN GRADUATE COMMITTEES

Sponsor, Student Intern Program, Colby-Sawyer College. Hosted and mentored three undergraduate students to assist in their Coop Student requirements.
Pidgeon, C. S. 1994-present. Master of Science. University of Vermont
Scanlon, Mary. 1996-Present. Master of Science. University of Arkansas
Rogers, Barry. 1996-Present. Master of Science. University of Arkansas
Garant, H. 1995 -Present. Ph.D Thayer School of Engineering, Dartmouth College.
Gentry, T. J. 1995 - Present. Master of Science. University of Arkansas
Garant, H. 1993. Master of Science. Thesis: "Biologically mediated transformation of chlorinated ethenes". Thayer School of Engineering, Dartmouth College.
Nichols, T. D. 1995. "Microbial responses to soils contaminated with a model organic contaminant". Master of Science Thesis, College of Agriculture, University of Arkansas.
Adjunct Graduate Faculty, College of Agriculture and Life Sciences, University of Arkansas.

SELECTED PUBLICATIONS:

Reynolds, C. M., G. S. Brar, and P. M. Currier. 199_. Biotreatment of organic contaminated soils in cold regions. (Accepted for publication in DoD Clean-up/Installation Restoration. Soil Science Society of America Special Publication.)

Nichols, T. D., D. C. Wolf, H. B. Rogers, C. A. Beyrouty, and C. M. Reynolds. 1996. Microbial populations in the rhizosphere of contaminated soils. (In press, J. Water, Air, and Soil Pollution)

Brar, G. S. and C. M. Reynolds. 1996. Soil physical environment and root growth in Northern climates. CRREL Special Report #797 (In press).

Reynolds, C. M., C. A. Beyrouty, D. C. Wolf, and J. L. Walworth. 1996. Rhizosphere enhanced bioremediation for cold regions: Contaminant effects on root distribution. Proceedings of Joint US/Canada, Military and Civilian Workshop on Technologies and Techniques for Hydrocarbon Remediation in Cold and Arctic Climates. 6-7 June 1995, Royal Military College of Canada, Kingston, Ontario, Canada.

Rogers, H. B., C. A. Beyrouty, T. D. Nichols Jr., D. C. Wolf and C. M. Reynolds. 1996. Selection of cold-tolerant plants for growth in soils contaminated wit organics. Journal of Soil Contamination, 5:(2): 171-186.

Walworth, J. L. and C. M. Reynolds. 1995. Bioremediation of a petroleum contaminated soil: Effects of phosphorus, nitrogen, and temperature. Journal of Soil Contamination, 4:4(3): 299-310.

Reynolds, C. M. and I. K. Iskandar. 1995. A modeling based evaluation of wastewater application practices on groundwater quality. CRREL Report 95-2.

Reynolds, C. M., M. Travis, W. A. Braley, and R. J. Scholze. 1994. Applying field expedient bioreactors and landfarming in cold climates. In: Second International Symposium, In-Situ and Onsite Bioreclamation. pg. 100-106. Lewis Publishers.

Reynolds, C. M. 1993. Field measured bioremediation rates in a cold region landfarm: Spatial variability relationships. In: Proceedings of the Seventh Annual East Coast Conference on Hydrocarbon Contaminated Soils, P. T. Kostecki and E. J. Calabrese (eds.) Lewis Publishers, Chelsea, MI. pg. 487-499

Brar, G. S., P. M. Currier, and C. M. Reynolds. 1993. Remediation of petroleum contaminated soils with bioventing in cold regions. Superfund XIV Conference, Nov. 29 - Dec. 1, 1993. Washington. D. C.

Currier, P. M., C. M. Reynolds, and S. A. Grant. 1993. The potential role of natural attenuation in remediating contaminated soils at cold region military installations. In Proceedings, 17th Annual Army Environmental Research and

Development Symposium and Third USACE Innovative Technology Transfer Workshop. 22-24 June 1993. Williamsburg, VA. pg. 501-505.

Reynolds, C. M. 1992. Effectiveness and variability of digestion procedures for zinc determination in aged, contaminated soils. CRREL Report 92-15.

Ayorinde, O. A. and C. M. Reynolds. 1992. Composting process, design, and analysis in cold climate. In Proceedings of the 11th International Conference on Offshore Mechanics and Arctic Engineering. Vol IV -Arctic and Polar Technology p. 409-413.

Reynolds, C. M. 1992. Microwave digestion procedures for characterizing metal contaminated soils: Applications, limitations, and projected capabilities. In Proceedings of Workshop on Engineering Aspects of Metal-Waste Management, International Conference on Metals in Soils, Waters, Plants and Animals. I. K. Iskandar (ed.), April 30- May 3, 1990. Orlando, Florida, USA. Lewis Publishers.

Ayorinde, O. A. and C. M. Reynolds. 1991. Low temperature effects on the design and performance of composting of explosives-contaminated soils. CRREL Report 91-4.

APPENDIX B. FACILITIES and EQUIPMENT

a. Laboratories and Fume hoods

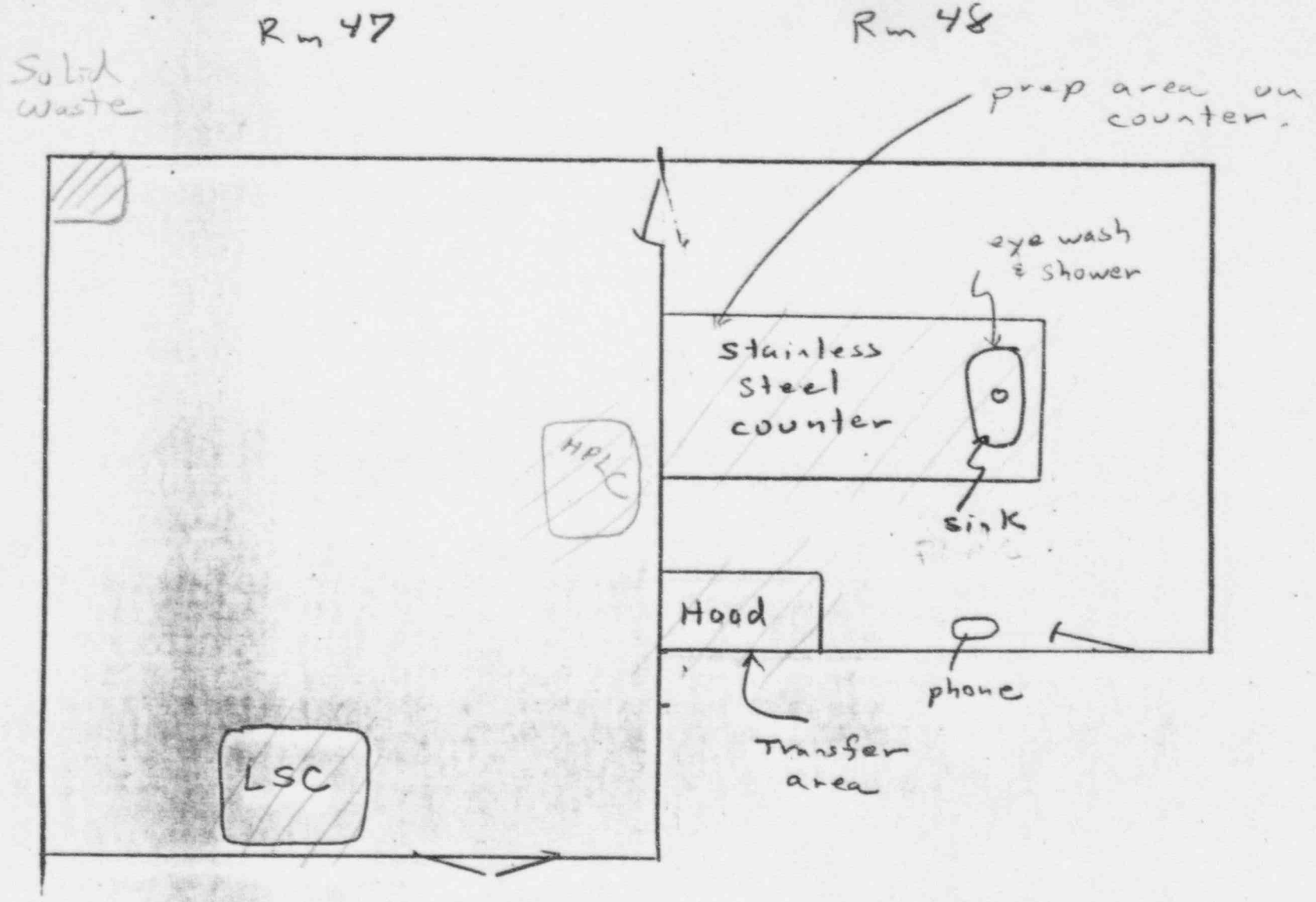
Lab drawings are attached. Locations of fume hoods, sewer disposal sinks, radioactive work areas and radioactive waste storage areas are marked. The liquid scintillation counter will be located in room 47, as will the radioactive waste storage area.

