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Meeting Minutes Transmittal - Approved

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

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The undersigned indicate by their signatures that these meeting minutes reflect the actual occurrences of the above dated Unit Managers Meeting.

Randall N. Krekel, Unit Manager, RL — Date: 1-12-94

Not present.

Daniel L. Duncan, RCRA Program Manager, EPA Region 10 — Date:

Alisa D. Huckaby, Unit Manager, Washington State Department of Ecology — Date: 1-12-94

4843 Alkali Metals Storage Facility, WHC Concurrence

Fred A. Ruck III, Contractor Representative, WHC — Date: 1/12/94

Not present.

J. A. (Mickey) Seamans, Contractor Representative, WHC — Date:

Purpose: Discuss Permitting Process

Meeting Minutes are attached. The minutes are comprised of the following:
Attachment 1 - Agenda
Attachment 2 - Summary of Discussion and Commitments/Agreements
Attachment 3 - Attendance List
Attachment 4 - Action Items
Attachment 5 - HEALTH PHYSICS PROCEDURES, WHC-IP-0718 (Information-only copy)
Attachment 6 - WHC RADIOLOGICAL CONTROL MANUAL, WHC-CM-1-6 (Information-only copy)
Attachment 7 - 4843 AMSF RADIOLOGICAL SURVEY AND POSSIBLE DECONTAMINATION SCENARIOS

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Attachment 1

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

Agenda

1. Approval of Past UMM Minutes

2. Status Action Items

   - 7/14/93:1
   - 7/14/93:2

3. Status Closure Activities

   - Radiation Survey Documents
   - Radiation Survey Information
   - Status of Ecology Review of NOD Comments

4. New Business

   - None

5. Set Next Meeting Date

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Attachment 2

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

Summary of Discussion and Commitments/Agreements

1. **Approval of Past UMM Minutes**

   The November 14, 1993 meeting minutes were reviewed and approved.

2. **Status Action Items**

   - **7-14-93:1** Pending; awaiting removal of waste from 4843 AMSF and scheduling of the survey.

   - **7-14-93:2** Information-only copies of the Health Physics Procedures, WHC-IP-0718 (Attachment 5), and the WHC Radiological Control Manual, WHC-CM-1-6 (Attachment 6), were provided to Ecology. Additional documents to be provided, see discussion under 'Radiation Survey Documents.'

     'Information-only' means that the documents are current as of December 14, 1993, but revisions may be made to the documents in the future.

3. **Status Closure Activities**

   - **Radiation Survey Documents**

     After the waste is removed from the 4843 AMSF, a radiation survey is planned. The survey date is still to be determined. The survey will determine if the building can be released and the radiation zone removed. WHC (J. G. Adler) provided Ecology (A. D. Huckaby) with two documents that will be used to support the radiation survey: the Health Physics Procedures, WHC-IP-0718 (Attachment 5) and the WHC Radiological Control Manual, WHC-CM-1-6 (Attachment 6). These documents are being supplied to help Ecology understand how the radiation survey planned for the 4843 AMSF will be conducted. These two documents were supplied 'information only', meaning that they are current as of December 14, 1993, but revisions to the documents may be made in the future. Ecology understood and agreed that 'information only' copies were appropriate.

     WHC (J. G. Adler) stated that the primary working document for the radiation survey will the Radiation Work Permit (RWP). FFTF Health Physics has indicated that there will not be a work plan or work

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package for the survey since it is a 'routine' type of survey. A new RWP will be written by FFTF Health Physics for the survey. A copy of this RWP will be provided to Ecology shortly before the survey is conducted.

- **Radiation Survey Information**

WHC (J. G. Adler) provided a handout (Attachment 7) to Ecology (A. D. Huckaby) that outlines what could occur after the radiation survey is conducted at the 4843 AMSF. The purpose of the handout is to include a couple of subjects not included in the discussion held at the November UMM and to outline the general RL/WHC strategy for dealing with buildings that contain radiation zones. The summary section of the handout stated the following:

> The 4843 AMSF contains a radiation zone, but does not have any contaminated surfaces at this time (December 1993).
>
> After the waste the 4843 AMSF is removed, a radiological survey is planned.
>
> If no contamination is found by the radiological survey, the building will be released and the radiation posting removed. RL/WHC consider this to be the most likely result of the survey.
>
> If radiological contamination is found, then decontamination will be initiated. Any smearable radiological contamination it would be decontaminated by FFTF Operations. If fixed radiological contamination were present, it would be decontaminated and/or disposed of by D & D. If both were present, then FFTF will decontaminate the smearable contamination and D & D would decontaminate/dispose of the fixed contamination. However, due to the current radiological condition of the 4843 AMSF, radiological contamination is not expected to be found.

- **Status of Ecology Review of NOD Comments**

WHC (J. G. Adler) asked if Ecology had any questions on the NOD Response Table. Ecology (A. D. Huckaby) stated that there were none at this time. Ecology also stated that other work has been given a higher priority and that the NOD response table is being worked on as time is available.

4. New Business

None.

5. Set Next Meeting Date

The next meeting has been set for January 12, 1994, for 8:00 am in Richland, Washington.

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Attachment 3

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14 1993
From 8:00 am to 10:00 am

Attendance List

Name	Organization	Phone #
Jason Adler	WHC	376-7513
Randall N. Krekel	DOE	376-4264
Steve Lijek	GSSC	946-3683
Kathy Knox	WHC	372-3596
Alison D. Huckaby	Ecology	736-3034
Fred A Ruck	WHC/KEPN Closure	376-9876

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Attachment 4

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

Action Items

Action Item #		Description
07-14-93:1	OPEN	Arrange for Ecology to attend radiation survey of 4843 AMSF. (WHC: J. G. Adler)
07-14-93:2	OPEN	Provide Ecology with copy of the radiation survey procedure. (WHC: J. G. Adler)

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Attachment 5

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

TITLE - HP PROCEDURES, WHC-IP-07
(Information-only copy)

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WHC-IP-0718

Health Physics Procedures

Westinghouse
Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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Westinghouse Hanford Company — Richland, Washington

Hanford Operations and Engineering Contractor for the U.S. Department of Energy underContract DE-AC06-87RL10930

Document No. WHC-IP-0718

Date 07/31/93

Copy No. 190

Title
Health Physics Procedures

(Reserved for Unclassified Document Control Use Only)

Author
Health Physics Policy and Procedures

INFORMATION ONLY

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1	11-29-93	RJM						

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A-6000-603 (11/92)

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INTERNAL PUBLICATION

Title	WHC-IP-0718	Rev. No.	Page
Health Physics Procedures		0	1 of 1
	Date: 11/17/93	Copy No.	RIDS*: DRS14.6A	Impact Level: 3ESQ

Author: Health Physics Policy and Procedures

Responsible Manager: W. C. Mallory

Signature: [signature] Date Approved: 11-22-93

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[X] NONE OF THE ABOVE. (REVIEW BY RESPONSIBLE MANAGER IN ACCORDANCE WITH WHC-CM-3-4 REQUIRED BEFORE THIS BOX CAN BE CHECKED.)

Signature: [signature] Date: 11-22-93

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PROCEDURE NUMBER	TITLE	REV	EFFECTIVE DATE

Letter designators and the facilities they represent are listed immediately following the Table of Contents.

ER	**EMERGENCY RESPONSE GUIDES**		
ER-01	*Offsite Radiological Surveys*	*1*	*12/01/93*
ER-02	*General Emergency Response Guidelines and Checklists*	*1*	*12/01/93*
ER-03	Personnel Decontamination	0	07/31/93
ER-04	CAM Alarms	0	07/31/93
ER-05	Radiation Area Monitor Alarm Response	0	07/31/93
2.0	**PERSONNEL PROTECTION**		
2.1	Qualitative Respirator Fit Test	0	07/31/93
2.2	Personal Effects Decontamination	0	07/31/93
3.0	**SURVEYS AND SAMPLING**		
3.1	SURVEYS		
3.1.1	Material Release Surveys	0	07/31/93
3.1.2	Survey Method for Reposting of Outdoor SCA's	0	07/31/93
3.1.3	HEPA Vacuum Cleaners - Inspection and Survey	0	07/31/93
3.1.4	Radiation Generating Device Survey	0	07/31/93
3.2	SHIPPING AND TRANSPORTATION		
3.2.1	Radioactive Material Shipment and Receipt Surveys	0	07/31/93
3.2.2	*Onsite Railcar Shipment Surveys*	*0*	*07/31/93*
3.3	SAMPLING		
3.3.1	Air Sampling	0	07/31/93
3.3.2	Gaseous Effluent Monitoring System Inspection and Sample Exchange	0	07/31/93
3.3.3	*Automated Bar Coding of Air Samples at Hanford (ABCASH) (Page Change 1) (1, 3, 10, 12, 21)*	*0*	*12/01/93*

PROCEDURE NUMBER	TITLE	REV	EFFECTIVE DATE
4.0	**INSTRUMENTATION**		
4.1	PSD Inspection and Source Check	0	07/31/93
4.2	Background and MDCR Determination with Portable Instruments	0	07/31/93
4.3	Program and Operate Gammacom Dosimeters	0	07/31/93
4.4C	*Eberline HFM-4A*	*1*	*12/01/93*
4.5C	Operation of the 400 Area Effluent Monitoring System	0	07/31/93
4.6C	Operation of Tri-Carb Liquid Scintillation Counter	0	07/31/93

LETTER DESIGNATORS

A 100 Area Facilities HP

B PUREX/B-Plant HP

C Southern Areas/Support Services HP

D T-Plant/Solid Waste Disposal HP

E Environmental Restoration HP

F Tank Waste Remediation HP

G PFP/Laboratory HP

If you have any questions about this manual, feel free to call the following personnel in Radiological Engineering:

W. C. (Bill) Mallory	376-4098
M. E. (Mark) Flatland	373-3323
W. L. (Wendy) Robbins	373-2146
E. V. (Ed) DosRamos	373-5297
T. A. (Tammy) Mosley	373-1816

TITLE:

OFFSITE RADIOLOGICAL SURVEYS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

1.1 **Purpose:** To provide instructions for the performance of offsite radiological surveys.

1.2 **Scope:** This procedure addresses the conduct of radiological surveys for private or other non-DOE property located off the Hanford site.

1.3 **Discussion:** Offsite radiological surveys are required when there is reason to suspect that personal contamination or loss of control of radioactive material could expose the general public to radioactive material.

2.0 PREREQUISITES

Survey Team selection. The Survey Team shall consist of two HPTs, one of which should be female, and an exempt Health Physics staff member. One team member should be familiar with the incident.

Offsite Trip Ticket if travelling outside 50 mile radius of Richland, Washington.

Survey Team briefing should include any additional information necessary to familiarize the survey team with the incident, possible isotopes, and contamination levels known or expected.

Property owners/occupants permission to conduct a radiological survey. This should include arrangements to meet the owners/occupants at a specific time and place to gain access to the property.

3.0 PRECAUTIONS AND LIMITATIONS

- The response vehicle shall not have emergency lights or any other emergency markings.

- *If smearable contamination is found, a contamination survey of any individual who may have come in contact with the material, and a survey of their routine pathway since that contact, should be completed.*

- *If individual/family names, addresses, telephone numbers, or vehicle license numbers are included in the Radiation Survey Report form, the report shall be stamped STRICTLY PRIVATE.*

4.0 REQUIRED EQUIPMENT AND MATERIALS

- *Government Vehicle*
- *Calibrated Survey Instruments (example: EGM, PAM)*
- *Calibrated Dose Rate Instrument*
- *Smear Media and Envelopes*

Off-site supplies as deemed necessary by the facility HP office where the incident is believed to have originated, such as but not limited to:

- Radiation Survey Reports
- Yellow plastic bags
- Property receipts
- Duplicate blanks for property inventory list, etc.
- Radioactive Shipment Record (RSR)
- *DOT Placards as necessary*

5.0 PROCEDURE

5.1 Proceed to offsite location.

NOTE: The exempt Health Physics staff member should make the initial contact with the property owners/occupants and explain in general terms how the radiological survey will be conducted and that the survey could include all parts of the property.

5.2 Determine if there are any known radioactive sources at the survey site. Before beginning the survey, ask the occupants if they are aware of any radioactive sources at the survey site (e.g., Coleman lantern mantles, disassembled smoke alarms, old luminous dial clocks and compasses, etc.).

5.3 Perform a thorough radiological survey. If the radiological survey is due to lost or missing radioactive material, perform a direct scan.

NOTE: Make sure the audible on each survey instrument is turned down or off to keep the property *owners/occupants* from deriving erroneous conclusions.

5.4 Check off each category listed below as the radiological survey is completed:

- Clothing worn at time of occurrence
- Furniture used since time of occurrence
- Telephone(s) if used since the occurrence
- Washing machine and drain line, dryer and dryer lint filter
- Bathroom (e.g., toilet, towels, sink, bathtub, shower, drains, personal items such as razor, and any floor drains, etc.)
- Bedroom used by the person involved in the occurrence
- Kitchen (e.g., counter tops, sinks, lunch box, *dishes*, etc.)
- Floor coverings such as rugs and carpets
- Clothes closets (especially the floor)
- Items which property *owners/occupants*/exempt staff member want surveyed
- Personal survey of those who could be potentially cross contaminated
- Personal vehicles used since the occurrence
- Furnace and/or air conditioner filters as applicable

5.6 If direct scan readings above background are observed, smear the area(s) or the material as necessary.

5.7 Retain the smears for further analysis. Place each smear in a separate envelope and label with location, date, and time of smear.

5.8 Report radiological survey results to HP exempt staff member.

NOTE: *Exempt staff member will inform owners/occupants of survey results.*

5.9 Inform the individual(s) being surveyed of the contamination or radiation levels detected in terms related to a Coleman lantern mantel and natural background.

5.10 Document results on a Radiation Survey Report form.

5.11 Isolate areas which have loose contamination. The use of masking tape is acceptable to prevent further spread of contamination.

5.12 Wrap contaminated items in yellow plastic. Small items such as glassware or clothing should be wrapped in yellow plastic sealed with masking tape.

5.13 Tag contaminated items as radioactive. Maintain a written inventory of all tagged items.

5.14 List all items surveyed on the Radiation Survey Report form.

5.15 Provide property *owners/occupants* with a signed receipt for personal property. Using the tagged item inventory, review list with property *owners/occupants* and sign a detailed receipt for all items removed from premises.

5.16 Double bag any material and tag as radioactive if the activity level of the item(s) surveyed is greater than Table 2-3 in WHC-CM-1-6.

5.17 Request assistance from HP supervisor as necessary. If the activity level of the item(s) surveyed is greater than Table 2-3 in WHC-CM-1-6, request assistance from the HP supervisor in contacting Hazardous Material Shipping and Transportation.

5.18 Place contaminated property into government vehicle for transport back to the Hanford Site for decontamination or disposal. Transport vehicle should be placarded in accordance with Article 424, WHC-CM-1-6.

5.19 Return contaminated material to the Hanford Site area or facility where the contamination or lost material originated for decontamination and disposition.

5.20 Complete a numbered Radiation Survey Report form. Attach a copy of each receipt issued to the property owner.

5.21 Provide a copy of the Radiation Survey Report and attachments to the HP manager.

5.22 Return survey equipment and supplies to designated storage.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Article 424.

WHC-CM-4-12, Health Physics Practices, Sections 10.4 and 10.5.

WHC-CM-1-3, Management Requirements and Procedures, Section 2.2

7.0 ATTACHMENTS

NONE

8.0 DOCUMENTATION

Radiation Survey Report, form number BD-6000-010.

Personnel Contamination Data - Clothing form, number A-6000-962 *(as required).*

Personnel Contamination Data - Skin form, number A-6000-957 (as required).

Offsite Trip Ticket, Stores form number 54-3000-353 (as required).

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1.0 PURPOSE AND SCOPE

This procedure provides the HPT with checklists and instruction for response to various radiological emergencies.

2.0 PREREQUISITES

HPT academic and *fundamentals* training

3.0 PRECAUTIONS/LIMITATIONS

- Emergency response teams should include at least two HPTs.
- Life threatening situations take precedence over radiological concerns.

4.0 REQUIRED EQUIPMENT/MATERIAL

- Equipment as identified on the applicable checklist(s)
- Any procedures that may apply to the emergency situation

5.0 PROCEDURE

5.1 Obtain applicable checklist(s) - see attachments 7.1 - 7.7

5.2 Check off each task as it is completed.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Article 346

WHC-CM-4-12, Health Physics Practices Manual, Part B, Section 12.1

7.0 ATTACHMENTS

7.1 Plume Tracking Checklist

7.2 Quick Sort Checklist

7.3 *Radioactive* Transportation Checklist

7.4 Air Sampling Checklist

7.5 Vegetation Sampling Checklist

7.6 Soil Sampling Checklist

7.7 Water Sampling Checklist

8.0 DOCUMENTATION

Radiation Survey Report

Field Logbook

ATTACHMENT 7.1

Plume Tracking Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and equipment.*	
2	Refuel trucks, if necessary, and load Emergency Kits.*	
3	Don protective clothing, respiratory equipment, and supplemental dosimetry (two self-reading dosimeters), as appropriate.	
4	Obtain final instructions and information from HP Supervision or Field Team Coordinator.	
5	Call on Radio.	
6	Obtain periodic dose rate readings. (Indication of plume location if count rate reading is 2X the background, or uRem reads *20* uRem/hr.)	
7	Obtain and label air samples (30 cubic feet *minimum* volume. If using charcoal or silver zeolite cartridge, 2 cubic feet per minute maximum flow rate) as requested.	
8	Perform walking stick survey around vehicle *as requested.*	
9	Obtain and label soil and/or vegetation samples as requested.	
10	Calculate** and report air sample results.	
11	Document results.	

*Instruments: GM/P-11 Probe, Pam, uRem, CP and Portable Grab Air Sampler. The emergency kit should be stocked with all necessary supplies and should contain a Radioactive Shipment Record and calculator.

**Formula:

$$\text{ACTIVITY } (\mu Ci/cc) = \frac{N \cdot k}{V \cdot E}$$

Where:

N = Net count rate in cpm (i.e., gross cpm - background cpm)

k = 2.0 E-11 [(μCi · ft^3) / (dpm · cc)]

V = Sample volume of air collected in cubic feet (i.e., flow rate x time sample filter on line).

E = Probe/Instrument efficiency in decimal

ATTACHMENT 7.2

Quick Sort Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and equipment.*	
2	Assemble personnel in a low-background area.	
3	Survey personnel for contamination giving priority to personnel with injuries, symptoms of radiation sickness, and those wearing protective clothing.**	
4	Remove contamination before performing quick sort survey. Segregate individuals as necessary based on survey results.	
5	*Perform quick sort. Survey each individual for neutron-induced activity by placing the P-11 probe at the abdomen or in the closed armpit.*	
6	*Instruct suspected neutron-induced personnel to remove dosimetry, jewelry, or metal objects and place in bag(s). Survey for activation. Retain dosimetry for evaluation.*	
7	Notify the Facility Emergency Coordinator of survey results and recommended action regarding medical care or decontamination.	
8	Verify that a Personnel Questionnaire Card is completed for each individual *found with induced activity, contaminated, or known to have been near the criticality site.*	
9	Perform follow-up actions: • Transport personnel needing medical care. • Send dosimetry and personnel belongings of activated personnel to dosimetry. • Exchange dosimetry of remaining personnel. • Retain personnel not sent to a medical facility until results are available.	
10	Perform follow-up personnel surveys as needed.	
11	Document results.	

*Instruments: GM with P-11 or HP-210 Probe, Pam, CP; The emergency kit should contain all other necessary supplies.

**Medical treatment shall take priority over decontamination. *An HPT shall accompany medical personnel while they are administering first aid or transporting contaminated individuals to the hospital.*

ATTACHMENT 7.3

Radioactive Transportation Accident Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and equipment.*	
2	Refuel vehicles, if necessary, and load Emergency Kits.*	
3	Proceed to location and *contact Emergency Response Person In Charge.* Evacuate personnel to an upwind location.	
4	*Administer first aid to injured personnel. Survey personnel. Decontaminate and/or segregate contaminated personnel as needed.***	
5	Identify the material from the Radioactive Shipment Record papers. **DO NOT TOUCH DAMAGED CONTAINERS OF SPILLED MATERIAL UNTIL QUALIFIED HELP ARRIVES. STOP SPREAD IF POSSIBLE BUT DO NOT TAKE UNNECESSARY RISKS.**	
6	Set boundaries at 2 mR/hr or at edge of contamination, and provide an access control point.	
7	Take air samples upwind and downwind (use Air Sampling Checklist, Attachment 7.4).	
8	Control radiation and contamination exposure or spread by issuing dosimetry and surveying all personnel and equipment leaving the event area.	
9	Clean up area per approved clean up plan.***	
10	Document results.	

*Instruments: GM/P-ll Probe, Pam, CP, and Grab Air Sampler; The emergency kits will be stocked with all the necessary equipment including dosimetry and an RSR. If hazards are unknown, the maximum PPE is required.

***Medical treatment shall take priority over decontamination. An HPT shall accompany medical personnel while they are administering first aid or transporting contaminated individuals to the hospital.*

***If responding to a Radiation Assistance Program (RAP) incident, cleanup is not to occur until the lead agency is in control of the event.

ATTACHMENT 7.4

Air Sampling Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and equipment.*	
2	Refuel vehicles, if necessary, and load Emergency Kits. *	
3	Proceed to event location. Maintain radio contact with office/PIC.	
4	Obtain grab sample at approximately the vehicle hood height. Sample for a minimum of fifteen minutes at the maximum sample flow rate. Refer to Table 1 below.	
5	Record best estimate of cpm from GM and Alpha survey instruments. Record volume and location on air sample envelope.	
6	Calculate and report air sample results.** Inform PIC and obtain further instructions. NOTE: If the cpm indicates marginal activity above radon background; a clean air sample may be required from a known clean location in order to obtain a true net count.	
7	Document results.	

*Instrumentation: GM/P-ll Probe, Pam, PAC-6, Portable Grab Air Sampler. The emergency kit should be stocked with all necessary supplies and should contain a Radioactive Shipment Record and calculator.

NOTE: The critical parameter for use of the following table is the air sample volume which must be collected. If the sample volume does not match those listed, the countrate can be normalized to the volume in Table 1. Airborne concentrations less than the DAC will not be reliably counted unless the sample volume is increased accordingly.

Table 1. Minimum Sample Volume to Obtain an Estimate of Airborne Concentrations Near the DAC with a Grab Sample.

Probe	Min. ft^3 Air to Count Reliably at the DAC (ft^3)	DAC (μCi/mL)	Type of Activity	Estimated Net Count Rate (cpm)
P-11	30	1×10^{-9}	Beta-gamma	100
HP-210	20	1×10^{-9}	Beta-gamma	100
P-11	600	3×10^{-10}	Uranium	100
HP-210	400	3×10^{-10}	Uranium	100
PAM	400	2×10^{-12}	Plutonium	3

**Formula:

$$\text{ACTIVITY } (\mu Ci/cc) = \frac{N \cdot k}{V \cdot E}.$$

Where:

N = Net count rate in cpm (i.e., gross cpm - background cpm)
k = 2.0 E-11 [(μCi · ft^3) / (dpm · cc)]
V = Sample volume of air collected in cubic feet (i.e., flow rate x time sample filter on line).
E = Probe/Instrument efficiency in decimal

ATTACHMENT 7.5

Vegetation Sampling Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and sampling equipment.*	
2	Obtain documentation.*	
3	Proceed to designated location.	
4	Survey vegetation to be sampled.	
5	Use shears or pruners to obtain sample. Cut enough vegetation to fill a one gallon zip-lock plastic bag.	
6	Double bag the sample.	
7	Mark the outer bag with sample I.D., location, date.	
8	Complete proper labels and documentation for radioactive samples.	
9	Contact OSS/T&P for proper packaging and delivery requirements.	
10	Deliver samples to designated laboratory.	
11	Retain copies of completed Chain of Custody.	
12	Complete documentation (i.e., Radiation Survey Report).	
13	Deliver copies of documentation to critical organizations.	

* <u>Vegetation Sampling Equipment</u>

- Maps of area to be sampled
- Portable radiation detection devices (calibrated and source checked)
- Shears
- Pruners
- One gallon zip-lock plastic bags
- Black indelible ink pen
- Protective clothing (including leather gloves where applicable)
- Environmental Sample label
- Surveyed by HPT for Shipment label (where applicable)
- Radioactive Materials label (where applicable)
- Radiation Survey Report
- Field Log Book
- Radioactive Shipment Record (RSR) (where applicable)
- Request for Special Analysis form
- Chain of Custody form

ATTACHMENT 7.6

Soil Sampling Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and sampling equipment.*	
2	Obtain documentation.*	
3	Proceed to designated location.	
4	Survey area to be sampled.	
5	Obtain 5 composite samples by hand troweling.	
6	Double bag the sample.	
7	Mark the outer bag with sample I.D., location, and date.	
8	Complete proper labels and documentation for radioactive samples.	
9	Return sample location to natural condition.	
10	Contact OSS/T&P for proper packaging and delivery requirements.	
11	Deliver samples to designated laboratory.	
12	Retain copies of completed Chain of Custody.	
13	Complete documentation (i.e., Radiation Survey Report).	
14	Deliver copies of documentation to critical organizations.	

* <u>Soil Sampling Equipment</u>

- Maps of area of interest
- Portable Radiation Detection Devices (calibrated and source checked)
- Small sampling trowel
- One gallon zip-lock plastic bags
- Soil separating device (i.e., sifter, cardboard box, etc.)
- Environmental Sample label
- Surveyed by HPT for Shipment label (where applicable)
- Radioactive Materials label (where applicable)
- Field Log Book
- Radiation Survey Report
- Radioactive Shipment Record (RSR) (where applicable)
- Request for Special Analysis form
- Chain of Custody form

ATTACHMENT 7.7

Water Sampling Checklist

Step	Action	Completed
1	Obtain and check operation of instruments and sampling equipment.*	
2	Obtain documentation.*	
3	Proceed to designated location.	
4	Fill sample bottle.	
5	Survey sample bottle.	
6	Obtain pH/temperature readings with machine (litmus paper and thermometer readings are acceptable).	
7	Record pH, temperature, date, and time on Water Sample Log	
8	Complete and apply proper labels (i.e., Environmental Sample label, Surveyed by HPT for Shipment label, etc.).	
9	Contact OSS/T&P for proper packaging and delivery requirements.	
10	Deliver samples to designated laboratory	
11	Retain copies of completed Chain of Custody	
12	Complete documentation (i.e., Radiation Survey Report)	
13	Deliver copies of documentation to critical organizations.	

* <u>Water Sampling Equipment</u>

- Maps of areas to be sampled
- Portable radiation detection devices (calibrated and source checked)
- One liter sample bottles with caps
- 24 ounce wax-coated paper sample cups
- Sampling device (extension rod with ring for holding cups)
- pH/temperature meter (litmus paper and thermometer may substitute)
- Protective clothing (including waterproof gloves and boots where applicable)
- Environmental Sample label
- Surveyed by HPT for Shipment label (where applicable)
- Radioactive Materials label (where applicable)
- Radiation Survey Report
- Field Log Book
- Radioactive Shipment Record (RSR) (where applicable)
- Water Sample Log Sheet
- Request for Special Analysis form
- Chain of Custody form

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TITLE:

PERSONNEL DECONTAMINATION

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure establishes the guidelines, methods, chemicals and materials needed to decontaminate personnel and document the results.

2.0 PREREQUISITES

- Completion of Health Physics Technician (HPT) academic and practical training.
- Detectable contamination on an individual or suspected internal deposition of radionuclides.

3.0 PRECAUTIONS/LIMITATIONS

Evaluation of the need for Diethylene Triamine Penta Acetate (DTPA) chelation therapy is based on the criteria in ER-03.1. Optimum time for chelation is within one hour of a radionuclide intake.

WARNING

Decontamination agents may cause skin rash, discomfort, stinging or eye irritation. Avoid contact with eyes.

If there is any evidence of skin redness or if the individual complains of soreness or stinging during any of the decontamination steps, stop the procedure immediately, flush the area with clean water, inform HP Supervision and contact the Health Service Center for assistance.

Prevent contaminated water from entering body openings such as eyes, ears, nose, mouth, etc.

Prevent the spread of contamination to unaffected areas or wounds.

Use only tepid (lukewarm) water.

All instances of personnel contamination must be recorded on a Personnel Contamination Data - Skin form.

Complete a Radiological Survey Report only when an incident scene survey is performed.

Immediately replace supplies after each use.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Decontamination reagents and supplies as listed on the Decontamination Stations Inventory (Attachment 7.1)
- Radiation survey instruments
- Sample counting equipment
- Protective clothing
- Radioactive liquid and solid waste disposal containers

5.0 PROCEDURE

5.1 Initial Survey and Observations

A. Observe the individual for existing skin conditions, injuries, shock, burns, etc.

B. If any medical problems or injuries are observed, request assistance from the Health Service Center, and notify HP Supervision and Dosimetry.

C. Perform a whole body survey of the individual.

D. If a radionuclide uptake is suspected and no medical problems or injuries are observed, proceed to step 5.8.

E. If no medical problems or injuries are observed, go to the applicable step for the contaminated body area(s).

NOTE: Decontamination and contamination monitoring should not interfere with or take precedence over medical care.

F. Concur with attending medical personnel to decontaminate severe injuries during medical treatment if the injured or attending personnel could receive a significant exposure from the contaminants.

G. If decontamination cannot be performed at the work area, minimize the spread of contamination by wrapping contaminated area(s) of the individual or lining the transport vehicle with plastic.

H. Escort contaminated individual to the Health Service Center, the Emergency Decontamination Facility (EDF), Hanford Square 1 Health Service Center, or the hospital as directed by the HEHF on call physician.

I. If possible, collect sample contaminants for analysis.

J. Document results on Personnel Contamination Data - Skin form.

5.2 Acid and Caustic Contamination

WARNING

Acids and caustics quickly destroy skin. Shower or flush with water immediately upon contact.

NOTE: Contamination controls may be disregarded if contamination is carried by a strong acid or base.

A. Flush for 15-20 minutes using the nearest safety shower to immediately remove chemical.

B. Contact the Health Service Center and HP Supervision for additional decontamination guidance.

5.3 General Body Decontamination

A. Have the individual shower in a decon shower stall, using pHisoderm (or equivalent liquid soap) and tepid water. Lano-Kleen or Lava soap may be used on toughened skin surfaces such as hands and feet.

B. Have the individual thoroughly pat dry with a towel.

NOTE: Wiping or rubbing may spread contamination.

C. Resurvey the individual.

D. Repeat the procedure a second time if the contamination does not localize to specific area(s) or no decrease in the contamination levels is noted.

E. If the contamination does not localize to specific area(s) or no decrease in the contamination levels is noted after two showers, contact HP Supervision and Dosimetry and request assistance from the Health Service Center.

F. Document results on Personnel Contamination Data - Skin form.

G. If contamination is present in localized area(s), proceed with Skin Decontamination, Step 5.5.

5.4 Particle Decontamination

A. If the skin has a sparse hair covering, press a piece of masking tape over the contaminated area and carefully remove.

B. If the hair coverage is thick, wipe the area with a damp tissue or gauze pad.

C. Survey the contaminated area and repeat the procedure until contamination is either completely removed or no decrease in the contamination levels is noted.

D. Document results on Personnel Contamination Data - Skin form.

CAUTION

Shaving may cause abrasion. Direction from the Health Service Center is advised.

E. If the contamination still remains and is not on the head, remove the hair with scissors or razor. If the contamination is found to be on the scalp and hair go to step 5.6; if on the skin, continue to step 5.5.

5.5 Skin Decontamination

5.5.1 Soap and Water Technique

A. If contamination exceeds 50,000 dpm direct obtain a dose rate and notify HP Supervision of results.

B. If skin is abraded or broken notify HP Supervision and the Health Service Center for assistance.

WARNING

Decontamination should not be performed on broken or abraded skin.

C. Wash the contaminated area with soap and tepid water for approximately one minute. A slight abrasive soap such as Lava may be used on toughened skin surfaces such as hands and feet.

D. Throughly pat dry the area.

E. Repeat soap and water decontamination as long as each application results in a reasonable (10-20%) reduction in contamination level.

F. Document results on Personnel Contamination Data - Skin form.

G. If the contamination is non-detectable, a skin cream may be applied to the area to prevent chapping.

H. If no further reduction in the contamination level is noted, continue to Step 5.5.2, pHisoderm Technique.

5.5.2 pHisoderm® Technique

A. Apply a sufficient amount of pHisoderm (or equivalent liquid soap) onto a clean, absorbent applicator (swab or gauze pad), and apply to the contaminated area.

B. Gently rub the skin with the applicator for approximately one minute.

C. Rinse the affected area with clean water.

D. Thoroughly pat dry the area.

E. If contamination is still detected, repeat Steps A through D up to three times as long as each application results in a reasonable (10-20%) reduction in contamination level and no skin irritation is observed.

F. Document results on Personnel Contamination Data - Skin form.

D. If the contamination is non-detectable, a skin cream may be applied to prevent chapping.

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G. If further reduction in the contamination level is not noted, continue to the Bleach Technique, Step 5.5.4 or the Laundry Soap Technique, Step 5.5.3.

NOTE: Results from step 5.5.4, Bleach Technique and Step 5.5.3, Laundry Soap Technique are very similar. The HPT may use either technique depending on the facility and the type of contamination present.

5.5.3 Laundry Soap Technique

A. Add laundry soap to a container, then add clean tepid water. Stir until a soapy solution is formed.

NOTE: A mixture of 50% Tide, 50% corn starch and clean tepid water may also be used to form a slurry.

B. Apply a sufficient amount of soapy solution to a clean, absorbent applicator (swab or gauze pad), and apply to the contaminated area.

C. Wait approximately two minutes then rinse the affected area with clean water and thoroughly pat dry.

D. If the contamination is still detected, repeat Steps B and C up to three times as long as each application results in a reasonable (10-20%) reduction in contamination level and no skin irritation is observed.

E. Document results on Personnel Contamination Data - Skin form.

F. If the contamination is non-detectable, a skin cream may be applied to prevent chapping.

G. If further reduction in the contamination level is not noted, continue to Step 5.5.5, EDTA Technique.

5.5.4 Bleach Technique

A. Apply a sufficient amount of bleach to a clean, absorbent applicator (swab or gauze pad), and apply to the contaminated area.

B. Observe the treated area for reddening or irritation.

C. If irritation occurs or the individual complains of severe stinging:

1. Flush the area immediately with fresh water
2. Discontinue bleach technique
3. Contact HP Supervision, the Health Service Center and Dosimetry

D. If no irritation is noted, wait up to one minute then rinse the affected area with clean water and thoroughly pat dry.

E. If the contamination is still detected, repeat Steps A, B and D up to three times as long as each application results in a reasonable (10-20%) reduction in contamination level and no skin irritation is observed.

F. Document results on Personnel Contamination Data - Skin form.

G. If the contamination is non-detectable, a skin cream may be applied to prevent chapping.

H. If further reduction in the contamination level is not noted, continue to Step 5.5.5, EDTA Technique.

5.5.5 EDTA (Na_4 EDTA) Technique

A. Dissolve $^1/_3$ of a teaspoon or ten grams of EDTA chemical salt in 100 ml of clean tepid water. This produces a solution of approximately 10% active ingredient (EDTA solution).

B. Add approximately one teaspoon of detergent or liquid hand soap to the solution to provide a lathering or lifting action to help in the removal of the contamination.

C. Apply a sufficient amount of EDTA/detergent solution to a clean, absorbent applicator (swab or gauze pad) and apply to the contaminated area.

D. If reddening or irritation occurs:

1. Flush the area immediately with fresh water
2. Discontinue EDTA technique
3. Contact HP Supervision, the Health Service Center and Dosimetry

E. If no irritation is noted, wait up to two minutes then rinse the affected area with clean water and thoroughly pat dry.

F. If the contamination is still detected, repeat Steps C and E up to three times as long as each application results in a reasonable (10-20%) reduction in contamination level and no skin irritation is observed.

G. Document results on Personnel Contamination Data - Skin form.

H. If the contamination is non-detectable, a skin cream may be applied to prevent chapping.

I. If further reduction in the contamination level is not noted, continue to Step 5.5.6, Potassium Permanganate Technique.

5.5.6 Potassium Permanganate ($KMnO_4$) Technique

WARNING

Failure to dissolve potassium permanganate in water may cause severe burning of skin.

A. Dissolve a pre-prepared capsule or approximately 1 gram of potassium permanganate crystals in 1 oz of clean tepid water. The concentration need not be exact, but undissolved crystals should remain in the bottom of the container.

B. Dissolve a pre-prepared capsule or approximately 1 gram of sodium bisulfite salt in 1 oz of clean tepid water. This produces an approximate 4% concentration to remove the potassium permanganate.

C. Dip an absorbent applicator into a pre-mixed container of potassium permanganate solution and apply to the contaminated area.

D. Allow the solution to dry thoroughly on skin.

NOTE: A slight burning sensation may be felt.

E. If skin irritation is noted, go to Step G, notify HP Supervision, the Health Service Center and Dosimetry for assistance.

F. Repeat the application one more time. Allow the solution to dry thoroughly on the skin.

G. To remove the $KMnO_4$ solution, dip an absorbent applicator in a pre-mixed container of sodium bisulfite and apply to the discolored area.

H. Gently rub the sodium bisulfite until the discoloration has been completely removed.

I. Rinse the affected area with clean water and thoroughly pat dry.

J. If the contamination is still detected, repeat Steps C through I up to three times as long as each application results in a reasonable (10-20%) reduction in contamination level or no skin irritation is observed.

K. Document results on Personnel Contamination Data - Skin form.

L. When the contamination is non-detectable, a skin cream may be applied to prevent chapping.

M. If further reduction in the contamination level is not noted, notify HP Supervision, the Health Service Center and Dosimetry for assistance.

5.6 Hair and Scalp Decontamination

CAUTION

Shaving may cause abrasion. Direction from the Health Service Center is advised.

NOTE: In extreme instances, it may be necessary to remove hair either by cutting or shaving. Hair removal from the scalp requires the permission of the affected individual.

5.6.1 When contamination is less than 3,000 dpm beta-gamma or less than 1,000 dpm alpha:

NOTE: Loose contamination on an individual's head or hair may require the use of a HEPA filtered vacuum cleaner or similar means of removal as the initial treatment.

A. Instruct the individual to remove all personal outer clothing and don a pair of coveralls or lab coat, and surgeons gloves.

B. Wrap a towel firmly around the individual's neck and place cotton in their ears to prevent contamination from spreading.

C. Bend the individual's head forward over a wash bowl or a decontamination sink.

D. Instruct the individual to shampoo their hair with pHisoderm or other suitable shampoo for approximately two minutes by massaging the mixture into the hair producing a heavy lather.

E. Rinse the lather from the hair with clean water by carefully directing spray over the scalp.

F. Dry the hair thoroughly with a towel.

G. Survey the dry hair and towel.

H. Repeat the process two more times as necessary, using a clean towel each time.

I. Document results on Personnel Contamination Data - Skin form.

J. If contamination still remains, notify HP Supervision, the Health Service Center, and Dosimetry for assistance.

5.6.2 When contamination levels exceed 3,000 dpm beta-gamma or 1,000 dpm alpha:

NOTE: Use of a HEPA filtered vacuum cleaner or similar means of removal is recommended in the initial treatment for severe instances of loose contamination on an individual's head or hair.

A. Isolate the contaminated area.

B. Attempt to "Spot Clean" the affected areas using the pHisoderm techniques described earlier in Step 5.5.2.

C. Dry the hair thoroughly with a towel.

D. Survey the dry hair and towel.

E. Repeat Steps A through D until the contamination levels are reduced to levels allowing a release survey or performance of a "shampoo" treatment as outlined in Step 5.6.1.

F. If contamination still remains after three washings, notify HP Supervision, the Health Service Center and Dosimetry for assistance.

G. Document results on Personnel Contamination Data - Skin form.

5.7 Facial Decontamination

NOTE: The face is defined as the area within the sealing area of a full face respirator.

A. Make immediate notifications using Table ER-03.1 if contamination levels exceed 500 dpm alpha or 10,000 dpm beta.

B. Apply only soap and water, pre-moistened towelettes, shaving cream type foam decontamination agents (Radcon foam), and/or Phisoderm for facial decontamination. Further decontamination efforts, if necessary, are to be done under HEHF direction.

C. Document results on a Personnel Contamination Data - Skin form.

D. Obtain Nasal Smears, Step 5.8.

E. If respirator was worn and is available, direct and smear survey respirator filters and inside of respirator; document results on a Radiological Survey Report.

5.8 Nasal Smear - Nasal smears are an indication of possible radionuclide intake.

A. Identify two Whatman filters for each individual for whom a nasal smear is taken by marking one "L" (for left nostril) and one "R" (for right nostril).

B. Moisten each filter with demineralized water.

C. Wrap each filter around a cotton tipped applicator.

D. Instruct the individual to smear the inside surface of each nostril.

E. Unfold the filter papers and place them smear side up to completely dry.

F. Survey the filters for gross contamination using a pancake type probe or an alpha detector.

G. Make immediate notifications using Table ER-03.1 if total contamination levels exceed 100 dpm alpha or 1000 dpm beta.

H. Count the smear filters on a smear counter.

NOTE: Total contamination levels are defined as any combination of measurements taken from direct surveys of smears from nostrils and results from smear counter.

I. Place filters into envelopes labeled with name, payroll number, date, time, and "L" or "R".

J. Enter results of count on the Daily Smear Counter Log Sheet.

K. Make immediate notifications using Table ER-03.1 if total contamination levels exceed 100 dpm alpha or 1000 dpm beta.

L. If the nasal smears are positive, but do not exceed 100 dpm alpha or 1000 dpm beta, contact HP Supervision immediately and Dosimetry no later than the next regularly scheduled work day (day shift).

M. Report results to individual from whom smears were taken.

N. If nasal smears are positive, begin decontamination efforts using the following steps:

1. Have the individual blow their nose into a tissue.

2. Survey the tissue and the nose area with a pancake type probe or an alpha detector as appropriate to determine gross levels of contamination.

3. Make immediate notifications using Table ER-03.1 if total contamination levels exceed 100 dpm alpha or 1000 dpm beta.

NOTE: Total contamination levels are defined as any combination of measurements taken from direct surveys of smears from nostrils, results from smear counter, and nose blow.

4. If the contamination is still detected, repeat Steps 1 and 2 as long as each blow results in a reasonable (10-20%) reduction in contamination level and no soreness or irritation of the nasal passages occurs.

5. If further reduction in the contamination level is not noted or the individual is unable to blow their nose, notify HP Supervision, Dosimetry and the Health Service Center for assistance.

6. Label and retain all samples until Dosimetry authorizes disposal.

O. Document results on Personnel Contamination Data - Skin form.

P. If action level guidelines from Table ER-03.1 are exceeded and the employee has the need to pass urine, issue a bioassay kit and retain the samples.

Q. Indicate pre/post DTPA injection in the Date and Time section on the bioassay kit.

R. If respirator was worn and is available, direct and smear survey respirator filters and inside of respirator; document results on a Radiological Survey Report.

5.9 Blood Smear

NOTE: Any skin break shall be surveyed by direct survey or blood smears.

A. Follow work practice controls for bloodborne pathogens as outlined in WHC-CM-4-12, HEALTH PHYSICS PRACTICES MANUAL, Section 11.10; Exposure Control Plan for Bloodborne Pathogens (pending).

NOTE: Use natural capillary action to obtain blood smear. Do not force blood flow or squeeze the wound.

CAUTION

Avoid pushing contamination into the wound.

B. Obtain blood smear on Whatman filter.

C. Completely dry the blood smear.

D. Count smear filter on a smear counter.

E. Properly bag and label blood smear.

F. Notify HP Supervision, the Medical Service Center, and Dosimetry of smear results.

G. Retain all samples until Dosimetry authorizes disposal.

H. Record results on Daily Smear Counter Log Sheet.

I. Document results on Personnel Contamination Data - Skin form.

5.10 Eye Decontamination

WARNING

Excessive water pressure may cause eye injury.

A. Flush the eyes with clean water or saline solution by holding the eyelids open while flushing. Instruct the individual to roll their eyeball to dislodge the contamination.

NOTE: Flushing can be accomplished by using an eyewash station or connecting a piece of hose to a sink faucet.

B. Contact the Health Service Center for assistance, and notify HP Supervision and Dosimetry.

NOTE: Notifications for assistance shall be done at the first opportunity, but shall not delay the start of the eye decontamination.

C. Document results on Personnel Contamination Data - Skin form.

5.11 Mouth Decontamination

NOTE: Methods such as open mouth survey, cotton swabs or cotton tipped applicators, and Whatman type smears are acceptable practices.

WARNING

Eating, drinking, chewing, or smoking prior to decontamination may result in an internal deposition.

A. If internal deposition is suspected, contact the Health Service Center for assistance, and notify HP Supervision and Dosimetry.

B. If the mouth is generally contaminated, have the individual swish tepid water or saline solution in the mouth while keeping head forward and spit into the collection container.

CAUTION

Individual should not swallow the mouth rinse.

C. For localized contamination, such as a spot on the tongue or teeth, dip cotton-tipped applicators or gauze sponges in pHisoderm and water, then rinse carefully.

NOTE: Soap or chemical solutions should not be used if the possibility of ingestion exists.

D. Repeat the rinse process or spot decontamination until no further contamination is detected.

E. Document results on Personnel Contamination Data - Skin form.

F. If further reduction in the contamination level is not noted after three times, notify HP Supervision, the Health Service Center and Dosimetry for assistance.

5.12 **General Response When Personnel Contamination Cannot Be Removed.**

A. If personnel contamination cannot be removed without inflicting damage to body tissue, notify HP Supervision, the Health Service Center and Dosimetry.

B. Cover the contaminated area(s) as directed by HEHF and HP Supervision. This is usually accomplished by using the following:

- A surgeon's glove or gloves for hand contamination.
- A "cut patch" or bandage for other body areas.

NOTE: HP Supervision or Dosimetry will explain any limitations or precautions to the individual and arrange for periodic surveys of the individual during the release period.

NOTE: HP and HEHF personnel will periodically evaluate and document the status of the contaminated individual during the release period.

C. HP or EDF personnel will perform further decontamination under the direction of HEHF.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Chapter 5, Part 4, Handling Radiologically Contaminated Personnel.

WHC-CM-4-12, Health Physics Practice Manual, Practice 6.5, Personnel Decontamination; Practice 11.10, Exposure Control Plan for Bloodborne Pathogens (pending).

WHC-CM-4-16, Dosimetry and Medical Services Manual, Section 1.2, Skin Contamination; Section 5.1, Internal Dosimetry Emergency Response.

WHC-CM-4-40, INDUSTRIAL HYGIENE MANUAL, Section 2.1

Nucleon Lectern Associates The Health Phycics and Radiological Health Handbook, June 1984; Pages 333 through 336.