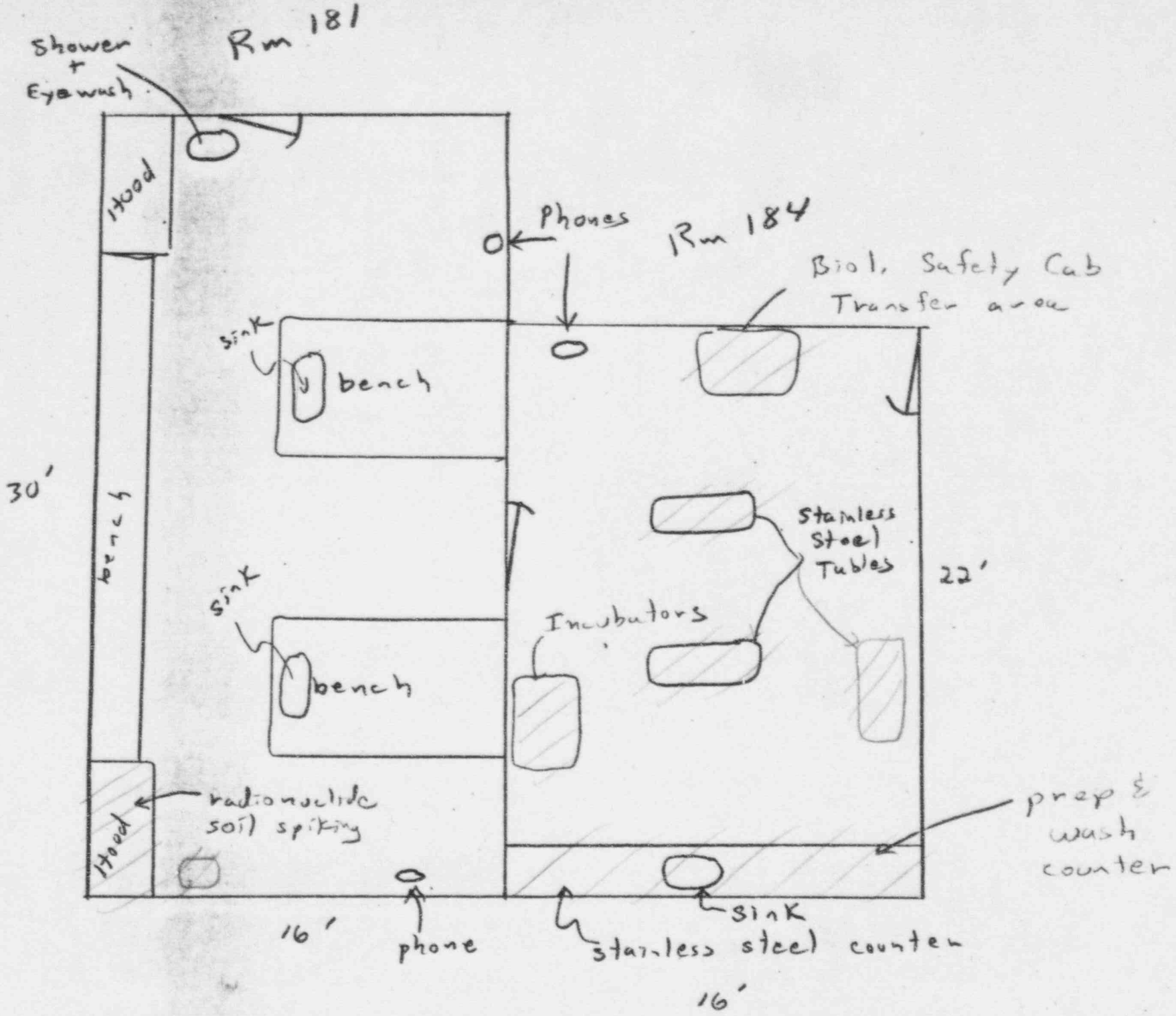
b. Storage Facilities.

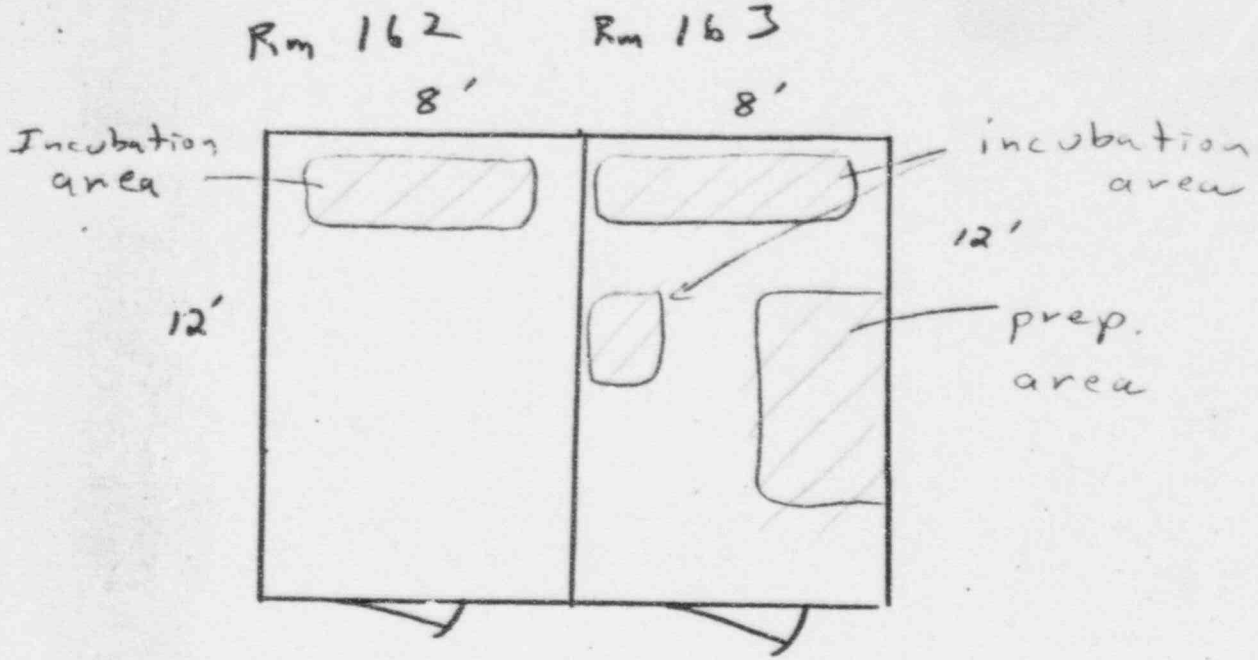
All radioactive materials not in use will be stored in the locked cold rooms; room 162 and 163, or locked in storage cabinets located in room 2 47, 48 and 181. All dry radioactive waste will be stored in lined containers in the corner of room 47. Liquid radioactive wastes will be disposed of promptly, or locked in the cold rooms.

c. Remote handling tools and equipment. None. The proposed activities do not involve quantities of radionuclides used at one time that would warrant remote handling tools. I-125 is the only gamma emitter and it is expected that 10 microcurie aliquots will be used per experiment. P-32 is the most powerful beta emitter. Lucite shielding from the shipping/storage vial, and additional shielding as necessary should provide adequate protection. Should radiation surveys indicate exposures greater than a five hundred micro roentgens per hour (500 μR/hr) at 1 inch from the containers, additional shielding will be required.

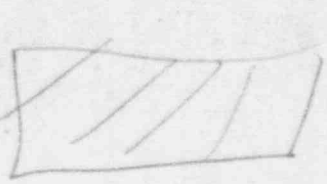
D. Respiratory Protection Equipment. None. The proposed activities pose little hazard of airborne radioactivity. The chemical forms of the radionuclides used are not extremely volatile, and a majority of the work with the unsealed forms will be performed under a fume hood, or with the radionuclide enclosed in a vial, flask etc.


Rm 47
Rm 48
Solid Waste
prep area on counter.
eye wash & shower
stainless steel counter
sink
HPLC
Hood
phone
Transfer area
LSC


Rm 181
Shower + Eyewash
Hood
Phones
Rm 184
Biol. Safety Cab
Transfer area
sink
bench
30'
bench
Stainless Steel Tables
22'
sink
Incubators
bench
Hood
radionuclide soil spiking
prep & wash counter
16'
phone
sink
stainless steel counter
16'


Rm 162
Rm 163
8'
8'
Incubation area
incubation area
12'
12'
prep. area

Cold Rooms


material used

APPENDIX C Auxiliary calculations and computations used in preparation of this application.

To assure no need for submission of decommissioning funding plan and financial surety.

Nuclide	Maximum Possession limit (mCi.) Requested	10 CFR 30 Appendix B Quantities (mCi.)	Ratio	Ratio / 10^3
Hydrogen-3	20	1	20	0.02
Carbon-14	10	0.1	100	0.1
Phosphorus-32	1	0.01	100	0.1
Sulphur-35	10	0.1	100	0.1
Iodine-125	0.5	0.001	500	0.5
Total			820	0.82

To assure no need for respiratory protection equipment, ensure air concentrations are below 10 CFR 20 App B Concentrations

Nuclide	Maximum Possession limit (μCi.) Requested	Maximum normally used per experiment (μCi)	10 CFR 20 Appendix B DAC (μCi/ml)	10 CFR 20 Appendix B ALI (μCi)
Hydrogen-3	2E+4	1E+2	1E-2	8E+4
Carbon-14	1E+4	1E+2	3E-4	2E+3
Phosphorus-32	1E+3	1E+1	9E-5	4E+2
Sulphur-35	1E+4	1E+2	1E-3	1E+4
Iodine-125	5E+2	1E+1	2E-5	4E+1
Total				

maximum possession limits requested were based on 100 total experiments ,using all nuclides and assuming no waste disposal possible. Actual experiments will use one nuclide or occasionally C-14 and H-3 combined. I-125 presented the highest hazard and was not expected to be needed half as much as the other nuclides, so I-125 experiments were expected to number 50.

To assure sewer disposal remains below 10 CFR 20 App B Concentrations. Assume max possession limit is sewer disposed each month.

Nuclide	Maximum Possession limit (μCi.) Requested	monthly sewer flow rate (ml/mo)	Average monthly concentration (μCi/ml)	10 CFR 20 Appendix B sewer disposal concentrations (μCi/ml)
Hydrogen-3	2.00e+04	4.30e+09	2.00e-05	1.00e-02
Carbon-14	1.00e+04	4.30e+09	2.33e-06	3.00e-04
Phosphorus-32	1.00e+03	4.30e+09	2.33e-07	9.00e-05
Sulphur-35	1.00e+04	4.30e+09	2.33e-06	1.00e-03
Iodine-125	5.00e+02	4.30e+09	1.16e-07	2.00e-05
Total			Sum of the ratios	2.05e-02

APPENDIX D CRREL Radiation Safety Program

U. S. ARMY COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
HANOVER, NEW HAMPSHIRE 03755-1290

CRREL REGULATION
NUMBER 385-1-2*

13 June 1996

Safety
RADIOLOGICAL SAFETY PROGRAM

1. Purpose. This regulation provides for the protection of the employees and visitors of the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL) and of the general public against radiation hazards.

2. Applicability. All personnel of this laboratory that initiate acquisition, possess, use, transport, or dispose of radioactive material are subject to this regulation.

3. References.

a. Nuclear Regulatory Commission, Title 10; Code of the Federal Register, Part 20.

b. AR 385-11 and AR 40-501.

c. ER 385-1-80.