7.0 ATTACHMENTS

7.1 Basic Inventory of Decontamination Stations

Table
ER-03.1 Notification Criteria

8.0 DOCUMENTATION

- Personnel Contamination Data - Skin form (A-6000-957)
- Personnel Contamination Data - Continuation (A-6700-253)
- Radiological Survey Report (BD-6000-010)

ATTACHMENT 7.1.
Basic Inventory of Decontamination Stations

Item	Quantity
Cotton-tipped applicators	1 package (minimum)
Whatman #5 sample papers	1 box
Sample envelopes	12 (minimum)
Soft hand brush	2 each
4 oz capped poly bottles (Filled with 100 ml of demineralized water)	4 each
Surgeon's gloves or equivalent	1 box (mixed sizes)
Veterinarian's Gloves (for hair washing)	2 pair
Plastic or Canvas Apron (water resistant)	1 each
Cotton balls	1 pkg (minimum)
Tongue depressors	12 each
Lan-O-Kleen (or equivalent hand soap)	1 box
Vi-Lan waterless hand cleaner (or equivalent)	1 tube
Tide (laundry detergent)	1 box
pHisoderm® (or equivalent liquid soap)	1 bottle
Soap	1 bar
Na_4 EDTA	1 100 gram bottle
Potassium Permanganate ($KMnO_4$)	20 capsules
Sodium Bisulfite ($NHSO_3$)	20 capsules
Household Bleach (Sodium Hypochlorite)	1 bottle
1 oz plastic cups	12 each
Note pad	1 pad
Black ballpoint pens	2 each
Wool Wax Creme (or equivalent)	1 jar
Radiacwash (pre-moistened towelettes)	10-15 packages
Radiacwash (commercial cleaner/surfactant)	1 bottle
Gauze sponges	1 pkg (minimum)
Disposable Safety Razor	2 each
Masking tape	1 roll (minimum)
Scissors, safety type or with the tips rounded	1 pair
Plastic bags (for waste and flush media storage)	10 each
Sanitary tissues (Kleenex)	1 box
Personnel Contamination Data - Skin form	10 each
Personnel Contamination Data - Clothing form	10 each
Radioactive Material Tags/Stickers	12 each
Saline solution, normal usp	4 bottles or bags
Ice Cream Cartons 1 gal.	4 each
Ice Cream Cartons 1 qt.	4 each
Bio Assay Kits (urinalysis)	4 each
Emergency Kit	1 each
Universal Precautions Kit	1 each
Table ER-03.1 "Notification Criteria" (based on WHC-CM-4-16, Dosimetry Manual, Section 5.1)	1 each posted
Optional: Corn Starch	1 Box

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Table ER-03.1
NOTIFICATION CRITERIA

Criteria for Notifying Dosimetry			
Indicator	Alpha Emitters (dpm)	Pure Beta Emitters, (e.g. Sr-90)	Mixed Fission/ Activation Products
Nasal or Mouth Smears[a,b]	≥100	≥1,000 dpm	≥2,000 dpm
Facial Contamination[b]	≥500	≥10,000 dpm	≥50,000 dpm
Head/Neck Contamination	≥5,000	≥5 mR/hr*	≥12.5 mR/hr*
Extremities, clothing[c]	≥10,000	≥10 mR/hr*	≥25 mR/hr*
Contamination Inside Respirator	Any detected after use		
Airborne Contamination	Acute exposure ≥ 10 DAC-hours (after incorporating respiratory protection factor)		
Skin Breaks	Any skin break	Any detectable activity associated with wound (e.g. by direct survey or blood smears)	

[a] Total activity.

[b] For alpha emitters, the levels given are meant as general guidelines for minimum detectable activity. However, if any activity is detected below these levels, Dosimetry shall be contacted.

[c] Clothing contamination levels apply to exposure without respiratory protection, such as contamination levels on inner coveralls while undressing.

* If GM counter approaches operational limit, switch to P-11 pancake probe and use the above exposure rate as a guideline. Conversion to exposure rate is based on a 10% counting efficiency and a conversion factor of 2000 cpm per mrem/hr.

Criteria for Notification to Medical (First Aid or HEHF Physician)			
Indicator	Alpha Emitters (dpm)	Pure Beta Emitters (eg. Sr-90)	Mixed Fission/ Activation Products
Nasal or Mouth Smears	> 1,000	> 5 mR/hr*	> 10 mR/hr*
Facial Contamination	> 25,000	> 25 mR/hr*	> 150 mR/hr*
Skin Breaks	> 100	> 20,000 dpm	> 40,000 dpm

NOTE: Facility Health & Safety personnel contact HEHF as appropriate; however, the decision to chelate (DTPA) is the responsibility of the physician, based on discussions with the WHC internal dosimetry advisor or the PNL exposure evaluator.

* If GM counter approaches operational limit, switch to P-11 pancake probe and use the above exposure rate as a guideline. Conversion to exposure rate is based on a 10% counting efficiency and a conversion factor of 2000 cpm per mrem/hr.

TITLE:

CAM ALARMS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

Health Physics Technicians (HPTs) will protect personnel from, and determine concentrations of, radioactive airborne contamination, in response to CAM alarms.

2.0 PREREQUISITES

HPT academic and generic training
Facility orientation

3.0 PRECAUTIONS/LIMITATIONS

Match personal protective equipment (PPE) to the radiological AND chemical hazards involved (maximum PPE in unknown situations).

Minimize time spent in (potentially) hazardous situations, keep exposure As Low As Reasonably Achievable (ALARA).

4.0 REQUIRED EQUIPMENT/MATERIALS

- Personal Protective Equipment (PPE), minimum--full face mask
- Portable survey instruments
- Sample counters
- Grab air sampler
- CAM filter media, envelopes, and plastic bags
- Clock or watch
- Calculator

5.0 PROCEDURE

NOTE: During a high activity alarm the CAM beacon and bell will be ON. During a voltage spike alarm the CAM beacon and bell will come ON, but then either/both alarm indicators will stop.

5.1 Respond to a CAM Annunciator Panel Alarm.

5.1.1 Acknowledge the alarm. The audible alarm should stop and the visual alarm should continue, unless the alarm was due to a voltage spike.

5.1.2 Note the time and meter reading.

5.1.3 Notify affected personnel and appropriate managers.

5.1.4 If the annunciator has a strip chart recorder or electronic history file, determine the time and reading at the beginning of increased activity.

5.2 Respond to a Continuous Air Monitor (CAM) Alarm.

5.2.1 Verify affected personnel have stopped work and have evacuated the area of concern.

1. If the HPT is on respiratory protection when the CAM alarm occurs, the HPT should determine the airborne concentration and evaluate the current respiratory requirements.

5.2.2 Warn personnel, and notify the HP Supervisor and Operation manager, of the CAM alarm.

5.2.3 Isolate the area to minimize exposure.

1. Close entrances and windows.

2. Secure ventilation in the following ways (if applicable):

   - Shut OFF non-filtered fans/blowers
   - Positive pressure (building supply ventilation--obtain help from Air Balance)

3. Verify **EVERY** access is posted, if applicable.

5.2.4 Perform surveys and collect information.

1. Perform whole body surveys. If facial contamination is detected, obtain nasal/mouth smears.

2. Obtain information from evacuated personnel about work activities, specific isotopes, and chemical hazards.

3. Determine if contamination is found outside the isolated area and note CAM readings in adjacent areas.

4. If possible, obtain a remote grab sample.

5. Enter the affected area in appropriate PPE.

6. If a remote grab sample was not taken, obtain one in the affected area. Steps 7 through 13 may be completed while the grab sample is being drawn.

7. Acknowledge the alarm. The audible alarm should stop and the visual alarm should continue (unless the alarm was due to a voltage spike).

NOTE: After pressing the ACKNOWLEDGE button, it may take some time for the CAM reading to stabilize--up to three minutes for alpha CAMs and one minute for beta CAMS.

8. Verify proper CAM operation.

   - Note the flow rate
   - Verify the alarm set point is correct
   - Review the strip chart recorder or electronic history file for spikes, rapid or slow increases above background (note the time and CAM reading at the start of the increase)

9. Note the time and CAM reading.

10. Exchange the CAM air sample, as applicable.

11. Draw a gas sample, if applicable.

12. Determine the extent and levels of removable contamination in the area.

13. Measure the dose rate, if applicable.

14. Take readings on the samples with portable instruments. Move to an area of lower background if needed or count the samples on a sample counter.

5.3 Calculate the Airborne Activity

5.3.1 Calculate the radioactive airborne concentration using the following equation (find conversions in step 5.3.4):

$$C = \frac{Nk}{VE}, \text{ where:} \quad (1)$$

C = Airborne concentration, in μCi/mL (μCi/cc)
k = 2.0E-11 μCi·ft^3/dpm·mL, conversion factor
N = Net count rate, in cpm
V = Volume of air sampled, in ft^3
E = Efficiency of the instrument used

5.3.2 If the information from 5.1.4 or step 8. of 5.2.4 is available, estimate the airborne concentration using steps 1 through 3 below.

1. Determine the net count rate (N) by subtracting the background reading from the current reading.

2. Determine the duration (Δt) of the activity increase, in minutes.

NOTE: Each horizontal line on a strip chart may represent thirty minutes from the next.

3. Determine the volume (V) by multiplying the flow rate (Q) by the duration (Δt).

$$V = (Q)(\Delta t), \text{ in cubic feet} \quad (2)$$

5.3.3 If a portable instrument or the CAM count rate is used, estimate the airborne concentration by substituting the count rate for the net count rate in the equation (1) above.

5.3.4 If counting instruments are used, divide the net counts by the count time to obtain the net count rate.

5.3.5 Convert differing units to the ones used above by using the following conversions:

Multiply # of → to obtain # of ←	by → ← by ←	to obtain # of → Divide # of ←
liters/min (Lpm)	3.5314E-2	ft^3/min (cfm)
liters	3.5314E-2	ft^3
m^3	35.314	ft^3
hours	60	minutes
cfm	60 (approx.)	std. ft^3/hr (SCFH)
cfm	60	ft^3/hr (cfh)

5.4 Report and Record Radiological Conditions.

5.4.1 Notify the HP Supervisor and Operations management of radiological conditions and record results.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Article 346.2

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Health Physics Air Sample Counter Log (A-6000-274)
Health Physics Daily Smear Sample Counter Log (A-6000-273)
Radiation Survey Report (BD-6000-010)

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TITLE:

RADIATION AREA MONITOR ALARM RESPONSE

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure provides the Health Physics personnel with direction and guidance for responding to a Radiation Area Monitor (RAM) alarm (installed, portable, or semi-portable RAM).

2.0 PREREQUISITES

- RAM OJT particular to the facility

3.0 PRECAUTIONS/LIMITATIONS

- Match Personal Protective Equipment (PPE, clothing and respiratory protection) to the hazards involved

4.0 REQUIRED EQUIPMENT/MATERIALS

- Dose Rate Instruments
- Contamination Survey Instruments (example: EGM, PAM)
- Supplemental Dosimetry (example: self-reading pocket dosimeter, if available)
- PPE, as applicable

5.0 PROCEDURE

5.1 Ensure All Personnel Have Evacuated the Immediate Area of the Alarm.

NOTE: In areas where RAMs have alert (amber light) **AND** high range (red light) alarms, an evacuation is not required for the alert (amber light) range alarm. This may vary per facility.

5.1.1 If personnel evacuated a Contamination Area, perform personnel contamination surveys.

5.1.2 Obtain the following information from evacuated personnel:

- Have all other personnel evacuated the alarm area
- What possible causes could there be for the alarm
- What activities were taking place at the time of the alarm

5.1.3 Read the self-reading dosimeter(s) of evacuated personnel, if any, and note any high readings.

5.2 Enter the Area of the Alarming RAM Wearing Appropriate PPE and Supplemental Dosimetry.

NOTE: The RAM detector may be remotely located from the alarm point.

5.2.1 Survey in all directions for increased dose rates as you approach the RAM detector, attempt to locate the radiation source of the alarm. Do **NOT** assume the alarm is due to an instrument malfunction.

5.2.2 If the dose rate exceeds 100 mrem/hr, evacuate the area and evaluate the situation.

NOTE: The HP supervisor or emergency director will evaluate reentry efforts.

5.2.3 Determine dose rates at the RAM detector and compare the readings to the RAM readout.

5.2.4 If both dose rates are high, attempt to locate the source. Maintain exposure to less than 100 mrem, unless otherwise instructed. Continue the procedure.

5.2.5 If dose rates are normal, check the RAM alarm set point (if possible) and attempt to reset the RAM.

NOTE: An Instrument Technician may be required to reset the RAM.

5.2.6 If the RAM appears to be operating properly and there is no apparent cause for the alarm, source check the RAM.

5.2.7 If necessary, tag out or replace the RAM.

5.2.8 Establish boundaries, as necessary, to control area access, until the source of the high dose rate has been identified and eliminated or reduced to normal conditions.

5.2.9 Contact the HP Supervisor as soon as possible with survey results.

9413139.1336

6.0 BIBLIOGRAPHY

HSRCM-1, Hanford Site Radiological Control Manual, Article 346.3

WHC-CM-1-6, WHC Radiological Control Manual, Article 346.3

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Radiation Survey Report (BD-6000-010)

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TITLE:

QUALITATIVE RESPIRATOR FIT TEST

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure defines the method and materials used to perform a Qualitative Respirator Fit Test.

2.0 PREREQUISITES

The Health Physics Technician (HPT) has completed training for this task.

3.0 PRECAUTIONS/LIMITATIONS

- Incidental respirator users shall have a qualitative respirator fit check performed by HP before each planned use of a full-face, air-purifying respirator.
- Adequate ventilation should be available in the test area to remove test "smoke".
- Broken ends of glass test smoke tubes are sharp and may cause injury.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Incidental User Medical Questionnaire
- Briefing Checklist
- Leather gloves for hand protection
- Rubber aspirator bulb
- Stannic Chloride "smoke" tubes
- Protective rubber tubing or tape (masking or duct)
- HEPA filtered respirator
- Temporary Mask Fit Card

5.0 PROCEDURE

5.1 Preparation for Incidental User Fit Test

5.1.1 Instruct the worker to complete an Incidental User Medical Questionnaire.

NOTE: It is the responsibility of the worker or their supervisor to contact HEHF if a "yes" answer on the Questionnaire is indicated.

5.1.2 Verify that the Training/Briefing qualification on the Incidental Mask Fit Card has not expired.

NOTE: Training/Briefing is valid for one year.

5.1.3 If the Training/Briefing date has expired:

A. Review the contents of the Briefing Checklist with the worker.

B. Have the worker sign the "Wearer's Signature" line at the lower right corner of the Checklist.

5.1.4 Request the worker to don a respirator and to perform a standard negative or positive pressure test of the respirator. (Provide proper instruction per respirator training or Radiation Worker Training if necessary.)

5.1.5 If a satisfactory respirator fit is not obtained repeat step 5.1.4.

5.1.6 If a satisfactory fit for the originally selected respirator is not obtained , then disqualify that respirator and repeat step 5.1.4 using another respirator type approved for onsite use.

5.1.7 If a satisfactory respirator fit still cannot be obtained, disqualify the worker for a qualitative respirator fit test.

5.1.8 Proceed to step 5.2, Qualitative Irritant Smoke Respirator Fit Test upon satisfactory completion of the respirator pressure test.

5.2 Qualitative Irritant Smoke Respirator Fit Test

WARNING

Broken ends of glass test smoke tubes are sharp and may cause injury when leather gloves are not worn.

5.2.1 Break open the ends of the "smoke" tube.

5.2.2 Insert one end of the tube in the rubber bulb.

5.2.3 Cover other exposed broken end of "smoke" tube with a short rubber tube or encircle the end with tape.

NOTE: The tester may elect to wear a respirator to avoid test "smoke" irritation if ventilation is less than adequate.

5.2.4 Stand the worker facing away from ventilation exhaust.

5.2.5 Instruct the worker to breathe normally.

5.2.6 Hold the "smoke" tube approximately two feet from the worker.

WARNING

Worker may react to the test "smoke". Reactions may include involuntary coughing, wincing, or other indications that an unusual odor is detected.

5.2.7 Apply a minimal amount of test "smoke" by lightly squeezing the rubber bulb.

5.2.8 If the worker reacts to the test smoke at any time, stop the test and return to step 5.1.4.

5.2.9 Adjust ventilation or worker's location if necessary to direct the test "smoke" to the respirator seal area.

5.2.10 Move closer to the worker.

5.2.11 Increase the "smoke" density.

5.2.12 Direct the "smoke" for no less than 30 seconds, at the respirator seal area during each of the following exercises.

5.2.13 Instruct the worker to perform the following exercises while "smoke" is being directed at the respirator seal area:

1. Normal breathing.

2. Deep breathing.

3. Nod head up and down.

4. Turn head right to left.

5. Move face in a circular motion.

6. Count out loud, 1 - 10, then backwards, 10 - 1.

7. Smile or grin.

5.2.14 Ensure that the test area is clear of irritant "smoke".

5.2.15 Instruct the worker to remove the respirator.

5.2.16 Certify the respirator fit if no reaction to the "smoke" or odor is noted by the worker.

5.3 Completion of Records

5.3.1 Record the fit test results at the bottom of the Incidental User Medical Questionnaire.

5.3.2 Issue and initial, or up-date, the temporary Incidental User Mask Fit Card as necessary.

5.3.3 Complete an entry in the Mask Fit Log for that facility.

5.4 Reassemble and Store the Test Kit

5.4.1 Inventory the supplies in the Test Kit.

5.4.2 Reorder supplies as necessary.

5.4.3 Store the Test Kit in its designated location.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Article 531, 532 and 533

WHC-CM-4-4, Industrial Safety Manual, Vol. 3, Section 7

WHC-CM-4-12, Health Physics Practices, Practice 6.4

WHC-CM-4-40, Industrial Hygiene Manual, Section 5.2

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Mask Fit Log Sheet

Training/Briefing Checklist

Incidental User Medical Questionnaire

Incidental User Mask Fit Card

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TITLE:

PERSONAL EFFECTS DECONTAMINATION

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure describes the methods and steps to decontaminate personal effects.

2.0 PREREQUISITES

Completion of Health Physics Technician (HPT) academic and practical training.

3.0 PRECAUTIONS/LIMITATIONS

Respiratory protection should be worn if inhalaton of radioactive material is possible during decontamination activities.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Tape - masking tape, duct tape or similar adhesive tape
- Scraping tools, emery cloth, rasp, or wire brush
- Absorbent applicators - cotton balls, sponge tips, gauze pads
- Soap and water

5.0 PROCEDURE

5.1 Survey the individual upon detection of contaminated personal effects (items).

5.2 If the individual is found to be contaminated, go to procedure ER-03, Personnel Decontamination, WHC-IP-0718.

5.2 Determine location of contamination on personal item(s).

NOTE: Decontamination of personal items may be attemped by the individual with assistance from the HPT and approval of HP Supervision.

NOTE: Items such as jewelry, watches, or prosthetic devices should be decontaminated only with the owner's consent to EACH step of the action.

5.3 Use a tape press to remove contamination.

5.4 If contamination remains after several attempts and the item is NOT porous material, continue with step 5.6.

5.5 If the item is porous, such as leather, continue with step 5.9.

CAUTION

The use of liquids on porous materials such as leather-soled shoes can cause the contamination to soak deeper into the material.

CAUTION

Exercise care to avoid cross-contaminating unaffected areas of the item.

5.6 Using an absorbent applicator, wash ONLY the contaminated area with soap and water solution.

NOTE: Do not use soap and water on "Dry Clean Only" items without owner's consent.

5.7 Thoroughly pat dry.

5.8 If contamination remains on clothing items, proceed to step 5.12.

5.9 If contamination remains on non-cloth articles, scrape contaminated area with one of the tools to remove the imbedded contamination.

5.10 Perform a final survey of all decontaminated personal items.

5.11 Return item(s) to the individual if the unconditional release criteria, as listed in WHC-CM-1-6, WHC Radiological Control Manual, Table 2-3, are met.

5.12 If the item cannot be decontaminated for unconditional release, properly package and identify the item, and turn over to the individual's management for disposal.

5.13 Record results on a Personnel Contamination Data - Clothing form.

9413139.1349

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Article 221, Table 2-3, Figure 4-1

WHC-CM-4-12, Health Physics Practices Manual, Part B, Section 6.5

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Personnel Contamination Data - Clothing form, No. A-6000-962

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1.0 PURPOSE AND SCOPE

This procedure provides the Health Physics Technician (HPT) with guidance and requirements for performing and documenting surface contamination release surveys of material and equipment.

2.0 PREREQUISITES

- HPT academic and fundamentals training
- Instrument background and minimum detectable activity (MDA), or minimum detectable count rate (MDCR), has been determined

3.0 PRECAUTIONS/LIMITATIONS

3.1 This procedure does **NOT** apply to materials that have been contaminated in depth or volume.

3.2 Materials used or stored in Contamination, High Contamination, or Airborne Radioactivity Areas shall be surveyed by an HPT prior to release to a Radiologically Controlled Area (RCA).

3.3 Materials used or stored in Radioactive Material Area (RMA), Radiological Buffer Area (RBA), or RCA shall be evaluated and surveyed by an HPT prior to release to Uncontrolled Areas. This evaluation will determine: 1) if the material has been contaminated under any coatings and 2) the isotopes of concern.

3.4 Background limits for direct surveys with portable/semi-portable count rate meter (CRM) instruments:

- Less than 150 cpm beta-gamma with a CRM and G-M pancake probe
- Less than 3 cpm alpha (audible pop per minute) with a PAM, or a PAC-6, or a Poppy

NOTE: Total contamination is equal to fixed plus removable contamination.

3.5 Surface Contamination Release Limits for transuranic isotopes and mixed fission products are provided below. Refer to WHC-CM-1-6, Table 2-3 for specific isotopes and their limits.

- Less than 20 dpm/100 cm^2 alpha removable contamination
- Less than 500 dpm/100 cm^2 alpha total contamination
- Less than 1000 dpm/100 cm^2 beta-gamma removable contamination
- Less than 5000 dpm/100 cm^2 beta-gamma total contamination

NOTE: Where an approved characterization study identifies that an "α *only*" or a "β *only*" contamination survey is sufficient, the other type of survey may be omitted.

3.6 Objects with inaccessible surfaces may be released if:

- There is no reasonable mechanism for contamination to be transported to the inaccessible surfaces of the object (example: the object has no internal fans or flow-through openings
- The object is determined to be free of contamination on its accessible surfaces by a 95% statistical survey before any decontamination efforts are undertaken

4.0 REQUIRED EQUIPMENT/MATERIALS

- Wipe material
- Contamination survey instruments
- Counting (scaler) instruments or bench top counters (optional)

5.0 PROCEDURE

5.1 Determine If the Material is a Candidate for Release.

5.1.1 Review the material criteria presented in the following table to determine the level of survey required.

MATERIAL CRITERIA	LEVEL OF SURVEY REQUIRED
1. Has never come into contact with unsealed radioactive sources **AND** has never been used or stored in any of the following: • Contamination Area • High Contamination Area • Airborne Radioactivity Area	May be released without a contamination survey (exempt facilities), unless specified by the HP Supervisor. The Material History Release form shall be used to document this release.
2. • Has been aggressively decontaminated (review 3.6 above) -OR- • Is likely contamination free (but cannot be released based on history alone)	Large Area Wipe on accessible surfaces. For surface areas: • greater than 300 ft^2, split into areas > 300 ft^2 and go to the next bullet • 5 to 300 ft^2, perform at least 60 static direct survey measurements • less than 5 ft^2, perform static measurements on locations likely to be contaminated and a **slow** scan (1 in./sec) of the rest
3. Has been decontaminated by non-aggressive techniques (review 3.6 above)	May be released based on a 100% contamination survey, large area wipe and **slow** scan

5.2 Perform a Large Area Wipe Survey and Determine the Wipe Activity.

NOTE: In lieu of counting instruments, portable instruments may be used.

5.3 Perform a Direct Survey.

5.3.1 Perform release surveys using 5 to 6 second static (contact) measurements and, if required, perform a **slow** scan--1 inch/second at 0.25 inches or less from the surface.

5.4 Determine the Material Status.

NOTE: Using the survey methods in this procedure, when activity is above portable/semi-portable instrument background or activity is above detectable counting limits the "survey results are positive." Conversely, when there is no detectable activity on both the portable/semi-portable and counting instruments the "survey results are negative."

5.4.1 If the survey results are positive:

- Tag or label the material as Radioactive Material
- Package the material, as appropriate
- Ensure the material is under radiological controls
- If a MATERIAL HISTORY RELEASE form is used, line through and initial contaminated items

5.4.2 If the survey results are negative:

1. Record the portable/semi-portable instrument survey results as less than the surface contamination limits in 3.5 above

2. Record the counting instrument survey results as less than the detection limits

3. Complete one of the following:

A. If the material is released to a RCA, attach a Radiation Release label to the material.

-OR-

B. If the material is released to an Uncontrolled Area:

- Verify the MATERIAL HISTORY RELEASE form has been completed
- If applicable, evaluate the material per 3.3 above and go to step 5.3.1 through this step to re-survey the material
- If the material is **NOT** going offsite, attach a Radiation Release label to the material
- If the material is released for unrestricted use (to the public), remove all Radiation Release labels (deface those that could not be removed) as applicable

NOTE: Material not immediately removed after being surveyed shall be controlled to prevent radioactive contamination while awaiting its release.

5.5 Document Material Information on a Radiation Survey Report.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Articles 421-423

WHC-CM-4-12, Health Physics Practices, Sections 6.3 and 11.1

PNL-MA-562, Radiation Protection Instrument Manual, EGM-PAM & PAC-6

[HP] Internal Memo, EXEMPTIONS FROM RADIATION PROTECTION RELEASE

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Radiation Survey Report (form number BD-6000-010)

Radiation Survey Report log

Smear Sample Counter log (form number A-6000-273 or JetForm), when used

Material History Release form (form number under development), when used

NOTE: Material custodians may use the Material Release History Record form (A-6000-343 or macro WEF178), until the Material History Release form becomes available.

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TITLE:

SURVEY METHOD FOR REPOSTING OF OUTDOOR SCAs

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

1.1 **Purpose:** This procedure provides a survey method for reposting outdoor posted "Surface Contamination" areas to either a posted Radiological Controlled Area (Underground Radioactive Material) or to an unposted status. This may require a require a Soil Sampling Plan, based on characterization results and history.

1.2 **Discussion:** To meet representative statistical requirements any area of one half acre (21,780 square feet), up to one acre (43,560 square feet) will require a minimum of forty five (45) survey/sample locations. These locations should be one square meter, (approximately 3 ft by 3 ft) in size. Areas smaller than one half acre should be surveyed, using normal methods, i.e., using a GM with probe attached to a walking stick, and a complete survey of the entire area.

Large Areas (>1 Acre) should follow the direction provided by the Sampling Plan, as applicable. Large outdoor areas should use technically enhanced mobile or portable monitoring equipment (MSCM, MSCM-II, Rad Rover I, USRADS) for preliminary surveying purposes, as appropriately.

Sample locations are to be approximate eighty (80') by eighty (80') feet, not to exceed 100 by 100 feet.

Surface Contamination Areas that are larger than an acre should have a statistical analysis performed to determine a sufficient number of sample locations.

2.0 PREREQUISITES

None

3.0 PRECAUTIONS/LIMITATIONS

- In areas where alpha contamination is expected or absence cannot be determined from history or isotopic characterization, surveys should include a beta-gamma and alpha survey.

- When surveying an outside surface which includes rough terrain and vegetation, care should be used to avoid damage to the detector.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Grid Map
- Walking Stick for GM Probe/α probe
- Surface Contamination Flags
- Yellow plastic bags (waste disposal)
- Sample containers and equipment for soil samples

As appropriate;

- Tractor-mounted, Calibrated Mobile Surface Contamination Monitor (MSCM).
- Calibrated instruments used with the Ultra Sonic Range and Data Collection System (USRADS).

5.0 PROCEDURE

5.1 Survey Method

5.1.1 Using the grid map, sketch the area to be surveyed/sampled. Add any distinguishing items, i.e.,pipes, diversion box, etc.

5.1.2 Identify sample points on the grid map.

5.1.3 Survey 100 percent of the survey/sample location.

5.1.4 Indicate on the grid map the net readings for that location.

5.1.5 Mark any spots reading greater than background with surface contamination flags and resurvey the location.

5.1.6 If elevated background levels occur, remove a scoop of soil and move to an area of lower background for survey.

5.1.7 If background is generally high throughout the area, remove and survey a sample from each grid site in a lower background area.

5.1.8 Continue surveying until all sample/survey locations have been completed.

5.1.9 Obtain soil samples, as required, in the center of each sample/survey location, at 1/2 to 2 inches in depth and place in a 250 ml, wide mouth plastic jar, or equivalent.

5.1.10 Deliver Samples to laboratory for analysis.

5.1.11 Complete a "Radiation Survey Report" form and attach a copy of the completed grid sheet.

5.1.12 Post accordingly once the area is identified as being free of surface contamination, (i.e., "Underground Radioactive Material", "Radiological Controlled Area", Unposted etc.,).

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Chapter 2

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

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TITLE:

HEPA VACUUM CLEANERS - INSPECTION AND SURVEY

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure provides instruction for the periodic inspection and radiological survey of High Efficiency Particulate Air (HEPA) filtered vacuum cleaners.

2.0 PREREQUISITES

- HPT has completed training applicable to this task
- Facility orientation

3.0 PRECAUTIONS/LIMITATIONS

Opening or disassembling a HEPA vacuum cleaner shall be done under a RWP.

Exercise caution when handling reinforced vacuum hoses to prevent injury from protruding wires.

Hose ends shall be taped closed when in storage.

Surface Contamination Limits for Pu-239 and mixed fission products (refer to WHC-CM-1-6, Table 2-3 for other specific isotopes and their limits):

- Less than 20 dpm/100 cm^2 removable alpha contamination
- Less than 1000 dpm/100 cm^2 removable beta-gamma contamination

4.0 REQUIRED EQUIPMENT/MATERIALS

- Calibrated survey instruments

5.0 PROCEDURE

5.1 Verify that the "DOP Test" sticker indicates a current leak test has been performed.

NOTE: A leak test must have been performed within one year of this inspection date (the test may be done more frequently).

5.2 Verify that the tamper seal(s) across the head/body joint are intact and the gasket material, if visible, is in good condition.

5.3 If any seal is broken or there is evidence of tampering, or the DOP Test sticker indicates the vacuum is overdue for service, notify facility operations that the vacuum cleaner should not be used until it is serviced by Ventilation Balance.

5.4 If hoses and extensions are not clamped or locked in place, notify facility operation for required maintenance.

NOTE: Tape may be used to prevent leakage from joints during use.

5.5 Perform exterior contamination and dose rate survey of the vacuum cleaner.

1. If external contamination does not exceed the limits for surface contamination, attach an Internally Contaminated sticker and Radioactive Material tag to the vacuum cleaner.

2. If external contamination exceeds the surface contamination limits, post the area for contamination, or wrap or bag the vacuum cleaner to contain the contamination and remove the unit for decontamination.

3. If contact dose rate readings of $\geq$ 2 mrem/hr are found, post the area as a Radiation Area.

4. If external radiation exceeds a dose rate of 25 mrem/hr or a lower limit specified by the task description, recommend to facility operations that the vacuum cleaner be cleaned or serviced.

5. Update dose rate information on the existing Radioactive Material tag, or attach a new tag if needed with dose rate and contamination information.

5.6 Document contamination and dose rate survey results, and any notification made for vacuum cleaner service or maintenance, on the Radiation Survey Report form.

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6.0 BIBLIOGRAPHY

INPO 88-020, Use Of Vacuum Cleaners In Radiologically Controlled Areas

ANSI/UL 586-1990, High Efficiency Particulate Air Filter Units

WHC-CM-1-6, WHC Radiological Control Manual, Article 464, Vacuum Cleaners and Air Handling Equipment.

7.0 ATTACHMENT

None

8.0 DOCUMENTATION

Radiation Survey Report (BD-6000-010)

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1.0 PURPOSE AND SCOPE

To provide direction for performing and documenting dose rate surveys of Radiation Generating Devices (RGD)s. Surveys of RGDs are required prior to initial operation, after relocation, modification or repair, and semi-annually during use.

2.0 PREREQUISITES

- HPT has completed training applicable to this task.
- RWP and operations procedures are available.
- Manufacturer's service manuals are available. Set-up survey requirements and permissible radiation leakage levels and acceptance criteria are known.
- All applicable interlocks and warning lights have been identified and verified to be operating by RGD safety officer, operator, or maintenance technician.

3.0 PRECAUTIONS/LIMITATIONS

- Dose rate surveys are performed at the maximum power for normal RGD operation.
- Magnetic fields around the window of an eletron beam welder may influence dose rate readings on the survey instrument.

4.0 REQUIRED EQUIPMENT/MATERIALS

Calibrated Survey Instruments

5.0 PROCEDURE

5.1 Perform dose rate survey on shielded enclosures for fixed radiographic units.

Dose rate limits:

- 10 mR/hr at one foot from outside surface of the enclosure in any accessible and occupied space
- 100 mR/hr at one foot from outside surface of the enclosure in accessible but unoccupied space

5.1.1 Survey around cell door and perimeter of the shielded enclosure.

5.1.2 Post a **CAUTION - RADIATION AREA** sign at the 2 mR/hr boundary.

5.1.3 Go to 5.5 to document the radiation survey data.

5.2 Perform dose rate survey on portable or mobile radiographic installations.

Dose rate limits:

- 2 mR/hr at the perimeter of all occupiable work space
- 100 mR/hr at the perimeter of accessible but unoccupied space

5.2.1 Post access areas with the appropriate radiation warning signs for radiation limit:

LIMIT		SIGN
$\geq$ 100 mR/hr	< 5000 mR/hr	**CAUTION - HIGH RADIATION**
$\geq$ 2 mR/hr	< 100 mR/hr	**CAUTION - RADIATION AREA**

5.2.3 Go to 5.5 to document the radiation survey data.

5.3 Perform dose rate survey on diffraction units, baggage checker units and cabinet x-ray units.

Dose rate limit:

- 0.5 mR/hr at the surface of the RGD unit.

5.3.1 Survey accessible surfaces (window open) for RGD shielding integrity.

5.3.2 Survey parcel inspection area after emergency stop.

5.3.3 Go to 5.5 to document the radiation survey data.

5.4 Perform dose rate survey on ELECTRON BEAM DEVICES including: electron beam welder, electron microscope, and electron microprobe.

Dose rate limit:

- 1 mR/hr at one foot from any accessible surface.

5.4.1 Survey the electron beam device for shielding integrity at the following accessible surfaces:

- Windows
- Penetrations
- Column
- Modification/chamber extension (if in place)

5.4.2 Go to 5.5 to document radiation survey data.

5.5 Document Radiation Survey Data.

5.5.1 Complete the Scheduled Radiation Survey Report form for all semi-annual surveys; for all other surveys complete a Radiation Survey Report form.

5.5.2 Report to the supervisor and the RGD safety officer if radiation dose rates from the RGD installation are not within acceptable limits.

6.0 BIBLIOGRAPHY

WHC-CM-1-3, Management Requirements & Procedures, Section 5.11

WHC-CM-1-6, WHC Radiological Control Manual,
- Article 365, Radiation Generating Devices,
- Appendix G; Supplemental Requirements For Radiation-Generating Device Installations, and
- Appendix H; Supplementary Requirements for Open Radiography.

ANSI-543, General Safety Standard for Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV.

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

Scheduled Radiation Survey Report form

Radiation Survey Report form (BD-6000-010)

TITLE:

RADIOACTIVE MATERIAL SHIPMENT AND RECEIPT SURVEYS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

1.1 **Purpose:** To direct performance of radiological surveys for shipments of radioactive material and conveyances in support of shipping and receipt activities at the Hanford Site.

1.2 **Scope:** This procedure is applicable for surveys of all shipments of radioactive material, both for receipt and transfer, onsite and offsite.

1.3 **Discussion:** Shipments will be controlled by a qualified shipper in accordance with shipping limits contained in 49 CFR 173 and as required by the Department of Transportation (DOT). Shipments and conveyances identified as DOE will fall under the limits specified in Table 2-3 of the "WHC-CM-1-6, WHC Radiological Control Manual."

2.0 PREREQUISITES

- HPT has completed applicable training and OJT for this task.

3.0 PRECAUTIONS/LIMITATIONS

- All shipments will be approved and controlled by a qualified shipper.
- A Radioactive Shipment Record (RSR) must accompany all shipments of radioactive material.
- Surveys of radioactive material transport vehicles and packages are directed by a qualified and designated shipper, who bears responsibility for the shipment.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Beta/gamma survey instrument
- Alpha survey instrument
- Neutron dose rate instrument, as required
- Beta/gamma dose rate instrument

5.0 PROCEDURE

5.1 Offsite Shipping

5.1.1 Perform a dose rate survey of the shipment and the loaded vehicle as requested by the shipper. Dose rate readings should be obtained:

A. In the vehicle cab, this should not exceed 2 mrem/hr.

B. At surface of the package to locate the highest reading.

C. At one meter from the package with the highest reading,to support the Transport Index as requested by the shipper.

(1) If the isotope of concern is a neutron emitter, take a neutron reading at contact and add this to the gamma reading to be reported as the Transport Index (TI).

D. At the edge of the transport vehicle.

E. At one meter from the transport vehicle.

F. If applicable or requested by the shipper, at two meters from the transport vehicle.

5.1.2 Survey each package for removable contamination.

5.1.3 Complete the "Area Monitor" section of the Offsite RSR.

5.1.4 Document all survey results on a Radiation Survey Report.

5.2 Onsite Shipping

NOTE: Routine RSRs specify dose rate and removable contamination limits. Onsite RSRs require the documentation of dose rates and removable contamination levels in the space provided on the RSR.

5.2.1 Take dose rate readings:

A. At contact and at one meter for each package.

B. At the edge of the loaded vehicle on a vertical plane.

C. At one meter from the edge of the loaded vehicle on a vertical plane.

D. In the cab, not to exceed 2 mrem/hr.

5.2.2 Survey each package for removable contamination.

5.2.3 Complete the "Radiation Monitoring" section of the Onsite RSR.

5.2.4 Document all survey results on a Radiation Survey Report.

5.3 Receiving

5.3.1 Obtain a dose rate reading on each package.

A. Survey the package(s) at surface to locate the highest reading.

B. Survey the package(s) with the highest reading at one meter to verify the Transport Index (TI) as requested by the shipper.

(1) If the isotope of concern is a neutron emitter, take a neutron reading at contact and add this to the gamma reading to be reported as the Transport Index.

5.3.2 Perform a contamination survey of each package.

5.3.3. Perform transport vehicle dose rate survey as requested by the shipper.

A. In the cab, not to exceed 2 mrem/hr.

B. At the edge of the transport vehicle.

C. At one meter from the transport vehicle.

D. If requested by the shipper, at two meters from the transport vehicle.

5.4 Make notifications as necessary.

NOTE: Shipments delayed for an extended period while in transit must be controlled to meet the requirements of the WHC Radiological Control Manual. The 2 mrem/hr boundary must be established if applicable.

5.4.1 Establish the 2 mrem/hr boundary.

5.4.2 Notify the transport driver of the 2 mrem/hr perimeter location.

5.4.3 Notify the shipper of any exceeded limits.

5.4.4 Notify HP supervisor of any exceeded limits and document results.

6.0 BIBLIOGRAPHY

Code of Federal Regulations, Chapter 49, Part 173, applicable parts.

WHC-CM-2-14, Hazardous Material Packaging and Shipping, Section IV.

WHC-CM-1-6, WHC Radiological Control Manual, Article 424.

7.0 ATTACHMENTS

7.1 Table 3-1, Guidelines

8.0 DOCUMENTATION

8.1 Onsite Radioactive Shipping Record

8.2 Offsite Radioactive Shipping Record

8.3 Radiation Survey Report

Table 3-1

This table is provided to help the HPT identify the type of conveyance and which limits to apply. The table is based on interpretation by Health Physics Policy and Procedures and clarification from WHC Transportation and Packaging of DOT requirements for radioactive shipments at the Hanford site.

Hanford contractor vehicles fall under the 49 CFR 173 limits as provided in WHC-CM-1-6, Article 424, Item 3.

LOCATION		TYPE OF CONVEYANCE	LIMITS
TO	FROM		
ON-SITE	OFF-SITE	DOE[1]	TABLE 2-3
ON-SITE	ON-SITE	DOE[1]	TABLE 2-3
ALL	ALL	COMMERCIAL[2]	49 CFR
ON-SITE	ON-SITE	HANFORD OPERATIONS[2]	49 CFR
OFF-SITE	ON-SITE	HANFORD OPERATIONS[2]	49 CFR
ON-SITE	OFF-SITE	HANFORD OPERATIONS[2]	49 CFR

NOTE:

1. Conveyance owned and licensed by the DOE, and driven by a DOE employee.

2. Non-DOE conveyances. This includes commercial vehicles and Hanford Operations vehicles maintained by Hanford contractors.

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TITLE:

ONSITE RAILCAR SHIPMENT SURVEYS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure provides survey instructions and requirements for shipping and receiving onsite railcar shipments of radioactive material.

2.0 PREREQUISITES

- Health Physics Technician Practical Training
- All onsite railcar shipments will be accompanied by an Onsite Radioactive Shipment Record (ORSR).
- All shipments will be approved and controlled by a qualified shipper in accordance with shipping limits contained in 49 CFR 173 and as required by the Department of Transportation.

3.0 PRECAUTIONS/LIMITATIONS

Shipments identified as DOE will comply with dose rate limits outlined in 49 CFR 173 and contamination limits specified in Table 2-3 of WHC-CM-1-6 or dose rate and contamination limits specified by the applicable Safety Analysis Report for Packaging.

Shipments identified as DOT comply with dose rate and contamination limits outlined in 49 CFR 173.

The dose rate shall not exceed 2 mrem/hr in any normally occupied position of the engine cab.

High dose rates may be present.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Calibrated Radiation Survey Instruments
- Calibrated Dose Rate Instrument(s) (CP, XCP, R07, Snoopy or equivalant)
- Smear Media for performing gross smears

5.0 PROCEDURE

5.1 Obtain a checklist applicable to the type of railcar being surveyed. See Attachments 7.1 - 7.3.

5.2 Have shipper identify shipment as SARP, DOE, or DOT for applicable dose rate and contamination limits.

NOTE: Steps 5.3 and 5.4 may be performed simultaneously.

WARNING

HIGH DOSE RATES MAY BE PRESENT

5.3 Establish beta/gamma (open-window) and neutron (as required) dose rates at the points listed on the appropriate checklist.

NOTE: One and two meter dose rate readings are taken from the vertical planes projected by the outer edges of the vehicle (excluding the top and underside of the vehicle).

5.3.1 If dose rate interference is encountered, have railcar moved to another location for the survey.

5.3.2 Add beta/gamma and neutron dose rate readings. The sum is the reportable dose rate level.

5.3.3 If dose rates exceed 1 R/hr at one meter, **STOP WORK** and contact HP supervision for additional guidance.

5.4 Determine alpha and beta/gamma removable contamination levels by obtaining 300 cm^2 smears.

NOTE: Contamination levels are determined by the Safety Analysis Report for Packaging (SARP). Shipments identified as DOE will comply with the limits specified in Table 2-3 of WHC-CM-1-6.

5.5 Notify HP supervision if any limits are exceeded.

5.6 Complete the railcar checklist and the Radiation Monitoring section of the ORSR.

NOTE: The recordable ORSR dose rate reading for "at sides" includes top and bottom readings.

5.6.1 For shipments which have multiple radioactive packages, record the maximum contact dose rate and the maximum removable contamination measurement on the ORSR.

5.6.2 If all radiation and contamination levels are within SARP limits, check "NO" for "RM Escort Required" and "RM supervisor review required" on the ORSR.

5.6.3 If any radiation or contamination levels exceed limits, check "YES" for "RM supervisor review required" on the ORSR and refer the shipper to HP supervision.

NOTE: HP Supervision and the shipper will determine the need for HPT Escort.

5.7 Post a 2 mrem/hr boundary around the transport vehicle during unscheduled stops/delays and notify any approaching personnel of the 2 mrem/hr boundary.

5.8 Document results on a Radiation Survey Report.

6.0 BIBLIOGRAPHY

Code of Federal Regulations, Chapter 49, Part 173, applicable parts.

WHC-CM-1-6, WHC Radiological Control Manual, Article 424, Table 2-3.

WHC-CM-2-14, Hazardous Material Packaging and Shipping, Section IV, paragraphs 1.3.3, 1.4.1, 3.3.3.

Safety Analysis Report for Packaging (SARP): SD-RE-SAP-010, Supplement to SARP Irradiated Fuel Cask Cars (HCS-028-001)

SARP: SD-RE-SAP-013, Railroad, Tank Car, HRCQ, Fissile, Exempt, (HCS-044-001-03)

SARP: SD-RE-SAP-014, Irradiated Fuel, Cask, Cask Cars (HCS-028-001-00)

SARP: SD-RE-SAP-027, Multipurpose Transfer Box, Interarea, Intra-area (HCS-039-001)

7.0 ATTACHMENTS

7.1 Railroad Liquid Waste Tanker Checklist
7.2 Railroad Well Car Checklist
7.3 Railroad Flat Car Checklist

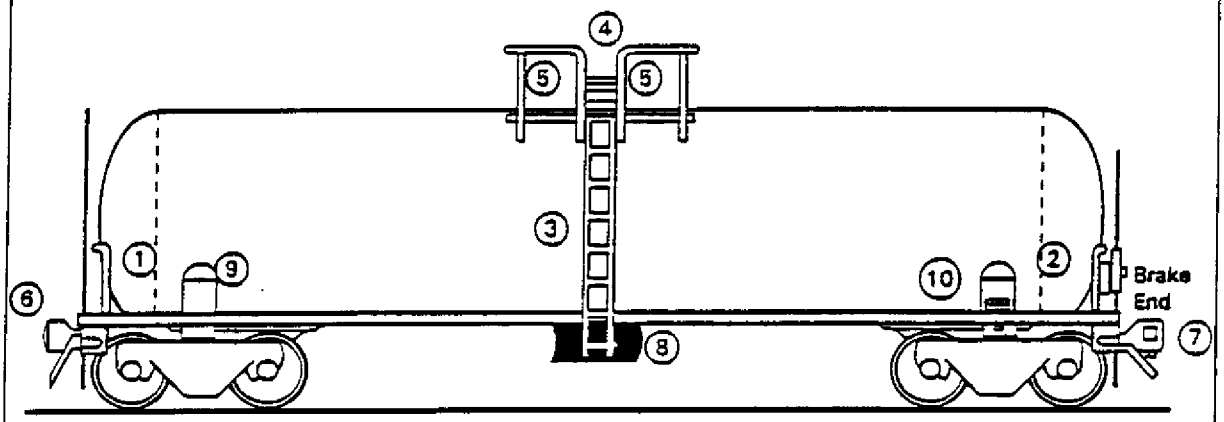
8.0 DOCUMENTATION

- Applicable railcar checklist
- Onsite Radioactive Shipment Record
- Radiation Survey Report

ATTACHMENT 7.1

RAILROAD LIQUID WASTE TANKER CHECKLIST

(Check One) ☐ Receipt Survey ☐ Shipment Survey	Tanker No.	Date



Dose Rate in mrem/hr Beta/Gamma and Neutron		
Loc. No.	1 m	C
1	NA	
2	NA	
3*		
4	NA	
5		
6		NA
7		NA
8*	NA	
9*		
10*		

Smear Survey in dpm/300 cm^2		
	Alpha	Beta
Cupola - Outside		
Inside (if applicable)		
Platform (Deck)		
Under Platform		
Handrails		
Ladder		
Tanker Sides		
Tanker Ends		
Belly/Drain		
Walk Platform		
Cupplings/Knuckle Assembly and Lever		
Hand Brake		
Wheel Truck Assemblies		
Wheels		

m = Meter from Vertical Plane
C = Contact
* High Dose Rate Location

REFERENCE RADIATION SURVEY REPORT NO. _____ (Attach checklist to survey report)

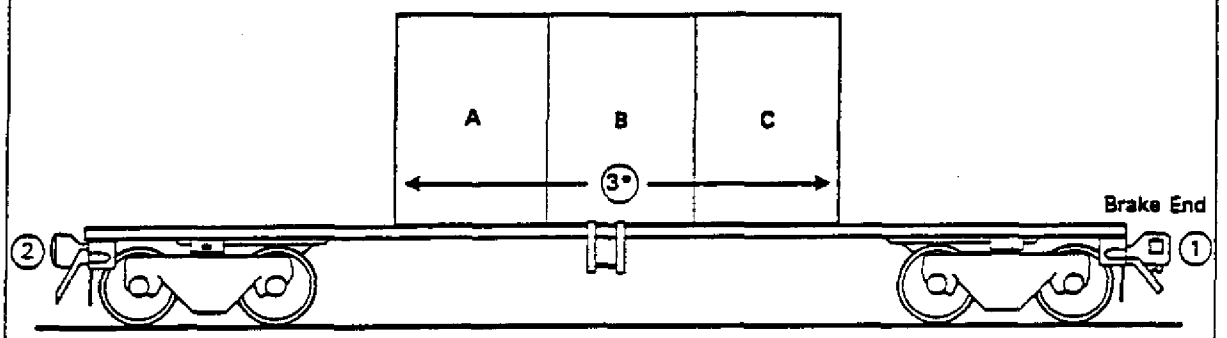
HPT SIGNATURE _____

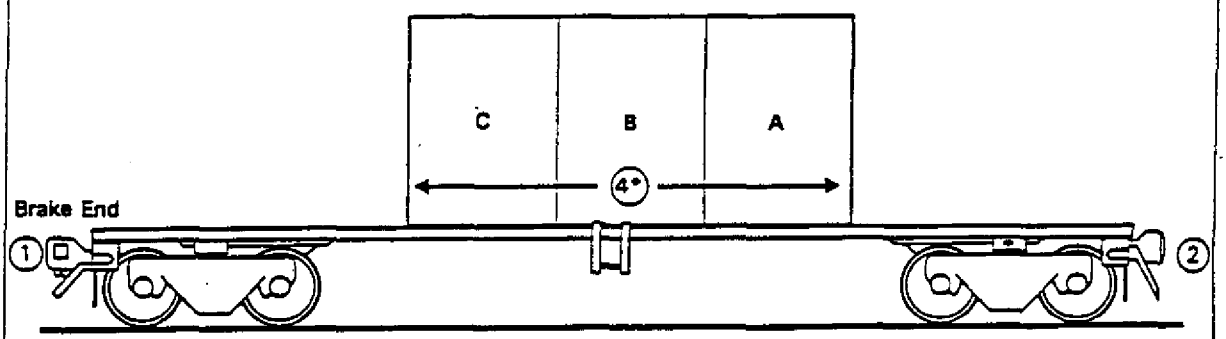
A-6000-254 (07/93)

ATTACHMENT 7.2

RAILROAD WELL CAR CHECKLIST

(Check One) ☐ Receipt Survey ☐ Shipment Survey	Well Car No.	Date





(Reverse Angle)

Dose Rate in mrem/hr Beta/Gamma and Neutron			
Loc. No.	2 m	1 m	C
1			
2			
3*			
4*			

Smear Survey in dpm/300 cm^2		
	Alpha	Beta
Hand Brake		
Cupplings/Knuckle Assembly and Lever		
Ladder		
Wheels		
Wheel Truck Assemblies		
Sides (as required)		

m = Meter from Vertical Plane
C = Contact
* Survey Entire Side and Report Highest Dose Rate.