4. Policy. The policy of this laboratory is that an effective Radiation Protection Program will be maintained through the issuance of and adherence to required regulations. Official positions established by this regulation:

a. The Radiological Protection Officer (RPO). The Director shall appoint the RPO. The Director may also appoint a first and second alternate RPO. These appointments are by Special Order. References to the position, "RPO", shall also include the alternate RPO's.

b. The Radioisotope Safety Committee. As required by Army Regulation (AR) 385-11, the Director shall appoint members to a Radioisotope Safety Committee. The minimum composition of that Committee shall be; the Radiation Protection Officer, who will serve as chairman of the Committee, the commander or commander's deputy, and members of each division working with radioisotopes or sealed sources. These appointments are made by Special Order. The chairman will call meetings quarterly, and minutes of each meeting will be recorded.

*This regulation supersedes CRRELR 385-1-2, 8 September 1989

5. Responsibilities. The RPO has responsibility for overall radiation protection and has the authority to ensure radiological safety.

a. The RPO is responsible for:

(1) Ensuring the safety of all personnel and facilities involved in work with radiation,

(2) Ensuring compliance with all applicable Federal, State, Local, DA, USACE and Command regulations concerning ionizing radiation by all personnel with his command,

(3) Promoting the ALARA principle.

b. To accomplish this the RPO will:

(1) Limit or cease operations within their command where there may be a radiation safety issue and resolve the issue before allowing operations to continue,

(2) Review and approve individuals qualifications, their proposed uses of radioactive material or radiation generating equipment, and their facilities and equipment, prior to allowing operations to commence. Applications for possession and use of radioactive materials must be cleared through the RSO prior to submission to the licensing agency,

(3) Ensure all required training (initial and refresher) is available and is completed as scheduled, for all personnel,

(4) Review their radiation safety program annually for content and implementation within their command,

(5) Inspect and review work with radiation within his command as needed to assure compliance,

(6) Write and review Standard Operating Procedures as needed,

(7) Stay technically competent and keep up-to-date with current radiation safety regulations and practices,

(8) Ensure adequate monitoring equipment is available to support the safe operation of the project,

(9) Ensure inexperienced personnel have been instructed in safe working procedures and are alert to the hazards radiation and radioactive material.

(10) The RPO exercises general surveillance over all radiation activities, rendering assistance whenever necessary.

(11) The RPO ensures that personnel monitoring devices are being properly used and the monitoring device readings are properly recorded. If an overexposure or readings above twice the average reading occur, the RPO will attempt to evaluate the cause, take the necessary action to prevent a recurrence, and prepare and file an incident report.

(12) The RPO will ensure that required warning signs are properly displayed.

(13) The RPO will maintain the inventory of all radiation measuring equipment, including records of servicing and calibration.

(14) The RPO will have all health physics instruments calibrated on an annual basis.

(15) The RPO will issue the appropriate monitoring equipment to trained individuals who will be working at field sites remote from the USACRREL, Hanover, facilities.

(16) The RPO will maintain the following personnel records:

(a) Exposure Records (DD Form 1141),

(b) Issue and return of personnel monitoring devices,

© Copies of Training Records.

(17) The RPO will supervise the shipment of all radioactive materials, including waste disposal.

(18) The RPO will store, issue, wipe test and dispose of all radioactive material.

(19) The RPO will keep records on all sources, including locations, date of issue, date of transfer and date of disposal.

(20) The RPO will perform leak tests on all sealed source radioactive materials semiannually and conduct radiation surveys of radiation work, storage and disposal areas quarterly. All leak tests will be analyzed by US Army Ionizing Radiation Dosimetry Center(USAIRDC), Ft. Rucker, AL and recorded on ENG From 3309 and copies forwarded to CDR USACE (CESO), Wash., DC 20314-5000. The RPO will retain copies of each leak test until records are released for disposal by CESO.

(21) In the event of a radiation incident:

(a) Any individual suspecting or knowing of an accident, incident, loss or theft involving radioactive material or radiation will notify the RPO as soon as possible. The RPO will notify the CESO in a timely manner, of any accident, incident, loss or theft that

requires reporting to the NRC or other regulatory agency

(b) The RPO will isolate the site to prevent personnel over-exposure and to contain the contamination.

© The RPO will notify the NRC or other regulatory agency in the required time frame, of all accidents, incidents, losses or thefts that require reporting. All telephone reports will be followed up by a written report within 30 days.

(d) All written reports will address the following items:

(1) A description of the material involved, including the kind, quantity and chemical and physical form of the material,

(2) A description of the circumstances surrounding the incident,

(3) A statement of the disposition, or probable disposition of the material involved,

(4) An estimate of doses received by any individuals, and the circumstances of the exposure,

(5) Actions taken.

(6) Procedures or measures proposed or adopted to prevent recurrence.

(e) The following are some of the reportable accidents/ incidents, and the required reporting times:

(1) Theft or loss of 1000 times the 10 CFR 20, Appendix C quantity of a radioactive material must be reported immediately;

(2) Theft or loss of 10 times the 10 CFR 20, Appendix C quantity of a radioactive material must be reported within 30 days;

(3) Incidents that cause or threaten to cause an individual to receive 25 rem TEDE, 75 rem EDE, or 250 rem Shallow Dose Equivalent (SDE), must be reported immediately;

(4) A release of radioactive material, either inside or outside a restricted area, that could possibly result in a 24 hour dose of greater than 5 times the annual limits must be reported immediately;

(5) Incidents that cause or threaten to cause an individual to receive 5 rem TEDE, 5 rem EDE, or 50 rem SDE, must be reported within 24 hours;

(6) Release of radioactive material, either inside or outside a restricted area,

that could possibly result in a 24 hour dose of greater than the annual limits must be reported within 24 hours.

(7) Incidents that cause an occupational worker, member of the public, a minor or an embryo/fetus of a declared pregnant woman to receive a dose in excess of the appropriate regulatory dose, must be reported within 30 days;

(8) A release of radioactive material, inside a restricted area, greater than the license limits must be reported within 30 days;

(9) A release of radioactive material, outside a restricted area, greater than 10 times any license limit, regardless of any exposure to an individual, must be reported within 30 days.

(f) Reports must include the information required in 10 CFR 20 Subpart M, or as required by other regulatory agencies.

(1) The CDR USACE (CESO), WASH DC 20314-1000, Phone: (202) 272-8565

(2) The NRC and/or Agreement state representative appropriate for the region in which the incident occurs. Reporting requirements and procedures are contained in AR 385-40, Chapter 10. Army addresses and emergency telephone numbers are contained in AR 385-11, Table 4.

c. The Radioisotope Safety Committee receives its authority from the Director.

(1) The Committee is responsible for:

(a) Establishment review and modification of a radiation protection program at USACRREL, and work sites established by USACRREL employees, .

(b) Ensuring compliance of the USACRREL radiation protection program with applicable Federal, State and local laws and regulations.

(2) To meet its responsibilities, the Radioisotope Safety Committee has the authority to:

(a) Review, approve, or disapprove applications for a license for the use of radioactive material prior to submission to the licensing agency.

(b) Suspend an approved procurement application.

© Suspend an individual's or project's use of radioactive material or radioactive sources.

(d) Apply restrictions on the amount of radiation exposure that an individual may receive during a specified time interval.

d. Each individual who may use radioactive material or be exposed to ionizing radiation above background is responsible for complying with the procedures and precautions contained in this document.

6. Control of Radiation Exposure.

a. All exposure to ionizing radiation will be kept to a minimum.

b. The external and internal exposure from each radioactive source shall be controlled in such a way as to provide reasonable assurance that no individual shall receive an absorbed dose in excess of those listed in Appendix B.

c. Radiation Surveys, wipe testing and leak testing.

(1) The RPO will provide a GM Survey Meter, that personnel may use to monitor radiation exposure and surface contamination. (For personnel using only Tritium, wipe surveys will be provided.)

(2) Leak testing of sealed sources: The RPO will leak-test semi-annually all sealed sources containing radioactive material in excess of exempt quantities as described in 10 CFR 30, Appendix B. The counting procedure used will have a sensitivity of less than 0.005 microcuries of the possible contaminant.

(3) For use of unsealed sources:

(a) Contamination surveys will be performed monthly, or after each operation. No survey is required for months where no work with radioactive materials was performed, but the authorized user shall document that there was no use that month.

(b) Surveys for removable contamination will be performed using smears and counting the smears in the liquid scintillation counter. Action level is 220 disintegrations per minute above background. Action will be decontamination and resurveying. If contamination is fixed, and radiation levels exceed 0.05 mR/hr, marking and possibly isolating the area or equipment may be necessary and will be at the discretion of the RPO.

© Surveys will include a GM survey of the work area, the storage area the waste area and the disposal sink to look for elevated radiation readings. Action level is twice background. Action will be smear survey for removable contamination, decontamination if removable, if contamination is fixed, and radiation levels exceed 0.05 mR/hr, marking and possibly isolating the area or equipment may be necessary and will be at the discretion of the RPO.

(d) Air sampling will be performed where volatile radionuclides are used, and where there is a potential for airborne contamination exceeding 10% of the DAC. Air will be sampled in the breathing zone. Filters or cartridges will be selected as appropriate by the RPO.

(e) Effluent air sampling will be performed where volatile radionuclides are used, and where there is a potential for effluent air contamination exceeding 50% of the 10 CFR Appendix B air effluent values. Filters or cartridges and sampling methods will be selected as appropriate by the RPO.

(4). Wipe test procedures:

A wipe test, also called a 'smear' or 'swipe' test, is collected using various materials. The most common material is a filter paper type material designed specifically for this purpose. Another common material for small spaces are cotton swabs, similar to long handled 'Q-tips.' This material can be used wet or dry but dry wipe tests are preferred.

(a) Wipe testing is performed by using the piece of filter paper or cotton swab and wiping it over an area approximately 100 square centimeters.

(b) Use normal finger pressure on a dry filter paper or swab and wipe in an "S" shape for a distance of 50 centimeters and wiping again in a backwards "S" shape at right angles to the first one for another 50 centimeters. The wipe is packaged in an envelope and sent to a lab for analysis. If an item is too small or irregularly shaped for this procedure, then wipe the entire surface area of small items or an accessible 100 square centimeter area of irregular shaped items.

(5) Wipe test analysis:

(a) Wipe test analysis will be performed using the Liquid scintillation counter.

(b) Wipes will be counted using energy windows that bracket all energies of radiation emitted from all nuclides used in the areas where the wipes were taken.

© Results of wipe test analyses will be correlated with the date and locations of the wipes and the records reviewed by the RSO and filed until the records are released for disposal by CESO.