REFERENCE RADIATION SURVEY REPORT NO. _____ (Attach checklist to survey report)

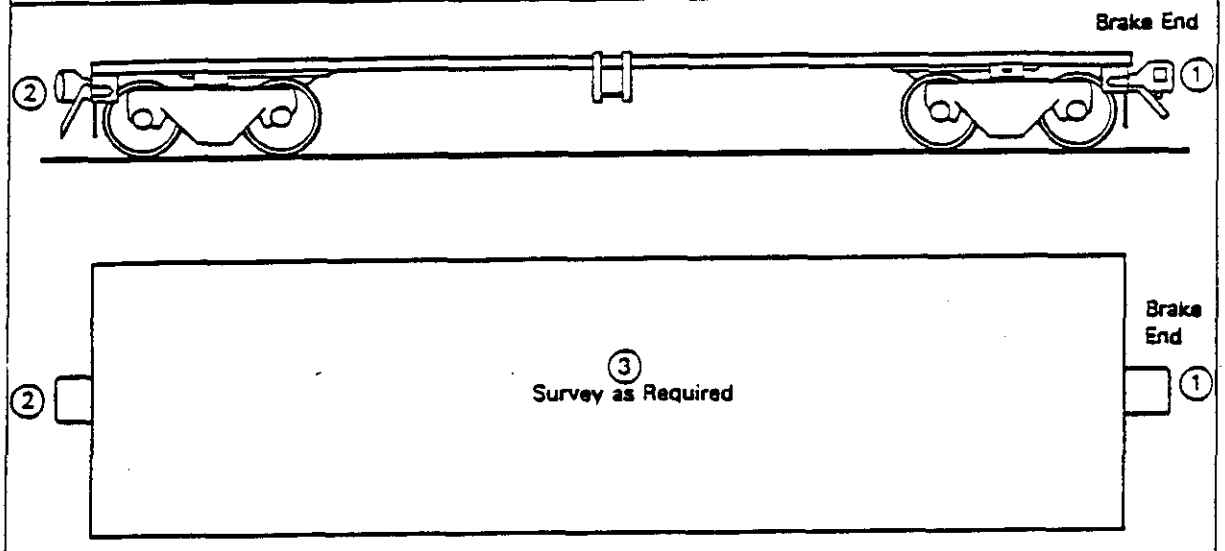
HPT SIGNATURE _____

A-6000-255 (07/93)

ATTACHMENT 7.3

RAILROAD FLAT CAR CHECKLIST

(Check One) ☐ Receipt Survey ☐ Shipment Survey	Flat Car No.	Date



Dose Rate in mrem/hr Beta/Gamma and Neutron			Smear Survey in dpm/300 cm^2		
Loc. No.	1 m	C		Alpha	Beta
1			Hand Brake		
2			Cupplings/Knuckle Assembly and Lever		
3 (as required)			Wheel Truck Assemblies		
			Wheels		
			Ladder		
			Top (as required)		

m = Meter from Vertical Plane
C = Contact

REFERENCE RADIATION SURVEY REPORT NO. _____ (Attach checklist to survey report)

HPT SIGNATURE _____

A-6000-253 (07/93)

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TITLE:

AIR SAMPLING

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure provides instruction for grab sampling of airborne contaminants, which includes natural activity (Radon) in the work place/breathing zone.

2.0 PREREQUISITES

None

3.0 PRECAUTIONS/LIMITATIONS

Air samples should be counted on portable survey instruments prior to counting on fixed counting instruments such as, Canberra or Tennelec, mini-scalers, etc. Samples greater than 6,000 dpm alpha or 15,000 dpm beta-gamma may result in contaminating the counting detector.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Air Sample media, Gelman Versapor AN-3000, or H&V LB5211
- Air Sampler (calibrated), portable.
- Air Sample envelope or small plastic bag
- Counting system (bench monitors)

5.0 PROCEDURE

5.1 Grab Air sampling

5.1.1 Prepare to take "grab" sample. Place the sampler head so that it faces "upstream", as appropriate.

NOTE: For breathing air zone sampling, the portable grab air sampler should draw air that the worker could potentially inhale. This is normally the volume of air one (1) cubic foot in front of the workers face.

5.1.2 Install the air sample collection media and reset the elapsed time meter if applicable.

5.1.3 Start the "grab" sampler. Turn the pump "ON" and verify that it is running.

NOTE: Air samples should be taken at approximately 2 cfm and draw a total of approximately 100 cubic feet. Different total volumes of drawn air may be required, depending on facility and activity needs.

5.1.4 Adjust the sampler flow rate as needed.

5.1.5 Record date, time, sample location and flow rate information on the air sample envelope.

5.1.6 Remove the air sample and replace it with a new sample filter.

5.1.7 Count the air filter.

5.1.8 Record the airborne activity concentration on both the Air Sample Log book and Radiation Survey Report form.

5.2 Concentration Determination

5.2.1 Use the following equation for determining sample activity in micro-curies per cubic centimeter:

$$\text{ACTIVITY } (\mu Ci/cc) = \frac{N \cdot k}{V \cdot E}$$

Where:

N = Net count rate in cpm (i.e., gross cpm - background cpm)

k = 2.0 E-11 [(μCi · ft^3) / (dpm ·cc)]

V = Sample volume in cubic feet

E = Probe/Instrument efficiency in decimal

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NOTE: k is derived from the conversion factors for dpm to μCi, cc to cubic feet, and the following factors: absorption, line loss, and sample head efficiency.

10% of DAC (VALUES IN μCi/cc)

Co-60	1E-09
Cs-137	7E-09
Sr-90	2E-10
Pu-239	2E-13
U-238	2E-12

5.2.2 Notify the HP supervisor, if the calculated DAC value is greater than the values listed above.

NOTE: Respirator selection guide based on airborne activity levels can be found in Attachment 7.1.

NOTE: Derived Air Concentrations (DAC values) are specified in DOE Order 5480.11, Attachment 1.

5.2.3 Allow for a decay period (approximately 30 minutes), recount the sample and determine the activity.

5.2.4 If the sample is still greater than 10% of the DAC limits after 24 hrs, submit sample to the labs for radioanalyses.

5.2.5 Notify the facility HP supervisor of the 24 hr results.

5.3 Radon Sampling

5.3.1 Draw an air sample for 5 minutes.

5.3.2 Record the total volume drawn and concentration activity on both the Air Sample Log book and Radiation Survey Report form.

NOTE: **RULE OF THUMB.** If ratios of gross beta to alpha counts indicate a 3:1 or 5:1, then a fairly accurate assumption is that the activity present is progeny from Thoron or Radon buildup, respectively.

5.3.3 Begin a decay/count period of 30 $\pm$ 10 minutes. Determine and record activity levels after each period.

5.3.5 As directed, perform a Working Level determination using the following formula:

$$\frac{\text{alpha cpm}}{\text{Smpl. Vol.(cu.ft.) x counter alpha eff. x k factor}} = \text{WL}$$

k FACTORS

Decay Interval (min)	k factor
40	4135
45	3852
50	3568
55	3285
60	3030

5.3.6 Record the activity results on both the Air Sample Log book and Radiation Survey Report form.

6.0 BIBLIOGRAPHY

DOE Order 5480.11, Radiation Protection for Occupational Workers

WHC-CM-1-6, WHC Radiological Control Manual

7.0 ATTACHMENTS

7.1 Respirator selection guide

8.0 DOCUMENTATION

Air Sample Log Book
Radiation Survey Report Form

ATTACHMENT 7.1

Respirator Selection Guide

Respirator Type	Range of Concentration for Use (uci/cc)	
	Pu-239	Sr-90
Full-face mask	2E-13 to 1E-11	2E-10 to 1E-8
PAPR	1E-11 to 1E-10	1E-8 to 1E-7
Supplied Air	1E-11 to 4E-10	1E-8 to 4E-7
Supplied Air w/Egress Bottle	1E-11 to 2E-9	1E-8 to 2E-6
SCBA	1E-11 to 2E-9	1E-8 to 2E-6

- The values for Sr-90 are used for aerosols containing particles of mixed fission products.
- Protection factors are listed in WHC-CM-4-3, Vol. 3, Section 7.
- Airborne Radioactivity Areas, with concentration levels exceeding the protection factor for SCBA, will require management evaluation and approval prior to entry.

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TITLE:

GASEOUS EFFLUENT MONITORING SYSTEM INSPECTION AND SAMPLE EXCHANGE

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE/SCOPE

This procedure provides the steps needed to perform inspections of the Gaseous Effluent Monitoring Systems (Stack Packs) and the exchange sequence for Effluent Air Samples.

2.0 PREREQUISITES

None

3.0 PRECAUTIONS/LIMITATIONS

- Potentially dangerous fumes may exist in the stack pack cabinet

4.0 REQUIRED EQUIPMENT/MATERIALS

- 47 mm Versapor 3000 or equivalent air sample filters
- Air sample envelopes
- Portable Count Rate Survey Instruments

5.0 PROCEDURE

5.1 Monthly Inspection of the Gaseous Effluent Monitoring Systems.

5.1.1 Inspect the following Record Sample System:

- Vacuum System
- Gas Meter Totalizer
- Rotameter
- Rubber "O" rings
- Sample holders

5.1.2 Inspect the following CAM sample system:

- Rotameters
- CAM calibration due dates
- Rubber "O" rings
- Alarm Set Point
- CAM background meter readings
- Beta CAM operating in Background Subtraction mode
- Alpha CAM operating in PHA-SUB mode
- Instrument power
- Vacuum System

5.1.3 Sign, date, and mark the time on the chart as appropriate.

5.1.4 Complete the HPT Gaseous Effluent Sampling/Monitoring System Evaluation Checklist (A-6000-226.1).

5.1.5 Indicate any discrepancies of the checklist items on the HPT Gaseous Effluent Sampling/Monitoring System Evaluation Comment Sheet (A-6000-226.2) and notify the HP Supervisor.

5.2 Inspection of the Stack Pack Cabinet

5.2.1 Inspect the following:

- Housekeeping
- Ventilation
- Lighting
- Strobe warning lamp
- Door latch and hinges

5.2.2 If the stack pack system is inoperable, notify HP Supervisor.

5.2.3 Indicate any discrepancies of the Checklist items on the HPT Gaseous Effluent Sampling/Monitoring System Evaluation Comment Sheet (A-6000-226.2).

5.3 Exchange Record Air Sample And CAM Air Sample

NOTE: Record Air Samples should be drawn for 168 hours (7 days) to ensure a representative sample.

5.3.1 Prepare a 47 mm sample filter and sample envelope for each exchange. Write the EDP code and date along the outside edge.

5.3.2 Record the required sample OFF information on the record and CAM sample envelope.

5.3.3 Remove the filter(s) and insert it in the envelope(s).

5.3.4 Install a new sample filter in the holder and reassemble.

5.3.5 Reset the Record Sample Timer.

5.3.6 Record the required sample "ON" information on the white (Brown for CAM) sample envelope for the next sample exchange.

5.3.7 Count sample filter with a portable survey instrument and record levels on the back side of the sample envelope, as applicable.

5.3.8 Log the activity levels of the Record Samples in the facility Health Physics Effluent Record Sample log (BD-6000-325). Depending on facility instrumentation, this step may occur after lab results are sent back to the facility.

5.3.9 Prepare the sample envelope and sample for delivery to the 222-S Counting Lab.

5.3.10 Complete Chain of Custody Record Sheet.

5.4 Documentation

5.4.1 Record the time, date and reason for system deficiency on a Radiation Survey Report and in the HP Field Log Book for that facility.

5.4.2 Send a copy of the Radiation Survey Report to EMM.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Chapter 5, Section 5.5.5

WHC-CM-7-5, Environmental Compliance, Section 2, Air Quality

WHC-EP-0438-1, A Guide for Preparing Hanford Site Facility Effluent Monitoring Plans

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

HPT Gaseous Effluent Sampling/Monitoring System Evaluation Checklist (A-6000-226.1)

HPT Gaseous Effluent Sampling/Monitoring System Evaluation Comment Sheet (A-6000-226.2)

Health Physics Effluent Record Sample log (BD-6000-325)

Chain of Custody Record sheet

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HEALTH PHYSICS PROCEDURES	Effective Date	December 1, 1993
	Organization	ESQ/Health Physics

TITLE:

AUTOMATED BAR CODING OF AIR SAMPLES AT HANFORD (ABCASH)

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure describes how to use the Automated Bar Coding of Air Samples at Hanford (ABCASH) system. The ABCASH system provides automated data acquisition and tracking of air filter sample information.

2.0 PREREQUISITES

ABCASH software and hardware installed on a personal computer (PC) at the facility. (Contact ABCASH support personnel or 222-S Health Physics (HP) personnel for more information.)

Completed ABCASH Access Application Form, Attachment 7.3.

Location Data for each sample location at the facility checked for accuracy. Refer to WHC-SD-EN-UM-003, User Manual for ABCASH Database and User Interface (ADUI) (the user manual), section 5.3.1 to view and modify Location Data.

3.0 PRECAUTIONS/LIMITATIONS

3.1 **Precaution:** The ABCASH Bar Code Unit (ABCU) emits LASER light that can cause damage when aimed directly into the eyes.

3.2 **Limitation:** When the ABCU encounters an error condition, it will beep twice to call attention to the error. Usually, an error message will appear on the ABCU's screen. Refer to section 5.10 of this procedure for instructions on error handling. For errors encountered on the ABCASH workstation (computer) refer to the user manual, *section 3.0.*

4.0 REQUIRED EQUIPMENT/MATERIALS

- IBM compatible 386 SX (or higher) with, 4 mega-bytes of RAM, QEMM 386, DOS Rev. 3.3 (or higher), access to the Hanford Local Area Network (HLAN), hard drive configured as C drive with at least 6 mega-bytes free space
- Hewlett-Packard LaserJet III printer configured as LPT1 (directly connected or via HLAN)
- Cradle/Battery charger (Symbol model 3860) with cable
- ABCASH Bar Code Unit (ABCU, Symbol model LDT ETR 3805)
- Holster (optional) for ABCU.
- A copy of the **User Manual for ABCASH Database and User Interface (ADUI), WHC-SD-EN-UM-003**, current revision.
- Sample envelopes (brown & white as needed)
- Peel & stick labels (stores # 53-4945-100)
- Filters

5.0 PROCEDURE

5.1 Sample Envelope Preparation

5.1.1 Logon to HLAN and access the ABCASH system per the user manual, section 4.0 STARTING THE ADUI APPLICATION.

NOTE: Printed labels are grouped by day of the week.

5.1.2 Print bar code labels for envelopes. Refer to the user manual, section 7.1 for assistance.

5.1.3 Place the bar code labels on the front, upper right corner of the sample envelopes.

NOTE: Generic bar code labels are for alarm samples and should be prepared in advance. They will not have location codes or descriptions on them.

5.1.4 Print a few generic bar code labels and place them on the envelopes refer to the user manual, section 7.1 for instructions on how to print generic bar code labels.

5.1.5 Store envelopes with generic bar code labels in a readily accessible place known to all HPTs.

NOTE: The employee ID bar code label is used to make the logon to ABCASH quicker by bar coding the employee's ID number. This allows the user to scan the label instead of *manually* entering an ID number.

5.1.6 Print employee ID bar code label as outlined in the user manual, section 7.2 and place on the back of a badge holder or other suitable location that will allow easy scanning. This is an optional step.

5.1.7 Logoff or quit the ABCASH system.

5.2 Data Collection

NOTE: The following steps describe how to operate the ABCASH Bar Code Unit (ABCU), also known as the hand held, to gather data on the air filter samples. See Attachments 7.1 and 7.2 for illustrations.

5.2.1 Obtain a set of pre-printed labels/envelopes for the current day's samples. Refer to the steps in 5.1 of this procedure for printing instructions.

5.2.2 Configure an ABCU for the facility it will be used in by downloading the Employee/Location information to it. Refer to the user manual, section 10.1 for instructions.

5.2.3 Review section *5.10 of this procedure* before continuing with this procedure. If any of the following steps relating to the operation of the ABCU do not function or create an error message, refer to section *5.10* for resolution.

5.2.4 Press the red key marked PWR to logon to the ABCU. Refer to the figures in attachments 7.1 and 7.2 for location of controls on the ABCU.

The following will appear on the screen.

```
ABCASH

Press any key
to begin^
```

5.2.5 If the above did not appear on the screen, press and release the "FUNC" key and then the "7" (exit) key. Repeat this until the above screen appears.

NOTE: The ABCU will automatically turn itself off after approximately four minutes of inactivity to conserve battery power. This is normal and will not affect any data taken with the ABCU. It will not log the user off of the ABCU.

5.2.6 If needed, adjust the ABCU's display for better readability:

- Screen Light -- to illuminate the ABCU's screen press and release the FUNC key and then press and release the "9" (light) key. This will turn the screen back-light on for two minutes.

- Screen Dark & Brite -- to adjust the darkness or brightness of the characters on the screen press and release the FUNC key and then press and release either the "6" (dark) or "3" (brite) key.

5.2.7 Press the ENTER key on the keyboard. The following screen will appear.

```
Employee ID:
^
```

The "ALPHA" red key toggles between lettering ("^" prompt) and numbering ("v" prompt) modes.

WARNING

The ABCU emits LASER light that can cause damage to the eyes

5.2.8 Enter your employee ID number using one of the following methods:

- Manually - Press the number keys and then press the ENTER key. Use the backspace key to delete an incorrect number or letter.

  OR

- Scan Employee ID bar code label. Refer to step 5.2.17 for scanning instructions.

A screen similar to the following will appear.

```
Date: 6/9/91

OK (0=No/[1=Yes])?v
```

5.2.9 Verify the date shown on the ABCU screen is today's date.

NOTE: Items in [ ] can be selected by pressing ENTER.

5.2.10 If the date is correct, press the ENTER key to choose "Yes" and proceed to step 5.2.13.

5.2.11 If the date is incorrect, enter "0" and press the ENTER key. A screen similar to the following will appear.

```
Date: 6/9/91

OK (0=No/[1=Yes])?0

Date (mm/dd/yy):
v
```

1. Enter the correct date and press ENTER.

2. Verify the date shown on the ABCU screen is today's date.

NOTE: The ABCU displays the time of day in a 24 hour format (i.e., 1 PM is 13:00, 2 PM is 14:00, etc.)

The ABCU screen will display a screen similar to the following.

```
Time: 11.22.22

OK (0=No/[1=Yes])?v
```

5.2.12 If the time shown is correct, press ENTER and go to step 5.2.15.

5.2.13 If the time is incorrect, enter "0" and press the ENTER key. The following screen will appear.

```
Time: 8.32.19

OK (0=No/[Yes=1])?0


Time (hh.mm):
v
```

5.2.14 Enter the correct time and press the ENTER key.

The ABCU will display the ABCASH menu shown below.

```
      ABCASH MENU

1 = Collect Data
2 = Transmit Data
3 = Receive Loc/Emp
4 = Quit

Choice: v
```

5.2.15 Enter 1 and press the ENTER key.

The following screen will appear.

```
Location:   v
```

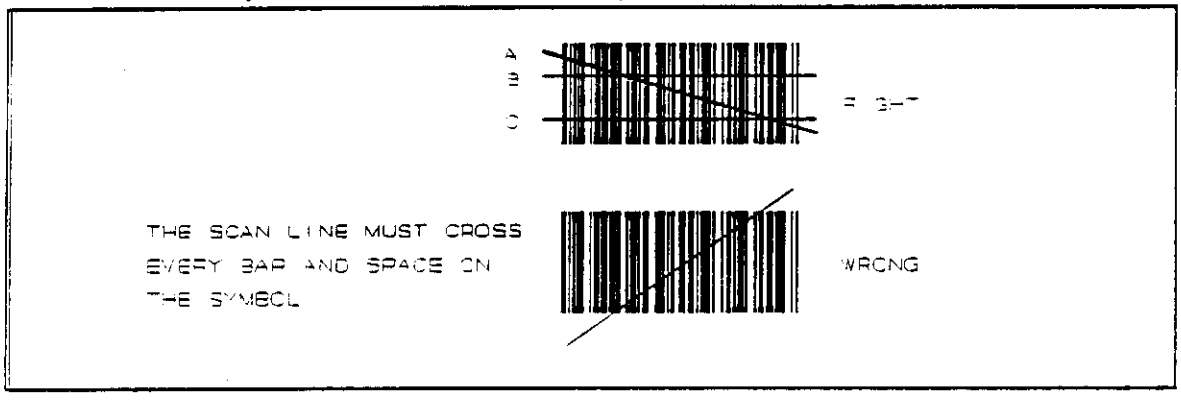
5.2.16 Proceed to an air sample location.

WARNING

The ABCU emits LASER light that can cause damage to the eyes.

5.2.17 Point the ABCU at the location tag bar code and pull the trigger.

NOTE: The unit can scan a bar code label from up to 11 inches. When the bar code is successfully scanned, the unit will beep once.



NOTE: When the ABCU encounters an error condition, it will beep twice. Usually, an error message will appear on the ABCU's screen. Section 5.10 of this procedure lists the errors and steps to correct them.

- If the ABCU is not configured for the Location Code scanned, the following screen will appear.

```
Location: v



A123 not configured
OK (0=No/[1=Yes])?v
```

NOTE: The Location Code A123 is the Location Code the ABCU was not configured to accept.

5.2.18 To override or accept this Location Code press the ENTER key. To prevent this error from occurring again refer to the user manual, sections 5.3.1 and 10.1.

After the location tag has been successfully scanned the following screen will appear.

```
Sample Number:
 v
```

NOTE: For first time use of the ABCASH ABCU at a facility or sample location, ON Readings only will be collected with the ABCU, skipping the OFF reading data collection with the ABCU. This will also be done if an inactive sample location is reactivated.

5.3 Collect "OFF Readings"

NOTE: Because the ON/OFF Readings are being recorded electronically it is not necessary to write this information on the sample envelopes.

5.3.1 If this is the first time the ABCU has been used at this location/facility:

1. Manually record OFF Readings by writing them on the sample envelope found at the sample location.

2. Press and release the FUNC key and then press and release the "4" (Skip) key to skip gathering the OFF data with the ABCU.

3. Go to step 5.4.

5.3.2 If the ABCU has been previously used at this location/facility:

1. Scan the bar code label on the sample envelope found at the sample location.

   The ABCU will prompt the user for the "Off Readings" for the air filter sample. A screen similar to the one shown below will appear.

```
  OFF Readings

?????:
 [169.9]
 v
```

   The ????? field will be one of the following data types: Timer, Gasmeter, Rotameter or Vacuum.

2. To accept the displayed value, press the ENTER key. To change the displayed value, enter the different value (using the number and "." keys) and press ENTER.

NOTE: The Off and On data types for each location will vary depending upon the configuration for a location. At a minimum, the Time and one other reading type (ie, rotameter, vacuum, etc.) will be taken at every location. The time on and off is automatically recorded by the ABCU.

3. Repeat step *2 above* for each OFF Reading data type for the present sample location.

   When all of the OFF Reading data for the sample location is entered, a screen similar to the one below will appear.

```
  OFF Readings
S174269
Time:        14:19
Timer:       169.9
Gasmeter:    252462.0
Rotameter:   3.3
Vacuum:      3.5
OK (0=No/[1=Yes])?v
```

4. To accept the displayed value(s), press the ENTER key and proceed to step 5.4.

5. To change the values, enter "0" and press the ENTER key. This will repeat the "OFF Reading" data input process in steps *2-4 above*.

   After accepting the OFF Readings a screen similar to the one below will appear.

```
Change Air Filter

Press any key to
enter ON valuesv
```

5.4 Exchange The Air Sample Filter

5.5 Collect "ON Readings"

5.5.1 Press the ENTER key.

The ABCU will prompt the user for the "ON Readings" for the air filter sample. A screen similar to the one below will appear.

```
   ON Readings

 ?????:
  [169.9]
  v
```

The ????? field will be one of the following data types: Timer, Gasmeter, Rotameter or Vacuum.

5.5.2 To accept the displayed value, press the ENTER key. To change the displayed value, use the number keys to enter the different value and press ENTER.

5.5.3 Repeat step 5.5.2 for each ON Reading data type for the present sample location.

When all of the ON Reading data for the sample location is entered a screen similar to the following will appear.

```
   ON Readings
SS069
Time:       14:21
Timer:      169.9
Gasmeter:   252462.0
Rotameter:  3.3
Vacuum:     3.5
OK (0=No/[1=Yes])?v
```

5.5.4 To accept the displayed value, press the ENTER key and go to step 5.5.7.

5.5.5 To change the values, enter "0" and press the ENTER key. This will repeat the "ON Reading" data input process in step 5.5.2 for each ON reading.

When the On Readings are accepted the following screen will appear.

```
Location Complete
Proceed to next
Location

Press any key to
enter new Location's
OFF valuesv
```

5.5.6 Press the ENTER key and proceed to the next air sample location.

NOTE: Multiple samples from the same location can be recorded by the ABCU. For example, if a filter that was changed at the start of a filter change run needs to be changed again (ie, because of an alarm) it can be changed again during that same run with the same ABCU.

5.5.7 Repeat steps *5.2.17* through 5.5.6 until all air filters scheduled to be changed are completed.

5.6 Collection Data Transfer

NOTE: This section outlines the steps necessary to transfer the collection data from the ABCU (handheld) to the workstation (computer).

5.6.1 Proceed to the ABCASH workstation (computer) that has the cradle attached to it.

5.6.2 Examine the screen of the ABCU. If the ABCASH MENU is not displayed, press and release the FUNC key and then the EXIT (7) key until the menu is displayed. See the example below.

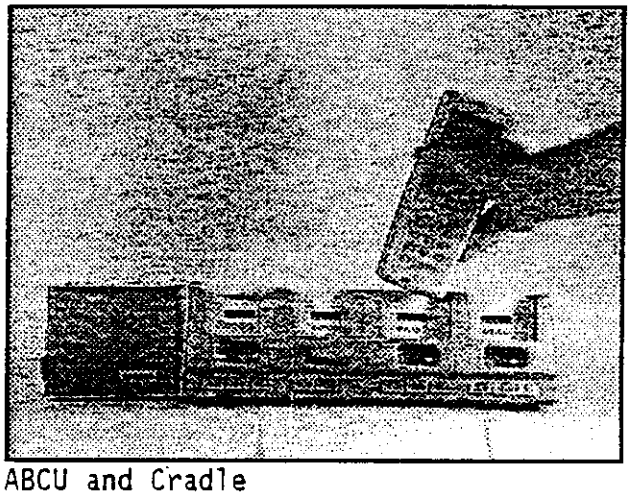
```
     ABCASH MENU

1 = Collect Data
2 = Transmit Data
3 = Receive Loc/Emp
4 = Quit

Choice: v
```

NOTE: If the Transmit Data option (#2) on the ABCU ABCASH MENU is in reverse video (similar to the example above), the ABCU has air filter sample collection data in it. If the Transmit Data option is displayed normally, there is no collection data in the ABCU.

5.6.3 Select option #2 Transmit Data by pressing the "2" key and then pressing the ENTER key. The ABCU display will look similar to the example below.

```
Set up PC to receive

1 = Begin Transfer
2 = Abort Transfer

Choice: v
```

5.6.4 Place the ABCU into any slot of the cradle. See the figure at right.



ABCU and Cradle

5.6.5 If not already logged on to ABCASH, logon to ABCASH as outlined in the user manual, section 4.0.

5.6.6 Transfer collection data from the ABCU to the PC. Refer to the user manual, section 5.1.1 for instructions.

5.6.7 If there were no errors with the collection data, go to step 5.6.8.

NOTE: If errors were encountered during the transfer of collection data from the ABCU to the PC, a BC Transfer Errors Report will be printed.

CAUTION

Errors must be corrected before proceeding.

1. Examine the BC Transfer Errors Report and refer to the user manual, section 5.1.2 MODIFY COLLECTION DATA for instructions on how to correct the error(s).

2. File the BC Transfer Errors Report in a three ring binder in a section marked "BC Transfer Error Reports".

5.6.8 After a successful collection data transfer, two copies of a Collection Data Report will be printed. Review the report for accuracy.

5.6.9 If the Collection Data Report is accurate, go to step 5.6.10.

1. If the Collection Data Report is not accurate, correct the data. Refer to the user manual, section 5.1.2 for instructions.

2. Print two copies of the corrected Collection Data Report. Refer to the user manual, section 8.1.1.

5.6.10 Sign and date both copies of the report on the "Prepared by:" line.

NOTE: "Approved by:" line for Supervisor verification.

1. File one copy in a three ring binder in a section marked "Collection Data Reports".

2. Send the other copy with the samples to the lab.

5.7 Send Collection Data To The Air Sample Database

5.7.1 Perform the steps in the user manual, section 5.1.3.

5.7.2 If there are no errors, go to step 5.7.4.

5.7.3 If errors are encountered:

1. Correct any errors that may have been generated during the transfer in step 5.7.1. Refer to the user manual, section 5.1.2 MODIFY COLLECTION DATA for instructions.

2. File error report in a three ring binder in a section marked "Local Transfer Error Reports".

3. After correcting all errors generated by the transfer of data to the Air Sample Database perform step 5.7.1.

5.7.4 Review the Local Transfer Report that was printed after a successful transfer to the Air Sample Database.

1. Sign and date the report on the "Performed by:" line.

2. Send a copy of the report with the sample envelopes to the lab.

3. File the original in a three ring binder under a section titled "Local Transfer to Air Sample Database Reports".

5.8 Data Validation

5.8.1 The HPT Supervisor, or designate, will validate the collection data from the ABCU using the following steps:

1. Logon to ABCASH as outlined in the user manual, section 4.0 STARTING THE ADUI APPLICATION.

2. Validate the collection data pertaining to the data transferred in section 5.6 of this procedure. Refer to the user manual, section 5.2.3.

3. Quit ABCASH and logoff from HLAN.

5.9 Sample Custody Change

NOTE: The HPT transporting the air filter samples will take custody of the samples.

5.9.1 Logon to ABCASH. Refer to the user manual, section 4.0.

5.9.2 Refer to the user manual, section 5.2.1 for instructions on Sample Custody Change.

5.9.3 After successfully performing a Sample Custody Change two copies of a Custody Change Report will be printed. Sign and date both copies on the "Delivered by" line.

5.9.4 If there are any problems, contact HP Supervision.

5.9.5 Upon completion of Sample Custody Change, logoff from ABCASH and HLAN.

5.9.6 Take both copies of the Custody Change Report to the lab with the samples and obtain receiver's signature and date.

1. Leave one copy of the Custody Change Report with the receiver.

2. Return or send the other copy to the originating facility to be filed in a "Custody Change Reports" section of a three ring binder.

5.10 ABCASH Bar Code Unit (ABCU) Error Conditions

5.10.1 When the ABCU encounters an error, it will beep twice. Examine the ABCU screen and determine which error condition listed best matches the error experienced.

5.10.2 **The ABCU will not power on.** Ensure that the battery is charged. Replace battery if necessary and press the red PWR key. If unsuccessful, perform steps A-C below.

A. Perform warm boot procedure: press and hold the "+" key and the "/" key on the ABCU.

B. While holding the "+" and "/" keys press and release the red PWR key.

C. Release the "+" and "/" keys. This will restart the program in the ABCU without losing any data.

5.10.3 **The ABCU will not power off.** Press and hold the red PWR key for 30 seconds.

A. After the ABCU has powered off perform the warm boot procedure listed in step 5.10.2 A-C.

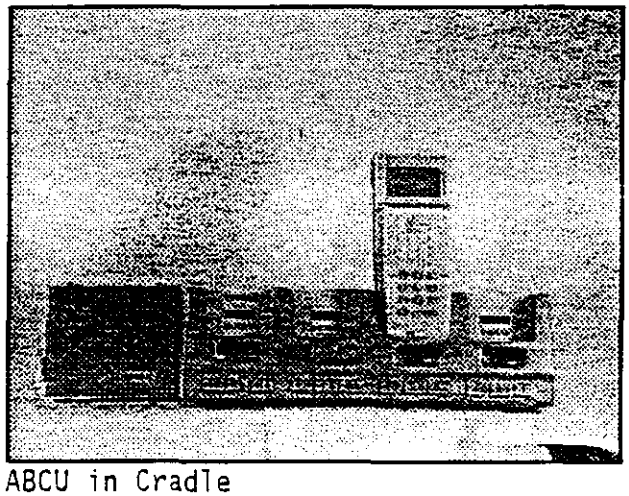
NOTE: In the event of a complete battery failure, or loss of power, the ABCU has a backup power source that keeps all data intact for at least 15 minutes. This allows time to replace or charge the battery pack in the ABCU. If power is not restored within 15 minutes, any collection data could be lost.

Low Battery Warning. When the battery in the ABCU is getting low on power, the cursor changes from a v or ^ to a solid ▼ or ▲. One possible example of the ABCU screen with a low battery indication is shown below.

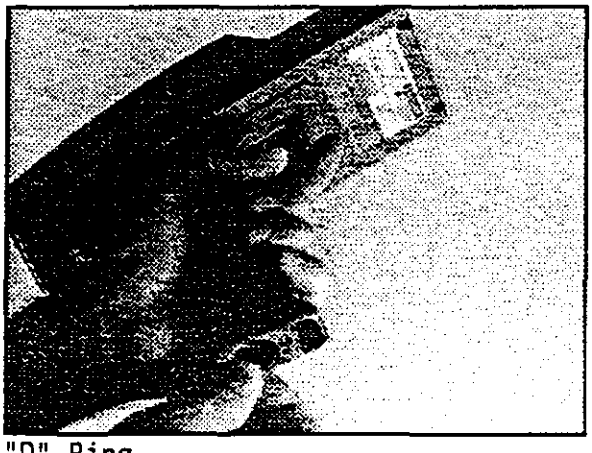
```
      ABCASH MENU

1 = Collect Data
2 = Transmit Data
3 = Receive Loc/Emp
4 = Quit

Choice: ▼
```

5.10.4 Recharge or replace the battery IMMEDIATELY. Refer to steps A through D below for instructions.

A. To charge battery pack in ABCU place the ABCU into any open slot in the cradle. Refer to figure at right. The center red light marked TERMINAL CHARGE will blink indicating the ABCU is charging. The light will stop blinking when the ABCU is fully charged. The left red light marked TERMINAL IN COMM. will light up but not blink indicating the ABCU interface is inactive.



ABCU in Cradle



"D" Ring

B.
To replace the battery pack, twist the D ring on the bottom of the handle 90 degrees counter-clockwise as shown in the figure to the left.

C. Remove the end cap as shown in the figure at the right. The end cap has an O ring seal and fits very tightly in the handle.

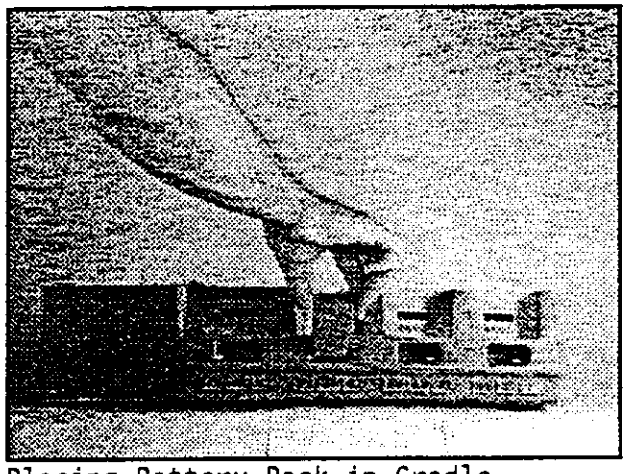
Removing End Cap

D. Tap the ABCU's handle base against the palm of your hand to dislodge the battery. Remove the battery as shown in the figure at right.

E. To insert a charged battery into the handle reverse the order of steps D through B.

Changing the Battery Pack

F. To charge a battery pack place it in any empty slot as shown in the figure at right. The red light marked BATTERY CHARGE will blink indicating the battery pack is charging. The battery pack is fully charged when the light stops blinking.



Placing Battery Pack in Cradle

NOTE: The user must have a Default Custody of "Filter Change" to logon to the ABCU and be authorized to use the ABCASH system.

Employee ID Not Found. The screen shown below will appear indicating this error.

```
Employee ID:


Emp. ID Not Found

Press any keyv
```

5.10.5 This error is encountered when an employee ID number is entered into the ABCU and is not found by the program. Check the ID number for accuracy and reenter the ID number into the ABCU. If the error persists, contact ABCASH support personnel or 222S Lab personnel for assistance.

5.10.6 **Invalid Input.** When the ABCU detects an Invalid Input, it will display a screen similar to the one below.

```
Invalid Input
Press any keyv
```

One cause of an Invalid Input error would be improper scanning sequence (ie, scan sample envelope instead of a Location Tag). Check and repeat the step(s) that preceded the error.

5.10.7 **Sample Number Already Collected.** An example of this error is shown below.

```
Sample Number:

Sample Number
Already Collected
Press any keyv
```

This error indicates that an attempt was made to use a bar coded sample envelope previously scanned. To correct this error, press any key and scan another bar coded sample envelope.

5.10.8 **Reading out of Range.** A screen similar to the one shown below indicates this type of error.

```
   OFF Readings

 Rotameter:
  [3.3]
  25

Reading out of Range
OK (0=No/[1=Yes])?v
```

This error means that the value entered (25) is not in the range expected for this particular reading (Rotameter).

A. To accept the entered value, press the ENTER key.

B. To change the entered value press "0" and then press the ENTER key. This will repeat the reading entry step.

5.10.9 **ERROR--Files Missing.** This error will produce a screen similar to the one shown below.

```
ERROR--Files Missing

Emp File Missing
Loc File Missing

Receive files from
PC (ADUI) [1/Y]? v
```

This error screen indicates that the ABCU lost both the Employee and Location data files. This can occur if the ABCU's battery becomes completely discharged for longer than 15 minutes. The data stored in the ABCU's RAM, including any collection data, is lost. Any ABCU displaying this error will have to be reconfigured as outlined in the user manual, section 10.1 *HANDHELD COMPUTER UNIT EMPLOYEE/LOCATION LIST DOWNLOAD*.

5.10.10 **Workstation Failure.** If the ABCASH workstation is not operational data can be collected using the ABCU and download whenever the workstation is repaired/operational.

5.10.11 **Total ABCASH Failure.** If the ABCASH system is completely non-operational, collect air filter samples and data manually per approved Health Physics Procedures.

5.11 **ALARM or Off Normal Sample Collection.** For alarm (non-routine) sample/data collection follow the steps in section 5.2 Data Collection using the generic bar code labeled sample envelopes.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Articles 551, 555

WHC-CM-4-12, Health Physics Practices Manual, Section 5.2

WHC-SD-EN-RD-003, ABCASH System Requirements

WHC-SD-EN-SDD-002, ABCASH Design Description

WHC-SD-EN-UM-003, User Manual for ABCASH Database and User Interface (ADUI)

7.0 ATTACHMENTS

7.1 Top and Side Views of ABCU

7.2 View of ABCU Keyboard

7.3 ABCASH Access Application Form

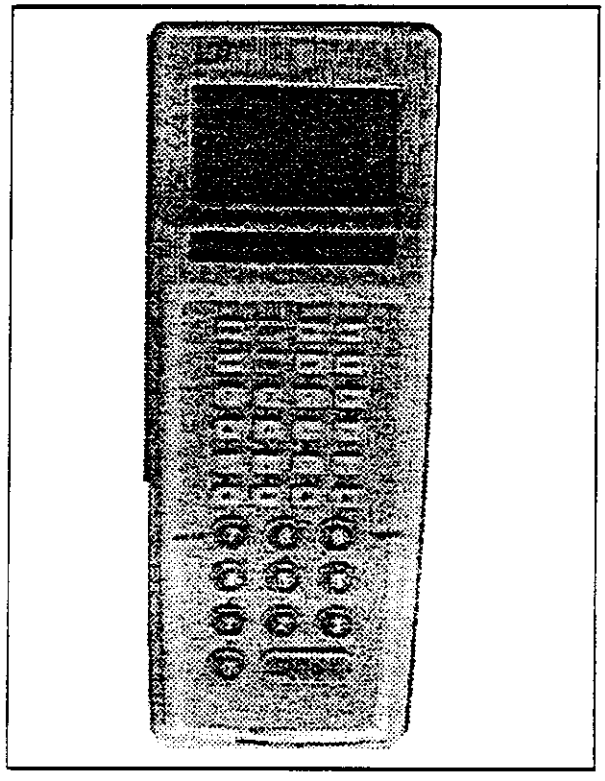
8.0 DOCUMENTATION

ABCASH Access Application Form

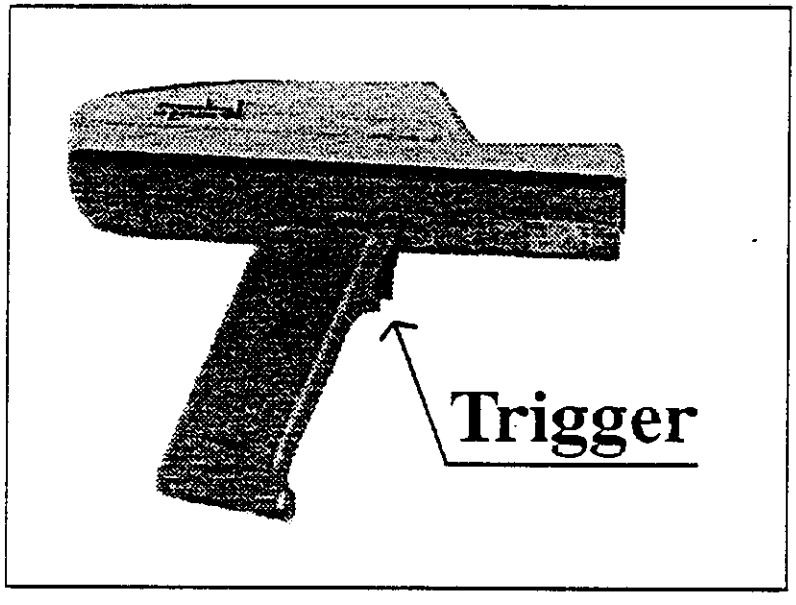
ATTACHMENT 7.1

TOP AND SIDE VIEWS OF ABCU

Top View of ABCU



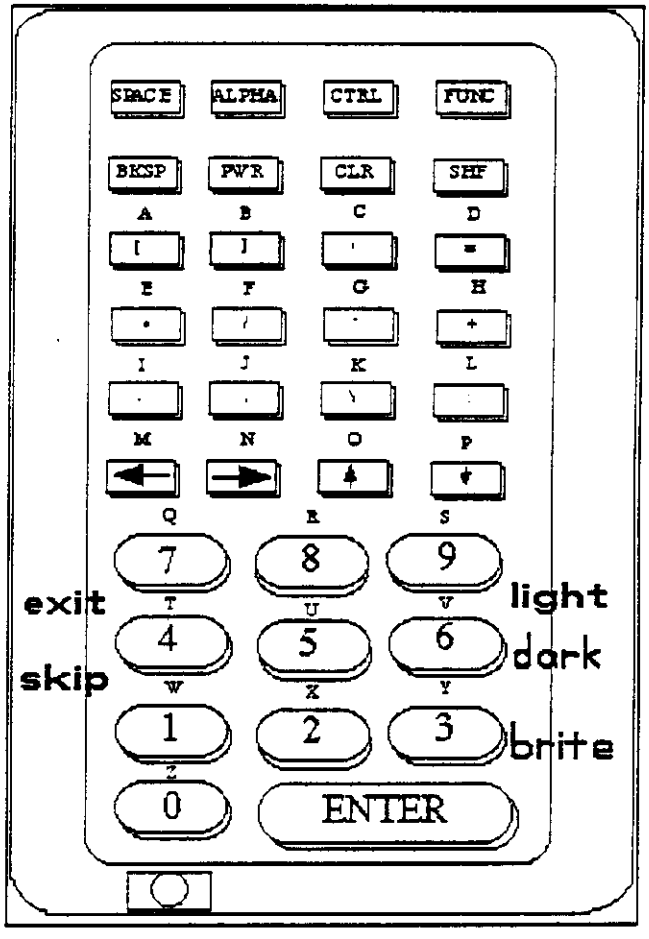
Side View of ABCU



ATTACHMENT 7.2

VIEW OF ABCU KEYBOARD

Keyboard of ABCU



ATTACHMENT 7.3

ABCASH Access Application Form

All users, including those who will gather the field data, must complete this form to access the ABCASH computer system. Return the completed form to: **ABCASH Administrator L4-90**. Access will be available upon receipt of this form.