(6) For Sealed Sources:

(a) The RPO will perform leak tests on all sealed source radioactive materials semiannually and conduct radiation surveys of radiation work, storage and disposal areas quarterly. Surveys will be documented reporting locations surveyed, date surveyed, equipment used and results of surveys.

(b) All leak tests will be analyzed by US Army Ionizing Radiation Dosimetry Center(USAIRDC), Ft. Rucker, AL and recorded on ENG From 3309 and copies forwarded to CDR USACE (CESO), Wash., DC 20314-5000.

© The RPO will retain copies of each leak test and survey record until records are released for disposal by CESO.

(7) Leak test procedures:

(a) A leak test is performed in a manner similar to a wipe test. The primary difference is that most sealed sources emit much more radiation than most contamination, and for ALARA purposes it is best to keep as much distance between the source and the person performing the leak test. This is done by using long handled cotton swabs or forceps to hold a filter paper swab, increasing the distance between the source and the hand.

(b) The swab or filter paper is wiped with moderate pressure across the surface of the source, or if inaccessible, across the surface most likely to be contaminated (e.g. inside the shielding below the source).

© The swab or filter paper is placed in a lined envelope and sent to USAIRDC for analysis.

(d) The results of the leak test will be correlated with the source tested and the date tested and filed by the RPO until the record is released for disposal by CESO.

d. Personnel Dosimetry.

(1) Personnel dosimetry will be issued by the RPO to all individuals working with sealed and unsealed sources of radiation, except personnel working only with low energy beta emitters such as Tritium and Carbon 14.

(2) At their discretion, the RPO may issue personnel dosimetry to any individual requesting it.

(3) All personnel issued Personnel Dosimetry will supply their previous dose history, or a signed declaration that they have no previous dose history to the RPO prior to receiving a dosimeter. Work with radiation will not proceed without appropriate dosimetry.

(4) The RPO will make an earnest effort to obtain copies of previous dose histories from previous employers for individuals issued personnel dosimetry.

(5) The RPO will evaluate the potential for internal exposure for operations involving unsealed form radiative material. Where the potential exists for individuals to receive 10% of their ALI, a bioassay program will be instituted. Bioassay programs are dependent on the specific circumstances, materials used and operations performed. Where an RPO is required to evaluate the need for bioassays or design a bioassay

program, CESO should be contacted to secure appropriate health physics services.

e. Caution Signs and Labels.

(1). Appropriate warnings are required in all areas, rooms, and on all containers in which significant amounts of radiation or radioactive material may be found. Warnings consist of postings and labelings. In general, areas or rooms are "posted" with signs whereas containers, devices, equipment, etc. are "labeled." The specific warning to be used depends on the type and degree of hazard present. The RPO will post rooms, hoods, work areas, etc. The AU is responsible for appropriate labeling.

(2) Posting caution signs.

(a) USACE policy is that any room or area in which radioactive material, covered by an NRC license, an Agreement State license, or a Department of the Army Radiation Authorization (DARA), is used or stored shall be posted "Caution, Radioactive Material".

(b) A room or area in which radioactive material is used or stored may require additional posting if the dose rate in the room or area is likely to exceed 5 mrem in any one hour. Table 6-1 specifies when a room or area must be posted as a Radiation Area, a High Radiation Area, or a Very High Radiation Area.

(3) Required labeling.

(a) When a container has a quantity of radioactive material equal to or greater than that listed in Table 6-2, a "Caution, Radioactive Mate-' ' label will be affixed to the container. Most gauges and instruments containing radioactive material, such as soil density gauges, electron capture sections of gas chromatographs, or sediment density probes will require this label.

(b) Each AU shall, prior to disposal of any uncontaminated empty container to an unrestricted area, remove or deface the label or otherwise clearly indicate that the container no longer contains radioactive material.

© Be advised that this labeling requirement is separate from the labeling requirements of DOT. A package of radioactive material prepared for transportation may also need DOT labels as described in Chapter 8 - Transportation of Radioactive Material.

Table 6-1

Dose Rate	Distance From Source	Posting Required
1. 5 mrem in any one	1.	1. "Caution, Radiation

hour.	30 cm	Area"
2. 100 mrem in any one hour.	2. 30 cm	2. "Caution, High Radiation Area"
3. 500 rad in any one hour.	3. 1 m	3. "Grave Danger, Very High Radiation Area"

(d) An AU is not required to label:

(1) containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits.

(2) containers when they are in transport and packaged and labeled in accordance with DOT regulations.

(3) containers which are accessible only to individuals authorized to handle or use them or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record.

(e) Signs and labels shall have a yellow background with a magenta or black standard radiation symbol. Lettering shall be magenta or black, but magenta is the preferred color.

(f) Airborne Radioactivity.

(1) If the activities engaged in are suspected to create airborne radioactivity (e.g., vapors or aerosols), the RPO shall conduct the appropriate surveys and calculations to determine if posting the area is required. If necessary, these areas will be posted with a "Caution, Airborne Radioactivity Area".

(2) The RPO will arrange a time to conduct the posting of each authorized use location prior to approving that location for radioactive material use. A facility posting checklist is utilized to document postings.

(g) Rooms/Areas in Which Radioactive Material is No Longer Used or Stored. The AU is responsible for notifying the RPO by memo when radioactive material usage in a room or area has ceased. The RPO will remove signs and complete a facility termination checklist to document that the unnecessary signs have been removed.

f. Receiving Radioactive Material.

(1) NRC regulations require that written instructions for receiving and opening packages be maintained and followed by all personnel receiving radioactive material.

The following written instructions meet the NRC requirements. When a package is received it will be inspected as follows:

(a) A visual check is made to see if the package is damaged (wet or crushed). If there is evidence of degradation of package integrity, the package will be monitored for radioactive contamination and radiation levels.

(b) Monitor the external surfaces of a labeled package (a package labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in DOT regulations, 49 CFR 172) for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in 10 CFR 20 or the package appears undamaged and the wipe test results from the shipper are documented.

© Monitor the external surfaces of a labeled package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the A_2 quantity listed in 10 CFR 71 Appendix A, and the radioactive material is in the form of a gas or in special form.

(d) Monitoring shall be performed as soon as practicable after receipt of the package, but not later than 3 hours after the package is received if it is received during normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after normal working hours.

(e) The receiver will immediately notify the final delivery carrier and, by telephone and telegram, mailgram, or facsimile, the RPSO, and the NRC when removable radioactive surface contamination exceeds:

2200 disintegrations per minute (dpm)/100 cm^2 beta, gamma or

220 dpm/100 cm^2 alpha or

if the external radiation level exceeds the Transport Index at 1 meter from the package.

(f) When a radioactive material package is received there is a chance the radioactive material has leaked out of the inner container. One could receive a radiation exposure if a contaminated package is opened without taking proper precautions. Always assume a radioactive material package is contaminated until proven otherwise.

(2) Personnel opening radioactive material packages should use the following procedure:

Wear gloves.
Check to be sure the contents match the packing slip.
Remove and wipe test the inner container if contamination is suspected.
If contamination is not found, store the radioactive material in a secure storage area that is conspicuously posted for radioactive material, as required above.
If internal contamination is found, dispose of all contaminated shipping material as radioactive w
If the radioactive material is still usable, clean the outside of the container, and store in an area po
Survey the receipt area for contamination.

Deface or remove all labels on the uncontaminated shipping box and dispose of as normal trash.

TABLE 6-2

Quantities Requiring Container Labeling

Atm No	Material	µCi
95	Americium-241	0.01
51	Antimony-122	100
51	Antimony-124	10
51	Antimony-125	10
33	Arsenic-73	100
33	Arsenic-74	10
33	Arsenic-76	10
33	Arsenic-77	100
56	Barium-131	10
56	Barium-133	10
56	Barium-140	10
83	Bismuth-210	1
35	Bromine-82	10
48	Cadmium-109	10
48	Cadmium-115m	10
48	Cadmium-115	100
20	Calcium-45	10
20	Calcium-47	10
6	Carbon-14	100
58	Cerium-141	100
58	Cerium-143	100
58	Cerium-144	1
55	Cesium-131	1,000
55	Cesium-134m	100
55	Cesium-134	1
55	Cesium-135	10
55	Cesium-136	10
55	Cesium-137	10
17	Chlorine-36	10
17	Chlorine-38	100
24	Chromium-51	1,000
27	Cobalt-58m	100
27	Cobalt-58	10
27	Cobalt-60	1
29	Copper-64	100
66	Dysprosium-165	10
66	Dysprosium-166	100
68	Erbium-169	100
68	Erbium-171	100
63	Europium-152m	100
63	Europium-152	1
63	Europium-154	1
63	Europium-155	10
9	Fluorine-18	1,000
64	Gadolinium-153	10
64	Gadolinium-159	100
31	Gallium-72	10
32	Germanium-71	100
79	Gold-198	100
79	Gold-199	100
72	Hafnium-181	10
67	Holmium-166	100
1	Hydrogen-3	1,000
49	Indium-113m	100
49	Indium-114m	10
49	Indium-115m	100
49	Indium-115	100
53	Iodine-125	1
53	Iodine-126	1
53	Iodine-129	0.1
53	Iodine-131	1
53	Iodine-132	10
53	Iodine-133	1
53	Iodine-134	10
53	Iodine-135	10
77	Iridium-192	10
77	Iridium-194	100
26	Iron-55	100
26	Iron-59	10
36	Krypton-85	100
36	Krypton-87	10
57	Lanthanum-140	10
71	Lutetium-177	100
25	Manganese-52	10
25	Manganese-54	10
25	Manganese-56	10
80	Mercury-197m	100
80	Mercury-197	100
80	Mercury-203	10
42	Molybdenum-99	100
60	Neodymium-147	100

60	Neodymium-149	100
28	Nickel-59	100
28	Nickel-63	10
28	Nickel-65	100
41	Niobium-93m	10
41	Niobium-95	10
41	Niobium-97	10
76	Osmium-185	10

Atm No	Material	µCi
76	Osmium-191m	100
76	Osmium-191	100
76	Osmium-193	100
46	Palladium-103	100
46	Palladium-109	100
15	Phosphorus-32	10
78	Platinum-191	100
78	Platinum-193m	100
78	Platinum-193	100
78	Platinum-197m	100
78	Platinum-197	100
94	Plutonium-239	0.01
84	Polonium-210	0.1
19	Potassium-42	10
59	Praseodymium-142	100
59	Praseodymium-143	100
61	Promethium-147	10
61	Promethium-149	10
88	Radium-226	0.01
75	Rhenium-186	100
75	Rhenium-188	100
45	Rhodium-103m	100
45	Rhodium-105	100
37	Rubidium-86	10
37	Rubidium-87	10
44	Ruthenium-97	100
44	Ruthenium-103	10
44	Ruthenium-105	10
44	Ruthenium-106	1
62	Samarium-151	10
62	Samarium-153	100
21	Scandium-46	10
21	Scandium-47	100
21	Scandium-48	10
34	Selenium-75	10
14	Silicon-31	100
47	Silver-105	10
47	Silver-110m	1
47	Silver-111	100
11	Sodium-24	10
38	Strontium-85	10
38	Strontium-89	1
38	Strontium-90	0.1
38	Strontium-91	10

Atm No	Material	µCi
38	Strontium-92	10
16	Sulphur-35	100
73	Tantalum-182	10
43	Technetium-96	10
43	Technetium-97m	100
43	Technetium-97	100
43	Technetium-99m	100
43	Technetium-99	10
52	Tellurium-125m	10
52	Tellurium-127m	10
52	Tellurium-127	100
52	Tellurium-129m	10
52	Tellurium-129	100
52	Tellurium-131m	10
52	Tellurium-132	10
65	Terbium-160	10
81	Thallium-200	100
81	Thallium-201	100
81	Thallium-202	100
81	Thallium-204	10
90	Thorium (natural)	100
69	Thulium-170	10
69	Thulium-171	10
50	Tin-113	10
50	Tin-125	10
74	Tungsten-181	10
74	Tungsten-185	10
74	Tungsten-187	100
92	Uranium (natural)	100
92	Uranium-233	0.01
92	Uranium-234/235	0.01
23	Vanadium-48	10
54	Xenon-131m	1,000
54	Xenon-133	100
54	Xenon-135	100
70	Ytterbium-175	100
39	Yttrium-90	10
39	Yttrium-91	10
39	Yttrium-92	100
39	Yttrium-93	100

30 Zinc-65 10
30 Zinc-69m 100
30 Zinc-69 1,000
40 Zirconium-93 10

Atm No	Material	µCi
40	Zirconium-95	10
40	Zirconium-97	10

Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition 0.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition.0.1
Note: To convert µCi to kBq, multiply the µCi value by 37.

Table 6-3
Typical A_1 Quantities in Special (sealed source) Form:

H-3 .....1000 Ci
C-14.....1000 Ci
Na-22.....8 Ci
P-32 .....30 Ci
S-35 .....1000 Ci
Co-57..... 90 Ci
Fe-59 .....10 Ci
Co-60..... 7 Ci
Ni-63 ..... 1000 Ci
Sr-90.....10 Ci
I-125.....1000 Ci
Ba-133.....40 Ci
Cs-137.....30 Ci
Pm-147.....1000 Ci
Tl-204.....300 Ci
Po-210.....200 Ci
Ra-226.....10 Ci
Th-232..... unlimited
U-238 ..... unlimited
Am-241 .....8 Ci
Cf-252 .....2 Ci

Table 6-4
Typical A_2 Quantities in Normal (unsealed) Form:

H-3 .....20 Ci
C-14.....60 Ci
Na-22.....8 Ci
P-32 .....30 Ci
S-35 .....60 Ci
Co-57..... 90 Ci
Fe-59 .....10 Ci
Co-60..... 7 Ci
Ni-63 ..... 100 Ci
Sr-90.....0.4 Ci
I-125.....70 Ci
Ba-133.....10 Ci
Cs-137.....10 Ci
Pm-147.....25 Ci
Tl-204.....10 Ci
Po-210.....0.2 Ci
Ra-226.....0.05 Ci
Th-232..... unlimited
U-238 ..... unlimited
Am-241 .....0.008 Ci
Cf-252 .....0.009 Ci

g. Radioactive Material Inventory.

(1) The RPO for each USACE Command is responsible for all radioactive material owned or possessed by the Command, regardless of whether the material is authorized under a general license, a specific license, or DARA. In order to ensure control of all radioactive material, the RPO shall maintain a written inventory of all radioactive material within the Command.

(2) The inventory should be categorized into NRC specifically licensed materials, NRC generally licensed materials, and DARA authorized materials.

(3) The RPO for each Command owning or possessing radioactive material shall physically inventory each radioactive item at least semi-annually, and more often if their license requires it. This will usually be accomplished along with the semi-annual wipe test.

(4) For remote sources, such as those assigned to dredges, the RPO may have an AU perform the physical inventory of the source(s).

h. Storing Radioactive Material.

(1) All radioactive material will be stored in a secure manner when not in use.

(a) Sealed sources used in the field may be locked in their storage containers.

(b) Sealed sources stored in a building may be locked in a storage room or storage cabinet.

© Unsealed sources may be locked in a storage container, cabinet, drawer, refrigerator, or freezer.

(d) Labs where unsealed sources are used shall be locked whenever the lab is unattended.

(e) Sealed sources in fixed use locations may be secured in their work position.

(2) Ensure that where ever radioactive sources are stored, proper labeling and posting is used.

I. Audits and Reviews.

(1) The RPSO will audit each Command that possesses a radioactive material license or DARA annually. The audit is to ensure personnel safety and compliance with regulatory requirements.

(a) The audit will consist of a records review, facility inspection, interviews with the RPO and AUs, and an exit interview with the RSC or the commander.

(b) The audit will be documented and a copy furnished to the commander and the RPO.

(2) The RPO will annually review their implementation of the USACE Radiation Safety Program for the Command annually for content and implementation. The RPO will assure that the quality and timeliness of their program meet the radiation safety guidelines outlined in this manual.

(3) The RPO will review work with radiation within his Command. The RPO will perform the annual review with the purpose of anticipating the needs of the program in the coming year. The review will be documented and a copy forwarded to the RPSO.

(4) Additional audits and reviews may be performed as deemed beneficial to the Command by the RPSO, the RPO, or the commander.

7. Registration and Authorization.

a. All personnel engaged in the use or procurement of radioactive materials are required to:

(1) Request and obtain approval in writing for their experimental protocol and material, from the Radioisotope Committee through their division Chief and the RPO prior to ordering isotopes,

(2) Submit a copy of the requisition and receipt documents for isotopes to the RPO,

(3) Conduct periodic wipe tests of experimental areas and submit results to the RPO,

(4) Determine the need, and procure, if necessary, the required radioactivity counting equipment, and,

(5) Budget for the cost of procurement and disposal of isotopes.

(6) Submit to training as specified by the Radioisotope Safety Committee

b. The Radioisotope Safety Committee will review these procedures and determine, on the basis of their experience and training with radioactive materials, if the worker will be allowed to use the radioactive material. In the review, the Radioisotope Safety Committee will consider at least the following:

(1) Prior experience with radioactivity,

(2) Prior experience with the particular radionuclides requested,
(3) Prior experience with the general procedures outlined,

(4) The individual's training in radiation safety, and,

(5) The level and toxicity of the requested nuclides.

c. Each room or laboratory in which any radioactive material is to be used, handled or stored must be registered with and approved for use by the RPO, and have an area survey conducted prior to bringing the radioactive material into the room. This is to establish a reference background level prior to introduction of radioactive materials.

8. Transportation of Radioactive Material.

a. Shipping to and from USACRREL:

(1) The RPO will be consulted prior to ordering any radioactive materials,

(2) Transportation personnel shall contact the RPO before shipping radioactive materials, and immediately upon the receipt of radioactive materials.

(3) All radioactive materials received will be immediately delivered to the RPO for survey.

(4) The RPO or alternate will complete the Radioactive Materials Movement Form DA 3252-R.

b. Within the borders of USACRREL.

(1) The material shall be transported in a closed, shatterproof container that is properly labeled.

(2) The measured dose rates shall not exceed:

(a) 20 mrem/hr at any point on the external surface of the container.

(b) 2 mrem/hr at one meter from any external surface of the package.

© The transferable surface contamination as measured by wipe tests shall not exceed 220 disintegrations/minute/100 cm^2.

(3) The transportation and transfer of radioactive material or experimental equipment containing radioactive material from one room to another must have prior approval of the RPO. During transit, the material shall be in the possession and

responsible charge of an authorized user of the material.

11. Storage of Radioactive Material.

a. Radioactive material must be kept or stored in a manner which will minimize exposure to personnel. This means that access is limited. Or, the material or instrument is kept in a locked space that can't be easily transported, and is adequately marked as containing radioactive materials.

b. Radioactive material must be stored sufficiently shielded so that the radiation level at 1 meter from the shielding does not exceed 2 mR/hr.

c. Suitable storage precautions will be taken against fire, explosion, flood, or unauthorized removal.

d. The Fire Department will be kept advised of the location of stored radioisotopes.

12. Disposal of Radioactive Material. Will be done in accordance with AR 385-11.

13. Emergency Procedures.

a. In the event of external exposure in excess of Appendix B. 1a, or accidental release of radioactive material, the RPO must be notified immediately.

b. Emergency procedures to be followed in the event of a radiation contamination accident are specified in Appendix D for contamination with or without injury.

c. Emergency Procedures for Using and Handling Moisture Probes are described in Appendix C.

15. General Radiation Protection Requirements and Precautions.

a. There will be no smoking, eating, or storage of food in any area where unsealed sources of radioactive material are being used or transferred unless otherwise authorized by the Radioisotope Safety Committee.

b. All radioactive material must be handled in a manner that will minimize exposure.

c. When hand or clothing contamination is possible, protective gloves and a lab coat will be worn. These protective items will not be removed from the room where the material is being used.

d. Material and equipment will be surveyed prior to removal from a potentially

contaminated area. This requires the measurement of the radiation levels of people, items or materials prior to their use or introduction to the area that could become contaminated.

16. Protection of employees who provide information. This laboratory shall comply with the Nuclear Regulatory Commission's amendments of 10 CFR parts 19, 30, 40, 50, 60, 70, 72 and 150 published in the Federal Register Vol. 47, No. 135, 14 July 1982, which provides for the protection of employees against termination or other acts of job related discrimination because of their engagement in activities furthering the purposes of the Atomic Energy Act and the Energy Reorganization Act. Furthermore, the amendments will make the employees aware that if such discrimination had occurred a remedy is available through the Wage and Hour Division of the Department of Labor.