NAME _____ PAYROLL #: _____

JOB TITLE: _____ SHIFT: _____

WORK LOCATION: _____ PHONE: _____
Building/Room/Area/Mail Stop

MANAGER'S NAME: _____ PHONE: _____

USER'S SIGNATURE: _____

MANAGER'S SIGNATURE: _____

COMPUTER SECURITY TRAINING [Yes] [No] MANAGER'S INITIALS: _____

USER PASSWORD: _____
one to eight characters

ABCASH users must have the following workstation configuration:

- IBM compatible 386 SX or higher
- QEMM 386
- Access to HLAN
- Hard drive configured as 'C' with 10 MB free disk space
- 4 MB RAM
- DOS 3.3 or higher
- LaserJet III configured as LPT1

Please check the appropriate user privilege:

[ ] **LIMITED**	User can only view the sample data and results.	[ ] **NEW**	LIMITED plus: User can enter and modify newly collected air sample data.
[ ] **GENERAL**	NEW plus: User can add or modify Air Sample database sample data. User can download sample locations, and employees, to bar code unit.	[ ] **GLOBAL**	GENERAL plus: User can validate Air Sample database sample data. User can transfer sample data to Lab Computer. User can receive sample results and QA data from Lab Computer.
[ ] **SUPER**	GLOBAL plus: User can delete Air Sample database sample data. User can add, delete, modify location and valid use data. User can add, delete, modify location and valid user data.	[ ] **SYSADMIN**	SUPER plus: User can archive and restore data.

Please check the appropriate default custody:

[ ] LAB RECEIVING [ ] LAB ANALYSIS [ ] LAB DISPOSAL [ ] TRANSPORT

[ ] LAB ARCHIVE [ ] LAB COMPOSITE [ ] OTHER [ ] FILTER CHANGE

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1.0 PURPOSE AND SCOPE

This procedure provides the Health Physics Technician (HPT) with information and instructions for inspecting and source checking gas proportional Personnel Survey Devices (PSDs). This includes the Portal II PCM (Personnel Contamination Monitor) and the following Eberline PSD models: Personnel Contamination Monitors (PCMs), Portal Monitor - 6 series (PMs), and Hand & Foot Monitors (HFMs).

2.0 PREREQUISITES

- HPT academic and fundamental training
- OJT for the particular PSD in question

3.0 PRECAUTIONS/LIMITATIONS

1. Perform this procedure:

   - Daily, for personnel release Eberline PCMs
   - Weekly, for all other PSDs

NOTE: Eberline PCMs at the exits from Contamination Areas, that do not require a frisk after using the PCM, are personnel release PCMs.

2. Handle sources with extreme care. Avoid scratching or handling sources in any way that might affect source activity or integrity. Cover and protect sources at all times when not in use. **NEVER** put a source in your pocket.

3. Keep sources at least three feet away from a PSD when not in use, because PSDs are continuously counting and updating background.

NOTE: The word "light" will be used throughout this text to mean incandescent lamps or Light Emitting Diodes (LEDs).

4. PSDs shall meet the following critical limits:

   - Calibration is current (maintenance calibration sticker attached)
   - One or both BOTTLE EMPTY lights are OFF (Eberline PMs/PCMs, only)
   - TROUBLE, HIGH BACKGROUND, and FAIL lights must be OFF
   - ALL counting sensors (pressure or light beam) function properly
   - All detectors pass the source alarm check, beta/alpha (as equipped)

5. PSDs should meet the following criteria:

   - COUNTING and/or COUNT COMPLETE indicators function properly
   - Gas flow rates and pressure regulator readings are as follows:

PSD	Flow Rates (cc/min)		Press. Regulator (psig)	
Model	Inlet	Outlet	High Side	Low Side
HFMs	30 - 70	Indication	200, minimum	4 - 6
ALL others	20 - 30	Indication	200, minimum	4 - 6

4.0 REQUIRED EQUIPMENT AND MATERIALS

1. A 4880 to 5770 dpm/100cm^2 Cs-137 beta check source for most PSDs (other PSDs may use different source values). All sources shall be approved by HP Radiological Engineering.

2. A beta source holder (clip) capable of maintaining the source about three inches from the detectors (Eberline PCMs and PMs only)

3. A 400 to 600 dpm Pu-239 HP Radiological Engineering geometry approved alpha check source, for most PSDs with alpha capabilities (other PSDs may use different source values). All sources shall be approved by HP Radiological Engineering.

4. PSD Inspection and Alarm Check Data Sheet (Data Sheet), form number BD-6000-839 (a JetForm)

5. Service Required tag or label, as needed, form numbers 54-6000-451 or 54-6000-452, respectively

6. Plastic sheeting, if applicable (plastic wrap or equivalent)

7. Instrument cabinet keys, if applicable (may be required for entry into the cabinet to verify gas readings, usage, and elapsed time)

5.0 PROCEDURE

5.1 Record or Verify the Date, Instrument, and Source Information.

5.1.1 When starting a new Data Sheet, record all the requested information across the top of the form. Outstanding problems identified on the previous Data Sheet should be transposed to Comments on the new one, and when:

- The manufacturer's serial number is unavailable, enter the U.S. D.O.E. Property Number
- Only one source isotope is used, enter "N/A" in the blanks related to the other source isotope (enter two of the same isotope, when used)

5.1.2 If a Data Sheet is in use, verify the information on the Data Sheet and PSD match.

5.1.3 Record the Date and Time in the appropriate columns on the next blank line of the data sheet. If the Data Sheet is full, start a new one using step 5.1.1.

5.1.4 If any of the following conditions exist, go to step 5.8.

- Calibration is overdue
- The calibration sticker is missing
- The TROUBLE light is ON
- The HIGH BACKGROUND light is ON
- The FAIL light is ON

5.2 Clean and Inspect the PSD.

5.2.1 Vacuum the threshold (foot detectors) and change/replace the sticky step off pad, as necessary.

5.2.2 Inspect the PSD for damage (punctured detectors, broken screens, or other obvious signs of damage) and check the appropriate column under Detector Damage on the Data Sheet.

5.3 Test the Ultrasonic Motion Sensor (Eberline PMs and PCMs, only).

NOTE: Some instruments have had the ultrasonic motion sensor deactivated.

5.3.1 If the ultrasonic motion sensor has been deactivated, go to step 5.4.

5.3.2 Before you activate the ultrasonic motion sensor, the display should read "COUNTING BACKGROUND."

5.3.3 The PSD should detect your approach within 3 feet and the display should change to read "STEP UP - INSERT RIGHT ARM" or "READY."

5.4 Verify Gas (P-10) Pressures and Flow Rates.

5.4.1 When both "BOTTLE EMPTY" lights are ON (Eberline PCMs/PMs, only), go to step 5.8. The PSD can remain in operation with one "BOTTLE EMPTY" light ON.

5.4.2 If the pressure regulator, flow meters, and instrument keypad are NOT visible, unlock and open the PSD cabinet.

5.4.3 Verify the pressure regulator high and low readings are within the limits.

5.4.4 Check the appropriate column under Pressure Regulator, check "N/A" if the gas is from a building supply.

5.4.5 Verify the inlet and outlet flow rates are within the limits.

5.4.6 Check the appropriate column under Flow Rates on the Data Sheet.

5.5 Record the Usage and Elapsed Time.

5.5.1 For the Portal II PCM, enter "N/A" in the Usage and Elapsed Time columns, close and lock the PSD cabinet, and go to step 5.6.

5.5.2 Obtain Eberline PSD usage and elapsed time, by following these steps:

1. Place the TEST-OPERATE switch in the TEST position or enter the Password.
2. Press the "+" key, until "USAGE" is displayed.
3. Press the "ENTER" key and record the USAGE and ELAPSED TIME.
4. For PCM-1Bs or PM-6As, press the "RUB OUT" key to clear the USAGE and ELAPSED TIME.
5. For all other PSDs, press the "+" key twice to clear the USAGE and ELAPSED TIME.

5.5.3 Return the TEST-OPERATE switch to the OPERATE position, if applicable.

5.6 Initiate Counting and Verify Counting Sensor Operation.

5.6.1 Initiate counting in accordance with the PSD design.

NOTE: Once the PSD starts counting, a light and/or display message should indicate that counting has begun.

5.6.2 When interrupting counting:

- Verify that an alarm sounds
- A "RECOUNT" light comes ON and/or message is displayed
- Or a "COUNT INCOMPLETE" (or like) message is displayed

5.6.3 Interrupt counting with the sensor interruptions listed below (initiate counting between each interruption):

A. For Eberline PCMs:

- Pull an arm out
- If equipped with a foot sensor, lift a foot
- If equipped with red buttons, release the button

B. For Eberline PMs:

- Step out
- If equipped with hand pods, lift or remove a hand

C. For Eberline HFMs:

- Lift a hand (simulator switch for HFM-4As)
- While leaving your hands on the hand switches, step off the monitor

D. For Portal II PCMs:

- Lift a foot
- Lift or remove a hand

5.6.4 Complete the count. When complete, one or more of the following should occur:

- A light will come ON to indicate the count is complete or "OK"
- Some kind of "COUNT COMPLETE" message will be displayed
- A short beep will sound
- The flashing light will go OFF

5.6.5 If you are at an Eberline PCM, turn around and complete steps 5.6.1 thru 5.6.5 for the left side (no need to check the same sensors twice).

5.7 Source Check the PSD.

5.7.1 For Eberline PCMs and PMs ONLY, place the beta check source in the source holder (clip). More than one source may be used at the same time, in different detectors.

CAUTION

To prevent Eberline detector damage, DO NOT use the beta source clip on: PCM forearm/palm detectors, any hand detectors, or any foot detectors.

5.7.2 Initiate and interrupt counting.

5.7.3 Place the source, or source holder, over the center of a detector and initiate counting.

5.7.4 The PSD should alarm, indicating the detector or zone being source checked. If the PSD does not alarm, initiate counting one more time.

5.7.5 Whether or not the PSD alarms, repeat steps 5.7.2 thru 5.7.5 until all the detectors have been source checked.

5.7.6 If the PSD has alpha capabilities, place the alpha source over the center of a detector and complete steps 5.7.3 thru 5.7.5. DO NOT use the beta source clip with the alpha source.

5.7.7 Check the appropriate column under Alarm Check. If equipped, exit the SOURCE CHECK mode.

5.7.8 Close/lock the PSD cabinet, as necessary.

5.8 Actions in Response to PSD Problems and Failures.

5.8.1 If one or more of the following conditions exist, enter the date and record each problem or failure condition in the Comments section of the Data Sheet. If none of the following conditions exist, go to step 5.9.

- Calibration has expired or the calibration sticker is missing
- TROUBLE, HIGH BACKGROUND, or FAIL lights are illuminated
- PSD is damaged
- BOTTLE EMPTY light ON
- PSD does not indicate counting in progress
- Counting sensors do not interrupt counting
- Interruptions do not cause alarm or RECOUNT light/message to come ON
- Count complete indicators not operating
- Detectors do not alarm--respond to source

5.8.2 If one or more of the following conditions exist, go to step 5.8.3. If none of the following conditions exist, go to step 5.8.4.

- Calibration has expired
- The calibration sticker is missing
- TROUBLE, HIGH BACKGROUND, or FAIL lights are illuminated
- Both BOTTLE EMPTY lights are ON
- Interruptions do not cause alarm or RECOUNT light/message to come ON
- Detectors do not alarm--respond to source

5.8.3 Remove the instrument from service, using the following steps:

1. Take the PSD out of service. A sign should be posted at the PSD which provides personnel with one of the following:

   - alternate survey directions (example: Survey with the EGM), or
   - directions to another survey instrument and location (example: Go to the Hand and Foot Monitor in corridor xxx), or
   - to "Contact HPT (at PAX #xxx or xxx-xxxx) for assistance."

2. Record the following information on both sections of a Service Required label/tag:

   - Date
   - Name (print your first two initials and last name)
   - Component ID - instrument serial number or Westinghouse/DOE property number
   - Info. - specific facility information
   - Description of Problem

3. Separate the two parts of the Service Required label/tag, along the perforated line.

4. Retain the Job Control System (JCS) information half of the Service Required label/tag (label top half or tag bottom half).

5. Complete the appropriate action below for the label (bottom half, field label) or tag (top half, field tag):

   - Label - peel the back off and affix to the PSD
   - Tag - peel the back off the clear adhesive flaps, affix the flaps to the tag, and hang the tag on the PSD

NOTE: Maintenance, the HP Supervisor, or cognizant Radiological Engineer may direct the HPT where to affix (hang) the Service Required label (tag).

5.8.4 Notify the HP Supervisor of the items recorded in the Comments section of the Data Sheet. If the PSD was tagged out, deliver the JCS information tag to the HP Supervisor. You or the HP Supervisor shall notify Maintenance of problems and failures.

5.9 **Complete the One Line Entry on the Data Sheet.**

5.9.1 Indicate instrument status, check the appropriate Instrument Usable status column on the Data Sheet.

   - Y - Operable
   - N - Not operable, instrument has been tagged out

5.9.2 Initial and print name to complete the Data Sheet line entry.

5.9.3 Initial the end of the Comments entry, if applicable.

6.0 BIBLIOGRAPHY

HSRCM-1, Hanford Site Radiological Control Manual, Article 761

WHC-CM-1-6, WHC Radiological Control Manual, Article 761

WHC-CM-1-5, Standard Operationing Practices, Section 1.1

Technical Manuals, Eberline: HFM-4A, HFM-6, PM-6, PM-6A, PCM-1, PCM-1A, PCM-1B

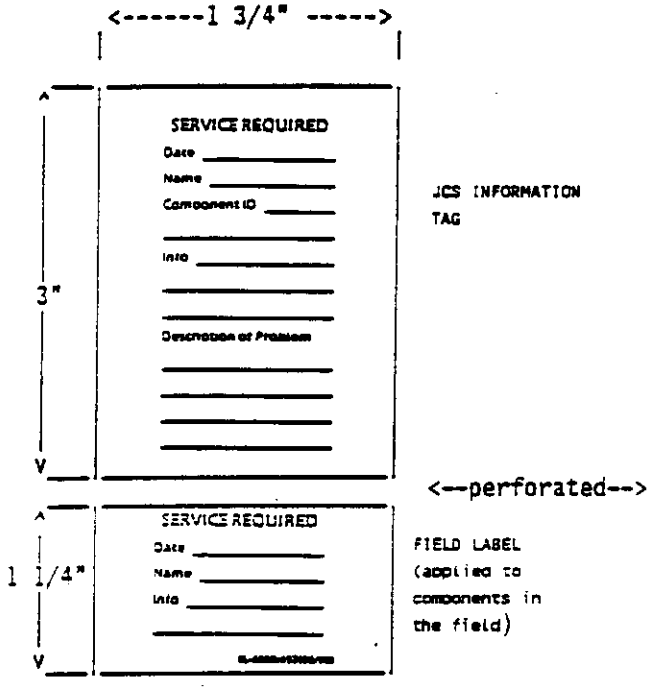
7.0 ATTACHMENTS

7.1 Service Required tag and label (54-6000-451 and 54-6000-452)

8.0 DOCUMENTATION

PSD Inspection and Alarm Check Data Sheet (BD-6000-839 - a JetForm)

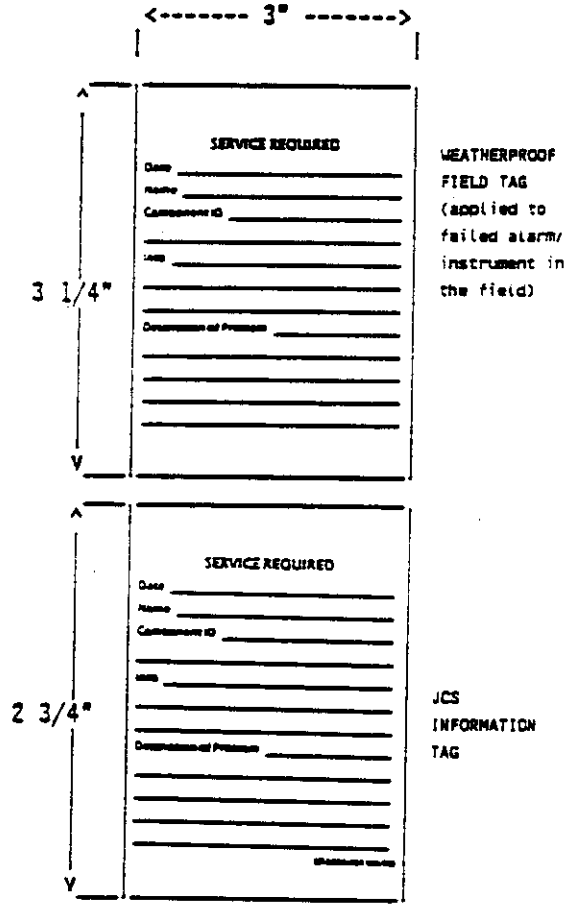
ATTACHMENT 7.1
Service Required Tag and Label



TWO-PART SERVICE REQUIRED LABEL
(Color: Light Green)

The "Service Required" label is an adhesive-backed, two-part sticker with perforations as shown. The field label is applied to the components in the facility. The JCS information copy is used as an aid to transfer information from the field to the JCS ADP or appropriate JCS "J" forms.

FORM BL-6000-452



TWO-PART SERVICE REQUIRED TAG
(Color: Light Green)

The "Service Required" tag consists of two identical parts: a weatherproof tag to be attached to the component in the field (tag has clear adhesive flaps for weatherproofing) and a JCS information copy of the tag. The JCS information copy is used as an aid to transfer information from the field to the JCS ADP or appropriate JCS "J" forms.

FORM BT-6000-451

TITLE:

BACKGROUND AND MDCR DETERMINATION WITH PORTABLE INSTRUMENTS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure provides the Health Physics Technician (HPT) with information and calculations to determine environmental survey background and to determine instrument Minimum Detectable Count Rate (MDCR) and Minimum Detectable Activity (MDA) with a statistical 95% confidence level, using portable count rate meter (CRM) and micro-R meter instruments. MDCR is based on instrument background and is that amount above background where activity is considered present.

2.0 PREREQUISITES

- HPT academic and generic training
- OJTs for applicable instrumentation

3.0 PRECAUTIONS/LIMITATIONS

3.1 For rate meters the following time constants, in seconds, apply to the metered response:

INSTRUMENT (Manufacturer & Model)	τ, TIME CONSTANT (response)	
	MIN. (fast)	MAX. (slow)
Eberline (most CRMs)	2	10
Eberline RM-19 & PAC-6 Ludlum 177-8	2	20
Ludlum 177-36 & 177-37	2.2	22
Bicron Surveyor (PAM) (scale-τ)	X1-12, X10-5, X100-2	
Hanford Poppy (scale-τ)	X1-10, X10-5, ≥ X100-2	
Ludlum (most CRMs and μR Meters)	4	22
Ludlum 12S μR Survey Meter	3	11

NOTE: The USRADS uses a 1 second time constant for all its instruments.

3.2 Another environmental background area must be chosen when the waist-level and near ground level readings vary more than 20%.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Calibrated instruments and equipment

5.0 PROCEDURE

5.1 Determine Background for Environmental Surveys.

5.1.1 Select an area adjacent to the intended survey area and define (mark) a background survey area that is approximately (choose one):

A. 200' x 200' with the UltraSonic Ranging And Data System (USRADS), collecting approximately 1,000 data points of information

-OR-

B. 50' x 50' without the USRADS

NOTE: For the USRADS, the background survey area should be selected based on records or knowledge of previous land use and potential for resident radioactive material.

5.1.2 For the 50' by 50' area, survey at least 10 different locations and record the readings on the survey report.

1. For beta-gamma CRMs, take two 30 second background readings at each location - one at waist height and one 1 to 2 inches from the surface.

5.1.3 If records or knowledge of the area are unavailable **AND** USRADS is to be used, perform a preliminary survey using the method described in 5.1.2, 1. above.

5.1.4 When using the USRADS, perform the area survey using the applicable operating procedures and attach copies of the track maps, data outputs, and survey record form.

5.1.5 Evaluate the background survey results with respect to the limits in 3.2 above. If necessary, choose another location and repeat the steps above.

5.2 Determine the Minimum Detectable Count Rate (MDCR).

5.2.1 Determine the MDCR from the count rate meter background using the following equation (or use the attached graphs):

$$MDCR = 4.65\sqrt{\frac{R_b}{2\tau}}$$

Where: R_b = Background Count Rate (Avg. Bkgd. may be used)
τ = Rate Meter Time Constant (from 3.1 above)

Example: R_b = 30 cpm
τ = 10 seconds ($0.1\overline{6}$ minutes)

$$MDCR = 4.65\sqrt{\frac{30\ cpm}{2 \times 0.1\overline{6}\ min}} = 4.65\sqrt{90}\ cpm$$

$$MDCR = 4.65 \times 9.49\ cpm = 44.1\ cpm\ (\approx 45\ cpm)$$

So, activity is present at 45 cpm or greater above background (75 cpm total).

5.3 Determine the Minimum Detectable Activity (MDA).

5.3.1 If the isotope of concern and the detector efficiency (eff.) are known/assumed, use the following equation to determine the MDA:

$$MDA = \frac{MDCR}{eff.}$$

Example: MDCR = 44.1 (from the previous example)
eff. = 0.28 (28% efficiency)

$$MDA = \frac{44.1\ cpm}{0.28} = 157.5\ dpm\ (\approx 158\ dpm)$$

6.0 BIBLIOGRAPHY

Basic Radiation Protection Technology, Environmental Survey Techniques - The Lower Limit of Detection, Daniel A. Gollnick, Pacific Radiation Press

7.0 ATTACHMENTS

7.1 MDCR for Count Rate Meters

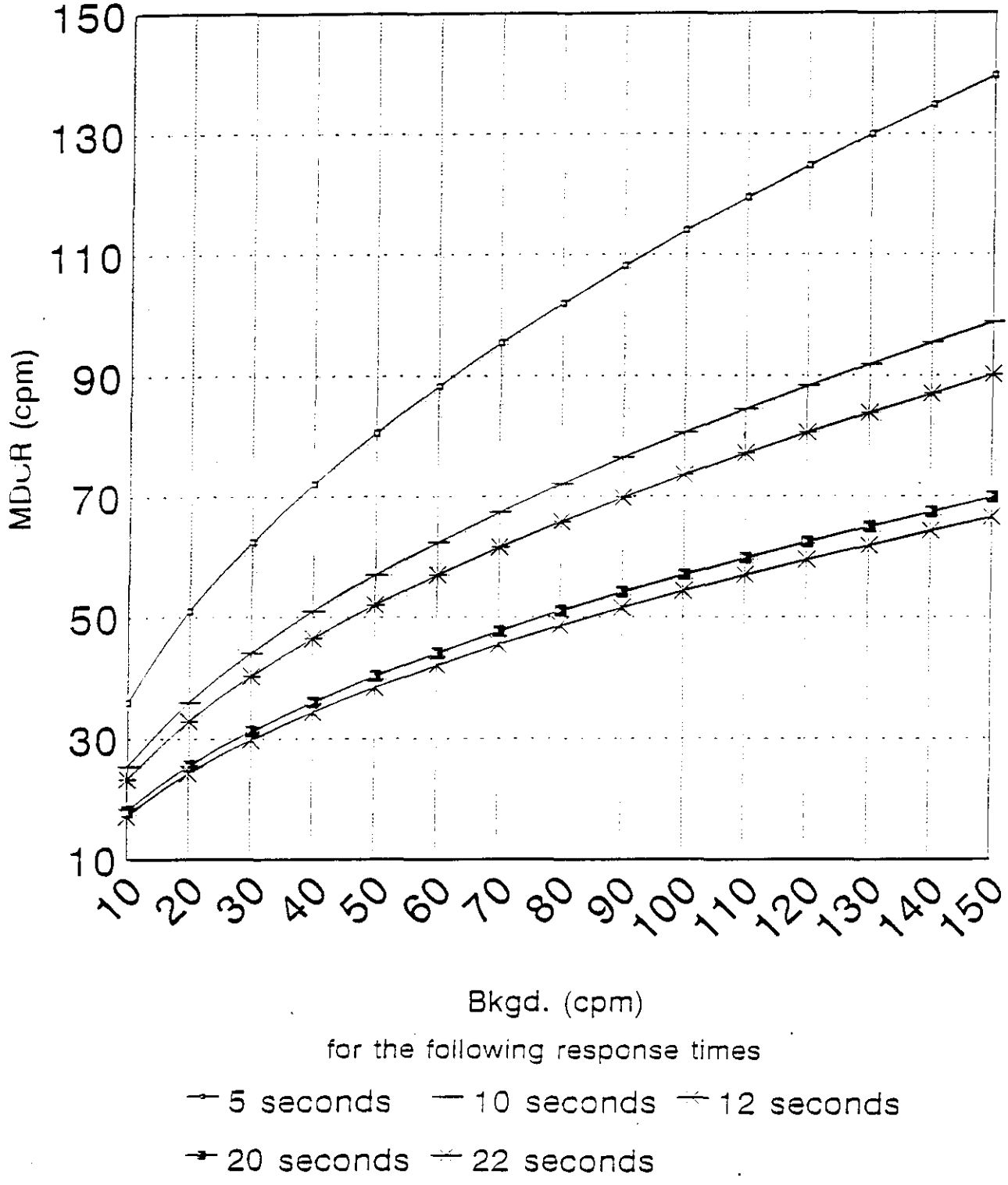
7.2 MDCR for micro-R Meters

8.0 DOCUMENTATION

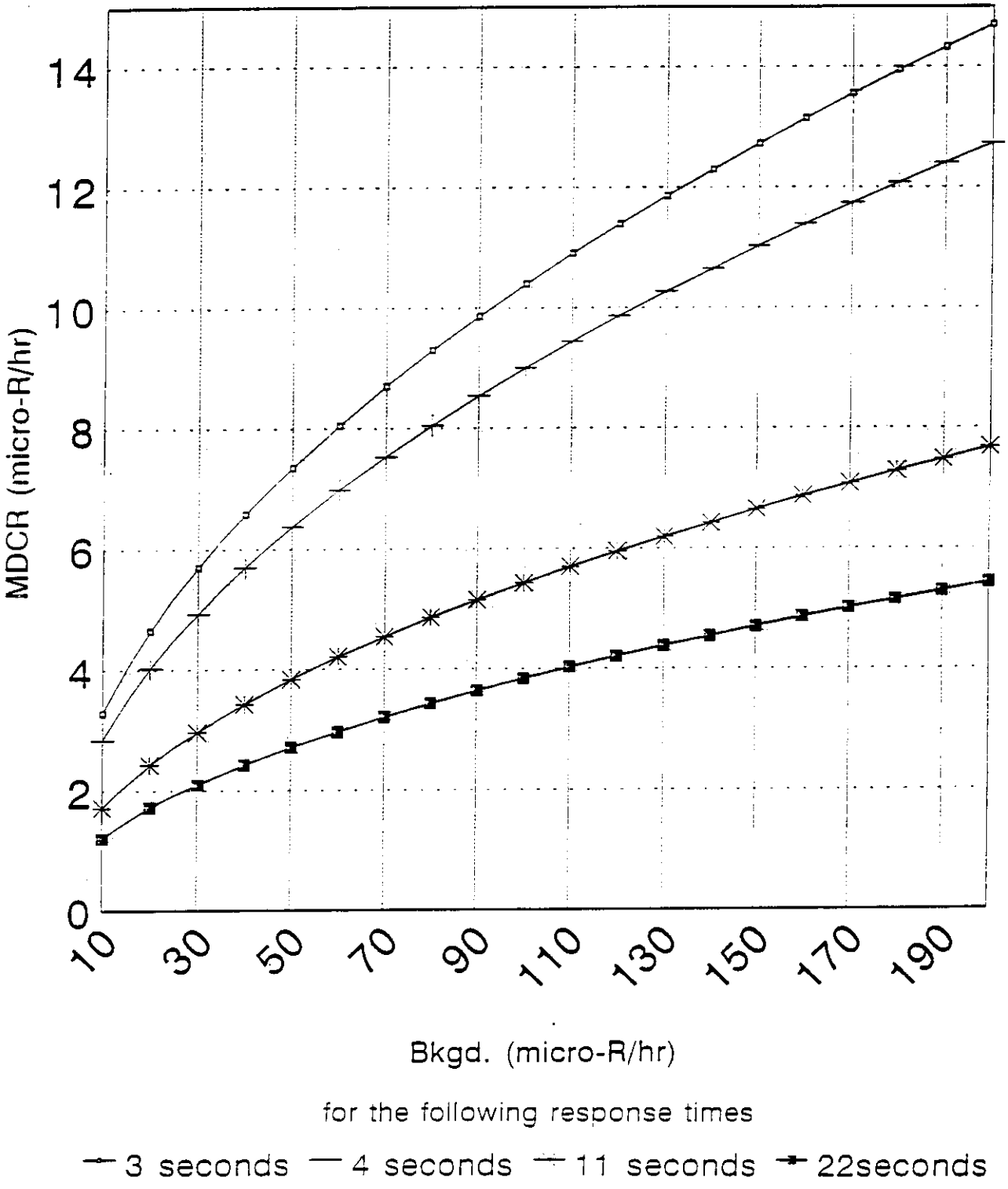
Radiation Survey Report (BD-6000-010), as applicable

Sample Counter Control Chart (A-6000-204), as applicable

MDCR for Count Rate Meters



MDCR for micro-R Meters



TITLE:

PROGRAM AND OPERATE GAMMACOM DOSIMETERS

Approved by

W. C. Mallory, Manager
Radiological Engineering

1.0 PURPOSE AND SCOPE

This procedure describes the steps required to program and operate the GAMMACOM Dosimeter.

2.0 PREREQUISITES

HPT academic and practical training

3.0 PRECAUTIONS/LIMITATIONS

An alarming dosimeter such as the GAMMACOM shall be used upon entry to a Very High Radiation Area, when the dose to the worker is expected to exceed 10% of an Administrative Control Limit (WHC-CM-1-6, Table 2-1) in one working day or upon entry into any open radiography operation.

Use should be considered for entry into a High Radiation Area or when exposures are expected to be above 100 mrem in one working day.

The "Dose Alarm" should be set at 75% of the approved exposure.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Calibrated GAMMACOM pocket alarming dosimeter
- Programma 2 digital dosimeter controller

5.0 PROCEDURE

5.1 Programming the dosimeter

NOTE: If the programmer power is on and the date has been entered, skip to step 5.1.5.

5.1.1 Turn the power switch located on the left side of the Programma 2 Dosimeter Controller to the "ON" position. The green light should come on.

5.1.2 Turn the key on the right side of the programmer to the "READ & WRITE" position (clockwise as far as the key will turn).

5.1.3 Enter the following date information (all number entries must have two digits):

A. Last two digits of current year

B. Number of the current month

C. The day of the month

D. The day of the week (Sunday =01...Saturday = 07)

E. Hour (military)

F. Minute

G. Second

5.1.4 Enter "Y" if the date information is correct or "N" to start over.

5.1.5 Turn the GAMMACOM dosimeter on by pressing the button on the top of the dosimeter (it should have a dose and dose rate reading on the display).

NOTE: If a battery symbol comes on, the battery is low.

5.1.6 If the battery is low, fill out an instrument service tag and remove the dosimeter from service.

5.1.7 Place the dosimeter in the reader slot of the programmer with the clip pointing away.

5.1.8 Press and hold the "I" button, wait until it beeps (approximately two seconds), the option menu should appear.

5.1.9 Press the "C" button, the LCD screen will appear.

5.1.10 Press #1 to load previously stored values from memory
or
press #2 to insert new values.

The following will appear:
C (change)
E (enter)
S (scroll down)
I+S (scroll up)

NOTE: An arrow will appear on the current line. To change or enter data press "C", enter the new value, and press "E" for enter. When data is entered the arrow will disappear. When "E" is pressed the arrow will reappear.

5.1.11 Press the "S" (scroll) button until the arrow is on the line reading "DOSE".

5.1.12 Assure that the "DOSE" line reads "0". If it does not, change it to zero ("0").

5.1.13 Scroll down to "DOSE ALARM". Enter the desired accumulated dose at which the alarm will sound.

NOTE: "Dose Alarm" should be set at 75% of approved exposure as per the WRAM Dose Reporting Dosimeter (DRD) tracking system.

5.1.14 Scroll down to "RATE ALARM". Enter the desired dose rate at which the alarm will sound.

5.1.15 Set the RATE LEVELS as per expected exposure levels.

NOTE: The rate levels are used to track the amount of time spent in a specific intensity radiation field. For example, if level one is 10 and level two is 20, the dosimeter will track the amount of time the dosimeter was in a field greater than 10 mR/hr but less than 20.

5.1.16 Scroll down to "CODE #3", enter location code (where dosimeter is to be used).

5.1.17 Scroll down to "CODE #2", enter the Gammacom's serial number.

5.1.18 Scroll through the rest of the data and assure that the values on the display are consistent with those listed in Attachment 7.1.

Present -> STD may be used to provide a separate store of commonly used values for quick access.

PRESS "C" to change: N= PRESENT VALUES NOT STORED
Y= PRESENT VALUES STORED IN MEMORY
E= STANDARD MEMORY IS EMPTY

5.1.19 Scroll down to "READY TO OUTPUT Yes or No". After all information is entered correctly press the Y (yes) button. The "Writing Please Wait" prompt will appear.

NOTE: When the programmer has completed the transfer of information it will go back to the "Read and Write" mode. The new information is now programmed into the dosimeter.

5.1.20 Verify that the Gammacom is on, and is reading "0.0". The Gammacom is now ready for use.

NOTE: If the dosimeter is not going to be immediately used, turn it off (see section 5.3). If the dosimeter is not turned off, it will start recording dose from the time it is programmed.

5.1.21 Take the dosimeter out of the Programmer.

NOTE: To program another dosimeter, repeat steps 5.1.5 through 5.1.20

5.2 Reading the dosimeter

5.2.1 Assure that the dosimeter and programmer are on.

NOTE: If the dosimeter and/or programmer are not on, follow steps 5.1.1 through 5.1.6 replacing step 5.1.2 with step 5.2.2.

5.2.2 Turn the key on the right side of the programmer to the "READ ONLY" (middle) position.

5.2.3 Press and hold the "I" button, wait until it beeps (approximately two seconds), the option menu should appear.

5.2.4 Record all pertinent information using one of the following two methods.

1. Log the data in the WRAM system.

A. Press "E" "Display".

B. Scroll through the information ("S" scrolls forward, "I&S" scrolls backward) and record applicable information.

2. Press "P" to print the data.

A. Attach the print-out to a Radiation Survey Report, or dispose of it after the information is recorded.

5.2.5 After information has been recorded, press "R" to reset.

5.2.6 Turn the dosimeter off after it has been read (see section 5.3).

5.3 Turning the dosimeter off

5.3.1 Turn the key on the right side of the programmer to the "Read and Write" position (key turned clockwise as far as possible).

5.3.2 Place the dosimeter in the reader slot.

5.3.3 Press and hold the "I" button, wait until it beeps (approximately two seconds), the option menu should appear.

5.3.4 Press the "0" Zero and "Off" button consecutively. "Writing Please Wait" will be displayed and then the dosimeter will turn off.

6.0 BIBLIOGRAPHY

User Manual - Gammacom 4200 M Mark II - mR Digital Dosimeter; R.A. Stephen and Company Limited; Mitcham, England.

WHC-CM-1-6, WHC Radiological Control Manual; Articles 211, 511, 513, Table 2-1

7.0 ATTACHMENTS

7.1 Gammacom Present Settings

ATTACHMENT 7.1
GAMMACOM PRESENT SETTINGS

Dose - 0

Dose Alarm - 75% of approved exposure as per Radiation Area Entry Permit

Rate Alarm - To be determined

Or as appropriate for expected exposure

RATE 1 - 50

RATE 2 - 100

RATE 3 - 500

RATE 4 - 1000

CODE 3 - Location of Work

CODE 2 - Gammacom's outside number

CODE 1 - N/A

ALARM CANCEL - N

SYMBOLS - Y

1 mR - 10 mR BUZZ - Y
(or as appropriate for expected exposure)

RATE DAMPING - Y

ZERO TIMES - N

ZERO MAX. R. - N

CALIBRATION CHECK

PRESENT-STD. - N

1.0 PURPOSE AND SCOPE

This procedure provides the Health Physics Technician (HPT) with information and instructions for operational/functional checking and establishing the alarm set points (ASPs) for the Eberline Hand and Foot Monitor, HFM-4A.

2.0 PREREQUISITES

- HPT academic and fundamental training
- OJT for HFM-4A

3.0 PRECAUTIONS/LIMITATIONS

3.1 This procedure is performed at least quarterly and is required after any of the following:

- Maintenance or repairs
- HFM-4A relocation
- Prolonged outages, greater than one shift

3.2 Activity ("A" Values) are the minimum detection activity used to calculate "Release Activity" and based on the hand and foot detector size, they are:

"A" VALUES

CHANNEL	LIMIT
1, 2, 3 (beta-gamma)	5,000 dpm
1, 2, 3 (alpha)	1,000 dpm

3.3 The channel efficiency ranges are:

- 5% -to- 17% alpha
- 6% -to- 25% beta

3.4 If the gross source count from any one detector, within Channel 1, differs by more than ±20% from the average source count, the HFM-4A shall be tagged out of service and Instrument Maintenance contacted.

3.5 The gas flow rate limits are:

- Inlet Flow: 30 -to- 70 cc/min
- Outlet Flow: An indication of flow

4.0 REQUIRED EQUIPMENT/MATERIALS

- HFM-4A Source Check Worksheet (A-6000-293 - a JetForm)
- Alpha (Pu-239) source ~1,000 dpm, for source checks
- Alpha (Pu-239) source *15,000 - 30,000* dpm, for efficiency checks
- Beta (Cs-137) source ~5,000 dpm/100 cm^2, for source checks
- Beta (Cs-137) source *15,000 - 30,000* dpm/100 cm^2, for efficiency checks

NOTE: Alpha sources are not required at FFTF. All sources shall be approved by HP Radiological Engineering.

5.0 PROCEDURE

5.1 Prepare the HFM-4A for Efficiency Testing.

5.1.1 Check the gas flow meters and compare the reading to the limits in 3.5 above. Make the appropriate verification check on the work sheet and contact Instrument Maintenance, as necessary.

5.1.2 Inspect for damage to and dirt on detector probes. Vacuum the detectors to remove dirt, as necessary.

5.1.3 Align the control switches (left side of monitor) on the central board (left to right) as follows:

- OPN: "Hands and Feet"
- MODEL: "Model A"
- CYCLE: "Manual"
- DISPLAY: "Set channel as necessary to collect count data"
- LINE FREQUENCY: "60 HZ"
- COUNT TIME: "30"
- TIME MULT: "X2"

NOTE: Any failure of the HFM-4A requires that the instrument be tagged "Out of Service", portable instruments *are to* be placed at that location, and Instrument Maintenance *is to* be notified.

5.2 Collect Background Readings.

NOTE: Alpha background and source readings are not required at FFTF.

5.2.1 Switch DISPLAY to "Channel 1" (Ch 1), the electronics and counting response associated with the hand detectors.

5.2.2 Press "Reset Start Button" on back (left side) of HFM-4A to start count.

5.2.3 Read (at control board) and record the Channel 1 alpha and beta background (Rb) counts.

5.2.4 Switch DISPLAY to "Channel 2" (Ch 2), the electronics and counting response associated with the left foot detector.

5.2.5 Read and record the Channel 2 alpha and beta (Rb) background counts.

5.2.6 Switch DISPLAY to "Channel 3" (Ch3), the electronics and counting response associated with the right foot *detector.*

5.2.7 Read and record the Channel 3 alpha and beta (Rb) background counts.

5.3 Collect Check Source Readings.

NOTE: Alpha and beta source readings may be obtained and documented simultaneously by placing alpha and beta sources in separate hand slots (for example: the alpha source in right slot and beta source in left slot, only when in Channel 1). The alpha source readings are obtained on only those instruments which are using both alpha and beta capabilities.

NOTE: When placing sources into the hand slots, do not trip the hand micro switches or the HFM will count backwards. Ensure that the source is approximately centered and flush with the detector.

5.3.1 Collect source readings for hand *detectors.*

1. Switch DISPLAY to "Channel 1."

2. Place the alpha *(15,000 - 30,000 dpm)* source into the left hand slot, with the activity side directed toward the palm detector.

3. Press *the* count button.

4. Read and record the left hand palm (LP) alpha source counts.

5. Reposition the alpha source to the left hand back (LB) detector.

6. Press *the* count button.

7. Read and record the left hand back (LB) alpha source counts.

8. Remove the alpha source.

9. Place the beta *(15,000 - 30,000 dpm)* source to the left hand palm (LP) detector.

10. Press *the* count button.

11. Read and record the left hand palm (LP) beta source counts.

12. Reposition the beta source to the left hand back (LB) detector.

13. Press *the* count button.

14. Read and record the left hand back (LB) beta source counts.

15. Remove the beta source.

16. Repeat 5.3.1, steps 1 through 15, for the right hand. Record the alpha and beta source counts for the right hand palm (RP) and right hand back (RB) detectors.

5.3.2 Collect source *readings* for foot detectors.

1. Switch DISPLAY to "Channel 2."

2. Place the alpha source on the left foot (Ch 2) detector.

3. Press the count button.

4. Read and record the left foot (Ch 2) alpha source counts.

5. Remove the alpha source.

6. Place the beta source on the left foot (Ch 2) detector.

7. Press the count button.

8. Read and record the left foot (Ch 2) beta source counts.

9. Remove beta source.

10. Switch DISPLAY to "Channel 3."

11. Repeat *5.3.2*, steps 1 through 9, for the right foot (Ch 3) detector. Record the alpha and beta source counts for the right foot (Ch 3) detector.

5.4 Calculate Detector Efficiencies.

NOTE: The reverse side of the work sheet is used to calculate the alpha and the beta detector efficiencies. The calculated efficiencies are recorded on the front side of the work sheet.

5.4.1 Calculate the alpha and the beta hand (Ch 1) detector efficiencies, using the following formula:

$$E\,(\text{Efficiency}) = \frac{\dfrac{LP + LB + RP + RB}{4} - Rb\,(Ch\ 1)}{\text{Source Activity(dpm)}}$$

5.4.2 Calculate the alpha and the beta foot (Ch 2 and Ch 3) detector efficiencies, using the following formula:

$$E_{(Ch\,X)} = \frac{\text{Gross Source Counts}_{(Ch\,X)} - Rb_{(Ch\,X)}}{\text{Source Activity(dpm)}}$$

5.4.3 Record the alpha and beta channel efficiencies on the front side of the work sheet.

5.4.4 If channel efficiencies are outside the limits found in 3.3 above, tag the instrument out of service and contact Instrument Maintenance.

5.4.5 Calculate the "Average Gross Count, Channel 1" using the equation provided on the work sheet.

Example: LP = 2800 counts
LB = 2630 counts
RP = 1700 counts
RB = 2918 counts

$$\text{Average} = \frac{LP + LB + RP + RB}{4} = \frac{10{,}048}{4} = 2512\text{counts}$$

5.4.6 Calculate the Acceptable Count Range (± 20%) for Channel 1 and compare to the limit specified in 3.4 above.

Example:

$$\pm 20\% = (0.8)(2512) \text{ -to- } (1.2)(2512) = 2009 \text{ -to- } 3014 \text{ counts}$$

The RP detector gross source count is less than the lower 20% limit. The HPT would tag the instrument out of service and contact Instrument Maintenance.

5.5 Calculate the "Release Activity" (Ra) for Each Channel.

NOTE: The release activity formulas and space to perform the calculations are provided on the reverse side of work sheet. Release Activity (Ra) is the *count rate* (cpm) for release, based on channel detector efficiency.

5.5.1 Calculate the Beta Release Activity (Ra, in cpm) for each channel, using the following equation:

$$\text{Beta } Ra_{(Ch\,X)} = E_{(Ch\,X)}(5{,}000 \text{ dpm})$$

5.5.2 Calculate the alpha Ra (cpm) for each channel, using the following equation:

$$\text{Alpha } Ra_{(Ch\,X)} = E_{(Ch\,X)}(1{,}000 \text{ dpm})$$

5.6 Calculate and Record the Alarm Set Point (ASP) for Each Channel.

NOTE: Ra is the Release Activity (from 5.5 above) and 0.2 minutes (12 seconds) is the count time *in the following equations*.

5.6.1 Calculate the Alpha ASP for each channel from the alpha information above, using the following equation:

$$\text{Alpha } ASP_{(Ch\,X)} = 0.2\left(Ra_{(Ch\,X)} + Rb_{(Ch\,X)}\right) - (0.6)\sqrt{Ra_{(Ch\,X)} + Rb_{(Ch\,X)}}$$

5.6.2 Calculate the Beta ASP for each channel from the beta information above, using the following equation:

$$\text{Beta } ASP_{(Ch\,X)} = 0.2\left(Ra_{(Ch\,X)}\right) - (0.6)\sqrt{Ra_{(Ch\,X)} + 2Rb_{(Ch\,X)}}$$

5.7 Dial the Calculated Alarm Set Points in (Alpha and Beta), on the Control Board.

5.8 Align the Control Switches on the Control Board for Operation.

- OPN: "Hands and Feet"
- MODEL: "Model A"
- CYCLE: "AUTO"
- DISPLAY: "Channel 1"
- LINE FREQUENCY: "60 HZ"
- COUNT TIME: "6"
- TIME MULT: "X2"

5.9 Source Check Each Detector Using the ~1,000 dpm Alpha and ~5,000 dpm Beta-Gamma Source to Verify Proper Alarm Operations.

5.10 File the Completed Eberline HFM-4A Source Check Worksheet in the HP Field Office.

6.0 BIBLIOGRAPHY

Technical Manaul, Eberline HFM-4A

7.0 ATTACHMENTS

NONE

8.0 DOCUMENTATION

Eberline HFM-4A Source Check Worksheet (A-6000-293 - a JetForm)

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TITLE:

OPERATION OF THE 400 AREA EFFLUENT MONITORING SYSTEM

Approved by

R.L. Watts, Manager
Southern Areas and Support Services HP

1.0 PURPOSE AND SCOPE

1.1 **Purpose:** This procedure establishes the method to perform operational checks and respond to off standard situations involving the 400 Area effluent systems. The steps described are required to functionally check installed and temporary effluent monitors and to perform sample changeout. This procedure is intended to be used in conjunction with the Operations procedures EC-96-1, SA-96-14, SN-96-6 and SN-96-8.

NOTE: The overall responsibility for operating and maintaining the EMS is with Operations. Operations' procedures define the frequency and details the surveillance required.

1.2 Discussion:

The AM-2NG Noble Gas CAM consists of:
- Blower - regulator assembly
- Optional filter assembly (particulate filter and charcoal cartridge)
- Nuclear detector assembly (845 cc sample chamber and a SC-2B beta plastic scintillator detector)
- Counting rate meter assembly
- Graphic recorder assembly

Alarm display:
- Fail-safe indication (i.e., green or white light on is normal function)
- High (alert) alarm (i.e., amber light)
- High-High (evacuation) alarm (i.e., red light, rotating red beam, and audible bell alarm)

The installed Effluent Monitors consist of:
- Installed Effluent Monitoring System (EMS) consisting of fourteen channels for beta particulate and noble gases. Eleven of the channels are for environmental releases and three channels are for process monitoring. The channels are identified by cabinet number, location, and channel number. Each channel is alarmed locally and in the Control Room. The system is interfaced with the Data Handling and Display System (DDH and DS) with visual display and printout in the control/computer rooms.

- Selected channels are interfaced with the containment isolation valves (CIS) that divert process effluent to Cell Atmosphere Process System (CAPS). All channels associated with environmental release activate a life support system (i.e., divert Control Room supply air through HEPA filters) or divert exhaust air through HEPAs in case high activity is detected.

- The EMS is a fail safe system. An alarm is activated upon loss of signal, power, or flow. Two alarm set points are provided, "High" and "High-High". The alarm systems are detailed in Operations procedures SN-96-6 and SN-96-8.

2.0 PREREQUISITES

Health Physics Technicians must be qualified on the particular 400 Area effluent system they will operate:

- AM-2NG Noble Gas CAM
- ACT-100 Tritium Gaseous Effluent Sampler
- Installed Effluent Monitoring System (EMS)
- MASF Temporary effluent system.