(CECRL-SE)

FOR THE COMMANDER:

MARK C. NELSON
LTC, EN
Commander

4 Appendices
APP A Safe Handling Procedures
APP B Maximum Permissable Doses for Radiation Workers, (Revised.)
APP C Standard and Emergency Procedures for Using and Handling Moisture Probes.
APP D Emergency Procedures for a Radiation Contamination Incident.
APP E Standard and Emergency Operating Procedures for use of Bore Hole Probes more than Three Feet below the Surface.

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APPENDIX A

SAFE HANDLING PROCEDURES

d. *General Rules for the Safe Use of Radionuclides*: The following work habits are particularly important in ensuring ALARA exposures:

1) Wear appropriate personnel monitoring devices at all times while in areas where radioactive materials are used or stored. Body monitors should be worn at waist or chest levels.

2) Wear laboratory coats or other protective clothing at all times in areas where unsealed radioactive materials are used. This protective clothing will not be worn outside of the controlled area.

3) Wear disposable gloves at all times while handling unsealed radioactive materials.

4) Monitor hands, shoes, and clothing and immediate area surrounding the work station for contamination after each procedure and before leaving area.

5) Do not eat, drink, smoke, or apply cosmetics in any area where radioactive materials are stored or used.

6) Never pipette radioactive material by mouth.

7) Dispose of radioactive waste only in specifically designated containers.

8) Do not store food or beverages in any area where radioactive material unsealed sources of radioactive material are being used or transferred unless otherwise authorized by the Radioisotope Safety Committee.

9) Avoid contaminating objects such as telephones, light switches, water tap handles, doorknobs, etc.

10) Handle sources of radioactive material with tongs or tweezers if appropriate to the operation.

11) Use easily discarded absorbent pads, absorbent on the top surface only, for containing and easily disposing of small amounts of contamination.

12) Whenever possible new procedures should first be performed with non-radioactive materials in order to discover and remedy potentially hazardous aspects of the procedure and to train personnel in the safe and efficient execution of the technique.

13) As general practice, procedures involving radioactive material should be confined to as small an area of a laboratory as is realistic, thus limiting the affected area in cases of accidental contamination.

14) The storage and use of radioactive materials in uncontrolled areas are prohibited.

15) All containers holding radioactive material, except as provided by 10 CFR 20.1905, shall bear a durable, clearly visible label identifying the radioactive contents. These labels shall bear the radiation caution symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". It shall also provide sufficient information to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposure.

16) The inter-laboratory transportation of radioactive material shall be carried out using a closed uncontaminated container. The container shall be labeled to indicate isotope, activity and user identity.

17) A suitable remote handling device must be used for a source or container which emits a dose rate, as measured at 10 cm, in excess of 1 R/hr. Such handling shall be practiced with a non-radioactive device that simulates the source in order to identify possible problems with the planned procedure.

18) When performing operations which might produce airborne contamination (e.g., evaporations, sanding or grinding, transfer of powdered or volatile material), approved ventilation must be used.

19) Material and equipment will be surveyed and wipe tested prior to removal from a potentially contaminated area. This requires the measurement of radiation levels of items or materials prior to their use or introduction to the area that could become contaminated.

e. *Handling Precautions for Specific Radionuclides*:

HYDROGEN-3 (TRITIUM)

Handling Precautions

1. Designate an area for handling ^{3}H and clearly label all containers..
2. Prohibit smoking, eating, drinking and mouth pipetting in the room where ^{3}H is handled.
3. Confine contamination by using transfer pipets, spill trays, and absorbent coverings.
4. Handle potentially volatile compounds in ventilated enclosures.
5. If enhanced containment is necessary, handle volatile compounds in closed systems vented through suitable traps.
6. Sample exhausted effluent by drawing a known quantity through a membrane filter followed by a water impinger.
7. Wear disposable lab coat, gloves and wrist guards for secondary protection.
8. Select gloves appropriate for the chemicals that are being handled.
9. Regularly monitor gloves and surfaces, and decontaminate surfaces to maintain contamination control. Always discard contaminated gloves and replace them as needed.
10. Use an open window ionization detector or liquid scintillation counter to detect ^{3}H.
11. Submit periodic urine samples for bioassay to determine uptake by personnel.
12. Isolate, label, and dispose wastes according to approved guidelines.
13. Establish air concentration, surface contamination and bioassay action levels below maximum permissible limits. Investigate any situations that threaten to cause these levels to be exceeded.
14. On completing an operation, secure all ^{3}H, remove and dispose of protective coverings, monitor and decontaminate yourself and surfaces, wash your hands and monitor your hands again.

COMMENTS

MilliCurie quantities of tritium do not present an external exposure hazard because the low energy betas emitted cannot penetrate the dead outer layer of skin. Tritium uptakes are distributed in whole body water. Three to four hours after intake, tritiated water is uniformly distributed in all body water. On the average, tritiated water is eliminated with a ten-day biological half-life. Elimination rates may be increased by increasing water intake.

Many tritium compounds readily penetrate gloves and skin. Handle these compounds remotely, wear two pairs of gloves and change the outer pair at least every 20 minutes. Tritiated DNA precursors are considered more toxic than tritiated water. However, they are generally less volatile and do not normally present a significantly greater hazard.

CARBON-14

Handling Precautions

1. Designate an area for handling ^{14}C and clearly label all containers.

2. Prohibit smoking, eating, drinking and mouth pipetting in the room where ^{14}C is handled.

3. Use transfer pipets, spill trays, and absorbent coverings to confine contamination.

4. Handle potentially volatile compounds in ventilated enclosures.

5. If enhanced containment is necessary, handle volatile compounds in closed systems vented through suitable traps.

6. Sample exhausted effluent by drawing a known quantity through a membrane filter followed by a dilute NaOH impinger.

7. Wear disposable laboratory coat, gloves and wrist guards for secondary protection.

8. Select gloves appropriate for chemicals handled.

9. Regularly monitor gloves and surfaces, and decontaminate surfaces to maintain contamination control. Always discard contaminated gloves and replace them as needed.

10. Use an end window Geiger-Mueller detector or liquid scintillation counter to detect ^{14}C.

11. Submit periodic urine and breath samples (as appropriate) for bioassay to determine uptake by personnel.

12. Isolate, label, and dispose waste according to approved guidelines.

13. Establish air concentration, surface contamination and bioassay action levels below maximum permissible limits. Investigate any situations that threaten to cause these levels to be exceeded.

14. On completing an operation, secure all ^{14}C, remove and dispose coverings, monitor and decontaminate yourself and surfaces, wash your hands and monitor your hands again.

COMMENTS:
MilliCurie quantities of ^{14}C do not present a significant external exposure hazard because the low energy betas emitted barely penetrate the dead outer layer of skin. Uptakes of many ^{14}C labeled carbonates may deposit in bones; many other ^{14}C labeled compounds, in fat. Most ^{14}C labeled compounds are rapidly metabolized and the radionuclide is exhaled as $^{14}CO_2$. Some compounds and their metabolites are eliminated via the urine. Biological half-lives vary from a few minutes to 35

days — ten days being a conservative value for most compounds.

Some ^{14}C labeled compounds may penetrate gloves and skin. Handle these compounds remotely; wear two pairs of gloves and change the outer layer frequently. Special caution should be taken when handling ^{14}C labeled halogenated acids. These compounds may be incorporated in the skin and give local dose commitments on the order of 10 — 100 rad per μCi (3 — 30 Gy per MBq) deposited.

PHOSPHORUS-32

Handling Precautions

1. Designate area for handling ^{32}P and clearly label all containers.

2. Store ^{32}P behind lead shielding.

3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.

4. Handle milliCurie (37 MBq) quantities of ^{32}P behind 1.3 cm (½ inch) thick Lucite shielding. Where necessary, increase shielding by attaching 3 to 6 mm (1/8 to 1/4 inch) thick lead sheets to the outside of the Lucite to reduce secondary radiation.

5. Do not work over open containers.

6. Practice routine operations to improve dexterity and speed before using ^{32}P.

7. Avoid skin exposure by using tools to indirectly handle unshielded sources and potentially contaminated vessels.

8. Prohibit smoking, eating, drinking and mouth pipetting in the room where ^{32}P is handled.

9. Use transfer pipets, spill trays and absorbent coverings to confine contamination.

10. Handle potentially volatile chemical forms of ^{32}P in ventilated enclosures.

11. Sample exhausted effluent and room air by continuously drawing a known quantity through membrane filter.

12. Use lab coat, wrist guards and disposable gloves for secondary protection.

13. Regularly monitor gloves and surfaces, and decontaminate surfaces to maintain contamination control. Always discard contaminated gloves and replace them as needed.

14. Use an end window Geiger-Mueller detector or a liquid scintillation counter to detect ^{32}P.

15. Submit urine samples for bioassay from two hours to seven days after handling ^{32}P to indicate uptake by personnel, as needed.

16. Isolate waste in a clearly labeled shielded container and hold for decay.

17. Establish surface contamination, air concentration, and urinalysis action levels below maximum permissible limits and investigate any situations that might cause these levels to be exceeded.

18. On completing an operation, secure all ^{32}P, remove protective clothing, dispose protective coverings, monitor and decontaminate yourself and surfaces. Wash

your hands and monitor your hands again.

COMMENTS:
The high energy beta emissions from ^{32}P can present a substantial skin dose hazard. Multi 100 mCi (3.7 GBq) quantities of ^{32}P can produce significant secondary radiation, presenting an external exposure hazard.

Uptakes of transportable compounds of ^{32}P tend to concentrate in bone. Phosphorus metabolism is complex: 30% is rapidly eliminated from the body, 40% exhibits a 19 day biological half-life, and the remaining 30% is reduced by radioactive decay. Non-transportable compounds of ^{32}P tend to concentrate in the lungs and lower large intestines.

The dose rate at the mouth of an open combi-vial containing 1 mCi (37 MBq) of ^{32}P in 1 ml of liquid is roughly 26 rem/hr (260 mSv/hr). Since this dose rate will not be attenuated significantly by air, shielding materials should be placed between the source and personnel to absorb most of the radiation. The best shield for a ^{32}P source is a material like Lucite 1.3 cm (½ inch) thick or other plastic, which will absorb the beta particles while generating little secondary radiation. For mCi (37 MBq) amounts of ^{32}P, thin high density shielding such as lead 3 — 6 mm thick should be added to the exterior of Lucite shields to absorb the higher intensity secondary radiation.