3.0 PRECAUTIONS/LIMITATIONS

- Notify the Control Room operator of source testing, if CAM is monitored by remote alarm or chart recorder.

- Arrange for the necessary support personnel if alarm testing of CAM will shut down an operating system.

- Count rate values are obtained by reading the meter of the CAM.

- When source checking, use care when opening the sample holder door to avoid dislodging the source from the shield plug.

- If a check source creates a low efficiency response repeatedly on more than one CAM, exchange the source for one of known calibration. Have the suspect source calibration checked.

- Report CAM abnormalities in the HP Logbook, to the HP Supervisor and to the Shift Operator's Manager (SOM).

- Indicate the summary of the days operational performance testing on the Scheduled Radiation Survey Report.

- Return the check sources to their designated storage location. Sources are to be handled by the edges only, avoiding fingerprints on, or scratching of, the activity area of the sources.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Currently calibrated Noble Gas CAM
- CAM Source Check Sheet
- Timekeeping device
- Filter paper or charcoal cartridge or ACT-100 cartridge
- Gelman AN3000 (3 micron) filter paper
- Standard SrY-90 or Cl-36 sources (calibration checked)
- Air sample envelopes

5.0 PROCEDURE

5.1 Noble Gas Continuous Monitor

This procedure establishes the steps and documentation to inspect, source check, and determine efficiency of the NMC Module AM-2NG-51M Noble Gas CAM.

5.1.1 Perform the Operational Check of the Noble Gas CAM

1. Switch on master and high voltage supplies (allow a 5-minute warm-up).

2. Turn off vacuum pump (if on).

3. Place input mode switch to TEST position.

4. If strip-chart recorder does not read between 3200 and 4000, remove CAM from service, attach Instrument Service Tag, and return the unit to the Calibration Contractor for repair and/or exchange.

5. Any failure of the operational check shall be reported to the HP Supervisor.

5.1.2 Establishing Efficiency Performance by Operational Source Check

1. This task is performed upon receipt from calibration, after any power loss, or maintenance, and monthly while in operation.

2. Notify any remote alarm location before performing the source check.

3. Enter the CAM serial number, calibration date, CAM location, check source type, serial number, and activity in dpm, date and time of source check on the CAM Source Check Sheet.

4. Shut off the vacuum to the CAM if it is already in service.

5. Place the input mode switch in "OP" position. Allow CAM count to stabilize (2 to 3 minutes).

6. Read and record the background count rate (BKG) on the CAM Source Check Sheet.

7. Check the CAM alarm set point. Temporarily increase the set point, if necessary, to avoid an alarm while efficiency testing.

8. Remove detector shield plug assembly. Mount the Cl-36 source on the end of the assembly and insert the plug into the detector housing. Allow CAM count to stabilize (2 to 3 minutes).

9. Read and record the stabilized response count rate. Record the stabilization time (ST) on the CAM Source Check Sheet.

10. Calculate and record the net cpm for the check source using the following formula:

    Indicated cpm - background cpm = Net cpm

11. Calculate and record the counting efficiency using the following formula:

    $$\frac{\text{Net cpm}}{\text{Source dpm}} \times 100 = \%\ \text{Eff.}$$

12. The efficiency should be between 5-15%. If not, repeat the efficiency test. If the CAM efficiency remains out of limits, remove CAM from service, attach Instrument Service Tag, and return to Calibration Contractor.

13. Remove shield plug assembly and remove Cl-36 source.

5.1.3 Verify Alarm Set Point (ASP)

1. For determining alarm set point (ASP), the following formula applies:

$$ASP = \frac{A \times V \times E}{k}$$

A = DAC limit for Noble Gas (Krypton 85)
V = Volume of collection chamber (850 cc)
k = 4.5×10^{-7} - conversion constant for uCi to dpm
E = Efficiency of detector (decimal)

2. For determining the Noble Gas CAM alarm set point:

$$\frac{A \times V}{k} = 2000$$

3. To determine the Hi alarm set point (ASP):

Hi ASP = 2000 x E (decimal form)

4. To determine the Hi-Hi alarm set point, multiply the Hi ASP by 10.

5. Record the ASPs on the CAM Source Check Sheet. Draw a diagonal line in the ASP box. Record the Hi ASP above the diagonal and the Hi-Hi ASP below the diagonal. Set ASP on CAM.

6. Alarm set knobs are located behind the snap-out panel. Low setting should be turned completely counter clockwise. The "medium" setting is the calculated Hi ASP. The "high" setting is for the Hi-Hi ASP.

7. Insert a SY-90 (or any source with sufficient activity to trip alarm) into shield assembly. Verify that the alarm activates.

8. Contact the remote alarm locations to verify that the alarm was tripped and notify the Control Room operator that test is complete.

5.1.4 Return the CAM to Operation

1. Place shield plug assembly in the detector housing.

2. Turn on the vacuum pump or vacuum supply. Adjust the photohelic to control flow to 2.0 - 4.0 CFM.

3. If the flow line is blocked so that the preset level cannot be reached, the yellow lamp will light continuously. Should the flow line rupture or shield port be left open, the red lamp will light continuously. Either condition requires immediate attention. Notify the HP Supervisor.

5.2 Radeco Model ACT-100 Tritium Gaseous Effluent Sampler (ACT-100)

This procedure shall be used to operate the ACT-100 on the combined exhaust (C-356) when required by FFTF Operations Procedures for the operation of the Fusion MOTA experiment.

5.2.1 Changing the Cartridge

1. If not already off, turn the electrical power switch to the ACT-100 to "Off".

CAUTION

If the ACT-100 has been running prior to changing the cartridge, the catalytic converter under the wire mesh below the cartridge holder may be very hot.

2. Lift the two restraining straps that hold the cartridge holder in place. Do not use too much force as they will easily bend. Disconnect tubing on cap end of cartridge via quick disconnect.

3. Carefully lift the cartridge holder out of the holder and hold horizontal. Unscrew the right side cap. This will disconnect the cartridge holder outlet.

4. Tape or use caps to seal the ends of the cartridge. Bag and tag cartridge for analysis if required by FFTF Operations.

5. Obtain new cartridge, remove end caps with can opener.

6. On the new cartridge, check to ensure that the connections are hand tight. Check the desiccant window to ensure that the desiccant in the cartridge is blue.

7. Slide the new cartridge into the cartridge holder. Replace the outlet end cap and "O" ring. Be careful not to cross thread the cap and the cartridge holder.

8. Connect quick disconnect on end of cartridge and place the cartridge holder into the cartridge restraining straps and fasten in place. Close the lid. The unit is now ready for use.

5.2.2 Connecting the ACT-100 to C-356.

1. If not already in place, place the ACT-100 adjacent to the Triton on C-356.

2. Connect the inlet of the ACT-100 to the upstream inlet of C-356 with tygon tubing using the quick disconnects.

NOTE: DO NOT reposition the three-way valve. There is sufficient flow through the sampling system to supply both the ACT-100 and the installed Triton.

3. Reset elapsed TIMER meter to zero by turning the knurled white knob.

4. Turn the power switch to the ON position. The rotameter flow should be between 60 - 100 cc/min.

5. Record the start time and flow rate on a sample filter envelope and attach to the side of the ACT-100.

5.3 INSTALLED UNITS

The HPT is responsible for the following actions in this section. This section establishes the instructions for operating the Installed Effluent Monitoring System (EMS).

- Assisting Operations in the source check of EMS
- Completing shift turnover on EMS status
- Submit a J-3 to the Shift Operator's Manager (SOM) for chart paper replacement or for maintenance.

5.3.1 Perform Operational Inspection

CAUTION

The vacuum pumps on the installed monitors are "Positive Displacement" pumps and must have an air flow path whenever running to prevent damage to pump. Proper positioning of the three-way valve is critical.

1. All inspections, operations (e.g., filter change, source check, alarms) and changes shall be noted on the strip chart and the HP Field Logbook. Enter location, time, date, action, initials and arrow pointing to chart marking. Operations maintains the strip charts.

2. Observe the operation of each channel once per day and report any problems to the Control Room. Record any malfunctions or problems on shift turnover sheet and in HP Logbook.

5.3.3 Change Filter Media

1. This process is performed weekly, or as required by SA-96-14. Use Gelman AN3000 (3 micron) filters on all installed CAMs except C-346A which requires LB5211 paper.

2. Notify the Control Room that a filter change is to be performed.

3. Record flow rate for each channel on the air sample envelope(s). Record the date on and location on the edge of the new filter.

NOTE: All channels are maintained between 1.8 and 2.8 CFM flow rate by a photohelic device.

4. Record the sampling date (on and off), time (on and off), location, and the initials of the collector on the air sample envelope and the strip chart.

5. Survey the filter, presently in the effluent monitor, prior to removing. An open window GM probe (e.g., HP-260) should be used.

6. If radiation (other than verified radon) is detectable above background for beta/gamma or alpha, the sample shall be considered radioactive and shipped to PNL Radiochemistry as radioactive material.

7. If a reading greater than $\approx$6000 cpm beta/gamma or 1000 cpm alpha is measured, flag the sample for special processing to prevent contamination of low level counting equipment.

8. Remove the filter and replace it with the new Gelman AN 3000 filter. Place removed filter in air sample envelope.

9. Notify the Control Room when the filter exchange is complete for all the units.

5.3.4 Change Iodine Charcoal

1. Perform this task bi-weekly, or as required by SA-96-14. This operation can normally be performed concurrently with the particulate filter sample collection.

2. Notify the Control Room that a sample change is to be performed.

3. Record the flow rate (normal 2CFM), date (on and off), time (on and off), and initial the sample envelope and recorder strip chart.

4. Record date and time on, and initial the new charcoal cartridge.

5. Survey the charcoal cartridge, prior to removing, with an open window GM probe.

6. If radiation levels are detectable for beta/gamma the sample shall be considered radioactive. If the reading exceeds ≈6000 cpm, flag the sample for special processing to prevent contaminating counting system.

7. Remove the used charcoal cartridge and replace with the new cartridge. Write date, time and location on cartridge.

8. Notify the Control Room when all sample exchanges have been completed.

5.3.5 Collect Gas Samples for Gamma Analysis

NOTE: This task is performed as required by Operations. The effluent diversion fittings required for this task are located on the air sampling lines above the cabinets for each channel.

1. Notify the Control Room that the sample is being collected.

2. Connect the gas sample chamber to the effluent diversion fittings. This diverts air through chambers and vents back into air sample line. Open the valves to the sample chamber to allow flow through the chamber.

3. Divert the effluent air through the sample chamber by closing the shut-off valve and allow the air to flow through the chamber for approximately 2 minutes to purge the chamber.

4. Open the shut-off valve. Close the valves in the sample chamber line. Disconnect the sample chamber from the air sample line.

5. Record the date, time, channel number, and collector of the sample on the attached label.

6. Notify Control Room that sample collection is complete.

5.3.6 Air Filter Changeout For the Model 955B Triton

1. Grasp the transparent cover and rotate in either direction until released. This provides access to the filter.

NOTE: The filter element is a Gelman, two inch diameter (nominal pore size is 0.5 micron) or equivalent.

2. Remove the old filter. Place a new filter element on the backup plate and make sure that it is properly seated, i.e., the filter element is placed on the backup plate with the rough side upwards.

3. Place the O-ring (2 inch outside diameter, 0.070 inch width) on top of the filter.

4. Insert the transparent plastic cover. Press it down and turn it to lock it into the filter body.

5. The O-rings should occasionally be lubricated with a trace of grease to reduce friction between it and the plastic cover. The small O-ring in the filter inlet (and also the one in the gas outlet connector) requires infrequent lubrication; smear a trace of grease on the metal fitting on the inlet. Wipe clean.

5.4 MASF Temporary

This procedure establishes the instructions to connect an Eberline AMS-3 CAM to the MASF effluent system and perform an operational functional check.

5.4. Temporary Installation of CAM on Effluent System

1. Notify the MASF lead engineer of any source checks or other alarm tests.

NOTE: Several of the following steps will affect the operation of the ventilation system in MASF. EDS personnel shall either be present or authorize and direct the installation of the temporary CAM in accordance with this procedure or MASF procedure MI-18-4.

2. Check to ensure that the installed cabinet sample pump is secured.

NOTE: The next step will cause the HVAC fans to shutdown unless they are placed in the Manual (RUN) mode.

3. Plug the Eberline AMS-3 into a wall outlet. Do not plug into the power strip in the installed monitor cabinet. When the cabinet is electrically shut off, this power bar is not energized.

NOTE: If the installed cabinet is not electrically isolated on a failure mode, it will bypass the temporary CAM alarm circuitry and will not allow the ventilation system to operate.

4. Connect the inlet of the Eberline AMS-3 to the quick disconnect to the sample inlet of the installed monitor. Connect the outlet of the vacuum pump to the quick disconnect to the sample outlet of the installed monitor. Connect the inlet of the vacuum pump to the outlet of the Eberline AMS-3.

5. Position the sample valves adjacent to the quick disconnects such that their handles are in the horizontal position. This blocks the duct sample lines to the cabinet and vents the cabinet sample lines to atmosphere.

6. Disconnect the Amphenol MS3100 series connector at the rear of the cabinet.

7. Connect the temporary CAM alarm cable (stored in the HPT office) to the connector, labeled "HVAC CONTROL CIRCUIT". This connects to the HVAC/Temperature Control Cabinet.

8. Connect the other end of the CAM alarm cable to the back of the Eberline AMS-3 CAM to the points labeled under the "HIGH ALARM" as { C } and { NC }. Either lead on the cable may be connected without affecting the circuitry.

9. Start the vacuum pump and energize the Eberline AMS-3 CAM.

10. Perform an efficiency check per WHC-IP-0718 procedure.

11. Set the high alarm on the Eberline AMS-3 at 10,000 cpm. Place the Sr-90 wand to test the alarm circuit on the CAM. Check to ensure that the CAM will alarm at the designated set-point.

NOTE: The Power Operator or EDS representative will now have to re-establish the ventilation system.The temporary Eberline CAM has only a local high alarm and indication functions. The automatic shutdown of the HVAC fans occurs when a high alarm condition is present.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual

Operations Procedures:

EC-96-1, Monthly Radiation Effluent Monitoring Source Check and Channel Functional Test

SA-96-14, Response to High or High-High Airborne Activity

SN-96-6, Operation of AEB-E Combined/RSB/HTS-S and Control Building Radiation Monitors

SN-96-8, Operation of RSB Unlined Cel Exhaust and ARGON Blower, and Valve Cell Radiation Monitors and Cell 489 Pressure Monitors

MASF Procedure MI-18-4

7.0 ATTACHMENTS

None

8.0 DOCUMENTATION

400 Area Health Physics Logbook

Scheduled Radiation Survey Report

CAM Source Check Sheet

TITLE:

OPERATION OF TRI-CARB LIQUID SCINTILLATION COUNTER

Approved by

Richard L Watts

R. L. Watts, Manager
Southern Areas and Support Services HP

1.0 PURPOSE AND SCOPE

1.1 **Purpose:** This procedure establishes the standard method for startup, calibration, testing, and operation of the Tri-Carb 1600CA Liquid Scintillation Analyzer (LSA).

1.2 **Scope:** The Tri-Carb 1600CA LSA is used for identifying radioactivity which is in the tritium energy range on smears and liquid samples.

2.0 PREREQUISITES

- Health Physics Technician must be qualified on the Tri-Carb LSA.
- The CRT indicator light on the front monitor should be illuminated.
- The power to the printer should be on and the printer should be "ON-LINE" for operation.
- The printer should have an adequate supply of paper.
- The lid to the LSA should be lifted to verify that the sample changer is free of any obstructions.
- Both sides of the track assembly (CLEAR AREA) should be empty before commencing any counting evolution.

3.0 PRECAUTIONS/LIMITATIONS

A. Power to the LSA should be maintained at all times to improve the overall system stability. Power should be interrupted only when necessary (See D below).

B. Clear Zones on both sides of the track assembly must remain clear during operation to avoid damage to the LSA.

C. When the sample rack is in the process of transferring from one side of the track assembly to the other, DO NOT MANUALLY REMOVE the sample rack. This could damage the LSA.

D. With the exception of section 5.3, all other sections can be run in conjunction with each other and in any order. When section 5.3 is performed both 5.4 and 5.5 of this procedure must be executed. Section 5.3 is performed whenever there is a loss of electrical power or maintenance work is performed on the LSA; otherwise these sections are performed annually.

E. If the LSA malfunctions, press the escape (ESC) button on the computer to stop operation. If pressing the ESC button does not stop the LSA counting sequence and apparent damage could occur to the LSA, shut off power to the LSA.

F. Pressing the "ESC" key will immediately stop the LSA regardless of where it is at in the counting sequence. To restart the counting sequence, press the "F2" key once.

G. Protocol criteria cannot be changed when that protocol is active. The protocol that is active must be completed, or another must be started before the original protocol criteria can be modified.

H. The protocol numbered rack will determine which protocol is run, not the computer keys. The proper sources and samples must be in the appropriate protocol rack to assure the proper test is run.

I. During operation of the LSA, the lid must be closed to limit room light interference.

4.0 REQUIRED EQUIPMENT/MATERIALS

- Tri-Carb 1600CA LSA
- NIST traceable calibration standards:

Source	Serial No.	Dated
C-14	102	1-16-89
H-3	41	4-10-89
*H-3	A	2-14-89
*H-3	B	2-14-93
*H-3	C	2-14-89
*H-3	D	2-14-89
*H-3	E	2-14-89
*H-3	F	2-14-89
*H-3	G	2-14-89
*H-3	H	2-14-89
*H-3	I	2-14-89
*H-3	J	2-14-89
Background		1-89

* These sources are part of a source set.

- Liquid Scintillation Vials
- Ultimate Gold LSC Cocktail or equivalent
- Auto Repipet dispenser set at 15 mls
- Whatman 4.25 Filter Papers or equivalent
- Auto repipet with 1 ml disposable tips (optional)

5.0 PROCEDURE

5.1 Daily Performance Test of The Tri-Carb LSA

5.1.1 Loading the LSA

1. Load the **"Background"** standard dated JAN 89 into vial slot #1 and **H-3** standard S/N 41 into vial slot #2 of the sample rack labeled "Protocol 1".

2. Gently push the tab behind the "Protocol 1" label to the left.

3. Place the "Protocol 1" rack on the right side of the track assembly with the track number pointing to the right.

4. Load **H-3** standard S/N "A" into vial slot #1 of the sample rack labeled "Protocol 3".

5. Gently push the tab behind the "Protocol 3" label to the left.

6. Place the "Protocol 3" rack on the right side of the track assembly with the rack number pointing to the right.

5.1.2 Running Performance Tests

1. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

2. Press the "F2" key once to start the performance test.

NOTE: The LSA will stop shortly after the performance test is completed and the computer will indicate "IDLE". (See Table 1)

NOTE: Turning the lights off in the counting room can improve the counting results.

Table 1: Computer CRT LSA Status Display

DISPLAY	MEANING
"SEARCHING"	LSA is looking for racks with their flags set.
"COUNTING PROTOCOL"	LSA is running the performance test.
"IDLE"	LSA not active and track assembly is not in motion.

3. Take the printer off-line by pushing the "ON-LINE" button once, press the **FORM FEED** button on the printer twice and remove pages from printer.

4. Place the printer back on-line by pressing the ON-LINE button once.

5.1.3 Evaluation of Performance Test

1. Evaluate the background test using Table 2.

Table 2: Performance Test Evaluation

Protocol 1 "H-3 Bkg/Eff"	Sample #1 System Background Count	• Value must be less than 50 • A "**B**" must appear in the flag column.
	Sample #2 H-3 Efficiency Check	• % Eff value must be at least 60 or greater.
Note:	If the above conditions are not met or if any other flags appear, the LSA is not functioning properly; notify the HP manager.	

2. Evaluate the daily counts using Table 3.

Table 3: Daily Count Evaluation

Protocol 3 "Daily Source Test"	Verify that all 5 counts fall within the 95% confidence level boundaries established in the CHI-SQUARE test.	• If less than 5 counts fall within the 95% confidence level boundaries, evaluate the previous (i.e., since the last CHI-SQUARE test) daily counts: 1. If the cumulative number of daily counts outside the 95% confidence level is less than or equal to 5%, continue running the LSA. 2. If the cumulative number of daily counts outside the 95% confidence level is greater than 5%, notify the HP manager.
Note:	If satisfactory results are not obtained, document failure in the shift logbook; contact the HP Manager by the next normal working day. Evaluation of all the data is necessary before continuing. If any flag appears, other than those indicated, then the LSA is not functioning properly; the HP manager should be notified using a DSI.	

3. Plot the printout results of each of the 5-one minute counts as a dot in the applicable day column, on the SAMPLE CONTROL CHART.

4. Plot the average count (the last count on the printout and has an "A" in the flag column) on the SAMPLE COUNTER CONTROL CHART (Figure 1), by entering the count value as a "X".

5. Connect the previous days "X" count, with a line, to indicate that the counting system is functioning within the desired operating limits.

6. Examine the SAMPLE COUNTER CONTROL CHART for trends. If abnormal trends are observed, contact the HP manager to arrange for maintenance.

7. Place your initials in the appropriate day column box on the SAMPLE COUNTER CONTROL CHART.

8. Sign your name and payroll number in the space provided on both printouts.

9. Place the signed pages in the TRI-CARB sample logbook.

5.1.4 Minimum Detectable Count Rate (MDCR) Determination

1. Calculate the MDCR at the 95% confidence level. (Background value obtained in step 5.1.3.A.1)

NOTE: Background count results are average counts per minute (cpm) obtained over a ten minute count. Sample count time is four minutes. R_{Bkg} is the cpm not the total counts.

2. Record the MDCR level (as a whole number) in the appropriate box on the SAMPLE COUNTER CONTROL CHART.

5.2 Tritium Sample Counting Using the LSA

5.2.1 Sample Preparation

1. Obtain a standard technical smear (using a filter dampened with distilled water) or a liquid sample in the area to be surveyed. (The Whatman "5" or equivalent filter is used for the smear)

NOTE: All handling of the sample vials should be by the lid and/or lid and bottom to avoid smudges which could affect the light pulse output.

2. Roll the smear with the smeared side on the inside of the roll and place in a sample vial;

   or

   Measure or pipet 1 ml from the liquid sample and place in a sample vial.

3. Using the auto Repipet dispenser, pipet 15 mls of Ultimate Gold into the sample vial.

4. Screw on the plastic lid. Keep track of samples by writing locations on the vial lids.

5. Gently swirl for mixing but DO NOT agitate as this will cause air bubbles.

5.2.2 Loading the LSA

1. Load vial labeled "B" into vial slot #1 of the sample rack labeled "Protocol 2".

NOTE: The above step provides background for sample counting.

2. Place samples to be counted in "Protocol 2" rack starting with slot #2 to the right of the sample vial labeled "B".

3. Gently push the tab behind the Protocol 2 label to the left.

4. Place the Protocol 2 rack on the right side of the track assembly.

5. Let the samples sit for at least 30 minutes inside the LSA (out of the room light).

6. If additional sample counts are required, place the samples in an empty unlabeled rack(s), starting with slot #1. Then place the rack(s) directly behind the Protocol 2 rack on the track assembly.

5.2.3 Counting Samples

1. Load racks in the following order:

   - Protocol 2 Rack [samples are loading starting in slot #2]

   - Additional sample Racks

2. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

3. Press the "F2" key once to start the normal counting sequence. Count time is 10 minutes for background and 4 minutes per sample.

NOTE: The LSA will stop shortly after counting sequence is completed and the computer will display "IDLE". (See Table 1)

5.2.4 Evaluation of Counting Results

1. Take the printer off-line by pushing **ON-LINE** button once, press the **FORM FEED** button twice and remove result printout pages.

2. Write the sample description beside each sample on the page.

3. Place the printer back on-line by pressing the ON-LINE button once.

4. Evaluate Protocol 2 "H-3 DPM" using Table 4

Table 4: Sample Evaluation

Protocol 2	Sample #1 Background Sample	• A "B" must be in the flag column
	Samples	• An "E" appearing in flag column indicates the DPM have been extrapolated and should appear only adjacent to sample results. • Compare the H-3 DPM results with the action levels on the applicable RWP or the WHC-CM-1-6 manual. (See Note 2)
NOTE 1:	If the flags identified in the above criteria do not show as indicated, the LSA is not functioning properly; notify the HP manager.	
NOTE 2:	Liquid samples which the LSA identifies as having an activity level $\geq$ 1000 dpm must be evaluated by HP supervision prior to being released.	

5. On the printout, sign your name and payroll number in the space provided.

6. Place signed pages in the TRI-CARB sample logbook.

5.2.5 Disposal of Sample Vials

1. Place sample vials exceeding the WHC-CM-1-6 control levels or the RWP action levels in the container marked for radioactive samples. Do not remove the lids. Keep the sample vial and its contents intact. Operations Support will dispose of sample vials.

2. Sample vials, where the action levels have not been exceeded, will be opened and emptied into the appropriate containers.

3. The storage containers must be labeled with the Hanford Hazardous Material Label.

5.3 Startup/Calibration/Response Test For LSA

NOTE: If this section is performed, it is required that sections 5.4 and 5.5 are also completed.

5.3.1 LSA System Calibration

1. Load the C-14 standard S/N 102 into vial slot #1 of the rack labeled "SNC".

2. Gently push the tab behind the "SNC" label to the left.

3. Place the "SNC" rack on the right side of the track assembly with the rack number to the right.

4. Remove all other racks from the LSA.

5. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

6. Press the "F2" key once to start the calibration sequence.

CAUTION

DO NOT press the "ESC" key while the system is running the "SNC" test or else the system calibration will be lost.

NOTE: The LSA will stop shortly after the calibration sequence is completed and the computer will display "IDLE". (See Table 1)

7. After the LSA has stopped remove the "SNC" rack from the LSA.

5.3.2 LSA System Response Test

1. Remove Background standard from "Protocol 1" rack and place it in vial slot #1 of the rack labeled "Protocol 6".

2. Gently push the tab behind the "Protocol 6" label to the left.

3. Place the "Protocol 6" rack on the right side of the track assembly with the rack number to the right.

4. Remove the C-14 standard S/N 104 from the "SNC" rack and place it in vial slot #1 of the rack labeled "Protocol 7".

5. Gently push the tab behind the "Protocol 7" label to the left.

6. Place the "Protocol 7" rack on the right side of the track assembly directly behind the "Protocol 6" rack with the rack number to the right.

7. Remove H-3 standard S/N 41 from "Protocol 1" rack and place it in vial slot #1 of the rack labeled "Protocol 8".

8. Gently push the tab behind the "Protocol 8" label to the left.

9. Place the "Protocol 8" rack on the right side of the track assembly directly behind the "Protocol 7" rack with the rack number to the right.

10. Remove all other racks from the LSA.

11. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

12. Press the "F2" key once to start the response test sequence.

NOTE: The LSA will stop shortly after the response test sequence is completed and the computer will display "IDLE". (See Table 1)

13. After the LSA has stopped remove all the racks from the LSA and return the sources as follows:

    - C-14 standard S/N 102 to vial slot #1 in the "SNC" rack.
    - H-3 standard S/N to vial slot #2 in the "Protocol 1" rack.
    - Background standard to vial slot #1 in the "Protocol 1" rack.

5.3.3 Evaluation of the LSA Response Test

1. Take the printer off-line by pushing **ON-LINE** button once, press the **FORM FEED** twice and remove result printout pages.

2. Place the printer back on-line by pressing the ON-LINE button once.

3. Evaluate the response test using Table 5.

TABLE 5: Response Test Evaluation

Protocol 6	"QIP/BKG TEST"	• BKG-A must be less than 50 counts. • BKG-B must be less than 80 counts and at least equal to BKG-A. • BKG-C must be less than 100 counts and at least equal to BKG-B. • The fourth value is the average of the preceding values and there must be an "A" in the Flag column.
Protocol 7	"QIP/14-C Response Test"	• All "QIP-A" values must be equal to or greater than 950 and less than or equal to 1050. • All "QIP-B" values must be equal to or greater than 148 and less than or equal to 164. • All % Eff must be at least 90. • The fourth value is the average of the preceding values and there must be an "A" in the Flag column. • All preceding counts must be within 3% of the average count.
Protocol 8	"QIP/#-H Response Test"	• All % Eff must be at least 60%. • The fourth value is the average of the preceding values and there must be an "A" in the Flag column.
NOTE: If any of the above conditions are **NOT** met or if any flags other than the ones specified above appear the Response Test is **INVALID**. Repeat steps 5.3.2 and 5.3.3. If the LSA fails a second time, contact the HP Manager.		

5.3.4 Perform step 5.4, Chi-Squared Test, of this procedure.

5.3.5 Perform step 5.5, Quench Curve, of this procedure

5.3.6 On the printout, sign your name and payroll number in the space provided.

5.3.7 Place the signed pages in the TRI-CARB sample logbook.

5.4 Chi-Squared Test on LSA

5.4.1 Loading the LSA

1. Remove the H-3 standard S/N "A" from "Protocol 3" rack and place it in vial slot #1 of the rack labeled "Protocol 9".

2. Gently push the tab behind the "Protocol 9" label to the left.

3. Place the "Protocol 9" rack on the right side of the track assembly.

5.4.2 Counting Sources

1. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

2. Press the "F2" key once to start the normal counting sequence.

NOTE: The LSA will stop shortly after counting sequence is completed and the computer will display "IDLE". (See Table 1)

3. After the LSA has stopped, remove the sample rack and place the H-3 standard S/N "A" in vial slot #1 of the "Protocol 3" rack.

5.4.3 Recording Source Information

1. Take the printer off-line by pushing **ON-LINE** button once, press **FORM FEED** button twice and remove result printout pages.

2. Place the printer back on-line by pressing the ON-LINE button once.

3. From Protocol 9 "CHI-2" page enter the first twenty (20) counts into the Chi-Squared computer program.

4. An "**A**" must appear in the flag column adjacent to the twenty-first (21st) value. If this flag is <u>**NOT**</u> present then the LSA is NOT functioning properly and all results are NOT valid. Repeat step 5.4.2. If the LSA fails a second time, contact the HP Manager.

5. If any other flags appear in the flag column, verify that the standard is in the proper location in the "Protocol 9 " rack. If it is in the correct location, the LSA is NOT functioning properly and all results are NOT valid. Repeat step 5.4.2. If the LSA fails a second time, contact the HP Manager.

5.5 Quench Curve for LSA

5.5.1 Determination of current DPM value of Quench Source Set.

1. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

2. Press the "F4" key and the words "DECAY COMPUTATION" should appear on the top left of the CRT.

A. If the words "Decay Computation" do **NOT** appear then repeat steps 1 & 2.

B. If the words still do **NOT** appear then the LSA is not functioning correctly, notify the cognizant HP Manager.

3. Move the cursor until the "Ref DPM" value is highlighted.

4. Enter the value: **254600**

5. Move the cursor until the "Ref Date" month is highlighted.

6. Enter the value: **2**

7. Move the cursor until the "Ref Date" date is highlighted.

8. Enter the value: **14**

9. Move the cursor until the "Ref Date" year is highlighted.

10. Enter the value: **89**

11. Move the cursor until the "Radionuclide" is highlighted.

12. Press the "F2" key.

13. The Current DPM value for the Quench Source Set is now displayed; record this value, since it is required for use in step 5.5.2.10.

NOTE: If "3H" does **NOT** appear as the radionuclide then repeat step 5.5.1.12. If "3H" still does **NOT** appear then the LSA is **NOT** functioning correctly, notify the HP Manager.

5.5.2 Editing the Quench Curve Protocol "Protocol 10".

1. Press the "F1" key until the words "EDIT PROTOCOL" appear on the top left of the CRT.

2. Enter the value: 10

3. Press the "Pg Dn" key until the words "DPM PAGE" appear on the top left of the CRT.

4. Move the cursor until "Standards Data" value is highlighted.

5. Press the "F2" key.

NOTE: The "Standards Data" value must change to "count". If it does **NOT** the LSA is not functioning correctly, notify the HP manager.

6. Move the cursor until the "#Stds/Nuclide #1" value is highlighted.

7. Enter the value: 10

8. Move the cursor until the "Nuclide 1:DPM" value is highlighted.

9. Enter the value obtained in step 5.5.1.13

10. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

5.5.3 Loading the LSA.

1. Remove the Background standard from the "Protocol 1" rack and place it in vial slot #1 of the "Protocol 10" rack.

2. Remove the H-3 standard S/N "A" from the "Protocol 3" rack and place it in vial slot #2 of the "Protocol 10" rack.

3. Ensure that H-3 standards S/N "B" through "J" are in vial slot #3 through vial slot #11, respectively.

4. Gently push the tab behind the "Protocol 10" label to the left.

5. Place the "Protocol 10" rack on the right side of the track assembly with the rack number to the right.

6. Remove all other racks from the LSA.

7. Press the "F1" key until the words "STATUS PAGE" appear on the top left of the CRT.

8. Press the "F2" key once to commence the creation of the quench curve.

NOTE: The LSA will stop shortly after the quench curve has been created and the computer will display "IDLE". (See Table 1)

9. After the LSA has stopped remove all the racks from the LSA and return the sources as follows:

   - H-3 standard S/N "A" to vial slot #1 in the "Protocol 3" rack.
   - Background standard to vial slot #1 in the "Protocol 1" rack.

NOTE: The Protocol 10 "Quench" will consist of two (2) pages.

The values listed under the DPM and 95% CL must be 0.00 for all samples. A "**B**" must appear in the flag column beside sample #1 and an "**L**" must appear in the flag column beside all the samples. If any of the conditions are not met, the LSA is not functioning properly and the HP manager should be notified.

5.5.4 Transferring the Quench Curve to Protocol 2 "H-3 DPM".

1. Press the "F1" key until the words "EDIT PROTOCOL" appear on the top left of the CRT.

2. Enter the value: <u>2</u>

3. Move the cursor until the "Copy Protocol #" value is highlighted.

4. Enter the value: 10

5. Move cursor until the "Protocol Name" is highlighted.

6. Enter "H-3 DPM".

7. Press the "F1" key until the words" STATUS PAGE" appear on the top left of the CRT.

5.5.5 Sign your name and payroll number in the space provided on the printouts.

5.5.6 Place the signed pages in the TRI-CARB sample logbook.

6.0 BIBLIOGRAPHY

WHC-CM-1-6, WHC Radiological Control Manual, Table 2-3.

7.0 ATTACHMENTS

7.1 Sample Counter Control Log

8.0 DOCUMENTATION

Computer generated HP Lab Counter Test Log

LSA Test/Sample result printouts

HP Field Log Book

ATTACHMENT 7.1
Sample Counter Control Log

Health Physics	SAMPLE COUNTER CONTROL CHART ☐ Primary ☐ Secondary	Facility / Date Issued / Supersedes Issue Date

Months _____

| | | |

Attachment 6

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740 STVCN, RM 1600
Richland, Washington

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Part 1

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Preface

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INTRODUCTION

Approved by

R. E. Heineman, Manager
Health Physics

PURPOSE

This manual was prepared to provide a consolidated manual of radiological safety requirements for WHC operations. It combines radiation protection criteria and standards of the Hanford Site Radiological Control Manual (HSRCM) with supplemental requirements of WHC. The radiation protection requirements of this manual are responsive to the applicable requirements of the U. S. Department of Energy and other regulatory agencies.

SCOPE

This manual applies to all WHC organizations and subcontractors.

MANUAL ORGANIZATION

The *WHC Radiological Control Manual* (WHC-RCM), is divided into seven chapters whose numbers and titles duplicate those in the parent document, the *Hanford Site Radiological Control Manual* (HSRCM). Each chapter is presented in parts that consist of a number of articles. The numbers and titles of the parts and articles also duplicate those presented in the parent document.

The parts of each chapter are divided into subsections called articles. Each article is assigned a three-digit number; the first digit refers to the chapter, the second to the part, and the third to the subsection. For example, Article 284 refers to Chapter 2, Part 8, subsection 4.

WHC supplemental requirements are identified as WHC addenda to the relevant articles. To alert the reader to the articles with WHC supplemental requirements, the numbers for those articles are marked with an asterisk (for example, Article 284*).

To make the manual easier to use, an additional part (Part 0) has been added at the beginning of each chapter. This part summarizes the personnel responsibilities that are discussed later in the chapter and is intended to serve as a quick-find reference. Part 0 lists the major categories of responsibility relevant to Hanford Site-specific radiological control requirements implemented under this manual.

For consistency, the major categories of responsibility are numbered using a prescribed numbering format. The article numbers for the responsibilities are selected using this system:

- X00 Department of Energy
- X01 Senior Site Executive
- X02 Line Management
- X03 Radiological Control Manager
- X04 ALARA Committee
- X05 Radiological Assessor
- X06 Quality Assurance
- X07 Employees
- X08 Support Organizations
- X09 HSRCM Project Group

The first digit represents the chapter number, the second digit the part number, and the third digit the category number. In each chapter, the specific requirements for each applicable category are summarized and a parenthetical article number is provided to guide the user to the more detailed information within ensuing parts of the chapter. Not all categories are applicable in each chapter.

Although tables and figures are included within the text of chapters, forms, checklists, and additional short guidelines are called out as exhibits, which are inserted at the end of each chapter. More lengthy supplemental information is included in appendixes at the end of the manual.

CHANGE CONTROL

Changes to requirements of the HSRCM follow the provisions outlined in Article 113. The change process for WHC requirements are specified in WHC-CM-1-3, MRP 2.16, "Controlled Manual System." Specific WHC waiver mechanisms and compliance plan content are identified in the WHC addendum to Article 113.

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*Articles marked with an asterisk indicate WHC Addendums are included.

Part 0 Summary of Responsibilities

100 Department of Energy

Assistant Secretary for Environment, Safety and Health (DOE-EH)

- Review and update U.S. Department of Energy (DOE) Radiological Control Manual (RadCon Manual; DOE 1992) provisions and incorporate lessons learned and suggestions for improvement (Article 112.1).

101 Senior Site Executives

- At the end of each calendar year, provide to the DOE Field Office and the lead Program Secretarial Officer (PSO) a tabulation of all equivalency determinations made during the past 12 months (Article 113).

- Issue and endorse a site-specific RadCon Manual (Article 114.1).

- Use a phased approach to adopt the titles of positions used in the RadCon Manual (Article 115.1).

- Establish, approve, and maintain a radiological performance goals program (Article 132.1).

- Review radiological performance goals at least annually and revise them as appropriate (Article 132.3).

- Establish a Radiological Control Organization (Article 141.1).

- Ensure access by the Radiological Control Manager for radiological control matters (Article 141.3b).

- Ensure that the Radiological Control Manager meets the qualifications specified in Article 142 of the Hanford Site Radiological Control Manual (HSRCM) (Article 142).

- Hold line management accountable for implementation of the Radiological Control Program (Article 145.2).

102 Line Management

- Establish and communicate high standards for the performance of radiological control (Article 121.1).

- Document the commitment to a high-quality radiological control program (Article 121.1).

- Assess relevant knowledge and performance as a specific part of each person's performance evaluation (Article 121.3).

- Require and approve radiological improvement goals (Article 121.7).

- Approve changes of established goals and review progress at least quarterly (Article 121.7).
- Establish and maintain a performance indicator program (Article 121:8).
- Minimize the generation of radiological waste and discharges to the environment (Article 121.10).
- Control contamination at its source (Article 121.10).
- Reduce radiation exposures to workers and the public (Article 121.10).
- Establish and implement a comprehensive and effective radiological control training program (Article 121.11).
- Identify and document radiological control training requirements for each staff member (Article 121.12).
- Ensure that staff members requiring unescorted access to the various radiological control areas receive Radiological Worker training (Article 121.13).
- Provide and document appropriate job-specific radiological control training (Article 121.14).
- Produce and display the "Worker Responsibilities" rules at appropriate access points and work areas (Article 123).
- Periodically monitor work areas, observe personnel at work, and identify radiological deficiencies and concerns (Article 125.3).
- Involve workers in the development of procedures for performing radiological work (Article 125.4).
- Encourage work force to identify radiological control deficiencies and concerns and provide prompt corrective action (Article 125.5).
- Treat subcontractors and subcontracted employees the same as facility staff and ensure that they have comparable training and meet the same requirements and expectations (Article 125.8).
- Identify and correct, on a priority basis, conditions that could cause or promote the spread of contamination (Article 125.9).
- Establish a formal process to obtain pertinent facts following an unusual radiological situation or at the satisfactory conclusion of a new or unusual operation involving radiological controls (Article 127.1).
- Implement a prioritization system to implement actions for resolving deficiencies (Article 134.3).

- Address identified deficiencies and basic underlying reasons for the deficiencies when developing corrective actions plans for assessment activities (Article 134.4).
- Provide routine feedback on assessment findings, analyses, corrective actions, and action plan status to management (Article 134.5).
- Establish a Radiological Awareness Reports system (Article 135.2).
- Control contamination at the source and reduce airborne radioactivity, Contamination, and High Contamination Areas (Article 136.1).
- Plan work to avoid the routine use of respiratory protective devices (Article 136.2).
- Reduce internal exposures to the minimum practicable level (Article 136.3).
- Minimize collective neutron dose by setting aggressive goals (Article 137).
- Establish an ALARA Committee (Article 138.1).

103 Radiological Control Manager

- Apply the design criteria of Article 128 to new facilities and to major modifications to existing facilities (Article 128.1).
- Use performance indicators as a tool to focus management priorities and attention (Article 131).
- Provide a periodic report to the senior site executive on the status of the radiological performance goals (Article 133.1).
- Frequently provide radiation exposure data and other pertinent information to supervisors and managers (Article 133.2).
- Post in the workplace selected radiation exposure indicators related to the work group (Article 133.3).
- Conduct internal audits of the Radiological Control Program (Article 134.1).
- Ensure his/her contractor's adherence to the HSRCM (Article 141.2).
- Be available to the line manager to provide radiological support as needed to the work force (Article 141.2).
- Establish and be responsible for a high-quality Radiological Control Program (Article 141.3).

- Establish a continuing training program for the senior staff of the Radiological Control Organization (Article 143.1).

- Ensure that Radiological Control Technicians and their supervisors have the responsibility and authority to stop work (Article 144.2).

104 ALARA Committee

- Make recommendations to management to improve progress toward minimizing radiation exposure and radiological releases (Article 138.3).

- Evaluate construction and design of facilities and systems, planned major modifications or work activities, and experimental test plans for exposure, waste, and release minimization (Article 138.4).

- Review the overall conduct of the Radiological Control Program (Article 138.5).

105 Radiological Assessor

- Review and assess radiological control operations (Article 146.1).

106 Quality Assurance Organization

- Conduct internal audits of the Radiological Control Program (Article 134.1).

107 Employees

- Be responsible for understanding that proper radiological control is an integral part of the daily duties (Article 122.1).

- Participate in radiological control training as scheduled by management (Article 122.7).

- Observe the "Worker Responsibilities" poster rules (Article 123).

- Stop work and obtain guidance if a written requirement in a procedure cannot be responsibly followed (Article 125.4).

108 HSRCM Project Group

- Maintain the HSRCM (Article 116.4).

- Coordinate revisions of the HSRCM required by DOE RadCon Manual changes and site needs (Article 116.4).

- Maintain membership in the Hanford Radiation Protection Forum but do not represent any contractor (Article 116.4).

- Receive revisions of the DOE RadCon Manual and provide distribution to the appropriate contractor and DOE staff (Article 116.4).

- Act as the point of contact and interface with the PNL document control organization to maintain document control of both the DOE Radcon Manual and the HSRCM (Article 116.4).

- Prepare and distribute draft revisions of the HSRCM to DOE Richland Field Office (RL) and contractor representatives through the Hanford Radiation Protection Forum (Article 116.4).

- Work with RL and the contractors through the Hanford Radiation Protection Forum to ensure that

  - appropriate signatures are provided prior to issuing HSRCM revisions

  - potential impacts of revisions are identified and communicated to Hanford Radiation Protection Forum representatives

  - changes to the HSRCM requested by the Hanford Radiation Protection Forum representatives are coordinated (Article 116.4).

- Provide clarification and interpretation of HSRCM requirements to assist contractors in their response to audits and program reviews (Article 116.4).

- Maintain a current list of official exceptions, basis documents, and justifications (Article 116.4).

- Coordinate the development of sitewide forms required by the HSRCM (Article 116.4).

- Prepare annual work breakdown plans and submit them to RL for approval. The Plans should include budget and work scope proposals (Article 116.4).

Part 1 Hanford Site Radiological Control Manual

110 Introduction

This HSRCM was prepared by the Hanford Contractors to provide site-specific additions, supplements, and clarifications to the DOE Radiological Control (RadCon) Manual (DOE N5480.6; 1992). The guidance provided in this manual is based on the requirements given in Title 10 of the Code of Federal Regulations Part 835 (10 CFR 835), "Radiation Protection for Occupational Workers," DOE 5480.11, *Radiation Protection for Occupational Workers* (DOE 1988a), and the DOE RadCon Manual. The information given in this manual is also intended to be consistent and compatible with the guidance provided in the Implementation Guides and Technical Guides issued by the DOE Headquarters (HQ) EH organization.

The HSRCM and the supporting manuals, when taken in total, incorporate all of the DOE RadCon Manual. Thus, the HSRCM replaces the DOE RadCon Manual and will be revised as necessary to ensure that current requirements from Rules, Orders, and the DOE RadCon Manual are represented.

The system of identification of Articles used in the DOE RadCon Manual is retained in the HSRCM, except where new Articles have been developed to address site-specific needs. Any deviations from the DOE RadCon Manual will be documented on "EXCEPTION" forms, copies of which will be found in an appendix, as appropriate.

111 Radiological Control Policy

A key element of the Radiation Protection Guidance to the Federal Agencies for Occupational Exposure, approved by President Reagan on January 20, 1987, and a fundamental principle underlying this manual is:

> *"There should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure."*

The DOE is firmly committed to having a Radiological Control Program of the highest quality. This applies to those DOE activities that manage radiation and radioactive materials and that may potentially result in radiation exposure to workers, the public, and the environment.

The DOE Radiological Control Policy is summarized in Table 1-1.

112 Manual Applicability and Control

Throughout this document, the "DOE RadCon Manual" is used to identify the DOE-EH Radiological Control Manual, whereas, "HSRCM" is used to identify the Hanford Site Radiological Control Manual.

The DOE RadCon Manual establishes practices for the conduct of radiological control activities under the auspices of DOE. The DOE RadCon Manual states DOE's positions and views on the best

Table 1-1. Summary of the U.S. Department of Energy Radiological Control Policy

ALARA

Personal radiation exposure shall be maintained As Low As Reasonably Achievable (ALARA).

Radiation exposure of the work force and public shall be controlled so that radiation exposures are well below regulatory limits and so that there is no radiation exposure without commensurate benefit.

OWNERSHIP

Each individual involved in radiological work must demonstrate responsibility and accountability through an informed, disciplined, and cautious attitude toward radiation and radioactive material.

EXCELLENCE

Excellent performance is evident when radiation exposures are maintained well below regulatory limits, contamination is minimal, radioactive material is well controlled, and radiological spills or uncontrolled releases are prevented.

Continuing improvement is essential to good radiological control.

courses of action currently available in the area of radiological controls. Accordingly, the provisions in the DOE RadCon Manual should be viewed by contractors as an acceptable technique, method, or solution for fulfilling their duties and responsibilities. The HSRCM shall be used by the Office of Nuclear Safety (DOE-NS) in evaluating the performance of Hanford Contractors. For the Hanford Site, the contractors are Hanford Environmental Health Foundation (HEHF), Kaiser Engineers Hanford Company (KEH), Pacific Northwest Laboratory, (PNL), and Westinghouse Hanford Company (WHC).

The DOE RadCon Manual is not a substitute for Regulations; it is intended to be consistent with all relevant statutory and regulatory requirements and shall be revised whenever necessary to ensure such consistency. Some of the DOE RadCon Manual provisions, however, challenge the user to go well beyond minimum requirements. Following the course of action delineated in the DOE RadCon Manual will result in achieving and surpassing related statutory or regulatory requirements.

The following assumptions, practices, and requirements apply to the control and applicability of the HSRCM:

1. The HSRCM is a living document. The HSRCM Project Group (see Article 116) intends to review and update provisions periodically to incorporate lessons learned, suggestions for improvement, and to clarify problem areas that may have developed. The HSRCM Project Group is responsible for this task. Recommendations to correct or improve the HSRCM are encouraged and should be sent to the HSRCM Project Group, Mail Stop K3-53.

   Similarly, EH is responsible for reviewing and updating the DOE RadCon Manual. Recommendations to correct or improve the DOE RadCon Manual are encouraged and should be sent to the Radiological Control Program Advisor (Article 151) of the PSO responsible for the affected work activity. Information copies should also be sent to the other members of the Radiological Control Coordinating Committee. The PSO will transmit such recommendations to EH for consideration. The recommended wording of the change, as well as the basis and justification for the change should be included.

2. The RL intends to incorporate by reference the provisions in the HSRCM into contracts or regulatory plans, as appropriate. These incorporated provisions shall be enforceable pursuant to the contract or underlying regulations. No exception to or interpretation of an incorporated provision or compliance schedule shall be provided pursuant to the contract. When incorporating a provision, RL and DOE PSOs shall approve an implementation plan that includes a compliance schedule. It is expected that implementation of the HSRCM will occur in a phased manner over a period of time consistent with the schedules and resources identified in the DOE-approved implementation plan.

3. In those cases where RL contractors or subcontractors are used to conduct DOE-funded radiological activities at non-DOE sites or facilities, and such organizations do not possess a U.S. Nuclear Regulatory Commission (NRC) or Agreement State license for the proposed activity, the application of the HSRCM is required. The lead PSO and EH shall be included in the review and concurrence process in these situations. When a specific activity is being conducted pursuant to an NRC or Agreement State license, the provisions of the HSRCM are not binding to that activity.

4. The HSRCM shall be kept current and shall be entered into a Hanford document control system. All changes to the signed and controlled HSRCM shall be subject to the following process:

   a. If the change is for the correction of spelling, punctuation, and grammar, or errors in transmission of data ~~which~~that does not change the content or intent of the manual, the change may be made with the knowledge and concurrence of the Hanford Radiation Protection Forum. These changes are called editorial changes.

All changes that alter the requirements or revise the intent of the HSRCM must be provided to the members of the Hanford Radiation Protection Forum for their internal review process and written approval by their senior site executives prior to incorporation of the changes in the HSRCM. These changes are called substantive changes.

b. Proposed editorial changes shall be submitted in writing or by electronic mail to a member of the HSRCM Project Group. The proposed editorial change shall be presented to the Hanford Radiation Protection Forum for their concurrence. A page of the HSRCM, with the proposed change indicated, will be initialed by each of the contractor representatives denoting their concurrence with the change.

c. Upon concurrence and signature by the Hanford Radiation Protection Forum, the written editorial change, signed by a member of the HSRCM Project Group, will be provided to the secretary of the HSRCM Project Group and to each member of the HSRCM Project Group. The secretary will make the change identified by redline/strikeout on the working copy of the manual in the computer and make the change on the HLAN within ten working days. A working hard copy containing approved changes will be maintained by the HSRCM Project Group. Approved changes will also be provided to Document Control for distribution to the Controlled Copy holders. All changes will be made in the HSRCM on the HLAN and through Document Control at the same time.

d. Proposed substantive changes to the HSRCM will be provided in writing to the HSRCM Project Group and to the members of the Hanford Radiation Protection Forum. The appropriate supporting documentation and the basis for the proposed change will be provided to the Hanford Radiation Protection Forum members. A discussion period will be scheduled at a meeting of the Hanford Radiation Protection Forum. When the Hanford Radiation Protection Forum members agree that the change should be made, formal approval shall be required from each contractor senior site executive. The specific page(s) of the HSRCM, indicating the change to be made, and a signature page will be provided to each contractor representative. The contractor representative to the Hanford Radiation Protection Forum shall be responsible for getting the signature of their respective contractor senior site executive. The change will be incorporated in the HSRCM for distribution to Controlled Copy users and the changes made on the HLAN only after signed acceptance is received by the HSRCM Project Group.

5. The provisions of the HSRCM do not apply to facilities and activities of the Naval Nuclear Propulsion Program, which are covered separately under Executive Order 12344 (42 U.S.C 7158, note) and patients undergoing medical treatment at a DOE or DOE-funded facility.

113* Compliance

The HSRCM sets forth DOE's views on the proper course of action in the area of radiological control within the scope of DOE-sponsored activities. If a user fully implements a provision, the user will have complied with, and most likely exceeded, any related statutory, regulatory, or contractual requirement. When incorporated into contracts, the provisions of the HSRCM are binding requirements. For the purposes of the HSRCM, the words "shall," "should," and "may," have the meanings defined below.

The word "shall" identifies those elements and requirements that have been considered and found by DOE to be mandatory unless prior approval of an alternative approach is obtained from DOE-HQ.

If a contractor wants to implement an alternative approach, the following actions shall be taken.

1. The contractor shall submit the suggested alternative approach to the Hanford Radiation Protection Forum. The submittal shall contain the description of the alternative approach, the technical rationale and basis, the suggested wording and justification for how the alternative will achieve equal or improved performance, employing equal or better techniques, solutions, or methods.

2. After review and concurrence of the Hanford Radiation Protection Forum, the suggested alternative shall be submitted to the lead PSO for review. Prior to final approval by the lead PSO, other effected PSOs and DOE-EH shall concur on the suggested alternative approach.

The word "should" means the Hanford Contractors are required to adhere to the provision in the HSRCM until the provision is modified through a deliberate process described below. This process includes identification of an alternate method, demonstrating technical equivalency and approval by the Hanford Radiation Protection Forum. The use of "should" recognizes that there may be site- or facility-specific attributes that warrant special treatment and that literal compliance with the elements and requirements of the provision may not achieve the desired level of radiological control performance.

In those cases where a contractor identifies the need for an alternative technique, approach, or method in lieu of the "should" provision, the required actions are as follows:

1. The contractor shall document the suggested alternative approach with supporting technical basis, analysis, and justification to demonstrate technical equivalency.

2. The proposed exception shall be presented to the Hanford Radiation Protection Forum for review and concurrence prior to implementation to ensure the evaluation and consideration of potential impacts on other Hanford Contractors and to ensure consistency across the Hanford Site.

3. Prior to implementation, the approval of the Radiological Control Manager's and the contractor's senior line manager's responsible for operations shall be required. DOE approval is not required nor expected.

4. Approved changes will be incorporated in the HSRCM.

5. The documented justification, including the required approvals, shall be readily retrievable for review and audit by DOE.

6. At the conclusion of each calendar year each contractor shall provide to the RL Manager and the lead PSO, a tabulation of all such equivalency determinations approved within the past 12 months. For each of reference, these may be referred to as Article 113 determinations.

The word "may" indicates permission, neither a requirement nor a recommendation.

Article 113 WHC Addendum

WHC requirements are presented in text boxes captioned "Article XXX WHC Addendum." In these addenda, the words "shall" and "should" are defined as follows:

- "Shall" means those elements and requirements which are mandatory unless prior approval of an alternative approach is obtained by a formal waiver request, reviewed and approved by level 2 management. The waiver/compliance plan content is addressed in this addendum.

- "Should" means adherence to those elements and requirements unless modified by a deliberate process of demonstrating a technically equivalent approach and approved by the manager of Health Physics, prior to applying the equivalent technique. The justification shall be documented and maintained for proper record retention by the requesting organization. This may be in the form of an internal memo with the appropriate level 2 signatures.

Waivers and Compliance Plans

Requests for approval of waiver/compliance plans shall be in accordance with WHC-CM-1-3, MRP 2.21, "Controlled Manual Waiver Process."

Content

The level of detail in compliance plans shall be kept to the minimum necessary. Additional background documentation supporting each compliance plan shall be maintained by the requesting organization and Health Physics. The following information is required for a compliance plan:

1. The specific article and requirement addressed in the plan
2. Reason for noncompliance
3. Interim controls and limits
4. Actions and commitment dates
5. Requested duration
6. Effect of noncompliance
7. Justification for noncompliance.

114 Site-Specific Manual

Because Hanford is a multiple contractor site, RL has determined that a single site-specific Radiological Control Manual (prepared by the Hanford Contractors) is the most effective method of providing consistent guidance for implementation of the DOE RadCon Manual at the Hanford Site. This HSRCM consists primarily of the DOE RadCon Manual as written with site-specific additions, supplements, and clarifications. These are included in the appropriate chapters and are in or directly referenced to the corresponding Article in the DOE RadCon Manual. It is intended that the HSRCM address unique situations and provide more detailed and prescriptive direction. Any conflicts with or significant changes to the requirements of the DOE RadCon Manual will be identified and documented on "EXCEPTION" forms located in Appendix A of this manual.

This HSRCM was endorsed by each contractor's senior site executive prior to being issued. The contractor senior site executives at Hanford are President, HEHF; General Manager, KEH; Director, PNL; and President, WHC.

Requirements related to the HSRCM are as follows:

1. Any corporate Radiological Controls Manual prepared by a prime contractor who manages several sites should not take precedence over the HSRCM for the Hanford Site.

2. All individuals entering Hanford radiologically controlled areas, including subcontractors, visitors, DOE employees, and employees of state and federal regulatory agencies shall be held accountable to the requirements of the HSRCM.

3. The initial approval of the HSRCM by each contractor's senior site executive shall include approval of the original "EXCEPTIONS" to the DOE RadCon Manual in place at the time of the initial approval.

4. Future "EXCEPTIONS" to the DOE RadCon Manual or the HSRCM shall receive signature approval of each contractor's senior site executive or his delegate.

5. All revisions and changes to the HSRCM shall be authorized by the senior site executive of each contractor.

6. Where DOE employees are transporting nuclear devices or components, a program-specific Radiological Control Manual, based upon the provisions of the DOE RadCon Manual, shall be issued and approved by the RL Manager. Controlled copies of such manuals shall be provided to the lead PSO.

7. This manual is applicable to all future Hanford Contractors including Environmental Restoration Management Contract Contractors.

115 Application of Requirements

Program related titles and program formality are two elements to consider when applying DOE RadCon Manual requirements at the site-specific level. The Hanford Contractors have organizations that generally meet the requirements presented in the DOE RadCon Manual. Titles such as Radiological Control Manager and Radiological Control Technician that are used in the DOE RadCon Manual may have different local designations.

1. A phased approach for making the transition to the use of the position titles used in the DOE RadCon Manual should be incorporated in the RadCon Manual implementation plan. Corresponding position descriptions and organizational charts should be revised to accurately reflect required radiological responsibilities.

   Table 1-2 lists the titles and organizations given in the DOE RadCon Manual with the comparable title and organization for the Hanford Contractors.

2. The degree of formality in the radiological control programs for each of the Hanford Contractors and the extent of the associated administrative process should be commensurate with the potential for radioactive material contamination and the magnitude of the potential effective dose equivalent.

116 User Groups

Hanford Contractors are participating in several working groups to promote communication and consistent applications of radiological control elements. Examples of currently active Hanford groups are the Hanford Personnel Dosimetry Advisory Committee, the Hanford Radiation Protection Forum, the Hanford Protective Clothing Committee, Hanford Instrument Evaluation Committee, and the DOE Internal Dosimetry Program Advisory Committee. Involvement by Hanford Contractors in other user groups is encouraged and will be accomplished as appropriate for each contractor.

Guidance and requirements for User Groups are as follows:

1. Contractors are encouraged to establish informal working associations, working groups, and workshops with other DOE operations and facilities to promote dialogue among the radiological control organizations. These User Groups are further encouraged to develop consistent practices and standards for implementation of quality radiological control programs. User Groups should include representation from various contractors. Members should be assigned to the User Groups on a rotating basis.

Table 1-2. Comparison of DOE-EH and Hanford Contractor Position Titles(a).

DOE-EH	WHC	PNL	KEH	HEHF
Radiological Control Organization	Health Physics	Radiation Protection	Radiation Protection Department	Environment, Safety & Health
Radiological Control Manager	Health Physics Manager	Radiation Protection Manager	Radiation Protection Supervisor	Manager, ES&H
Radiological Control Technician	Health Physics Technician	Radiation Protection Technician	N/A	N/A
Radiological Assessor	Safety Compliance Assessment	N/A subcontracted every 2 years	TBD	N/A subcontracted every 2 years
Radiological Awareness Reports System	WHC Employee Concerns Program	Employee Concerns Program	Employee Concerns Program	Employee Concerns Program
Radiological Awareness Committee	WHC ALARA Committee	ALARA Committee	Executive Safety Committee	Safety & Preparedness Council
ALARA Committee	WHC ALARA Committee	ALARA Committee	Executive Safety Committee	Safety & Preparedness Council

(a) While the titles for the various organizations and positions are different, the corresponding position descriptions and organization charts reflect the radiological responsibilities.

2. Contractors working through the User Groups should develop radiological work practices handbooks to identify and adopt proven practices and procedures applicable to the particular category or class of facility associated with the User Group. The development of radiological work practices handbooks should be coordinated with DOE-EH.

3. A HSRCM Project Group function for coordination and control of the HSRCM shall be established and shall be responsible for maintenance of the HSRCM and coordination of revisions required by DOE RadCon Manual changes and site needs.

4. The Hanford Radiation Protection Forum shall be the Hanford Site organization that provides the interface between contractors and the PNL HSRCM Project Group.

The HSRCM Project Group shall do the following:

a. Maintain membership in the Hanford Radiation Protection Forum but not represent any contractor.

b. Receive revisions of the DOE RadCon Manual and provide distribution to the appropriate contractor and DOE staff.

c. Act as the point of contact and interface with the PNL document control organization to maintain document control of both the DOE RadCon Manual and the HSRCM.

d. Prepare and distribute draft revisions of the HSRCM to RL and contractor representatives through the Hanford Radiation Protection Forum.

e. Work with RL and the contractors through the Hanford Radiation Protection Forum to ensure that

   - appropriate signatures are provided prior to issuing HSRCM revisions
   - potential impacts of revisions are identified and communicated to Hanford Radiation Protection Forum representatives
   - changes to the HSRCM requested by the Hanford Radiation Protection Forum representatives are coordinated.

f. Provide clarification and interpretation of HSRCM requirements to assist contractors in response to audits and program reviews.

g. Maintain a current list of official exceptions, basis documents, and justifications.

h. Coordinate the development of sitewide forms required by the HSRCM.

i. Prepare annual work breakdown plans and submit them to RL for approval. The plans should include budget and work scope proposals.

Part 2 Leadership in Radiological Control

Superior, consistent performance is achieved when qualified personnel use approved procedures and management actively monitors the workplace and assesses ongoing activities. Such activities include, but are not limited to, operations, remediation, laboratory work, research and development, and cleanup. Constant review and informed interest by senior management is

required to achieve a superior Radiological Control Program. Management leads by example. What management does speaks louder than what management says. Therefore, the following requirements apply to management:

1. Management at all levels should emphasize the need for high standards for radiological control through direct communication, instruction, and inspection of the work space.

2. The RL Manager and the contractor senior site executives responsible for the site should have a basic knowledge of radiation, its effects, and radiological control requirements.

3. The RL Manager and the contractor senior site executives should be familiar with the current radiological performance record.

121 Senior Management Commitment

1. Senior managers of the Hanford Contractors should establish high standards for the performance of radiological work. They should have stated in writing, as demonstrated by the signature of the contractor senior site executive in concurrence with this HSRCM, their firm commitment to a Radiological Control Program of the highest quality.

2. Senior managers of the Hanford Contractors should demonstrate through the budget process and through their assignment of responsibility and authority their intent to ensure that orientation, training, and indoctrination reinforce rules and guidelines for each individual to minimize radiation exposure and control radioactive material.

3. Line management shall be responsible for implementation of the radiological control program. Managers should hold individuals and their supervisors accountable for radiological control performance. Relevant knowledge and performance should be assessed as a specific part of each person's performance evaluation. This assessment should not be limited to those who perform work in radiological areas, because many other workers have an impact on the radiological control program.

4. Senior managers should solicit feedback from their radiological control professionals, line management, and workers on radiological control performance.

5. Senior managers should adopt and promote a positive attitude toward radiological control to encourage initiatives that identify concerns at an early stage, prevent problems from worsening, and to promote doing the right job correctly the first time.

6. Because prevention of the spread of radioactive material is less costly than remediation management should be willing to accept change that will improve radiological control and management should promote this attitude throughout the organization.

7. Senior managers of the Hanford Contractors shall require and approve radiological improvement goals.

   a. Goals should be measurable, realistic, auditable, and challenging.

   b. Established goals should not be changed without technical justification and senior management approval.

   c. Senior management shall review progress toward the goals at least quarterly.

8. Management should adopt and maintain a performance indicator program for measuring and trending the effectiveness of the radiological control program against predetermined goals.

9. The authority and responsibility to establish a comprehensive and effective radiological control training program should be assigned to line managers and their subordinates. Training should be provided under the cognizance of a dedicated training organization, but the responsibility for quality and effectiveness shall rest with line management.

10. Senior managers should be alert to opportunities for minimizing the generation of radiological waste and discharges to the environment, controlling contamination at its source, and reducing radiation exposure to workers and the public.

11. Each of the Hanford Contractors has established a comprehensive and effective radiological control training program. The radiological control training program shall be based upon the criteria established in Chapter 6 of the HSRCM and shall use the standardized courses developed by DOE as well as site-specific information. In some instances, Hanford contractors are encouraged to share training resources.

12. Line management should identify and document radiological control training requirements for each staff member.

13. Line management should ensure that staff members requiring unescorted access to the various radiological control areas receive the appropriate Radiological Worker training.

14. Line management should provide and document appropriate job-specific radiological control training.

122 Worker Attitude

Minimizing individual radiation exposure can only be achieved if all persons involved in radiological activities have an understanding of and the proper respect for radiation. Guidelines for worker attitude apply, as follows:

1. Each worker should understand that proper radiological control is an integral part of daily duties.

2. Improving the attitude of the work force should be supported by the training program. To achieve this, training personnel should be knowledgeable about the work environment and those aspects of radiological control that are important to developing a better worker attitude and perspective.

3. The attitude that constant improvement is required in radiological work should be developed at all levels of management and in the work force. Cooperation between the work force and the Radiological Control Organization has to be developed and fostered. The workers should not view radiological controls as hurdles or restrictions to be bypassed.

4. Radiological Control Organization personnel should be helpful in showing workers how to follow the rules. This spirit of cooperation needs to be developed without subverting the control functions of the Radiological Control Technicians. A situation in which application of radiological controls is left solely to the Radiological Control Organization shall be unacceptable.

5. The Hanford Radiological Orientation training, the Radiological Worker training, and the Radiological Control Technician training shall be based on the standardized training modules provided by DOE. These training modules should emphasize the importance of proper radiological control, that it is an integral part of each worker's daily duties, and that the appropriate attitude of Radiological Workers is essential for excellence in radiological control.

6. The Hanford Radiological Training Programs should promote cooperation between radiological control functions and operational organizations.

7. Each worker should participate in radiological control training as scheduled by management.

123 Worker Responsibilities

Radiological control rules apply to each person in the workplace, where responsibilities are clearly defined and posted as indicated here.

1. A poster that displays the worker responsibilities should be produced and displayed at appropriate access points and work areas.

   a. The required poster shall appear in a sufficient number of places to permit individuals engaged in DOE-authorized activities to observe them on the way to or from any particular DOE-authorized activity location to which the poster applies.

   b. The poster shall be conspicuous, and shall be replaced if defaced or altered.

2. The poster should read as follows:

   TO MINIMIZE YOUR RADIATION EXPOSURE AND CONTROL RADIOACTIVE MATERIAL, OBSERVE THE FOLLOWING RULES:

   <u>OBEY</u>

   - Posted, written, and oral radiological control instructions and procedures, including instructions on Radiological Work Permits.
   - "Evacuate" and "stop work" orders from radiological control personnel promptly.

   <u>DO NOT</u>

   - Loiter in radiation areas.
   - Smoke, eat, drink, or chew in Contaminated Areas, High Contamination Areas, and Airborne Radioactivity Areas.

   <u>BE SURE TO</u>

   - Wear personnel monitoring devices where required by Radiological Work Permits, signs, procedures, or by radiological control personnel. Report immediately the loss, damage, or unexpected exposure of personnel monitoring devices or off-scale readings of self-reading dosimeters to the Radiological Control Organization.
   - Keep track of your radiation exposure status and avoid exceeding radiation Administrative Control Levels.
   - Wear Personnel Protective Equipment and Clothing properly whenever required by Radiological Work Permits and posting.

- Minimize the spread of potential radioactive spills and promptly notify the appropriate personnel of all spills.
- Avoid contact of skin, clothing, and equipment with contaminated surfaces.
- Place contaminated tools, equipment, and solid waste items on disposable surfaces, such as plastic sheets, when not in use.
- Notify radiological control personnel of alarming or faulty radiological control equipment.
- Notify radiological control personnel of offsite occupational exposures so that individual dosimetry records can be updated.

PRIOR TO ENTERING AREA

- Assure that you are mentally alert and in physically sound condition.
- Limit the amount of material taken into contaminated areas to minimize radioactive waste and future decontamination.

UPON LEAVING AREA

- Properly remove Personnel Protective Equipment and Clothing to minimize the spread of contamination.
- Survey or be surveyed for contamination when leaving posted Contamination, High Contamination, or Airborne Radioactivity Area and associated Radiological Buffer Areas and notify radiological control personnel when contamination is found.

124 Radiation and Risk Communications

Managers and supervisors of the Hanford Contractors are trained in personnel management, especially in areas related to personnel safety. Managers and supervisors of Radiological Workers are required to receive Radiological Worker training commensurate with the type of radiation work their workers are involved in. Managers and supervisors have the primary responsibility to work with workers who have concerns about radiation work. Additional resources may be used. HEHF is responsible for and has trained medical staff to provide expert information and counseling to workers concerned about radiation exposures, both internal and external. Also, each of the Hanford Contractors has a personnel relations organization to respond to employees concerns related to work activities.

125 Conduct of Radiological Operations

This manual is consistent with the guidance provided in DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities* (DOE 1990c), whose concepts apply to the conduct of radiological activities. The following requirements apply to how radiological activities are conducted by responsible staff members.

1. Managers at all levels should be involved in the planning, scheduling, and conduct of radiological work. Assurance of adequate radiological safety should not be compromised to achieve production, remediation, or research objectives.

2. Supervisors should be technically knowledgeable and inquisitive,and should ask questions of the work force concerning radiological work details to assure and demonstrate worker understanding.

3. Line managers should periodically monitor work areas to observe personnel at work and to identify radiological deficiencies and concerns. Frequent inspections and walk-throughs, including during off-hours and weekends (where appropriate), are essential to reinforce management expectations to the work force.

4. Managers, supervisors, and workers should be involved in the development of accurate, clear, written procedures for performing radiological work. If during the use of procedures, a written requirement cannot be responsibly followed, the work should be stopped and guidance obtained.

5. Supervisors and managers should encourage the work force to identify radiological control deficiencies and concerns. Prompt action should be taken to address and eliminate identified issues and prevent their recurrence. Retraining, indoctrination, and procedure review are useful in addressing these issues.

6. Managers and supervisors should establish working conditions that encourage improved radiological control. This includes temperature and humidity control, proper lighting, and the more difficult consideration of accessibility. Work conditions should be considered in planning work.

7. Cleanliness and good housekeeping are essential. A good Radiological Control Program cannot exist in a sloppy, dirty workplace. Cleaning up after operations should be automatic for each individual. (It is not practical to expect radiological control to be separated from the work environment.)

8. Subcontractors and subcontracted employees should be treated the same as facility staff in the area of radiological matters, should have comparable training, and shall meet the same requirements and expectations.

9. Conditions that could cause or promote the spread of contamination, such as a leaking roof or piping, should be identified and corrected on a priority basis.

126 Improving Worker Awareness of Radiological Conditions

1. In performing assigned duties within radiological areas, workers should be familiar with the area radiological conditions and be aware of the possibility that changes may occur due to unforeseen reasons.

2. The performance of surveys that become a part of the legal record (e.g., release surveys) shall be the responsibility of qualified Radiological Control Technicians.

3. Radiographers performing verification radiation surveys in support of radiographic operations shall be qualified in accordance with Article 655.

127 Critiques

It is DOE's desire and expectation, based on concern for the safety and well-being of workers and the general public, that radiological work practices be continually scrutinized and questioned so that opportunities for improvement can be identified, assessed, and incorporated into the HSRCM. Therefore, the following apply:

1. A formal process should be established by the Hanford Contractors to obtain pertinent facts following an unusual radiological situation or at the satisfactory conclusion of a new or unusual operation involving radiological controls. The process should be used to quickly establish facts in chronological order so that the underlying reasons or causes for the success or failure are well understood.

2. Work force participation should be encouraged.

128 Facility Modifications and Radiological Design Considerations

Radiological control performance is affected by human performance and engineered design features. The HSRCM primarily addresses the way people operate and use existing facilities and sites.

1. Designs for new facilities and major modifications to existing facilities should be based on the following additional radiological control design criteria:

   a. Individual worker dose should be ALARA and less than 500 mrem/yr.

   b. Discharges of radioactive liquid to the environment are covered by the provisions of DOE 5400.5 (DOE 1990a) and should not degrade the groundwater.

c. Control of contamination should be achieved by containment of radioactive material.

d. Efficiency of maintenance, decontamination, and operations should be maximized.

e. Components should be selected to minimize the buildup of radioactive material.

f. Support facilities should be provided for donning and removing protective clothing and for personnel monitoring, where appropriate.

g. Neutron quality factor of 20 should be used for design purposes.

2. Facilities currently under construction should be evaluated and the above criteria applied where practicable.

3. Existing facility designs that have office space and lunchrooms or eating areas within Radiation, High, and Very High Radiation Areas; Contamination and High Contamination Areas; Airborne Radioactivity Areas; Radioactive Material Areas; and Radiological Buffer Areas require priority attention, as follows:

   a. Lunchrooms or eating areas, restrooms, drinking fountains, showers, and similar facilities and devices should be strongly discouraged within these areas.

   b. Locating office spaces within these areas should be strongly discouraged. When such space is essential to support radiological work, steps should be taken to preclude unnecessary occupancy.

Part 3 Improving Radiological Performance

131 Radiological Performance Indicators

Radiological performance indicators are intended as a measure of and a motivation for improvement, not an end in themselves. These performance indicators are not to be viewed narrowly as numerical goals. These indicators should be used as tools to assist management in focusing their priorities and attention. The following are examples of indicators that may be appropriate:

1. Person-rem of collective dose. This goal should be based upon planned activities and historical performance. For those facilities that have neutron radiation, a goal for neutron person-rem should also be established.

2. Number of skin and personal clothing contamination occurrences. Personnel contaminations represent a breakdown of controls intended to prevent the spread of contamination.

3. Number of intakes of radioactive material. Personnel intakes of radioactive material should be minimized and management should focus attention on any failure of the controls that result in intakes.

4. Square feet of contaminated area (within buildings). Operating with a smaller contaminated area results in less radioactive waste, fewer personnel contaminations, and improved productivity. The reduction of existing contaminated areas needs to be balanced by the recognition that this generates radioactive waste. Goals for both should be correlated.

5. Square feet of contaminated area (outside buildings). Operating with a smaller contaminated area results in less radioactive waste, fewer personnel contaminations, and improved productivity. The reduction of existing contaminated areas needs to be balanced by the recognition that this generates radioactive waste. Goals for both should be correlated.

6. Cubic feet of radioactive waste. Minimizing the generation of radioactive waste reduces the environmental impact of DOE operations, helps reduce personnel exposure, and reduces costs associated with handling, packaging, and disposal.

7. Curies of liquid and airborne radioactive material released. Minimizing effluents to reduce the environmental impact of DOE operations and reduce the costs associated with remediation.

132 Management of Radiological Performance Goals

1. The contractor senior site executive shall establish, approve, and maintain a radiological performance goals program.

2. The performance goals should be measurable, achievable, auditable challenging, and meaningful in promoting improvement.

3. Radiological performance goals shall be developed by the Hanford Contractors as part of their ALARA programs. Criteria for establishing goals, measuring their status, and evaluating progress are provided in the program documents. Goals are reviewed routinely by management, revised annually, and transmitted to RL for information.

133 Radiological Performance Reports

1. The Radiological Control Manager should provide a periodic summary report to the contractor senior site executive for sites that exceed an annual collective dose of 1 person-rem. The report is suggested to be monthly but should not be less frequent than quarterly. The report should include at least the radiological performance goals defined in Article 131. Indicators that provide a more detailed analysis of performance are identified in Table 1-3 and should be contained in the report for the month as well as tracking and trending for the prior 12-month period.

2. The Radiological Control Manager should provide radiation exposure information, such as supplemental dosimeter readings or volume of waste generated, to supervisors and managers frequently enough to permit priority management of exposure control. The frequency should be consistent with the nature of the work load and the radiation exposure potential.

3. To promote worker awareness of their radiation exposure status, selected indicators related to their work group should be posted in the workplace.

4. The Hanford Contractors shall provide a quarterly report on radiological performance indicators to RL on the Performance Indicator Report Form shown in Exhibit 1-1 (54-3000-XXX). The report shall include status of progress on the radiological performance goals given in Article 131 and the radiological performance indicators given in Table 1-3. Radiological performance indicators that do not apply to a contractor shall be marked "Not Applicable." The report shall be due within 30 days of the end of each calendar quarter.

5. The following criteria shall be used in reporting the status of the radiological performance goals and indicators:

   a. The total shallow and deep dose received by all facility personnel (including subcontractors and visitors) as measured by the primary dosimeter, i.e., thermoluminescent dosimeter (TLD). The dose measured by direct reading dosimeters should be included only for those periods or situations when more accurate data are not available. Collective radiation dose shall be reported in units of person-rem.

      Data for this indicator are mainly collected quarterly by a contractor. For reporting under this indicator, the data should be collected on a facility basis. It is recognized that the collective radiation dose for certain personnel (maintenance, health physicists, construction, etc.), due to their sitewide services, may be difficult to identify as resulting from exposure at a given facility. How these personnel are handled in each specific facility case should be discussed in the written descriptive statements that are provided with the data.

Table 1-3. Radiological Performance Indicators.

Exposure control a. Collective dose b. Average worker dose c. Maximum dose to a worker d. Number of unplanned exposures resulting in doses greater than the Administrative Control Level e. Number of dose assessments for lost or damaged dosimeters f. Maximum neutron dose to a worker
Personnel contamination a. Number of skin and personal clothing contaminations b. Number of contaminated wounds c. Number of facial contaminations
Control of internal exposure a. Number of positive bioassays b. Number of airborne events c. Number of alarms on airborne monitors (actual and false) d. Number of Airborne Radioactivity Areas e. Area of Airborne Radioactivity Areas in square feet
Control of contaminated areas in operational areas a. Number of Contamination and High Contamination Areas b. Area of Contamination Areas in square feet c. Area of High Contamination Areas in square feet d. Number of spills
Minimization of radioactive waste a. Volume and activity of radioactive waste in cubic feet and Curies, respectively b. Number of cubic feet not subject to volume reduction by incineration, compaction, or other means
Control of radioactive discharges a. Activity of liquid radioactive material discharges in curies b. Activity of airborne radioactivity discharges in curies

b. To provide the external radiation dose information specified in the exposure control sections b and c of Table 1-3, Hanford Contractors shall complete a quarterly tabulation of radiation dose received by Radiological Workers in each of the following ranges: <0.10; 0.10 to 0.25; 0.25 to 0.50; 0.50 to 0.75; 0.75 to 1.00; 1.00 to 1.50, 1.50 to 2.00 and ≥ 2.0 rem.

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c. The performance indicators reported under exposure control (Table 1-3) are for the total population being considered, e.g., total number of persons issued dosimeters, total number of Radiological Workers, etc. The performance indicators reported under the other categories shall be reported by facility complex. (See Glossary for definition of facility complex.)

d. Skin and personal clothing contamination is defined as the number of individuals having confirmed skin contamination and the number of individuals having personal clothing contamination for all facility personnel, including subcontractors and visitors. Those instances in which the skin contamination and the clothing contamination involved the same individual shall be identified. Skin or clothing contamination due to radioactive noble gases or naturally occurring radon gas shall not be included. Positive nasal smears are to be reported as skin contamination. Each contractor will report the skin and personal clothing contamination of their own employees.

e. Detectable contamination in the area that would be covered by a full-face respirator shall be considered facial contamination.

f. Positive bioassay as a performance indicator shall be considered to be a confirmed intake resulting in a dose equal to or greater than the investigation level as defined in Appendix A of the Hanford Internal Dosimetry Program Manual.[1]

g. An airborne event shall be an event that leads to a detection of airborne radioactive material in an area not controlled and posted as an Airborne Radioactivity Area.

h. Alarms on airborne radioactive material monitors shall be reported as "actual" alarms or "false" alarms. "False" alarms shall include instrument failures, but exclude alarms due to buildup of naturally occurring radioactive material. Alarms due to buildup of naturally occurring radioactive material shall be documented in the internal communication log book for the facility (see Article 343).

i. The performance indicators for control of radioactive discharges shall be reported separately for airborne and liquid releases to the environment, as measured at the point of release and reported by facility complex, for the following radionuclides:

- plutonium
- uranium
- other actinides

1. Pacific Northwest Laboratory (PNL). Hanford Internal Dosimetry Manual. PNL-MA-552, Richland, Washington (internal document).

- noble gases
- particulate, including radiocesium and radiostrontium
- activation products
- tritium.

Data shall be cumulative over the reporting period and reported in units of curies.

j. In addition to the numerical data to be reported, each contractor shall provide a brief descriptive statement about each indicator, describing any significant trend (e.g., increasing, decreasing, no change, or information relevant to interpretation of the apparent trends or data).

134 Assessments

Assessment, as used in the HSRCM, refers to the process of providing independent feedback to senior line managers to indicate the adequacy of the Radiological Control Program. Inspections, audits, reviews, investigations, and self-assessments are part of the numerous checks and balances needed in a good Radiological Control Program. The following assessment practices guidelines apply at Hanford:

1. Internal audits of the Radiological Control Program shall be conducted so that over a 3-year period, all functional elements are assessed for program performance, applicability, content, and implementation. These internal audits should be performed by the Radiological Control Organization, the Quality Assurance Organization, and other organizations.

2. Managers, supervisors, and workers should look upon assessments as helpful. It is desirable to approach assessments with nothing to hide and with the Radiological Control Program as an open book. Results of assessments should be incorporated into the ongoing process of improving radiological control.

3. Managers should encourage the positive view that identifying minor deficiencies represents an opportunity for further improvement. The number of deficiencies in itself does not measure of the overall quality of the Radiological Control Program. A prioritization system to implement actions for resolving the deficiencies should be implemented.

4. In developing corrective action plans for assessment activities, managers should address basic underlying reasons for the identified deficiencies or concerns, not just the specific symptoms identified by the reviewer.

5. Feedback on findings from assessments, root cause analyses, status of corrective actions and adherence to action plan schedules should be routinely provided to management.

135 Workplace Awareness

1. Management initiatives to facilitate the expression of concerns on the part of the work force, to address such concerns and solve them are strongly encouraged to ensure the proper respect for and understanding of radiation.

2. A Radiological Awareness Reports system should be established and supported by management. To enhance work force awareness, the program should encourage continuous evaluation and improvements, track resolution of concerns, provide feedback to employee concerns, and post results and trends. It shall be permissible to integrate this system with similar reporting systems for other than radiological concerns.

136 Internal Exposures

Control and prevention of internal exposure from long-lived radionuclides in the workplace may present special challenges to a Radiological Control Program and warrant particular attention. Even though internal exposure is measured in the same units as external exposure and carries the same risk per unit of effective dose equivalent, it is perceived to be of greater significance because the exposure is the result of radioisotopes taken into the body.

Administration of internal dose assessment may be costly in terms of dollars and worker time. Control and analysis of samples also may be more complicated than the measurement elements required for external dosimetry.

In order to minimize internal exposures, the following guidelines apply:

1. Managers should take deliberate actions to control contamination at the source, and reduce Airborne Radioactivity, Contamination, and High Contamination Areas.

2. Work should be planned to avoid the routine use of respiratory protection devices.

3. Internal exposures should be reduced to the minimum practicable level and the following should be considered:

   - Workers may be exposed to unanticipated levels of elevated airborne radioactive material. Collecting representative airborne radioactive material samples and the time required for technicians or automated instruments to determine the airborne concentration of radionuclides may contribute to worker intakes of radioactive material.

- If controls fail, internal depositions of radionuclides may occur in a short period of time.

- The continued exposure of workers to airborne radioactive material over extended periods of time may create worker concerns.

- Doses from some internal radionuclides are difficult to measure. Although some radionuclides, such as cesium and tritium, can be readily measured at levels that produce only a few mrem, some long-lived radionuclides, like plutonium, may require years for accurate measurements of hundreds of mrem.

- Medical intervention, such as the administration of blocking and chelating agents, to mitigate internal deposition adds risks by introducing chemicals into the body.

- Sampling of body excretions and whole body or organ counting techniques may encourage worker perceptions of internal exposure significance.

137 Neutron Exposures

Because of the high variability in the quality factor for neutron radiation and the difficulty of performing dose equivalent assessments those facilities with neutron radiation should focus particular attention on minimizing collective neutron dose by setting very aggressive goals (see Article 131).

138 ALARA Committee

The Hanford Contractors have established ALARA programs to continually evaluate radiological work activities and ensure optimization in the use of radiation dose. Each of the contractor programs includes established criteria for determining the appropriate level of review and authorization for work involving radiation exposure. The ALARA programs incorporate the use of a committee that, although it may be called by a different name, serves as an ALARA Committee and performs the same functions. The ALARA programs include mechanisms for making recommendations to management. In addition, the Radiological Control Organizations, both through the ALARA programs and their radiological engineering responsibilities, provide review and evaluation of the construction and design of facilities and systems and planned major modifications or work activities.

1. An ALARA Committee should be established in each contractor organization. The membership should include line managers and workers, the Technical Support Organization, and the Radiological Control Organization.

2. The ALARA Committee may be part of a general safety or radiation safety committee whose functions include ALARA activities for smaller facilities.

3. The ALARA Committee should make recommendations to management to improve progress toward minimizing radiation exposure and radioactive material releases.

4. The Committee should evaluate items such as construction and design of facilities and systems, planned major modifications or work activities, as well as experimental test plans for exposure, waste and release minimization.

5. The ALARA Committee members should receive the results of all reviews and audits, both internal and external of the radiological control program, including those performed by the Radiological Assessor (see Article 146) and should review the overall conduct of the radiological control program.

Part 4 Contractor Radiological Control Organization

141 Radiological Control Organization

1. A Radiological Control Organization should be established for each contractor to provide technical support to line managers and workers.

   a. The Radiological Control Organization should be independent of the line organization responsible for production, operation, or research activities and should be at an equivalent reporting level.

   b. The user and inter-contractor groups active at the Hanford Site should promote sitewide consistency.

   c. As much as possible, considering the effective use of resources, radiological control personnel should be assigned and dedicated to a facility.

2. Radiological control personnel shall monitor adherence to the HSRCM and be available to the facility line manager to provide radiological support to the work force, as needed. To effectively function in this capacity, radiological control personnel should receive their day-to-day priorities from facility managers.

3. To ensure independence in making correct radiological decisions, the Radiological Control Organization should be accountable to the Radiological Control Manager.

   a. The Radiological Control Manager should head the Radiological Control Organization and be responsible for establishing a high-quality radiological control program.

   b. The Radiological Control Manager shall have access to the senior site executive for radiological control matters.

142 Radiological Control Manager Qualifications

1. The Radiological Control Manager should be an experienced professional in applied radiological protection and should be familiar with the design features and operations of the facilities that affect the potential for exposures of persons to radiation.

2. The Radiological Control Manager shall have the technical competence and experience to establish radiological control programs and the supervisory capability to direct the implementation and maintenance of radiological control programs.

3. The Radiological Control Manager should have a minimum of a bachelor's degree or the equivalent in a science or engineering subject, including some formal training in radiological control. Advanced academic degrees can count as experience where course work related to radiological control is involved. At least 3 years of professional experience should be in applied radiological control work. (Certification by the American Board of Health Physics provides equivalency to the above.)

4. In situations where the most effective manager for this position does not satisfy the above qualifications, special arrangements should be made. In these situations, the assignment of a deputy with the requisite expertise and qualifications may satisfy the requirement.

5. Management should provide a structured program leading to certification by the American Board of Health Physics to any persons assigned as or being considered for the Radiological Control Manager.

143 Radiological Control Organization Functions and Staffing

1. The senior staff of the Radiological Control Organization should include health physicists and other professionals with 4-year degrees in science or engineering. A continuing training program shall be established. Pursuit of certification by the American Board of Health Physics for senior and professional staff members is encouraged.

2. Radiological support personnel perform health physics and radiological engineering, dosimetry, bioassay, independent oversight, instrumentation and calibration functions. These individuals should have technical qualifications pertinent to their assigned duties.

144 Relationship Between Radiological Control Technicians and Workers

Radiological Control Technicians and their supervisors perform the functions of assisting and guiding workers in the radiological aspects of the job.

1. Radiological Workers should be sufficiently qualified to recognize the symptoms of deteriorating radiological conditions and seek advice from Radiological Control Technicians and their supervisors.

2. Radiological Control Technicians and their supervisors shall have the responsibility and authority to stop work or mitigate the effect of an activity if they suspect that the initiation or continued performance of a job, evolution, or test will result in the violation of radiological control standards or result in imminent danger or unacceptable risk. Any worker, working through his/her supervisor, also has stop work authority in accordance with Article 345.

145 Marginal Radiological Control Performance

1. When radiological control performance is less than adequate, consideration should be given to strengthening line management and the Radiological Control Organization to provide adequate radiological control.

2. In cases where the work force has not been adequately sensitized to radiological work practices, additional management attention is needed to assure the proper outcome. Line management shall be held accountable for implementation of the Radiological Control Program. Initial actions should include one or all of the following:

   - more direct supervision in the work space
   - curtailment of work schedules
   - deferral of work
   - addition of extra radiological control personnel
   - conduct of additional training.

3. When the workers and supervisors achieve the proper level of radiological performance, the number of radiological control personnel should be reevaluated.

146 Radiological Assessor

1. In addition to the normal reviews and inspections that are performed periodically as specified in DOE 5482.1B (DOE 1986a), an additional level of assessment is important in identifying problems to senior management. A Radiological Assessor shall perform these reviews.

2. The Radiological Assessor shall have access to the contractor senior site executive and be outside line organizations and the Radiological Control Organization.

3. This position should be staffed by a professional who is adept at identifying technical and management problems or may be subcontracted.

Part 5 DOE Line Management

151 DOE Employees in the Workplace

DOE employees involved in or monitoring radiological work activities at Hanford at a site or facility operated by an RL contractor are subject to and shall adhere to the provisions of the HSRCM.

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*Articles marked with an asterisk indicate WHC Addendums are included.

Part 0 Summary of Responsibilities

200 Department of Energy

Program Secretarial Officer

- Approve requests for an individual to exceed a whole body 2,000 mrem dose in a calendar year (Article 211.1).
- Approve each use of the 10-rem Planned Special Exposure provision (Article 213.3b).

Assistant Secretary for Environment, Safety, and Health

- Approve each use of the 10-rem Planned Special Exposure provision (Article 213.3b).

201 Senior Site Executive

- Establish an annual facility Administrative Control Level and reevaluate it annually (Article 211.2).
- Approve requests for an individual to exceed the facility Administrative Control Level (Article 211.3).
- Submit each proposed use of the 10-rem Planned Special Exposure to the lead PSO for approval (Article 213.3a).
- Establish Special Control Levels for use in special circumstances (Article 216).
- Approve the type of sign used to post Radiologically Controlled Areas (Article 232.2).

202 Line Management

- Establish a Lifetime Control Level of N rem to control a worker's lifetime occupational radiation exposure (Article 212.1).
- Establish Special Control Levels for personnel who have exceeded N rem lifetime dose (Article 212.1).

203 Radiological Control Manager

- Review each proposed use of the 10-rem Planned Special Exposure provision (Article 213.3a).
- Maintain an inventory of fixed contamination areas (Article 222.3).
- Approve the application of fixative coatings for contamination control (Article 222.2).

207 Employees

- Notify the Radiological Control Organization of medical exposures to radiation or radioactive material or accidental exposure of dosimeters to medical radiation sources (Article 216.5).

- Perform or obtain a personal survey when exiting Contamination Areas, High Contamination Areas, Airborne Radioactivity Areas, or Radiological Buffer Areas or when required by the Radiological Work Permit (RWP) (Article 221.1).

- Verify operability of hand-held survey instruments or automatic personnel contamination monitors prior to using them (Article 221.3).

Part 1 Administrative Control Levels and Dose Limits

The DOE's objective is to maintain personnel radiation exposure well below regulatory dose limits. To accomplish this objective, challenging numerical Administrative Control Levels are established at levels below the regulatory limits to administratively control and help reduce individual and collective radiation dose. Increasing levels of authority are required to approve higher Administrative Control Levels.

With issuance of this manual, the committed effective dose equivalent shall be used to assign internal dose received by personnel at DOE facilities. The committed effective dose equivalent is the resulting dose committed to the whole body from internally deposited radionuclides over a 50-year period after intake.

211 Administrative Control Levels

1. A DOE Administrative Control Level of 2,000 mrem/yr per person is established for all DOE activities. Approval by the PSO or designee shall be required prior to allowing a person to exceed a 2,000 mrem dose.

2. Annual Site Administrative Control Levels that have been established at Hanford are given in Table 2-1. Exposures shall be well below the levels in this table and maintained in accordance with ALARA principles.

   Based upon historical and projected radiation exposures, work load, and mission, the HSRCM Administrative Control Levels should be reevaluated annually. The choice of a low level for 1 year should not preclude choosing either a higher or lower level in a subsequent year because the level should be based on historical and projected exposures, work load, and site mission.

3. Approval authorities to exceed the multi-tiered Administrative Control Levels are given in Table 2-1. Approvals shall be documented prior to an individual's being allowed to exceed the control level.

4. No employee shall be allowed to go above the 1,000-mrem whole body dose equivalent level without the prior approval of the contractor senior site executive.

212 Lifetime Control Level

1. To administratively control a worker's lifetime occupational radiation exposure, a Lifetime Control Level of N rem shall be established where N is the age of the person in years. Formal approval by management as outlined in Table 2-1 shall be required to exceed the Lifetime Control Level. Special Control Levels (see Article 216) shall be established for personnel who have doses exceeding N rem either from past work or as a result of an accident.

Table 2-1. Administrative Control Levels.

Maximum Dose Equivalent (Annual), mrem				
TEDE	Skin and Extremity[d]	Lens of Eye[d]	Any Organ[d]	Approval Required to Exceed This Level[a, b]
500	15,000	4,500	15,000	Level 3 line manager & RCM[c]
750	22,500	6,750	22,500	Level 2 line manager & RCM
1,000	30,000	9,000	30,000	Contractor senior site executive
2,000				DOE PSO
Age x 1,000 = lifetime total effective dose equivalent (TEDE)				Level 1 line manager & RCM

notes

(a) See Table 1-2 in Chapter 1 for comparable position titles.

(b) Approvals are sequential. See Form 54-3000-XXX (Exhibit 2-1).
WHC Addendum - WHC personnel shall use Form A-6001-153

(c) RCM = Radiological Control Manager; approval may be delegated within the radiological control organization.