A high local dose can be received if the radioactive material is touched and allowed to remain on the skin or gloves. Both the hands and the face can receive a considerable dose of radiation near an open container of ^{32}P, particularly if the radionuclide is in a concentrated form. ***Therefore, never work over an open container of ^{32}P.***

SULFUR-35

Handling Precautions

1. Designate an area for handling ^{32}S and clearly label all containers.

2. Prohibit smoking, eating, drinking and mouth pipetting in rooms where ^{35}S is handled.

3. Use transfer pipets, spill trays and absorbent coverings to confine contamination.

4. Handle potentially volatile compounds in ventilated enclosures.

5. If enhanced containment is necessary, handle volatile compounds in closed systems that are vented through suitable traps.

6. Sample exhausted effluent by drawing a known quantity through a membrane filter followed by impinger containing dilute NaOH.

7. Wear disposable laboratory coat, gloves and wrist guards for secondary protection.

8. Select appropriate gloves for the chemicals being handled.

9. Regularly monitor gloves and surfaces, and decontaminate surfaces to maintain contamination control. Always discard contaminated gloves and replace them as needed.

10. Use an end window Geiger-Muller detector or liquid scintillation counter to detect ^{35}S.

11. Submit periodic urine samples for bioassay to evaluate uptake of ^{35}S by personnel.

12. Isolate, label and dispose of waste according to approved guidelines.

13. Establish the air concentration, surface contamination and bioassay action levels that are below maximum permissible limits. Investigate any situations that might cause these levels to be exceeded.

14. On completing an operation, secure all ^{35}S, remove and dispose of protective clothing and coverings, monitor and decontaminate yourself and surfaces, wash your hands and monitor them again to confirm the absence of contamination.

COMMENTS:
MilliCurie quantities of ^{35}S do not present a significant external exposure hazard, since the low energy beta emissions barely penetrate the outer layer of dead skin. Uptakes of ^{35}S tend to distribute throughout the whole body. The elimination rate for ^{35}S depends on the chemical form. Most ^{35}S labeled compounds are eliminated via the urine. Ninety days is a conservative biological half-life for ^{35}S.

^{35}S may be difficult to distinguish from ^{14}C because the beta emissions are of similar energy. If both radionuclides are being used in the same area, establish controls which are conservative for both.

IODINE-125

Handling Precautions

1. Designate an area for handling ^{125}I and clearly label all containers.

2. Store mCi (37 MBq) quantities of ^{125}I in containers surrounded by 3 mm thick lead.

3. Use tools to prevent direct handling of potentially contaminated vessels and unshielded multi mCi (37 MBq) sources.

4. Prohibit smoking, eating, drinking and mouth pipetting in the laboratory where ^{125}I is used.

5. Use transfer pipets, spill trays and absorbent coverings to confine contamination.

6. Handle quantities of unbound ^{125}I greater than 10 μCi (370 kBq) in a ventilated enclosure.

7. Handle mCi (37 MBq) quantities of unbound ^{125}I in closed systems vented through activated charcoal traps.

8. Sample exhausted effluent by continuously drawing a known quantity of air through cartridges containing activated charcoal.

9. Use a disposable laboratory coat, gloves and wrist guards for secondary protection.

10. Select gloves that are appropriate for the chemicals being handled.

11. Regularly monitor gloves and surfaces, and decontaminate surfaces to maintain contamination control. Always discard contaminated gloves and replace them as needed.

12. Use a NaI(Tl) detector or liquid scintillation counter to detect ^{125}I.

13. Submit urine samples for bioassay from 2 to 12 hours after handling unbound ^{125}I in quantities greater than 10 μCi to monitor for uptake by personnel.

14. Conduct periodic thyroid counts as appropriate to monitor for uptakes.

15. Isolate waste in sealed labeled containers.

16. Establish surface contamination, air concentration, urinanalysis and thyroid burden action levels below maximum permissible limits and investigate any situations that might cause these levels to be exceeded.

COMMENTS

Uptakes of ^{125}I tend to concentrate in the thyroid. Individual metabolism of ^{125}I uptakes varies over a wide range. The thyroid may be assumed to accumulate 30% of soluble ^{125}I uptake to the body and to retain

^{125}I with a 138 day biological half-life. The effective half-life is about 41 days. All ^{125}I in the body can be assumed to be eliminated via the urine. If 1 μCi of ^{125}I is ingested, the total dose to the thyroid will be about 2.3 rem.

Store $Na^{125}I$ solutions at room temperature, since freezing results in subsequent volatilization of ^{125}I. Avoid acidic solutions in order to minimize volatilization. Some radioiodine compounds may penetrate gloves and skin. When handling these compounds, use remote tools, wear two pairs of gloves and change the outer pair frequently or whenever they are suspected of being contaminated.

APPENDIX B
MAXIMUM PERMISSIBLE DOSES FOR RADIATION WORKERS

1. Occupational Dose Limit structure.

a. Doses to radiation workers are regulated by the NRC or Agreement State, OSHA, DA and USACE regulations. To ensure compliance with all regulatory agencies, USACE has established a three tiered approach to worker dose limits. Tier 1 is the NRC regulatory dose limits which are never to be exceeded. Tier 2 is the USACE dose limits which are effectively 10% of the NRC limits. The USACE limits will ensure that USACE workers will be in compliance with OSHA regulations and Agreement State regulations. Tier 3 is project specific dose goals which will set below the USACE dose limits. Project specific dose goals are used to promote the concept of ALARA; keeping the dose As Low As Reasonably Achievable, taking social, technical and financial considerations into account.

2. USACE Dose Limits.

a. Tier 1; NRC dose limits. Each user of radioactive material or radiation generating devices shall limit occupational doses to individuals to the following limits:

(1) An annual limit which is the more limiting of:
(a) 5 rems (0.05 Sieverts (Sv)) TEDE, or
(b) The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 50 rems (0.5 Sv), or
© 15 rems (0.15 Sv) to the lens of the eye, or
(d) 50 rems (0.5 Sv) shallow dose equivalent to the skin, or any extremity.

(2) The TEDE to the fetus of a declared pregnant work will be kept below 0.5 rem (0.005 Sv) during the entire gestation period.

b. Tier 2 USACE dose limits. Without the written approval of the Radiation Protection Staff Officer (RPSO) the annual occupational dose shall not exceed the more limiting of:
(1) 0.5 rems (0.005 Sieverts (Sv)) TEDE, or
(2) The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 5 rems (0.05 Sv), or
(3) 1.0 rems (0.01 Sv) to the lens of the eye, or
(4) 5 rems (0.05 Sv) shallow dose equivalent to the skin, or any extremity.

c. Tier 3 project specific dose goals. To keep doses ALARA, the user shall set administrative action levels below the annual dose limits. These action levels shall be realistic and attainable. Suggested action levels may be:
(1)Shall not exceed the more limiting of:
(a) 0.1 rems (0.001 Sieverts (Sv)) TEDE, or

(b) The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 0.5 rems (0.005 Sv), or

© 0.15 rems (0.0015 Sv) to the lens of the eye, or

(d) 0.5 rems (0.005 Sv) shallow dose equivalent to the skin, or any extremity.

Table B-1
Dose Limits

Body Part	NRC Annual Limits	USACE Annual Limits	Suggested ALARA Limits
Whole Body	5 rem	0.5 rem	0.1 rem
Individual Organ	50 rem	5.0 rem	0.5 rem
Lens of eye	15 rem	1.5 rem	0.15 rem
Skin	50 rem	5.0 rem	0.5 rem

d. Planned special exposures shall not be used without the written consent of the RPSO and the DA Radiation Safety Committee (DARSC).

e. Minors shall not be allowed occupational exposure on USACE sites.

f. The dose to an embryo/fetus shall not exceed 0.05 rem (0.0005 Sv) during the entire gestation period.

3. NRC and Agreement State Dose Limits.

a. NRC dose limits are the Tier 1 limits. NRC regulates only NRC licensed source, byproduct or special nuclear materials. Most all Agreement States have the same dose limits as NRC but some include regulation of NORM and NARM materials and radiation generating devices.

b. Each user of licensed radioactive material shall limit occupational doses to individuals to the following limits:

An annual limit which is the more limiting of:

(1) 5 rems (0.05 Sieverts (Sv)) TEDE, or

(2) The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 50 rems (0.5 Sv), or

(3) 15 rems (0.15 Sv) to the lens of the eye, or

(4) 50 rems (0.5 Sv) shallow dose equivalent to the skin, or any extremity.

c. Note that compliance with the USACE dose limits will comply with the NRC and Agreement State dose limits.

4. OSHA Dose Limits.

a. OSHA adopted the NRC dose limits as they were written before the new 10 CFR 20 was issued in 1991. Note that OSHA regulation apply to all radioactive materials including NORM and NARM, as well as radiation generating devices such as X-ray machines.

b. No employer shall use radioactive materials of radiation generating devices in a manner which would cause any individual to receive a dose during one calendar quarter in excess of:

(1) 1.25 rem to the whole body; head and trunk; active blood forming organs; lens of eyes or gonads.

(2) 18.75 rem to the hands and forearms; feet and ankles.

(3) 7.5 rem to the Skin of the whole body.

Note that compliance with the USACE dose limits will meet this requirement.

5. Monitoring requirements.

Both OSHA and NRC have requirements to monitor dose to individuals who can reasonably be expected to receive a dose greater than a maximum permissible dose. Compliance with USACE dose limits will keep workers doses below the maximum permissible doses. USACE will still monitor doses to individuals but without the various liabilities that come from a mandated dose monitoring program.

6. Doses to the Public.

a. NRC and Agreement States presently require that a licensee restrict dose to the public to 100 mrem/year TEDE from licensed activities. The EDE in any unrestricted area may not exceed 2 mrem in any one hour. The maximum allowable dose to the public from effluents from a licensed facility is 50 mrem/year and listed as a calculated concentration for each specific radionuclide yielding 50 mrem/year in Appendix B of 10 CFR 20. For decontaminated and decommissioned facilities to be released without restrictions, the dose from residual contamination must be below 25 mrem/year to the public.

b. The EPA has standards for radioactivity in community drinking water systems. The present standards are 5 picocuries per liter (pCi/l) of Ra-226 plus Ra-228, and 15 pCi/l of gross alpha particle activity, including Ra-226 but excluding uranium and radon. The present dose limits are 4 mrem/year from beta/gamma-emitting radionuclides to the whole body or any organ.

c. There are proposed rules from both the NRC and the EPA to limit dose to the public from radiation to 15 mrem/year. Note that this value is so far below natural background levels as to be unmeasurable by any instrumentation and only calculable through dose modeling.