(d) The values are based on the nonstochastic limit and are calculated as committed doses.

2. The internal contribution to lifetime dose should continue to be reassessed as further bioassay results and improved methods for assessing internal dose become available.

213* Radiological Worker Dose Limits

1. The dose limits provided in Table 2-2 shall not be exceeded, except as specified below. These regulatory limits are consistent with the Federal Regulation entitled "Radiation Protection Guidance to Federal Agencies for Occupational Exposure" (87 FR 1716).

2. It shall be permissible for Radiological Workers from other DOE or DOE contractor facilities to receive occupational exposure as a Radiological Worker if they

   - provide a record of current Radiological Worker I or II standardized core training
   - receive site-specific Radiological Worker I or II training at the Hanford facilities where they will be working
   - provide their radiation dose records for previous years and written estimates for the current year.

3. The proposed use of the 10-rem Planned Special Exposure (as specified in DOE 5480.11 [DOE 1988a]) shall be applied only in extraordinary situations and when the following requirements have been met:

   a. The proposed activity has been reviewed by the Radiological Control Manager and submitted by the senior site executive to the lead PSO for approval.

   b. The proposed activity has been jointly approved by the PSO and EH.*

4. Emergency exposure limits are not Planned Special Exposure limits. Guidelines for emergency exposures are provided in Exhibit 2-4

Article 213 WHC Addendum

Radiological Worker Dose Limits

1. When monitored, exposure to skin, extremities, and the lens of the eye are not included in the determination of the committed effective dose equivalent limits of Table 2-2, but are recorded separately.

2. Occupational doses reported from visits to offsite nuclear facilities shall be included in the employee's dosimetry record and reported as occupational dose for that year. The normally assigned WHC personnel TLD should not be used by a WHC employee while visiting or working at other nuclear installations.

3. Radiation doses received during emergency or accidental situations shall be recorded in the occupational radiation exposure records of the exposed individuals.

Table 2-2. Summary of Dose Limits[a, b].

Type of Exposure	Annual Limit
Radiological worker: Whole body (internal + external)	5 rem
Radiological worker: Lens of eye	15 rem
Radiological worker: Extremity (hands and arms below the elbow; feet and legs below the knees)	50 rem
Radiological worker: Any organ or tissue (other than lens of eye) and skin	50 rem
Declared pregnant worker: Embryo/fetus	0.5 rem in 9 months
Minors and students (under age 18): Whole body (internal + external)	0.1 rem
Visitors[c] and public: Whole body (internal + external)	0.1 rem

(a) The Administrative Control Levels for limiting exposure are described in Article 211.

(b) Table Notes:

1. Internal dose to the whole body shall be calculated and reported as committed effective dose equivalent. The committed effective dose equivalent is the resulting dose committed to the whole body from internally deposited radionuclides over a 50-year period after intake. See Exhibit 2-2 for the weighting factors to be used in converting organ dose equivalent to effective dose equivalent for the whole body dose.

2. Background, therapeutic, and diagnostic medical exposures shall not be included in either personnel radiation dose records or assessment of dose against the limits in this table.

3. See Exhibit 2-3 for guidance on non-uniform exposure of the skin.

(c) This applies to visitors who have not completed training in accordance with Articles 632 or 633 or have not met the special considerations of Article 658.

214 Visitor Dose Limit

1. Visitors to the Hanford Site shall be limited to an annual radiation dose of 100 mrem from the sum of internal and external radiation sources, unless they either qualify as Radiological Workers in accordance with Article 632 or 633, or meet the special considerations of Article 658.

2. If a visitor's employer provides a signed statement by that firm's Radiological Control Manager stating the administrative dose levels the employer wants to impose and the requirements of Article 632 or 633 have been met, the visitor shall be controlled as a Radiological Worker under the provided dose levels. Visitors shall not be permitted to exceed the administrative dose levels given in Table 2-1.

3. Employees or subcontractors of Hanford Contractors and staff of RL shall use their assigned dosimeter when entering Hanford facilities requiring dosimeters.

215* Embryo/Fetus Dose Limits

After a female Radiological Worker voluntarily notifies her employer in writing that she is pregnant, for the purposes of embryo/fetal dose protection, she shall be considered a declared pregnant worker.

1. The employer shall provide the option of a mutually agreeable re-assignment of work tasks, without loss of pay or promotional opportunity, so that further occupational radiation exposure is unlikely.

2. For a declared pregnant worker who chooses to continue working as a Radiological Worker:

   a. The dose limit for the embryo/fetus for the entire gestation period shall be 500 mrem.

   b. Efforts should be made to avoid exceeding a dose of 50 mrem/month to the pregnant worker.

3. If the dose to the embryo/fetus is determined to have already exceeded 500 mrem when a worker notifies her employer of her pregnancy, the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the gestation period.

Article 215 WHC Addendum

Embryo/Fetus Dose Limits

1. The pregnant employee's manager should notify Dosimetry as soon as possible after the employee voluntarily provides written notification of pregnancy.

2. If possible, the calculated dose received by the embryo/fetus from internally deposited radionuclides shall be calculated directly.

   If direct dose calculation is not possible, the committed effective dose equivalent (CEDE) determined for the mother resulting from incidents occurring during the gestation period will also be assigned to the embryo/fetus as a default value.

216* Special Control Levels

Certain situations require individualized exposure control levels.

1. In addition to considering recommendations from senior radiological control and medical officials, the contractor senior site executive should obtain advice from professionals in other disciplines, such as human resources and legal, in establishing Special Control Levels. The contractor senior site executive may wish to establish these Special Control Levels in consultation with the contractor's human resources personnel and HEHF staff.

2. A Special Control Level for annual occupational exposure shall be established for each person with a lifetime occupational dose exceeding N rem, where N is the age of the person in years. The Special Control Level shall not exceed 1 rem in a year and should allow the person's lifetime occupational dose to approach N rem as additional occupational exposure is received.

3. An employer should be attentive to special circumstances of employees, such as those undergoing radiation therapy, and shall work with the Radiological Control Organization to establish an appropriate Special Control Level.

4. Any employee who is expecting to receive radiation exposure from radiation therapy or administration of radioactive material under the control of a physician shall report the exposure to his or her management and to the Radiological Control Organization. The Radiological Control Organization shall ensure that the individual receives a temporary dosimeter. The Radiological Control Organization shall also make

recommendations on work restrictions while the individual's medical treatment and condition affects the radiation dose.

5. Employees shall not wear assigned personnel dosimeters during medical (radiation therapy or diagnostic procedures) and dental radiation exposures. Employees shall inform the Radiological Control Organization if such exposure accidentally occurs.

Article 216 WHC Addendum

Special Control Levels

1. Special control levels established for workers who exceed the DOE lifetime control level should not exceed 500 mrem per year.

2. If a special control level has not been established for an employee whose exposure has exceeded the DOE lifetime control level, an administrative control level of 100 mrem per year (the limit for nonradiation workers) should be assigned by Dosimetry.

3. Dosimetry shall counsel workers who are assigned a special control level. This counseling is to explain the basis for the special control level, the relative risks of additional exposure, and the risk estimates of their lifetime occupational exposure.

Part 2 Contamination Control and Control Levels

Control of radioactive contamination is achieved by using engineering controls and proper worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated.

221 Personnel Contamination Control

1. Personnel exiting Contamination Areas, High Contamination Areas, Airborne Radioactivity Areas, Soil Contamination Area, or Radiological Buffer Areas established for contamination control shall perform a personal survey or be surveyed by a Radiological Control Technician for contamination as required by Article 338. This does not apply to personnel exiting from areas that contain only radionuclides, such as tritium, that cannot be detected using hand-held or automatic survey equipment.

2. Monitoring for contamination should be performed using survey equipment that under laboratory conditions can detect total contamination of at least the values specified in Table 2-3. Use of automatic monitoring units that meet the above requirements is encouraged.

3. Individuals shall verify that the hand-held survey instrument or automatic personnel monitor is operable before each use for personnel contamination survey.

4. Personnel with detectable contamination on their skin or personal clothing, other than noble gases or radon daughters, should be promptly decontaminated as described in Article 541.

5. The guidance provided in the Contamination Survey and Release Practices Manual in Appendix B should be considered in evaluating personnel and personal effects contamination.

6. A record of the amount and location of contamination above Table 2-3 values shall be prepared for each person involved and sent to the employees occupational exposure record.

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Table 2-3. Summary of Contamination Values.

Nuclide (note 1)	Removable (dpm/100 cm^2) (note 2)	Total (Fixed + Removable) (dpm/100 cm^2) (see note 3)
U-natural, U-235, U-238 and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-90	1,000 beta/gamma	5,000 beta/gamma
Tritium organic compounds, surfaces contaminated by HT, HTO, and metal tritide aerosols	10,000	10,000

Table notes

1. The values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of the contaminated item. Where contamination by both alpha- and beta/gamma-emitting nuclides exists, the limits established for the alpha- and beta/gamma-emitting nuclides apply independently.

2. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, while applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. Except for transuranic elements, Ra-228, Ac-227, Th-228, Th-230, Pa-231, and alpha-emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

3. The levels may be averaged over 1 m^2 provided the maximum activity in any area of 100 cm^2 is less than three times the values in Table 2-3.

222* Contamination Control Levels

1. A surface shall be considered contaminated if either removable or total radioactive materials are detected above the levels in Table 2-3. It shall be posted as specified in this Article and in Article 235.

2. Surfaces exceeding the values of Table 2-3 for total contamination may be covered with a fixative coating to prevent the spread of contamination. However, management should not substitute painting of surface contamination in lieu of cost-effective decontamination efforts. A fixative coating shall not be applied without the approval of the Radiological Control Manager.

3. In addition to the posting criteria in Article 235, the conditions for establishing and maintaining Fixed Contamination Areas shall include all of the following:

   a. A comprehensive radiological survey shall be performed to quantify any contamination that remains.

   b. Removable contamination should be reduced to ALARA levels before a fixative coating is applied.

   c. A unique number that identifies a specific Fixed Contamination Area shall be included on the survey report and shall be used on the sign posting the area and the inventory.

   d. A formal inventory of Fixed Contamination Areas shall be maintained by the Radiological Control Organization and the records shall become a part of the radiation protection records program.

   e. Markings throughout Hanford shall be uniformly applied, be clearly visible from all directions, and contrast with the colors of the surface coatings.

   f. When there are conflicts in fixative requirements, they shall be resolved on a case-by-case basis by the Radiological Control Manager and the cognizant safety professional.

   g. Markings shall be kept legible.

   h. Painted-over contaminated surfaces should be covered by a yellow undercoat and at least two coats of a different finish color.

   i. Additional coating should be applied when the yellow color appears.

   j. A plan for identifying and adding to the inventory of existing areas of fixed contamination not included in the initial inventory should be developed.

4. The creation of a Fixed Contamination Area shall be fully documented. The document shall:

   - Be assigned a unique number
   - Include justification for fixing contamination in place rather than removing it
   - Include ongoing control of the area.

5. A Fixed Contamination Area may be located outside Radiologically Controlled Areas unless unrestricted access is likely to result in a dose to any person greater than 100 mrem in a year.

6. A Fixed Contamination Area is exempt from the general posting requirements of Article 231 and entry and exit requirements of Chapter 3.

7. For contaminated soil that is not releasable in accordance with DOE 5400.5 (DOE 1990a), a Soil Contamination Area shall be established to meet the following criteria:

   a. It shall be posted as specified in Article 235. Posting should include instructions or special warnings to workers such as "Consult With Radiological Control Organization Before Digging" or "Subsurface Contamination Exists."

   b. It shall meet the requirements of Articles 231.1 through 231.10.

8. Soil Contamination Areas may be located outside a Radiological Buffer Area.

Article 222 WHC Addendum

Controlling Contamination in Uncontrolled Areas

If contamination is identified outside of radiologically posted areas, the following actions should be taken:

1. Report the contamination survey results promptly to the responsible facility management

2. Establish appropriate access controls for the contaminated area

3. Clean up removable contamination promptly

4. Document the event and submit the report to the appropriate levels of management.

NOTE: Posting a contaminated area with no further remedial action is not sufficient for radiological control. (See Article 235 WHC Addendum)

223* Airborne Radioactivity Control Levels

1. Personnel should not be exposed unnecessarily to airborne radioactive material. Use of engineering and administrative controls to reduce the potential for internal exposure should be evaluated before allowing personnel, with or without respiratory protection, to enter areas with airborne radioactivity.

2. Occupied areas with airborne concentrations of radioactive materials that are greater than or potentially greater than 10% of a derived air concentration (DAC) shall be posted as specified in Article 235. For most radionuclides, air containing 10% of a DAC results in a committed effective dose equivalent of approximately 10 mrem if inhaled continuously for one work week. Values of DACs are provided in DOE 5480.11 (DOE 1988a).

Chapter 2, Part 3 WHC Addendum

Posting

WHC has a DOE-approved compliance plan for implementing the postings required by Articles 232-237. The interim posting and labeling requirements specified in the WHC Addenda to these articles shall be used until full compliance with the HSRCM posting requirements is attained.

Part 3* Posting

231* Posting Requirements

1. Radiological posting shall be used to alert personnel to the presence of radiation and radioactive materials and to aid them in minimizing exposures and preventing the spread of contamination. Boundaries used for radiological control purposes are depicted in Figure 2-1. Specifications and examples of signs and labels to be used are given in Appendix C to ensure consistency throughout the Hanford Site.

2. Signs shall contain the standard radiation symbol colored magenta on a yellow background, unless there is a documented basis for using black, i.e., excessive fading. Standardized signs, as described in the standardized core training, should be used where practicable. Lettering shall be magenta (or black).

3. Radiological posting should be displayed only to signify actual or potential radiological conditions. Signs used for training should be clearly marked, such as "For Training Purposes Only."

4. Posted areas should be as small as practicable to enhance efficiency of radiological control.

5. Posting should be maintained in a legible condition and updated based upon the results of the most recent surveys.

6. If more than one radiological condition (such as contamination and high radiation) exists in the same area, each condition should be identified.

7. In areas of ongoing work activities, the dose rate and contamination level or range of each should be included on or in conjunction with each posting as applicable.

8. Entrance points to areas of ongoing work activities controlled for radiological purposes shall state basic entry requirements, such as dosimetry, RWP, and respiratory protection required.

9. Rope, tape, chain, and similar barriers used to designate the boundaries of posted areas should be yellow and magenta in color.

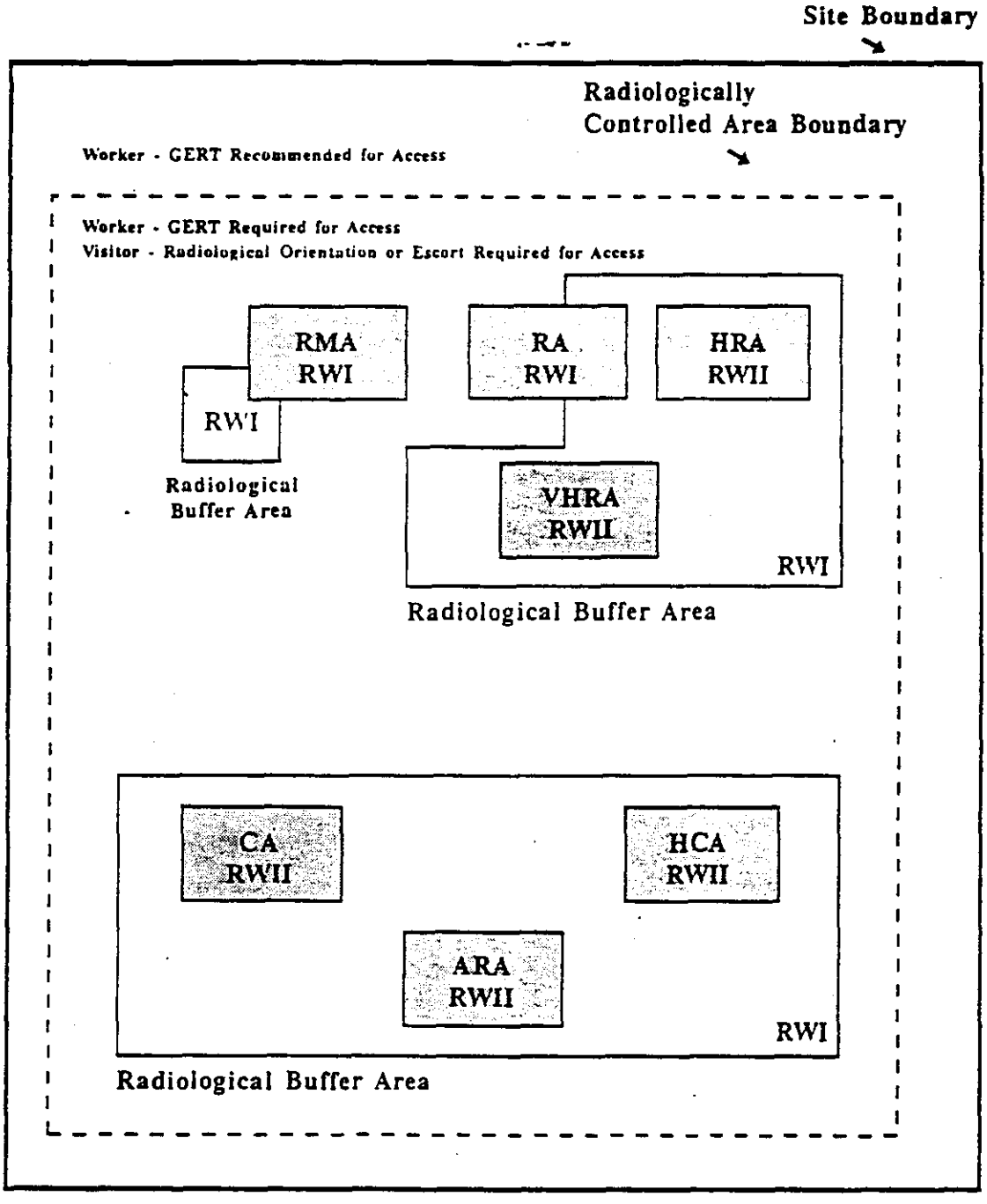
10. Physical barriers should be placed so that they are clearly visible from all directions and at various elevations. They should not be easily walked over or under, except at identified access points. These barriers shall be set up so that they do not impede the intended use of emergency exits or evacuation routes.

11. Doors should be posted so that the posting remains visible when doors are open or closed.

12. A radiological posting that signifies the presence of an intermittent radiological condition should include a statement specifying when the radiation is present, such as:

CAUTION
RADIATION AREA
WHEN RED LIGHT IS ON

Figure 2-1. Establishing Radiologically Controlled Areas.



Legend:
GERT - General Employee Radiological Training
RWI - Radiological Worker I
RWII - Radiological Worker II
RMA - Radioactive Material Area
RA - Radiation Area
HRA - High Radiation Area
VHRA - Very High Radiation Area
CA - Contamination Area
HCA - High Contamination Area
ARA - Airborne Radioactivity Area

Article 231 WHC Addendum

Posting Requirements

1. Unless exempted by Health Physics management, each of the following areas shall be surrounded by a continuous barrier to prevent inadvertent entry:

   - Radiation areas
   - High radiation areas
   - Very high radiation areas
   - Surface contamination areas
   - Airborne radioactivity areas.

2. Area posting signs should be placed one to two meters from the ground or floor, visible from all directions of approach to the area, and spaced no more than 30 meters apart. Exemptions to posting intervals for large outdoor areas may be approved by the Manager of Health Physics.

Temporary Radiological Areas

1. Areas that are only to be posted temporarily may be bounded by yellow and magenta (or black) striped rope and posted with temporary signs instead of permanent chain and permanent area signs.

2. Temporary high radiation areas and very high radiation areas do not require permanent barriers. Continuously manned entry control shall be maintained for all points of approach if these barriers are not locked.

3. The wording and style of temporary postings shall be the same as that used on permanent area signs.

4. A log identifying the date of posting and the area should be maintained for temporarily posted areas.

5. Within 90 days of the initial posting, appropriate action shall be taken to release temporarily posted areas from radiological controls. If the area cannot be released, the area shall be posted as a permanent radiological area.

232* Posting Radiologically Controlled Areas

1. Areas within the Hanford Site boundary should be clearly posted to alert personnel to the actual or potential presence of radiation and radioactive materials above natural background levels. For the Hanford Site, these areas shall be designated Radiologically Controlled Areas. Persons who enter only the Radiologically Controlled Area without entering Radiation, Contamination, Airborne Radioactivity, or Radiological Buffer Areas are not expected to receive more than 100 mrem in a year.

2. For the Hanford Site, the type of sign used for posting Radiologically Controlled Areas shall be approved by the site senior executive and RL. The signs used for posting shall be consistent throughout the Hanford Site to ensure applicability of the training material, maximum employee recognition, and uniformity. (See Appendix C.)

3. A Radiologically Controlled Area and a Radiological Buffer Area may be contiguous. A Radiologically Controlled Area that has the same boundaries as a Radiological Buffer Area does not have to be posted as a Radiologically Controlled Area.

Article 232 WHC Addendum

Posting Radiologically Controlled Areas

1. Any area where an individual could receive occupational radiation exposure equal to or exceeding 100 mrem per year shall be posted as a radiologically controlled area (RCA).

2. Radiologically controlled areas established only due to the radiation level need not be surrounded by a barrier to prevent inadvertent entry.

3. Areas between clean change rooms and surface contamination areas shall be posted as an RCA.

4. Indoor areas where contamination is fixed or has been stabilized (e.g., such as by carpentry, paint, or tile), and that have no detectable removable surface contamination on accessible surfaces shall be posted and controlled as a radiologically controlled area. The instruction portion of the signs for these areas should state "Contact HP before disturbing surfaces."

5. Stabilized fixed contaminated areas that have been painted should have "Caution - Fixed Contamination" stenciled on the outer layer.

233 Posting Radiological Buffer Areas

A Radiological Buffer Area shall be established within the Radiologically Controlled Area to provide a second boundary to minimize the spread of contamination. The Radiological Buffer Area is intended for use where ongoing work activities may create airborne radioactivity or the spread of contamination. It is not expected that Radiological Buffer Areas will be established around inactive or secured Contamination Areas.

1. The need for Radiological Buffer Areas in conjunction with Radioactive Material Areas should be evaluated.

2. The size of the Radiological Buffer Area should be commensurate with the potential for the spread of contamination outside Contamination, High Contamination, and Airborne Radioactivity Areas. As a minimum, the Radiological Buffer Area should include the area adjacent to any exit from and entrance to Contamination, High Contamination, and Airborne Radioactivity Areas.

3. A Radiological Buffer Area should not be required for High Contamination Areas that are completely within Contamination Areas.

4. A Radiological Buffer Area should surround or be contiguous with Radiation, High Radiation, and Very High Radiation Areas. The boundary for the Radiological Buffer Area and these radiation areas may be one and the same.

5. Posting of Radiological Buffer Areas shall be in accordance with Article 231 and shall contain the following wording:

   CAUTION
   RADIOLOGICAL BUFFER AREA

   Radiological Buffer Areas that have the same boundaries as radiation areas do not have to be posted as radiological buffer areas.

234* Posting Radiation Areas

1. Areas shall be posted to alert personnel to the presence of external radiation in accordance with Table 2-4 and Article 231.

2. Dose rate measurements used to determine criteria for Radiation Areas, High Radiation Areas, and Very High Radiation Areas should be made at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

3. Contact readings corrected to the surface dose rate should be used to determine the presence of Hot Spots.

4. Posting of Hot Spots shall not be required in High Radiation Areas with general area dose rates greater than 1 rem/h or in Very High Radiation Areas.

5. The type of personnel dosimeter used by the facility should be included on the sign if the personnel dosimeter is not a TLD.

6. The requirement for an RWP should be included either on or in conjunction with the posting.

7. The dose received in an hour may be used as the criterion for posting (see Column 2 of Table 2-4). In Table 2-4, the unit "rad" is associated with dose rates that pose an immediate danger (Very High Radiation Area [Prohibited Access]).

8. The HSRCM incorporates the more conservative posting of Very High Radiation Areas (Limited Access) at a radiation level of 5 rem/h measured at 30 cm. Personnel shall be made aware that posting of Very High Radiation Areas at other facilities may be less conservative.

Table 2-4. Criteria for Posting Radiation Areas.

Area	Dose Rate Criteria	Posting
Radiologically Controlled Area	> Background < 100 mrem in a year	RADIOLOGICALLY CONTROLLED AREA
Radiological Buffer Area	≥ 100 mrem in a year but < 2 mrem/h	CAUTION RADIOLOGICAL BUFFER AREA
Radiation Area	≥ 2 mrem/h but < 100 mrem/h	CAUTION RADIATION AREA TLD and RWP Required for Entry
High Radiation Area	100 mrem/h or greater but < 1 rem/h	DANGER HIGH RADIATION AREA TLD, Supplemental Dosimeter, and RWP Required for Entry[a]
High Radiation Area (Limited Access)	1 rem/h or greater but < 5 rem/h	DANGER HIGH RADIATION AREA TLD, Supplemental Dosimeter, and RWP Required for Entry Entrance Must be Locked or Continuously Guarded[a] (See Exhibit 3-2)
Very High Radiation Area (Limited Access)	5 rem/h or greater but < 500 rad/h	DANGER VERY HIGH RADIATION AREA SPECIAL CONTROLS REQUIRED FOR ENTRY[a]
Very High Radiation Area (Prohibited Access)	500 rad/h or greater	GRAVE DANGER NO ENTRY
Hot Spot	5 times general area dose rate and > 0.1 rem/h	CAUTION HOT SPOT

(a) Access requirements may be deleted or modified if personnel access is specifically prohibited.

Article 234 WHC Addendum

Posting Radiation Areas

1. Any area where an individual can receive a dose that is greater than two mrem but is less than 100 mrem in one hour at a distance of 30 cm from the radiation source (or from any surface through which the radiation penetrates) shall be posted as a radiation area.

2. "Hot Spot" and "Stand By Areas" should be designated on area status maps.

Posting High Radiation Areas

1. Any area where an individual can receive a dose that is 100 mrem or greater but is less than 5 rem in one hour at 30 cm from the radiation source (or from any surface through which the radiation penetrates) shall be posted as a high radiation area.

2. High radiation areas shall be posted within radiation areas as necessary to indicate the boundary of the increased hazard.

3. A "Hot Spot" sticker or sign should be used inside high radiation areas when general radiation levels are more than five times the general area and exceed 500 mrem/hr. "Hot Spot" postings shall not be required when the general area dose rates exceed 1 rem/hr.

Posting Very High Radiation Areas

1. Any area where an individual can receive a dose that is 5 rem or greater in one hour at 30 cm from the radiation source (or from any surface through which the radiation penetrates) shall be posted as a very high radiation area.

2. Very high radiation areas shall be posted within radiation areas, or high radiation areas as necessary to indicate the boundary of the increased hazard.

235* Posting Contamination, High Contamination, and Airborne Radioactivity Areas

1. Areas shall be posted to alert personnel to contamination in accordance with Table 2-5 and Article 231.

2. The requirement for an RWP should be included either on or in conjunction with each posting as applicable.

3. DAC values for use with Table 2-5 are found in DOE 5480.11, Attachment 1 (DOE 1988a).

4. With the exception of outdoor locations, all Contamination and High Contamination Areas shall be circumscribed by a rope, chain, fence, wall, or other physical barrier to prevent inadvertent entry. Posting of areas defined by chain or radiation rope shall be visible from any reasonable avenue of approach. Signs shall be no further than 30 m apart.

5. The boundaries of remote large outdoor contamination areas may be designated with signs spaced no more than 30 m apart instead of with a continuous barrier. Signs may be spaced closer if required to ensure their visibility from any reasonable avenue of approach. Approval of the Radiological Control Manager and line management shall be obtained prior to using this posting.

6. Security boundaries and other security measures serve to provide positive control of access to Contamination Areas outside of facility fences. If changes in security requirements occur, their impacts on contamination control of outside contaminated areas on the Hanford Site shall be reviewed and reevaluated. When necessary, additional controls shall be established to provide commensurate protection of workers and the public.

7. It is not necessary to erect a Radiological Buffer Area or a physical barrier around the boundary of a Soil Contamination Area unless survey results suggest that contamination can be spread outside the area (e.g., by travel through the area by personnel, vehicles, etc.). A Radiological Buffer Area should be established around Soil Contamination Areas that meet the requirements of, and are posted as, Contamination Areas. Soil Contamination Areas shall be located within a Radiologically Controlled Area (as specified in Article 232 of the DOE RadCon Manual [DOE 1992]).

8. Areas with matrix contamination above natural background levels that have not been released for unrestricted use according to the requirements of DOE 5400.5 (DOE 1990a) shall be posted for soil contamination (Article 235 of the DOE RadCon Manual).

Table 2-5.
Criteria for Posting Contamination, High Contamination, and Airborne Radioactivity Areas.

Area	Criteria	Posting
Radiological Buffer Area	< Table 2-3 values	RADIOLOGICAL BUFFER AREA
Contamination	Levels (dpm/100 cm^2) > 1 time but ≤ 100 times Table 2-3 values	CAUTION CONTAMINATION AREA RWP Required for Entry
High Contamination	Levels (dpm/100 cm^2) > 100 times Table 2-3 values	DANGER HIGH CONTAMINATION AREA RWP Required for Entry
Fixed Contamination	No removable contamination and total contamination levels > Table 2-3 Column 3 values	CAUTION FIXED CONTAMINATION
Soil Contamination	Contaminated soil not releasable in accordance with DOE 5400.5	CAUTION SOIL CONTAMINATION AREA
Airborne Radioactivity	Concentrations (μCi/cc) > 10% of any DAC value	CAUTION AIRBORNE RADIOACTIVITY AREA RWP Required for Entry

Article 235 WHC Addendum

Posting Surface Contamination Areas

1. Areas shall be posted as surface contamination areas (SCA) when:

   a. Removable surface contamination in the area exceeds Table 2-3 values, or

   b. Removable surface contamination is likely to be present on accessible surfaces, or

   c. There is a continuing history or probability of frequent occurrence of removable contamination in the area.

2. Surface contamination areas that are also radiation areas shall be posted to indicate both hazards. Combined signs ("Radiation Area/Surface Contamination") or separate signs (both "Surface Contamination" and "Radiation Area" signs) may be used.

3. Surface contamination areas that are also high radiation areas or very high radiation areas shall be posted with "Surface Contamination" signs and either "High Radiation Area" or "Very High Radiation Area" signs, as appropriate.

4. Contamination flags shall be used to identify spot contamination outside of permanent surface contamination areas.

   a. If spot contamination cannot be cleaned up within the current work shift the area containing the contamination shall be established as a temporary Surface Contamination Area.

   b. Contamination flags should be used to designate levels of removable surface contamination greater than 50,000 dpm within permanently posted outdoor SCAs. Exemptions shall be approved by Health Physics.

Article 235 WHC Addendum (cont.)

Posting Airborne Radioactivity Areas

1. Any area where airborne contamination levels are in excess of 10% of any derived air concentration (DAC) value shall be posted as an airborne radioactivity area.

2. Any area where work activities are likely to cause airborne contamination levels to exceed 10% of any DAC value shall be posted as an airborne radioactivity area.

3. Airborne radioactivity areas that are also radiation areas shall be posted to indicate both hazards. Combined signs ("Radiation Area/Airborne Radioactivity Area") or separate signs (both "Airborne Radioactivity Area" and "Radiation Area" signs) may be used.

4. Airborne radioactivity areas that are also high radiation areas or very high radiation areas shall be posted with "Airborne Radioactivity Area" signs and either "High Radiation Area" or "Very High Radiation Area" signs, as appropriate.

236* Posting Radioactive Material Areas

The definition of radioactive material and the requirements for labeling radioactive material are contained in Chapter 4. Requirements for posting Radioactive Material Areas are specified here.

1. Areas where radioactive materials are used, handled, or stored should be posted as follows:

   CAUTION
   RADIOACTIVE MATERIAL

   The posting shall meet the requirements in Article 231. Posting of areas that contain only instrument check or low-level counting instrument calibration sources (each source less than 10 times the quantity of radioactive material listed in Appendix D) is not required. Commercially available items that are obtainable under the provisions of a general license (e.g., internal sources in gas chromatographs, tritium lights, smoke detectors, etc.) will not require posting of a room as a Radioactive Material Area.

2. Radioactive Material Areas should be located within Radiologically Controlled Areas. Radioactive Material Areas and Radiologically Controlled Areas may be contiguous.

3. Posting for Radioactive Material Areas shall not be required when the radioactive material is inside a Contamination or Airborne Radioactivity Area.

Article 236 WHC Addendum

Posting Radioactive Material Areas

Areas where radioactive materials are used, handled, or stored shall be posted as "Caution - Radioactive Materials."

a. Posting for radioactive material areas (RMAs) is not required when the radioactive material is inside a contamination area or airborne radioactivity area.

b. Posting of areas that contain only instrument check or low level counting calibration sources each less than 10 times the value listed in Appendix D is not required.

c. Posting of areas containing commercially available items obtained under the provisions of a general byproduct license is not required.

237* Posting Underground Radioactive Material Areas

Underground Radioactive Material Areas can be located inside or outside Radiologically Controlled Areas and are exempt from the entry and exit requirements of Chapter 3.

1. Underground Radioactive Material Areas shall be established to indicate the presence of underground items that contain radioactive materials such as pipelines, radioactive cribs, covered ponds, covered ditches, catch tanks, inactive burial grounds, and sites of known, covered, unplanned releases (spills).

2. Underground Radioactive Material Areas shall be posted as follows:

   UNDERGROUND RADIOACTIVE MATERIAL

   The posting shall meet the applicable requirements of Article 231.

3. An area required to be posted as an Underground Radioactive Material Area shall also be posted as a Contamination Area when monitoring shows that radioactive material contamination can be transferred from the area at levels greater than those specified for removable contamination, as defined in Appendix D of 10 CFR 835 (see Article 235 of the DOE RadCon Manual).

4. An area required to be posted as an Underground Radioactive Material Area shall also be posted as a High Contamination Area when monitoring shows that radioactive material contamination can be transferred from the area at levels greater than 100 times those specified for removable contamination (as defined in Appendix D of 10 CFR 835, also see Article 235 of the DOE RadCon Manual).

Article 237 WHC Addendum

Posting Underground Radioactive Material Areas

1. Each radioactive crib, covered pond, covered ditch, pipeline, catch tank, inactive burial ground, or covered unplanned release site shall be posted with a "Caution Underground Radioactive Material" or "Radiologically Controlled Area" sign, except as allowed by item 2 below. If radiologically controlled area signs are used, the type of hazard shall be identified.

2. Where a large number of underground radioactive material areas coexist in a fenced compound, a "Radiologically Controlled Area" sign with the following statement added may be posted at each area entrance (instead of the postings required by item 1 above): "Caution - Underground Radioactive Material, Excavation Permit Required Before Digging at This Facility."

3. As determined by Health Physics, plaques for identifying buried radioactive material should be located within the buried soil.

4. Marker posts shall be placed in accordance with WHC-CM-7-5, *Environmental Compliance*, Section 6.0.

5. Whenever new piping that may contain radioactive material is buried, a yellow plastic sheet marked "Underground Radioactive Waste Line" shall be placed over all pipelines to provide a warning for future excavations.

Article 237 WHC Addendum (cont.)

Posting Areas for Cave-In Potential

1. If cave-in of an underground radioactive material area is possible, the area shall be posted with signs marked "Caution - Underground Radioactive Materials - Cave-In Potential." The area shall be surrounded with a chain or fence to prevent inadvertent entry.

2. If an area that may cave-in is accessible to the general public, a fence, marked as required above, shall be used to surround the area.

Posting Environmentally Stabilized Areas

Environmentally stabilized areas shall be posted with "Radiologically Controlled Area" signs marked to indicate "Caution - Underground Radioactive Material" and/or "Contact HP Before Entry," as appropriate.

NOTE: Environmentally stabilized areas that are not unconditionally released areas may require additional radiological controls.

Posting Fissionable Material Areas

1. Areas containing more than 3% of a minimum critical mass (MCM) of fissionable material which are not exempt from criticality prevention controls by reason of the <u>form</u> or <u>distribution</u> of the fissionable material shall be posted with "Caution - Fissile Material" signs.

2. Fissionable material areas include areas in isolated facilities and operational facilities where fissionable material is present (see WHC-CM-4-29, *Nuclear Criticality Safety Manual*, for facility definitions). Other warning signs may be necessary depending on other radiological hazards.

Postings for Radiation Generating Devices

1. Each radiation generating device shall be posted on all sides with "Radiation Generating Machine" or "Caution X-Rays" signs as appropriate.

2. Other postings appropriate for the area (radiation area, high radiation area, very high radiation area, and/or radioactive material area) shall also be used with the radiation generating device postings.

Article 237 WHC Addendum (cont.)

Posting Regulated Vehicles

Vehicles operated by WHC that are used in radiological areas and have fixed contamination within the cargo area exceeding Table 2-3 values, shall have "Regulated" placards permanently affixed to the front, back, and both sides of the vehicles.

Exhibit 2-1. Authorization to Increase Dose Equivalent Limit Form.

Under Development
Use existing contractor form/format until new form is available.

Exhibit 2-2. Weighting Factors for Organs and Tissues.

Organs or Tissues	Weighting Factor[a]
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder[b]	0.30

(a) Weighting factors as defined in Publication 26 of the International Commission on Radiological Protection (ICRP 1977) and Report 91 of the National Council on Radiation Protection and Measurements (NCRP 1987) are used to convert organ or tissue dose equivalent to effective dose equivalent for the whole body. The effective dose equivalent is obtained by multiplying the organ dose by the weighting factor. For example, a 5-rem dose to the thyroid would be multiplied by the weighting factor 0.03 to yield 0.15 rem.

(b) "Remainder" means the five other organs or tissues with the highest dose (e.g. liver, kidney, pancreas, stomach, small intestine, and upper large intestine). The weighting factor of 0.3 results from 0.06 for each of the five remainder organs.

Exhibit 2-3. Non-Uniform Exposure of the Skin.

Non-uniform exposures of the skin from x-rays, beta radiation, and radioactive materials on the skin, including hot particles shall be assessed and recorded as specified in the table below.

Area of Skin Irradiated	Method of Averaging, Adding to Other Doses Received, and Recording Non-Uniform Skin Dose
$\geq$ 100 cm^2	Averaged over the 100 cm^2 of skin receiving the maximum dose Added to any uniform dose equivalent also received by the skin Recorded as the annual extremity or skin (shallow) dose equivalent (H)
< 100 cm^2	Averaged over the 1 cm^2 of skin receiving the maximum dose (D), reduced by the fraction (f), which is the irradiated area in cm^2 divided by 100 cm^2 (i.e., H=fD) Added to any uniform dose equivalent also received by the skin Recorded as the annual extremity or skin (shallow) dose equivalent
< 10 cm^2	Averaged over the 1 cm^2 of skin receiving the maximum dose Not added to any other dose equivalent, extremity, or shallow dose equivalent (skin) recorded for the annual dose equivalent Recorded in a person's radiation dose record as a special entry

Exhibit 2-4. Guidelines for Control of Emergency Exposures[a].

In extremely rare cases, emergency exposure to radiation may be necessary to rescue personnel or to protect major property. The dose limits for personnel performing these operations are listed below.

Dose Limit (Whole Body)	Activity Performed	Conditions
5 rem	All	
10 rem	Protecting major property	Where lower dose limit is not practicable
25 rem	Lifesaving or protection of large populations	Where lower dose limit is not practicable
>25 rem	Lifesaving or protection of large populations	Only on a voluntary basis to personnel fully aware of the risks involved

Table notes:

1. The dose limit to the lens of the eye should be three times the listed values.

2. The dose limit to the skin of the whole body and the extremities should be ten times the listed values.

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Part 0 Summary of Responsibilities

302 Line Management

- Plan for maintenance, operation, and modification activities (Article 312.1).
- Review infrequent or first-time operations (Article 313.2).
- Provide enhanced oversight of infrequent or first-time work (Article 313.2d).
- Provide written approval for planned internal exposures (Article 316.5).
- Approve RWPs (Article 323.4).
- Provide adequate planning and control of work (Article 323).
- Conduct pre-job briefings (Article 324.3).
- Periodically monitor progress of work (Article 344.1).
- Periodically monitor collective dose for specific jobs (Article 344.3).
- Exercise stop-work authority (Article 345.1).
- Evaluate lessons learned from critiques (Article 353).

303 Radiological Control Manager

- Approve of planning for maintenance, operations, and modifications (Article 312.1).
- Provide enhanced oversight during infrequently performed or first-time work (Article 313.2d).
- Review and approve technical work documents for radiological work activities (Article 315.2).
- Specify radiological hold points in technical work documents (Article 315.3).
- Approve, in writing, planned internal exposures (Article 316.5).
- Review and approve RWPs (Article 323.2).
- Attend pre-job briefings (Article 324.4).
- Maintain logs (Article 343.1).
- Conduct and receive turnover briefings (Article 343.2).

- Conduct frequent tours of work areas (Article 344.2).
- Periodically monitor collective dose for specific jobs (Article 344.3).
- Exercise stop-work authority (Article 345.1).
- Authorize resumption of work following a stop-work order (Article 345.3).
- Evaluate lessons learned from critiques (Article 353).
- Establish radiological control requirements for incidental x-ray devices (Article 365.3).
- Modify radiological control requirements for unique construction or restoration project circumstances (Article 371).

304 ALARA Committee

- Review infrequent or first-time operations (Article 313.3).
- Approve radiological tasks anticipated to exceed individual or collective dose criteria (Article 312.4).

307 Employees

- Read and sign RWPs (Article 322.6).
- Attend pre-job briefings (Article 324.4).
- Perform monitoring for personal contamination (Article 332.2; 338).
- Keep radiological control personnel informed of changes in work (Article 343.4).
- Exercise stop-work authority (Article 345).

309 Support Organizations

- Attend pre-job briefings (Article 324.4).

Part 1 Planning Radiological Work

311 Requirements

1. Technical requirements for the conduct of work, including construction, modifications, operations, maintenance, and decommissioning, shall

incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA.

a. To accomplish this, the design and planning processes should incorporate radiological considerations in the early planning stages.

b. The Checklist for Reducing Occupational Radiation Exposure (Exhibit 3-1) may be helpful in reducing exposure.

312* Planning for Maintenance, Operations, and Modifications

1. Maintenance and modification plans and procedures shall be reviewed to identify and incorporate radiological requirements, such as engineering controls and dose and contamination reduction considerations. Performance of this review is the responsibility of line management, with support and approval from the Radiological Control Organization.

2. For routine tasks, such as surveillance, tours and minor nonradiological maintenance, performance of the above review and documentation of identified radiological requirements may be conducted as part of the RWP process (see Article 321).

3. The Hanford Site trigger levels that shall require formal radiological review of nonroutine or complex work activities are:

   - Estimated individual or collective dose for a task projected to exceed 1,000 person-mrem
   - Predicted airborne radioactivity concentrations in excess of the DAC or an integrated exposure of 200 DAC-hours
   - Work area removable contamination greater than 100 times the values in Table 2-3
   - Where dose rates exceed 1 rem/h in a work area
   - Potential releases of radioactive material to the environment
   - Request by line management.

4. Tasks with the potential to exceed the trigger levels listed above shall undergo a formal, documented radiological, or ALARA review. As a minimum, in this review the following should be considered:

   - Inclusion of Radiological Control Hold Points in the technical work documents
   - Elimination or reduction of radiation levels through line flushing and decontamination

Article 312.3 WHC Addendum

WHC Trigger Levels

The following are additional WHC trigger levels:

1. Estimated acute whole body radiation dose(s) greater than 250 mrem to any individual.
2. Estimated collective dose for a task projected to exceed 500 person mrem.
3. Work area removable contamination greater than 10 times the values in Table 2-3.
4. Planned personnel exposure to airborne contamination levels greater than one-tenth of any derived air concentration (DAC) value.

- Use of work processes and special tooling to reduce time in the work area
- Use of engineering controls to minimize the spread of contamination and generation of airborne radioactive material
- Specification of special radiological training or monitoring requirements
- Use of mock-ups for high exposure or complex tasks
- Engineering, design, and use of temporary shielding to reduce radiation levels
- Walkdown or dry-run of the activity using applicable procedures
- Staging and preparation of necessary materials and special tools
- Maximization of prefabrication and shop work
- Potential accident situations or unusual occurrences and a review of abnormal and emergency procedures and plans
- Identification of points where signatures and second party or independent verifications are required
- Establishment of success or completion criteria, with contingency plans to anticipate difficulties
- Development of a pre-job estimate of collective dose to be incurred for the job

- Provisions for waste minimization and disposal.

5. Radiological requirements identified as part of the above radiological review should be documented in the job plans, procedures, or work packages.

6. Radiological tasks anticipated to exceed individual or collective dose criteria established in Article 312.3 should be reviewed and approved by the appropriate contractor's ALARA Committee.

7. Optimization techniques, including cost-benefit analysis, represent a fundamental part of radiological design analysis and work review. For review of minor activities with low associated doses, a cost-benefit evaluation is an intrinsic part of the engineering review process and a detailed evaluation is not necessary. For review and planning of major tasks involving higher collective dose expenditures, a detailed and documented evaluation should be performed.

Article 312.7 WHC Addendum

Design Review

During design of new facilities or planning for modifications to existing facilities, an ALARA Checklist (A-6000-291 or WEF042) shall be used to document radiological/ALARA considerations.

313 Infrequent or First-Time Activities

1. At facilities with routine, recurring process operations, special management attention should be directed to radiological activities that are infrequently conducted or represent first-time operations.

2. Planning for such activities should include:

   a. Formal radiological review in accordance with Article 312.4.

   b. Senior management review directed toward anticipation of concerns and emphasis and specification of protective measures.

   c. Review and approval by the contractor's ALARA Committee.

   d. Enhanced line and Radiological Control Management oversight during the initiation and conduct of the work.

314 Temporary Shielding

Shielding used as part of bench-top activities (e.g., vial shields, shadow shields used in hoods, etc.) are exempt from the requirements of this Article unless specifically included in the RWP or technical work document.

1. The installation, use, and removal of temporary shielding should be controlled by procedures or technical work documents.

2. The effects of the additional weight of temporary shielding on systems and components should be evaluated and established to be within the design basis prior to installation.

3. Installed temporary shielding should be periodically inspected and surveyed to verify its effectiveness and integrity.

4. Radiation surveys should be performed during the alteration or removal of installed temporary shielding.

5. Installed temporary shielding should be visibly marked or labeled with the following or equivalent wording:

   TEMPORARY SHIELDING
   DO NOT REMOVE WITHOUT PERMISSION FROM RADIOLOGICAL CONTROL

6. Installed temporary shielding should be periodically evaluated to assess the need for its removal, replacement with permanent shielding, or removal of the radioactive source through decontamination or component replacement.

315* Technical Work Documents

1. Technical work documents, (e.g., procedures, work packages, or job or research plans) should be used to control hands-on work with radioactive material. Technical work documents are not required for incidental or routine work activities that involve a low potential of worker exposure or workplace contamination, such as the collection of trash or used protective clothing.

2. Technical work documents used to control radiological work activities should be reviewed and approved by the Radiological Control Organization.

3. Radiological Control Hold Points should be incorporated into technical work documents for steps that require action by the Radiological Control Organization to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactive material to the environment.

Article 315 WHC Addendum

Radiological Hold Points

Radiological hold points shall be denoted by the letters **HP** in bold print in the left hand margin of work controlling documents.

316 Minimization of Internal Exposure

The minimization and control of internal exposure, as discussed in Article 136, should be conducted in accordance with the hierarchy of controls described here:

1. Engineering controls, including containment of radioactive material at the source wherever practicable, should be the primary method of minimizing airborne radioactive material and internal exposure to workers.

2. Administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination, should be used as the secondary method to minimize worker internal exposure.