7. Maximum Permissible Levels of Radiation in Unrestricted Areas.

Radiation levels will not exceed 2 mrem/hr at any location within USACRREL except in areas approved for use of radioactive material or radiation-producing equipment. Areas where this level may be exceeded shall be marked and secured as restricted entry.

APPENDIX C
Emergency Procedures For Using and Handling Moisture Probes

1. Leaks, Loss or Damage (Fire and Explosion). To become qualified, all probe users must have had previous training in procedures for handling emergencies that could occur during transportation of testers (probes).

a. The RPO must be notified immediately upon discovery of a radiological incident. The telephone number is (603)646-4100.

b. When a tester is exposed to or damaged by fire or explosion. Personnel who have been trained in emergency procedures shall perform the following duties, in the order given:

(1) Notify all personnel who are not directly involved in the emergency to clear the area.

(2) Notify fire fighting and other emergency personnel of the situation.

(3) When a radiological hazard is not immediately imminent, attempt to extinguish fires with first-aid type extinguishers. Try to prevent water or fire fighting chemicals from coming into contact with radioactive sources.

(4) Notify the RPO of the situation.

c. After the emergency, the RPO shall:

(1) Monitor all personnel who were in the emergency area.

(2) Monitor all personnel who were involved in combating the emergency.

(3) Monitor the area and determine those protective measures that are necessary for the removal of radiation hazards.

2. Physical Loss of a Probe. When a probe is lost the RPO shall attempt to recover the probe.:

a. He first will make a physical search. He then will contact the property holder, his representatives, and/or any other individuals who may have knowledge of its last or current location. He shall also initiate a revision to the current operating procedure to prevent future occurrences.

b. If the probe cannot be recovered, the RPO shall report the loss to the Corps of Engineers and NRC. The report shall include: We need to identify what local agencies the NRC wants us to contact, in this situation.

(1) serial number of the lost probe

(2) circumstances concerning the loss

(3) action taken to prevent recurrence

3. Damaged or Leaking Probe. When a probe is leaking radiation or is suspected of leaking, the RPO or the user, at a field site, shall:

a. Immediately discontinue use of the probe. The user shall immediately notify the RPO of the situation.

b. Wrap the probe in plastic film and seal the package with tape, if appropriate, in a way that prevents further contamination.

c. Label the package as being contaminated with radioactivity.

d. Monitor personnel, equipment, and the area for contamination and decontaminate as required.

e. Report that the probe is damaged or leaking.

f. Dispose of the probe per AR 385-11.

g. Report (the completed) action to both the Corps of Engineers and NRC.

4. Shutter Failure. When the probe shutter fails to close or is damaged, the RPO shall:

a. Immediately discontinue use of the probe.

b. Place the probe in shipping case and lock the case.

c. Place shipping case in an isolated, locked area and secure it against unauthorized handling.

d. Ship for repair at an authorized manufacturer.

5. Personnel Exposed to Radiation.

a. Overexposure.

(1) The individual(s) shall immediately report to the medical officer in the event of suspected or actual overexposure.

(2) Notify the RPO of the suspected or actual overdose.

b. Skin.

(1) An individual's skin is considered overexposed when it monitors at a higher instrument reading than that of the previously determined background level.

(2) The individual shall immediately wash, particularly fingernails, the hair and creases in skin.

c. Cuts and Skin Abrasions. Thoroughly flush the wound with water when contamination is either suspected or confirmed.

d. Ingestion. Do not smoke, eat or drink when handling the probe or any other radioactive item. Immediately inform the medical officer when ingestion of radioactive contamination is suspected.

e. Clothing. Immediately remove clothing that monitors at 0.2 mrem/hr or more at a distance of 2.5 cm (one inch). Place clothing in a container. Seal and label the container as radioactive waste. A garbage can with attached lid, and a plastic bag that has been sealed shut with tape are both considered to be sealed containers. Place all clean-up rags in sealable containers. Disposable of all radioactive waste will be done by RPO according to AR 385-11.

6. Personnel Exposed to Excessive Radiation. The following action shall be taken should an individual receive a dose of ionizing radiation from the probe which exceeds 1.25 rem per calendar quarter, or an accumulated dose in excess of 5 rem per calendar year.

a. The individual shall immediately seek advice from the medical doctor, then notify the his supervisor of the overexposure.

b. The individual's supervisor shall remove the individual from duties involving occupational exposure to radiation until subsequent exposure limitations are established by proper medical authority.

c. The Director with assistance from RPO shall prepare and submit a written report of circumstances leading to the overexposure. The report shall include the serial number of the probe that caused the overexposure, and action taken to prevent recurrence of overexposure. The report shall be submitted to the Corps of Engineers and NRC.

7. Decontamination of Equipment and Area.

. Make sure not to spread the contaminant during the decontaminating process.

. Accomplish decontamination method according to the following order:

(1) Damp mopping.

(2) Water and detergent.

(3) Steam cleaning.

(4) Clean with solvents other than water.

(5) Surface removal by use of chemicals, abrasives, sand blasting, and grinding.

c. The only vacuum cleaners that shall be used are those with absolute filters which have been tested for filtration efficiency. Testing filtration efficiency is mandatory each time the filter is replaced and each time its contents are emptied.

8. Maintenance of Probes. Only limited and specific maintenance is authorized for the probes. Personnel authorized to perform maintenance are the operators and the RPO. Neither the operator nor the RPO are authorized to repair the probes.

a. Operators are authorized to perform the following limited maintenance:

(1) Cleaning the probe's external surfaces.

(2) Changing fuses.

(3) Changing batteries.

b. The RPO performs:

(1) Leak tests.

(2) When required, can perform maintenance mentioned under 8.a.

9. Probe Repair and Disposal. When the probe requires repair or disposal, it must be returned to a designated manufacturer's repair facility. Do not use the probe when it fails to operate according to pre-operation checks described in the operator's manual.

10. Assistance. When performing tests in the field or in the laboratory and need help or have questions concerning the probes, contact the RPO, his alternate or the Safety Office at (603)646-4230, (603)646-4231, (603)646-4480.

(Extracted from the Department of the Army Technical Bulletin TB 385-103 published September 1982.

APPENDIX D

EMERGENCY PROCEDURES FOR A RADIATION CONTAMINATION SURVEY

1. Contamination with or without injury during regular duty hours:

a. Notification:

(1) Dial the switchboard requesting the Radiation Protection Officer or the Radiation Protection Alternate.

(2) Tell the person who answers: "Someone has been injured in Room _____. Radioactivity is involved."

(3) Telephone numbers of the RPO and the RPO Alternate will be posted in radioactive areas.

b. Care of the injured:

(1) The RPO designated representative shall call Dartmouth-Hitchcock Medical Center, 646-5000, informing them of the type of accident involved, requesting a physician,

(2) Apply first aid, if necessary, and,

(3) Stay with the patient(s) until the physician arrives, and advises the physician on extent of patient's contamination.

c. Contamination control procedures while waiting for help:

(1) For a localized non-volatile liquid spill:

(a) Rope off or guard spill area against re-entry.

(b) Assemble potentially contaminated persons in one location and monitor them for contamination.

(c.) Prevent the spilled material from spreading.

(2) For a release of powdered material, a volatile liquid or gaseous activity:
(a) Evacuate personnel immediately, turning off any laboratory apparatus that needs constant attention and instruct personnel to stay in one location to prevent the

spread of contamination.

(b) Close and lock the room doors to prevent re-entry. Attempt to seal accessible openings into the area to prevent further escape of airborne activity to the adjacent area.

(c) Attempt to isolate the adjacent area against traffic and spectators.

2. Contamination with or without injury during regular duty hours: (We need a section that addresses this possibility, especially since we will have people doing work at staggered hours from the RPO's hours.) Most of it may duplicate the work hours SOP, but phone numbers and notification lists need to be attached.

APPENDIX E

STANDARD OPERATING PROCEDURES FOR USE OF BORE HOLE PROBES AT DEPTHS GREATER THAN THREE FEET BELOW THE SURFACE..

1. Anytime that you plan to lower a radioactive bore-hole probe into a bore-hole beyond a depth of three feet, you will lower a dummy "probe," whose stiffness, diameter and effective length are the same as the real probe, to the bottom of the hole. You will follow this procedure every time that a hole is re- -ed more than 4 hours after the prior visit, or when you have reason to suspect that co- -ions within the hole may have changed, (e.g., when construction activity has occurred near the hole during the period between visits).

The purpose of this procedure is to prevent a radioactive source becoming stuck.

If you cannot get the dummy probe to lower all the way, then DO NOT use the radioactive source probe in that bore-hole.

Emergency procedure if a probe becomes stuck in spite of the above precautions.

2. IF a radioactive bore-hole probe becomes stuck in a bore-hole, you will immediately secure the area around the hole, to avoid exposing anyone to the radioactive source. (If construction activities are in progress in the area, you will prevent them from affecting the hole and its surroundings. You may even have to stop ALL work in the area.) You will NOT excavate around the bore-hole to recover the probe. You WILL call the USACRREL Radiation Protection Officer, or in his absence, a member of the Radiation Safety Committee for instructions on what to do next.

The NRC regional offices are listed at the end of this operating procedure, as are the numbers for the USACRREL Radiation Protection Officer and his alternates. In your copy of this SOP you will add the state and/or local officials that are responsible for the area in which you are working. (THE USACRREL Radiation Safety Committee wants you to have already done the "research" that identifies the appropriate agency of the state in which you are going to work.)

You will always keep your copy of the SOP with the probe while it is in your possession and

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03620
STATUS CODE: 3
FEE CATEGORY: _____
EXP. DATE: 0
FEE COMMENTS: _____
DECOM FIN ASSUR REQD: _

LICENSE FEE TRANSMITTAL

A. REGION I

1. APPLICATION ATTACHED
APPLICANT/LICENSEE: DEPARTMENT OF THE ARMY
RECEIVED DATE: 960802
DOCKET NO: 3034215
CONTROL NO.: 123520
LICENSE NO.:
ACTION TYPE: NEW LICENSE

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

3. COMMENTS

SIGNED M. A. Perkins
DATE 9/4/96

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

1. FEE CATEGORY AND AMOUNT: _____

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

3. OTHER _____
_____

SIGNED _____
DATE _____