3. When engineering and administrative controls have been applied and the potential for airborne radioactive material still exists, respiratory protection should be used to limit internal exposures, except as provided in Article 316.5. Where external exposure conditions exist, optimization principles should be applied to balance the external and internal exposures. Use of respiratory protection should be considered under the following conditions or used as required by the Radiological Control Organization:

   a. Upon entry into posted Airborne Radioactivity Areas other than those posted solely for the control of exposure to noble gases

   b. During the uncontained breach of contaminated systems, components, or containers

   c. When working in areas or on equipment with removable contamination levels greater than 100 times the values in Table 2-3

   d. During work on contaminated or activated surfaces with the potential to generate airborne radioactive material.

4. The selection of respiratory protection equipment should include consideration of worker safety, comfort, and efficiency. Positive pressure respiratory protection devices should be used wherever practicable to alleviate fatigue and increase comfort. The use of

respiratory protection devices is not required if the airborne radioactive material consists solely of noble gases and short-lived daughter radionuclides.

5. In specific situations the use of respiratory protection may be contraindicated due to physical limitations or the potential for significantly increased external exposure. In such situations, written authorization should be obtained from the line organization manager and the Radiological Control Manager prior to incurring internal exposure. Specific justification of the need to accept the exposure, including a description of measures taken to mitigate the airborne radioactivity, should be documented as part of the authorization process. Such documentation is not required if the airborne radioactive material consists solely of noble gases and short-lived daughter radionuclides.

6. The following controls are applicable for activities authorized in accordance with the above:

   a. Stay time controls to limit intake should be established for the entry.

   b. Evaluation of workplace airborne radioactivity levels should be provided through the use of continuous air monitors or air-samplers with expedited assessment and analysis of results.

Part 2 Work Preparation

321 Radiological Work Permits

The RWP is an administrative mechanism used to establish radiological controls for intended work activities. The RWP informs workers of area radiological conditions and entry requirements and provides a mechanism to relate worker exposure to specific work activities.

1. The format shown in Exhibit 3-2 through 3-4 shall be used to prepare RWPs for the Hanford Site.

2. The RWP should include the following information, as applicable:

   - Description of work
   - Work area radiological conditions
   - Internal and external dosimetry requirements
   - Pre-job briefing requirements
   - Radiological Worker training requirements for entry
   - Protective clothing and respiratory protection requirements

- Radiological control coverage requirements and stay time controls
- Limiting radiological conditions that may void the RWP
- Special dose or contamination reduction considerations
- Special personnel survey considerations
- Technical work document number
- Unique identifying number
- Date of issuance and expiration
- Authorizing signatures.

322 Use of Radiological Work Permits

Job-specific RWPs are written for performance of a particular task that is not covered under a General RWP. Job-specific RWPs are written for short-term radiological work, work within temporary radiological areas, or work in areas with changing radiological conditions.

General RWPs govern routine or repetitive work where radiological conditions are stable such as inspections, surveillance, surveys, and tours. General RWPs may be used to govern specific maintenance and operations when such jobs do not involve work with elevated or complex radiological conditions.

Commercially available items that are obtainable under the provisions of a general license (e.g., internal sources in gas chromatographs, tritium lights, smoke detectors, etc.) are exempt from the requirement for an RWP. Electron microscopes and electron beam welders are also exempt from the requirement for an RWP.

1. RWPs shall be used to permit the following activities:

   - Handling of unsealed radioactive material and materials contaminated in excess of the levels specified in Table 2-3
   - Entry into Radiation Areas, High Radiation Areas, and Very High Radiation Areas
   - Entry into Contamination and High Contamination Areas
   - Entry into Airborne Radioactivity Areas
   - Operation of Radiation-Generating Devices
   - Radiography

- Use of vacuum cleaners in Contamination, High Contamination, Airborne Radioactivity, Radioactive Material, and Radiological Buffer Areas.

2. Radiological surveys shall be performed and evaluated for areas subject to changes in radiological conditions to determine the adequacy of RWP requirements.

   a. RWPs shall be updated if radiological conditions change to the extent that protective requirements need modification.

   b. Job-specific RWPs shall remain in effect only for the time to complete the job but not to exceed 90 days.

   c. The RWP shall be reviewed and approved to extend beyond the expiration date.

3. A general RWP shall be issued only for activities where

   - The whole body dose equivalent rate is ≤50 mrem/h
   - Smearable contamination levels are ≤50,000 dpm/100 cm^2 of beta-gamma radiation, ≤2,000 dpm/100 cm^2 of alpha general radiation in the work area
   - No Radiological Control Hold Points are identified; e.g., breaching a radioactive system
   - Only minor work activities are permitted.

   General RWPs should be approved for no longer than 1 year at which time they will be reviewed, evaluated, and rewritten as needed.

4. Radiological surveys shall be routinely reviewed to evaluate the adequacy of RWP requirements. RWPs shall be updated if radiological conditions change to the extent that protective requirements need modification.

5. A copy of the RWP shall be included in the work package (when used), posted at the access point to the radiological work areas, or a sign should be posted directing personnel to the location of the current RWP for the area.

6. Workers accessing an area permitted by an RWP shall be required to sign the RWP or log prior to initial entry and after any revisions to the RWP. Signing the RWP or log signifies that the worker has read it, is aware of the radiological conditions, understands the requirements, and agrees to comply with the requirements.

7. Worker pocket or electronic dosimeter readings should be recorded in a format that identifies and provides linkage to the applicable RWP.

8. An alternative formal mechanism, such as written procedures or experiment authorizations, may be used in lieu of an RWP as the administrative control over radiological work activities. If an alternative mechanism is used, it should meet the requirements of this Article and Articles 321 and 323.

323* Radiological Work Permit Preparation

The responsibility for ensuring adequate planning and control of work activities resides with line management.

1. The lead work group responsible for the planned activity or for the area should initiate the preparation of the RWP.

2. RWPs shall be reviewed and approved by the Radiological Control Organization.

3. The RWP shall be based on current radiological surveys and anticipated radiological conditions.

4. The RWP shall be approved by the supervisor responsible for the work or area and the appropriate radiological control supervisor. Revisions or extensions to RWPs shall be subject to the same approval process.

Article 323 WHC Addendum

Radiological Work Permit Preparation

The responsible facility management with support from Health Physics shall prepare an ALARA Management Worksheet (AMW; WEF043, BC-6000-217) when Health Physics classifies the work as ALARA review class 1 or 2 activity (as specified in WHC-CM-4-11).

Radiological work permits should not be used in lieu of work procedures or as a means for incorporating radiological control steps into the work procedures.

324 Pre-Job Briefings

1. As a minimum, pre-job briefings should be held prior to the conduct of work anticipated to exceed the trigger levels specified in Article 312.3.

2. As a minimum, the pre-job briefing should include:

   - Scope of work to be performed
   - Radiological conditions of the workplace
   - Procedural and RWP requirements

- Special radiological control requirements
- Radiologically limiting conditions, such as contamination or radiation levels that may void the RWP
- Radiological Control Hold Points
- Communications and coordination with other groups
- Provisions for housekeeping and final cleanup
- Consideration of potential accident situations or unusual occurrences and a review of abnormal and emergency procedures and plans
- Emergency response provisions.

3. Pre-job briefings should be conducted by the cognizant work supervisor.

4. Workers and supervisors directly participating in the job, cognizant radiological control personnel, and representatives from involved support organizations should attend the briefing. Personnel who may be assigned to the job after the pre-job briefing has been completed should receive a similar briefing from the cognizant work supervisor prior to starting work.

5. A summary of topics discussed and attendance at the pre-job briefing should be documented.

   a. This documentation should be maintained with the technical work document.

   b. When the work is complete, the documentation shall become a part of the radiological records.

325 Personal Protective Equipment and Clothing

1. Personnel shall wear protective clothing when:

   - Handling of contaminated materials with removable contamination in excess of Table 2-3 levels
   - Working in Contamination, High Contamination, and Airborne Radioactivity Areas
   - Required by the RWP.

2. Protective clothing and shoes designated for radiological control shall be:

   - Marked in accordance with Article 461

- Used only for radiological control purposes.

3. Protective clothing dress-out areas should be established directly adjacent to the work area, and workers should proceed directly to the radiological work area after donning Personal Protective Equipment and Clothing.

4. Personal Protective Equipment and Clothing shall be selected as prescribed by the controlling RWP. General guidelines for protective clothing selection and use are provided in Appendix E and in Table 3-1.

5. The use of laboratory coats as radiological protective clothing shall be appropriate for limited applications such as those listed in Table 3-1 where the potential for personal contamination is limited to the hands, arms, and upper front portion of the body.

   a. Laboratory coats should not be used as protective clothing except as specified on the RWP.

   b. Laboratory coats should not be used as protective clothing for performing physical work activities in High Contamination or Airborne Radioactivity Areas.

   c. The decision to use laboratory coats as protective clothing in Contamination Areas should be based on the activities to be performed (e.g., walk-through inspections, tours).

6. Instructions for donning and removing protective clothing should be posted at the dress-out and step-off pad areas.

7. The use of Personal Protective Equipment or Clothing (including respiratory protection) beyond that authorized by the Radiological Control Organization detracts from work performance, is contrary to ALARA principles and waste minimization practices, and should not be authorized.

8. Company-issued clothing, such as work coveralls and shoes, should be considered the same as personal clothing. Company-issued clothing should not be used for radiological control purposes.

9. There shall be a distinct difference between company-issued clothing (e.g., blue coveralls) and protective clothing (e.g., white or yellow).

Table 3-1 Guidelines for Selecting Protective Clothing (PC)[a,b].

Work Activity	Removable Contamination Levels		
	Low (1 to 10 times Table 2-3 values)	Moderate (10 to 100 times Table 2-3 values)	High (> 100 times Table 2-3 values)
Routine	Full set of PCs	Full set of PCs	Full set of PCs, double gloves, double shoe covers
Heavy work	Full set of PCs, work gloves	Double set of PCs, work gloves	Double set of PCs, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PCs	Double set of PCs (outer set non-permeable), rubber boots	Double set of PCs and non-permeable outer clothing, rubber boots

(a) For hands-off tours or inspections in areas with removable contamination at levels 1 to 10 times the values in Table 2-3, labcoats, shoe covers, and gloves may be used instead of full protective clothing.

(b) For benchtop and fume hood protective clothing requirements see Article 347.

Part 3* Entry and Exit Requirements

Chapter 3, Part 3 WHC Addendum

Entry and Exit Requirements

WHC has a DOE-approved compliance plan for implementing the entry requirements required by Articles 331-336. The interim entry requirements specified in the WHC Addenda shall be used until full compliance with the HSRCM entry and exit requirements articles is attained.

331* Radiologically Controlled Areas

Minimum requirements for unescorted entry into Radiologically Controlled Areas shall include the following:

- Successful completion of Visitor Orientation or General Employee Radiological Training.
- Personnel dosimeter.

Article 331 WHC Addendum

Entry and Exit Requirements

1. All entries into radiological areas shall be performed in accordance with the Westinghouse Radiation Area Management (WRAM) system requirements or equivalent system for that facility. Exemptions for using the WRAM system shall not be issued for entry into airborne radioactivity areas, surface contamination areas, radiation areas, high radiation areas or very high radiation areas.

2. RL personnel and RL-sponsored visitors should use Hanford qualification cards (HQC) instead of the WRAM system when presenting access qualifications. These visitors should be logged in and out of radiological areas using the WRAM or an equivalent entry control system. Entry requirements for escorted visitors performing inspections, audits or general observation activities in radiological areas are listed in Table 3-2.

3. Facilities not using the WRAM system shall implement a Health Physics approved program of entry controls to ensure that WHC personnel and unescorted WHC visitors entering radiological areas comply with the requirements summarized in Table 3-3 and specified by each facility.

332 Radiological Buffer Areas

1. Minimum requirements for unescorted entry into Radiological Buffer Areas shall include the following:

   - Radiological Worker I training
   - Personnel dosimeter.

2. Personnel who exit a Radiological Buffer Area that contains Contamination Areas, High Contamination Areas, or Airborne Radioactivity Areas should perform or obtain a personal contamination survey as specified in Article 338.

333 Radioactive Material Areas

1. Radiological Worker I training shall be required for unescorted entry into Radioactive Material Areas that contain either of the following:

   - Sealed radioactive sources
   - Radioactive material labeled and packaged in accordance with Articles 412 and 413.

2. Entry into Radioactive Material Areas where whole body dose rates exceed 2 mrem/h or removable contamination levels exceed Table 2-3 values shall be in accordance with the requirements of Articles 334.1 and 335.1, respectively.

334* Radiation, High Radiation and Very High Radiation Areas

1. Minimum requirements for unescorted entry into Radiation Areas shall include the following:

   - Radiological Worker I training
   - The worker's signature on the RWP, as applicable in accordance with Article 322.6
   - Use of personnel dosimetry.

2. Physical controls to prevent inadvertent or unauthorized access to High and Very High Radiation Areas shall be maintained in accordance with Exhibit 3-5.

3. Minimum requirements for unescorted entry into High Radiation Areas shall include:

   - Radiological Worker II training (or Radiological Worker I training with specialized High Radiation Area access training in accordance with Article 632.4)
   - The worker's signature on the RWP in accordance with Article 322.6
   - Use of personnel and supplemental dosimeters
   - A survey meter or dose rate indicating device at the work area.

4. Minimum requirements for unescorted entry into High Radiation Areas where existing dose rates could expose a worker to a whole body dose greater than 1 rem in 1 hour shall include those items listed in Article 334.3 and the following:

   - A determination of the worker's current dose, based on primary and supplemental dosimeter readings
   - Pre-job briefing, as applicable
   - Review of the unescorted entry request by the Radiological Control Organization and determination of the required level of Radiological Control Technician coverage.

5. Workers shall be prevented from entry to Very High Radiation Areas produced by Radiation-Generating Devices when the radiation source is exposed or the radiation beam is activated and very high radiation fields

are present. In addition to the controls required in Articles 334.2 and 334.3, a survey shall be made prior to the first entry to the area after the source has been secured or shielded to verify that the very high radiation field has been terminated.

6. Facility operations personnel should receive prior notification when personnel intend to enter areas where operational or system changes made by operations personnel could result in significantly increased area dose rates. Locks and tags should be used, as appropriate, to secure sources and process components whose operation could significantly increase area dose rates.

7. The number, issue, and use of keys shall be strictly controlled where locked entrances are used to control access to High and Very High Radiation Areas.

   a. Keys shall be kept in a locked container when not in use.

   b. A key log shall be used to log in and out a key and a list of authorized users shall be posted.

8. The Radiological Control Organization should maintain a list of High and Very High Radiation Areas.

9. Weekly verification of the physical access controls to High and Very High Radiation Areas should be made to verify that controls are adequate to prevent unauthorized entry.

Article 334 WHC Addendum

High Radiation Area Control

1. All permanent high radiation areas (as defined in the Article 234 WHC Addendum) shall have barriers that prevent unauthorized entry, such as fences or walls with entrances that are locked or guarded at all times.

2. Dedicated personnel shall be assigned to perform continuous control of temporary high radiation areas that do not have the barriers to prevent unauthorized entry required for permanent high radiation areas.

3. When locking systems are used for high radiation area entry control, a key control system shall be established, with the number of keys limited and their use controlled.

Very High Radiation Area Control

At least one of the following systems shall be used for entry control into a very high radiation area:

1. Control devices on each access point that automatically prevent entry when a very high radiation area exists.

2. A control device that causes a conspicuous visible or audible alarm.

3. Alarm devices that automatically cause audible and visible signals to alert personnel in the area before the radiation source is used or operated.

4. A key control system for locked access points shall be established, with the number of keys limited and their use controlled.

335* Contamination, High Contamination, and Airborne Radioactivity Areas

1. Minimum requirements for unescorted entry into Contamination Areas shall include the following:

   - Radiological Worker II training
   - The worker's signature on the RWP in accordance with Article 322.6, as applicable
   - Use of protective clothing
   - Use of personnel dosimetry, as appropriate.

2. Minimum requirements for unescorted entry into High Contamination or Airborne Radioactivity Areas shall include the following:

   - Radiological Worker II training
   - The worker's signature on the RWP in accordance with Article 322.6
   - Use of protective clothing and respiratory protection, as specified by the RWP
   - Pre-job briefing for High Contamination or Airborne Radioactivity Areas, as applicable
   - Use of personnel dosimetry, as specified by the RWP.

3. Personnel exiting Contamination, High Contamination, or Airborne Radioactivity Areas shall

   - Remove their protective clothing
   - Perform whole body surveying to detect personnel contamination in accordance with Article 338
   - Have tools or equipment being removed from the area monitored for release in accordance with Article 421 or for retention in the contaminated tool crib in accordance with Article 442.5.

4. Exit points from Contamination, High Contamination, or Airborne Radioactivity Areas should include the following:

   - Step-off pads located outside the exit point, contiguous with the area boundary
   - Step-off pads maintained free of radioactive contamination
   - Containers inside the area boundary for the collection of protective clothing and equipment
   - Contamination monitoring equipment located as close to the step-off pad as background radiation levels permit.

5. Examples of techniques that should be used to don and remove radiological protective clothing are given in Appendix E.

6. Multiple step-off pads should be used at the exits from High Contamination Areas. Use of multiple step-off pads is described in Appendix E.

Protective clothing and monitoring requirements specific to benchtop work, laboratory fume hoods, sample stations, and gloveboxes are identified in Article 347.

Article 335 WHC Addendum

Establishing Contamination Control Points

1. Control points shall be established as close as practical to the entrances and exits of each surface contamination area and airborne radioactivity area.

2. Control points shall be established with the minimum practical number of exits. Health Physics shall approve the configuration and number of exits.

3. Step-off pad(s) should be provided at the exit from the control point.

4. The floor of indoor control points should be covered with an easily decontaminated surface such as paper, plastic sheet, paint, or other material.

5. Receptacles and operating instruments should be provided at each active control point as follows:

   a. Segregated receptacles for radioactive waste and protective clothing. Outdoor laundry and waste containers should be protected from the weather.

   b. Instrumentation for contamination monitoring of personnel and materials.

   c. Shielded booths as determined by Health Physics.

Operation of the Contamination Control Point

1. All personnel leaving and materials brought from surface contamination areas or airborne radioactivity areas shall be surveyed for radioactive contamination at the control point by use of a personnel survey device (PSD) for a whole-body survey or a hand-held survey instrument.

2. Access control logs should be maintained at each control point to document personnel entries and provide work accountability if the WRAM system is not utilized.

3. Surveys of active contamination control points shall be performed daily. Contamination levels on final exit step-off pads shall be maintained at or less than the values of Table 2-3.

336* Visitor Entry Requirements

Visitors with a demonstrated need to enter the following areas may be allowed access if such access is controlled with a combination of training and the use of escorts trained for the specific area:

- Radiological Buffer Areas
- Radiation and High Radiation Areas
- Contamination Areas
- Radioactive Material Areas.

Training requirements for visitors are identified in Articles 622 and 657.

1. Persons under 18 years of age shall not be permitted to enter Radiation Areas or Contamination Areas without the approval of the Radiological Control Manager.

2. Area entry requirements and access restrictions for visitors shall be in accordance with Table 3-2.

3. Visitors shall be prevented from entering Very High Radiation Areas in accordance with Article 334.5, and they should be prohibited from accessing High Contamination and Airborne Radioactivity Areas.

4. All Hanford personnel serving as a qualified escort shall ensure that each visitor under his/her cognizance completes a Hanford Radiological Area Visitor Form. The qualified escort shall also sign the respective visitor form and complete it as appropriate.

Article 336 WHC Addendum

Visitor Entry Requirements

Escorted Visitors

1. Escorted visitors shall adhere to the entry requirements listed in Table 3-2 for entry into radiological areas when activities are limited to inspections, tours, audits or maintenance of uncontaminated, nonradiological system components.

   Any individuals handling or working directly with radioactive materials or contaminated and potentially contaminated materials or equipment, shall qualify as radiological workers, and adhere to the entry requirements specified in table 3-3.

2. Escorted visitors shall complete a "Visitor Radiation Exposure Disclosure" form prior to entry.

3. The host WHC manager shall forward the visitor radiation exposure disclosure form to Dosimetry.

Unescorted Visitors (worker qualified)

1. WHC-sponsored visitors shall provide the following before entering radiological areas, unless these records have already been entered into the WRAM or an equivalent entry control system:

   a. A completed Health Physics Entry Requirements Checklist for Non-WHC Personnel (A-6000-665 or Jetform)

   b. Visitor Radiation Exposure Disclosure form (A-6000-666 or Jetform)

2. The host WHC manager shall forward the visitor radiation exposure disclosure form to Dosimetry.

3. The use of offsite mask fit certification is authorized under the following conditions:
   a. A mask fit has been completed within the previous year
   b. The individual presenting the mask fit certification card has not changed physical appearance in a way that would affect the seal of the mask to the face
   c. WHC has the masks available which the individual is certified to wear.

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337* Controlling the Spread of Contamination

Required measures used to prevent the spread of contamination across the boundary of Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas are as follows:

1. Solid barriers should be used to enclose areas wherever practicable.

2. Items, such as hoses and cords, that cross the boundary should be marked and secured.

3. Airflow from areas of lesser to greater removable contamination potential should be controlled and directed.

4. Engineering controls and containment devices such as glovebags, gloveboxes, and tents should be used.

Article 337 WHC Addendum

Containment

Containment devices are used to mitigate the spread of contamination and reduce the risk to personnel. Implementing guidance is addressed in WHC-SD-GN-RD-20002, *Radiological Containments*. These or other technical specifications approved by Health Physics Radiological Engineering shall be used for containment application.

Containment Criteria

1. Jobs involving opening contaminated systems shall be performed with barriers to prevent the spread of contamination.

   NOTE: Work in canyons, hot cells or other areas with engineering controls are exempt from these containment requirements.

2. Containment should be considered in the work controlling documents if any task involves:

   a. The potential to spread contamination

   b. Exposing a contaminated fluid system

   c. Airborne contamination levels greater than 10% of any derived air concentration (DAC).

3. Health Physics shall approve any exemptions to the containment requirements and document such approval in the work controlling documentation for the job.

Control of Containment Devices

1. Health Physics shall approve containment design before the containment is constructed or procured.

2. Custodians should inspect active containments daily for integrity, wear, and signs of damage. Installed containments where there are no work activities in progress should be inspected at least weekly.

338 Surveys for Personnel Contamination

1. Personnel shall perform or obtain a survey for personnel contamination:

   - Immediately upon exiting Contamination Areas, High Contamination, Areas and Airborne Radioactivity Areas

   - As specified in the RWP or directed by the Radiological Control Organization.

2. In addition to item 1 immediately above, personnel exiting a Radiological Buffer Area that contains Contamination, High Contamination, or Airborne Radioactivity Areas should, as a minimum, perform a hand and foot survey.

   NOTE: This survey is optional if the Radiological Buffer Area exit is immediately adjacent to the location where the exiting worker has already performed a whole body survey.

3. Where surveys cannot be performed at the exit from Contamination Areas, High Contamination Areas, or Airborne Radioactivity Areas due to high background radiation levels, personnel shall

   - Remove all protective equipment and clothing at the exit
   - Proceed directly to the nearest designated monitoring station
   - Perform a whole body survey.

4. Personnel surveys shall be performed after removal of protective clothing and prior to washing, showering, or donning of personal clothing.

5. Personnel surveys shall be performed using instruments that meet the minimum detection requirements of Article 221.2. Guidelines for personnel surveying are provided in Appendix F.

6. Automated personnel contamination monitors should be used where practical.

7. Hand-carried personal items, such as notebooks, papers, and flashlights, shall be subject to the same survey requirements as the person carrying them. (The use of such items should be limited.)

8. Personal items, such as eyeglasses, sunglasses, personnel dosimeters, and items in pockets that remain under protective clothing while in the Contamination Area shall be subject to the same survey requirements as the person carrying them.

9. Instructions for personnel surveying should be posted adjacent to personnel survey instruments or monitors.

10. The personnel survey requirements contained in this Article are not applicable at facilities that contain only radionuclides, such as tritium, that cannot be detected by currently available hand-held or automated survey instrumentation. At such facilities, additional emphasis should be placed on worker bioassay programs and routine surface and airborne radioactive material contamination sampling programs.

Table 3-2. Visitor Entry Requirements[a].

Areas	Rad. Area Visitor Form	Hanford Dosimeter	Self-Reading Dosimeter	Visitor Orientation	Qualified Escort	Exit Contam. Survey	Prot. Clothing
Nonradiological							
Road Tour					X		
Intown Facilities							
Site Facility				X			
Outdoor Nonradiological Areas				X			
Radiological							
Radiologically Controlled Area	X	(b)		X			
Radiological Buffer Area	X	(b)		X	X	X	(c)
Radioactive Materials Area	X	(b)		X	X		
Radiation Area	X	X		X	X		
High Radiation Area	X	X	X	X	X		
Contamination Area	X	X		X	X	X	(c)
Soil Contamination Area	X	X	(c)	X	X	X	(c)
Very High Radiation Area	(d)						
High Contamination Area	(d)						
Airborne Area	(d)						

(a) Visitors shall be limited to observation and auditing activities upon entry to radiological areas. Individuals who anticipate becoming involved in handling radioactive materials or contaminated and potentially contaminated material or equipment shall qualify as Radiological Workers and shall meet applicable area entry requirements as identified in Articles 332 through 335.

(b) A Hanford basic dosimeter is acceptable as a minimum.

(c) Personnel protective clothing or self-reading dosimeter as required by the applicable RWP (if any).

(d) Visitor entry prohibited. Entry into such an area requires qualification as a Radiological Worker see Articles 334, 335, and 336.

Entry and Exit Requirements Addendum, Table 3-3

Entry and Exit Requirements, WHC Addendum

Table 3-3. Minimum Worker Entry Requirements By Radiological Area Type.

	Very High Radiation Area	High Radiation Area	Radiation Area	Surface Contamination Area	Airborne Radioactivity Area	Radioactive Materials Area	Underground Radioactive Materials Area
Access	Extremely Limited	Limited	Need to Enter	Trained & Qualified	Limited	Need to Enter	Need to Enter
Radiological Work Permit	X	X	X	X	X	A	A
Basic Dosimeter						X	X
Multi-Purpose Dosimeter	X	X	X	X	X		
PADI	X	X					
Pencil Dosimeter	X	X	A				
Protective Clothing				X	X		
Mask Fit					X		
Rad Worker Training	X	X	X	X	X	X	X
Facility Orientation	X	X	X	X	X	X	X

A - As required by Health Physics

Part 4 Radiological Work Controls

341 Requirements

1. Radiological work activities shall be conducted as specified by the controlling technical work document and RWP.

2. Prerequisite conditions, such as tag-outs and system isolation, should be verified in accordance with the technical work documents before work is initiated.

342* Work Conduct and Practices

1. Contamination levels caused by ongoing work shall be monitored and maintained ALARA. Work should be curtailed and decontamination performed at preestablished levels, taking into account worker exposure.

2. Tools and equipment should be inspected to verify operability before being brought into Contamination, High Contamination, or Airborne Radioactivity Areas.

3. The use of radiologically clean tools or equipment in Contamination, High Contamination, or Airborne Radioactivity Areas should be minimized by the implementation of a contaminated tool crib in accordance with Article 442.5. When such use is necessary, as in the case of portable radiological survey instruments, tools or equipment with complex or inaccessible areas should be wrapped or sleeved to minimize contamination. (Wrapping or sleeving is not required for instruments used in Surface Contamination Areas established in accordance with Article 347.)

4. Engineering controls, such as containment devices, portable or auxiliary ventilation and temporary shielding, should be installed in accordance with the technical work documents and inspected prior to their use.

5. Hoses and cables entering the work area should be secured to prevent safety hazards or the spread of contamination.

6. The identity of components and systems should be verified prior to working with them.

7. Work activities and shift changes should be scheduled to prevent idle time in Radiation Areas.

8. Where practicable, parts and components should be removed to areas with low dose rates to perform work.

9. Upon identification of radiological concerns, such as inappropriate work controls or procedural deficiencies, workers should immediately report the concern to line supervision and the Radiological Control Organization.

10. Requirements for area cleanup should be included in the technical work documents. Work activities should not be considered complete until support material and equipment have been removed and the area has been returned to at least prework status.

11. To minimize intakes of radioactive material by personnel, smoking, eating, chewing, or drinking, except as specified below, shall not be permitted in Contamination, High Contamination, Airborne Radioactivity Areas, or Radiological Buffer Areas. When a potential exists for personnel heat stress, drinking may be permitted within a Contamination Area under the following conditions and controls:

    - The potential for heat stress cannot be reduced by the use of administrative or engineering controls.

    - All drinking is from approved containers or sources.

- As a minimum, the worker's hands and faces are monitored for contamination prior to drinking.
- Participating workers are monitored as part of the bioassay program.
- The applicable requirements and controls are described in approved procedures.

12. Alarm settings and trips points for radiological protection instruments, etc. shall not be changed or altered without approval by the Radiological Control Manager. Radiological protection instruments shall not be disconnected or moved without approval by the Radiological Control Manager. Where such changes could alter the performance of the instrument, changes shall be approved by the Hanford Radiological Calibration Program manager.

13. The Radiological Control Manager may authorize drinking from installed drinking fountains within Radiological Buffer Areas provided that the drinking fountains are incorporated into a routine survey program.

Article 342 WHC Addendum

Radiological Deficiencies

1. Health Physics shall issue a Radiological Problem Report (RPR; form WEF051, A-7600-318) after any violation of this manual. Any employee may initiate a RPR.

2. Tracking and closure of radiological problem reports shall be in accordance with WHC-CM-1-4, *Corrective Action Management Manual*.

3. Radiological problem reports that are not entered on the QUEST system shall be trended and tracked to closure by Health Physics.

343 Logs and Communications

1. Radiological Control personnel should maintain logs to document radiological occurrences, status of work activities, and other relevant information.

2. During continuous or extended daily operations, oncoming Radiological Control personnel should review logs and receive a turnover briefing from the personnel they are relieving.

3. Communication systems required by the RWP or technical work document should be checked for operability before being brought into the work area and periodically during work.

4. Workers should keep Radiological Control personnel informed of the status of work activities that affect radiological conditions.

344 Review of Work in Progress

1. As part of their normal work review, work supervisors should periodically review ongoing jobs to ensure that prescribed radiological controls are being implemented.

2. Radiological Control personnel should conduct frequent tours of the workplace to review the adequacy of radiological work practices, posting, and area controls.

3. During the performance of jobs for which a pre-job dose estimate was made, the Radiological Control Organization, in cooperation with line management, should periodically monitor collective dose accumulation and compare it with the pre-job dose estimate. Differences should be reviewed to identify causes and assess the need for corrective actions.

345* Stop Radiological Work Authority

Radiological Control Technicians and their supervisors, line supervision, and any worker through their supervisor have the authority and responsibility to stop radiological work activities for any of the following reasons:

- Inadequate radiological controls
- Radiological controls not being implemented
- Radiological Control Hold Point not being satisfied.

1. Stop radiological work authority shall be exercised in a justifiable and responsible manner.

2. Once radiological work has been stopped, it shall not be resumed until proper radiological control has been reestablished.

3. Resumption of radiological work shall require the approval of the line manager responsible for the work and the Radiological Control Manager.

Article 345 WHC Addendum

Criteria for Stop Work Action

A stop work order should be issued when an underlying condition requires correction before work can proceed safely.

Additional WHC radiological control deficiencies that may require the issuance of a stop work directive are:

1. Activities that result in spread of radioactive contamination outside of established surface contamination area boundaries.

2. Loss of control of radioactive material.

3. Exposures that exceed administrative levels or radilogical work permit parameters.

Recovering from a Stop Work Action

The responsible facility management and Health Physics shall define the circumstances and actions that must be completed before the stop work order may be lifted as part of the corrective action plan.

346 Response to Abnormal Situations

1. Standard responses to abnormal radiological conditions shall be adopted and incorporated into RWPs, technical work documents, area and building emergency plans, or Radiological Worker training programs as appropriate.

2. Response to a continuous air monitor alarm should include the following actions:

   a. Initiate stop-work activities.

   b. Alert other personnel.

   c. Immediately exit the area.

   d. Notify Radiological Control personnel.

3. Response to increasing or unanticipated radiation levels, as identified by a supplemental dosimeter or Area Radiation Monitor Alarm, should include the following actions:

   a. Initiate stop-work activities.

   b. Alert other personnel.

   c. All personnel immediately exit the area.

   d. Notify Radiological Control personnel.

4. Response to a criticality alarm should include the following actions:

   a. Immediately evacuate the building in accordance with the facility Emergency Plan without stopping to remove protective clothing or performing exit monitoring.

   b. Report to designated assembly areas.

   c. Personnel in protective clothing remain segregated from others until contamination surveys are performed.

5. Response to a personnel contamination monitor alarm should include the following actions:

   a. Remain in the immediate area.

   b. Notify Radiological Control personnel.

   c. Take actions that may be available to minimize cross-contamination, such as putting a glove on a contaminated hand.

   d. Take follow-up actions in accordance with Article 541.

6. Response to a spill of radioactive material should include the following actions:

   a. Stop or secure the operation causing the spill.

   b. Warn others in the area.

   c. Isolate the spill area if possible.

   d. Minimize individual exposure and contamination.

   e. Secure unfiltered ventilation.

   f. Notify Radiological Control personnel.

7. For spills involving highly toxic chemicals, workers should immediately exit the area without attempting to stop or secure the spill. They should then promptly notify the Industrial Hygiene Department, hazardous material team, and Radiological Control Organization personnel.

347 Controls for Benchtop Work, Laboratory Fume Hoods, Sample Stations, and Gloveboxes

The following requirements are applicable to radiological work in localized benchtop areas, laboratory fume hoods, sample stations, and glovebox operations located in areas that are otherwise contamination free.

1. An RWP should be issued to control radiological work in localized benchtop areas, laboratory fume hoods, sample sinks, and gloveboxes.

2. The following controls shall apply to work with unsealed materials in localized benchtop and laboratory fume hood operations:

   a. Protective clothing shall include laboratory coats and gloves, as a minimum. Gloves should be secured at the wrist as necessary.

   b. Shoe covers should be considered based on the potential for floor contamination.

   c. Workers should periodically monitor their hands during work.

   d. Prior to leaving the area, workers should perform a whole body survey.

   e. Radioactive materials being transferred from one laboratory to another shall be packaged in accordance with Article 413 and shall be monitored for removable contamination prior to transfer. All other materials and equipment shall be released in accordance with Articles 421 and 422.

   f. Training, protective clothing, and self-survey requirements shall be specified in the applicable RWP.

3. The following controls shall apply to sample station operations:

   a. Protective clothing shall include laboratory coats and gloves, as a minimum. Gloves should be secured at the wrist as necessary.

   b. Shoe covers should be considered based on the potential for floor contamination.

   c. If there is a potential for splashing or airborne radioactive material, such as when taking pressurized samples, additional controls such as the use of rubber aprons, face shields, full protective clothing, or respiratory protection should be instituted.

   d. Workers should periodically monitor their hands during work.

   e. Prior to leaving the area, workers should perform a whole body survey.

   f. Training, protective clothing, and self-survey requirements shall be specified by the applicable RWP.

4. The following controls shall apply to glovebox operations:

   a. Gloveboxes should be inspected for integrity and operability prior to use.

   b. Gloveboxes should be marked with or survey measurements should be posted to identify whole body and extremity dose rates.

   c. Protective clothing shall include laboratory coats and gloves, as a minimum. Gloves should be secured at the wrist as necessary.

   d. Shoe covers should be considered based on the potential for floor contamination.

   e. Workers should periodically monitor their hands during work.

   f. Prior to leaving the area, workers should perform a whole body survey.

   g. Training, protective clothing, and self-survey requirements shall be specified by the applicable RWP.

348 Controls for Hot Particles

Hot particles are small, discrete, highly radioactive particles that may be associated with extremely high doses to a localized area in a short period of time. Hot particle contamination may be present or be generated when contaminated systems are opened or when operations such as machining, cutting, or grinding are performed on highly radioactive materials.

1. Hot particles are defined as small (typically less than 1 mm in diameter), generally insoluble particles that, when located on the surface of the skin may result in a dose being assigned to the skin of the whole body or extremities in excess of the Administrative Control Level in Table 2-1.

2. Measures for controlling hot particles, as identified in items 3 through 7 of this Article, should be implemented under the following conditions:

   - Upon identification of hot particles
   - During new or nonroutine operations with a high potential for hot particles, based on previous history
   - Upon direction of the Radiological Control Organization.

3. Areas or operations with the potential for hot particle contamination should be surveyed in accordance with Article 554.9.

4. Posting of Contamination Areas should identify the presence of hot particles.

5. Access to Contaminated Areas with hot particles should be controlled by a job-specific RWP. The following controls should be considered for inclusion on the RWP:

   - Periodic personnel monitoring during the work activity, at a frequency based on the potential magnitude of skin exposure
   - Additional Personal Protective Equipment and Clothing
   - Direct radiological control coverage during work or assistance during protective clothing removal
   - Use of sticky pads or multiple step-off pads.

6. Personal Protective Equipment and Clothing used in Contaminated Areas with hot particles should be segregated from other radiological protective equipment and clothing during laundering and shall be surveyed prior to reuse.

7. Response to hot particle skin contamination of personnel should include the following:

   - Immediate removal and retention of the hot particle for subsequent analysis
   - Analysis of the particle
   - Assessment of worker dose
   - Evaluation of work control adequacy.

Part 5 Evaluation of Performance

During the conduct of radiological work and the handling of radioactive materials, abnormal events may occur that could indicate a weakness or an area of programmatic breakdown of radiological controls.

1. Prompt, consistent gathering of facts related to such events is required to satisfy reporting and investigation requirements and to formulate corrective actions to prevent recurrence.

2. Successful performance or completion of unique activities should be evaluated to identify and incorporate appropriate lessons learned.

Analysis of the facts should reveal areas where improvements can be made or identify methods to prevent the recurrence of undesired results.

351* Conduct of Critiques

Critiques are meetings of the personnel who are knowledgeable about an event (either a success or an abnormal event) to help document a chronological list of the facts. The purpose of the critique is not to assign blame, but to establish and record the facts.

1. Critiques should be conducted for successes and abnormal events.

2. Critique leaders should be trained in the required elements of the critique process and the appropriate methods of conducting and controlling the critique.

3. Critique meetings should be conducted as soon as practicable after the event or situation is stabilized, or after a successful evolution is completed. Critiques of abnormal events preferably should be conducted before the personnel involved leave for the day.

4. As a minimum, the general critique process should include the following elements:

   - Formal meetings, chaired by a critique leader
   - Attendance by all who can contribute
   - Personal statement forms completed by selected personnel before the meeting
   - Attendance records
   - Minutes, recorded, and signed by the critique leader and all contributors
   - Personal statements, signed and attached to the meeting minutes
   - A list of the facts in chronological order
   - Supporting materials, including documents, records, photographs, parts and logs, maintained by the critique leader.

Evaluation of complex evolutions or events may require multiple critiques.

Article 351 WHC Addendum

Conduct of Critiques

A critique should be conducted if the following radiological situations occur:

- An event results in a stop work order
- An event results in a reportable occurrence
- An event must be reported to the state or other federal agencies
- When any high risk or complicated job is completed successfully.

General guidelines for conducting critiques may be found in WHC-SP-0708, *Westinghouse Hanford Company Conduct of Operations Manual*.

352* Post-Job Reviews

1. Performance should be reviewed after completion of nonroutine radiological work.

2. Post-job reviews should be performed for jobs or tasks that exceed the trigger levels established in Article 312.3.

3. Performance should be reviewed after completion of nonroutine radiological work.

Article 352 WHC Addendum

Post-Job Reviews

1. The facility/area ALARA team or facility ALARA point of contact shall perform a post-job review of ALARA class 1 and 2 activities.

2. The post-job review shall be documented on the Post ALARA Review and Continuation Sheet (PAR; WEF192, A-6000-871). The lessons learned while performing the job and any additional ALARA measures, modifications, or changes implemented during the job should be included.

353 Lessons Learned

Lessons learned are available from post-job reviews and reports of past radiological events on site and at other facilities. The Radiological Control Organization, in conjunction with line management, should evaluate lessons learned, provide prompt distribution, and incorporate the lessons into the Hanford Site Radiological Control Program, the radiological training program, and related operations.

Part 6 Special Applications

This Part provides supplemental information to augment the basic requirements of the HSRCM. The references in Articles 361 through 365 provide information used in developing the HSRCM requirements. Written guidance and requirements contained within DOE documents, consensus standards, or Federal Regulations that delineate specifics for each application are referenced.

Articles 361 through 363 of this Part are applicable to facilities where the majority of the work or operations involve the subject radionuclide as the significant source term. This Part is not intended to apply to facilities that use the subject radionuclides in limited or tracer amounts, such as analytical laboratories.

361 Plutonium Operations

Exposure to small quantities of plutonium is perceived to present greater risk than exposure to other radionuclides. Low levels of plutonium in the body are difficult to measure and biological removal processes for plutonium are slow. For these reasons:

1. Primary emphasis shall be placed on engineered features to contain plutonium and to prevent airborne and surface contamination.

2. In addition to the provisions of the HSRCM, guidance contained in the document, *Health Physics Manual of Good Practices for Plutonium Facilities*, (Faust et al. 1988) should be considered when developing procedures for plutonium operations on the Hanford Site. The HSRCM provides specific guidance related to dosimetry, radiological monitoring, instrumentation, contamination control, and applicable radiological control procedures.

362 Uranium Operations

Natural, depleted, and low-enriched uranium are unusual in that their chemical toxicity is more limiting in the human body than their radioactivity. Also, processed uranium sometimes contains transuranic and other radionuclides from recycled materials.

For these reasons, in addition to the provisions of the HSRCM, the guidance contained in the document, *Health Physics Manual of Good Practices for Uranium Facilities*, (Rich et al. 1988) should be considered when developing procedures for uranium operations on the Hanford Site. The manual provides specific guidance related to management controls, radiological monitoring, contamination control, and internal and external exposure controls.

363 Tritium Operations

The following characteristics of tritium require consideration in the implementation of the Radiological Control Program at tritium facilities:

1. Tritium emits low-energy beta particles that cannot be monitored using external dosimeters, consequently requiring the use of bioassay measurements to evaluate worker dose.

2. Worker exposure to tritium as water vapor causes a much greater dose than exposure to elemental tritium gas.

3. Normal personnel surveying techniques are ineffective for tritium. Consequently, a high reliance is placed on worker bioassay and routine contamination and air monitoring programs.

4. Due to its high permeability, tritium is difficult to contain. Special attention shall be directed to the selection of personal protective equipment and clothing.

For the above reasons, guidance contained in "Control and Measurement of Tritium at DOE Sites"[(a)] should be considered when developing procedures for tritium operations on the Hanford Site. The manual provides specific guidance related to internal dosimetry, contamination and air monitoring, tritium containment practices and techniques, and selection of Personal Protective Equipment and Clothing.

364 Accelerator Operations

Special considerations associated with accelerator facilities include the presence of extremely high dose rates, high-energy and heavy particles, the generation of activation products, and detection and monitoring difficulties associated with pulsed or high-energy radiation. For these reasons:

1. In addition to the provisions of the HSRCM, guidance contained in the *Health Physics Manual of Good Practices for Accelerator Facilities*, (McCall et al. 1988) should be considered when developing plans and procedures for accelerator operations at the Hanford Site. The manual provides specific guidance related to radiological monitoring, dosimetry, shielding design, use of interlocks, and procedures and administrative controls.

2. Consideration should be given to the information provided in the American National Standards Institute Standard N43.1, *Radiological Safety in the Design and Operation of Particle Accelerators* (ANSI 1978), when developing plans and procedures for accelerator operations at the Hanford Site.

3. Safety devices and interlocks shall be operational prior to and during operation of a beam. Operational status shall be verified by testing.

365 Radiation-Generating Devices

Special considerations associated with the use of Radiation-Generating Devices include the presence of extremely high dose rates and the potential for uncontrolled exposures. This Article implements the applicable requirements of ANSI N543 (ANSI 1974), *General Safety Standard for Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV* and ANSI N43.2 (ANSI R1989a) *Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment*, as mandated by DOE 5480.4 (DOE 1984).

1. Line management responsible for the design and operation of Radiation-Generating Devices shall identify a Qualified Expert, a Radiation-Generating Device Custodian, Radiation-Generating Device Operators.

   a. The Qualified Expert shall provide guidance and approval on the safe operation of Radiation-Generating Device. The Qualified Expert shall be appointed by line management and approved by the Radiological Control Organization. New or modified Radiation-Generating Device installations shall not be operated until the

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(a) "Control and Measurement of Tritium at DOE Sites." 1991. Draft Technical Guide 4.XX Rev. 3, Pacific Northwest Laboratory, Richland, Washington (contact: Jack Selby)

Qualified Expert reviews and approves the design or modification, and pre-operational inspection and surveys.

b. A Radiation-Generating Device Custodian shall provide control of Radiation-Generating Devices and Radiation-Generating Devices installations. The Radiation-Generating Device Custodian shall be appointed by line management and approved by the Radiological Control Organization. The Radiation-Generating Device Custodian shall be trained in accordance with Article 656, qualified by the Qualified Expert, and re-qualified by the Qualified Expert every 3 years.

The Radiation-Generating Device Custodian shall:

- Maintain control of all keys, combinations, or codes necessary for operation of the Radiation-Generating Device installation
- Maintain current as-built schematics, including diagrams of the interlocks
- Maintain a list of sealed sources for Radiation-Generating Devices
- Provide initial training to qualify staff as operators of Radiation-Generating Devices and provide retraining annually
- Ensure that operating and emergency inspection and test procedures are available and up to date
- Ensure that applicable operating and emergency, inspection and test procedures, and RWPs are being followed
- Inform all Radiation-Generating Device operators and the Radiological Control Organization of procedural and physical changes
- Ensure that calibrated and operable survey instruments specified by the Radiological Control Organization are available for use at each location where the Radiation-Generating Device is present
- Notify the Radiological Control Organization prior to purchase, receipt, installation, and initial use of maintenance of any Radiation-Generating Device
- Notify the Radiological Control Organization of all changes that may affect the safety of a device
- Maintain a list of all qualified Radiation-Generating Device operators
- Train operators of Radiation-Generating Device in site job-specific procedures

- Ensure that inspections and radiological surveys are conducted prior to operation of new or modified Radiation-Generating Device installations, and ensure that periodic inspections and surveys are conducted prior to operation and at intervals not to exceed every 6 months.

- Ensure that operating and maintenance logs are being maintained by the Radiation-Generating Device operators, and are periodically reviewed

- Ensure that required inspections and radiation surveys are performed at a minimum of every 6 months and documented

- Promptly terminate all unsafe Radiation-Generating Device operations.

c. Radiation-Generating Device Operators

Radiation-Generating Device Operators shall be qualified by line management. The Radiation-Generating Device Custodian shall approve appointment of qualified Radiation-Generating Device Operators after the operators demonstrate their qualification. Radiation-Generating Device Operators shall be trained in accordance with Article 656 and qualified by the Radiation-Generating Device Custodian. The level of training shall be commensurate with the Radiation-Generating Device Operator's job assignment. The Radiation-Generating Device Operator shall

- Ensure proper control of the Radiation-Generating Device installation or area

- Follow applicable procedures and RWPs or alternative authorization at the job site and ensure that other personnel adhere to the requirements

- Ensure that required dosimeters are worn properly by all personnel in the vicinity of the Radiation-Generating Device operations

- Establish control of all adjacent areas where personnel could receive a dose approaching dose limit

- Promptly terminate unsafe Radiation-Generating Device operations

- Maintain operational and maintenance logs.

The Radiation-Generating Device Operator shall have a working knowledge of:

- Methods used in the limiting of exposures to ALARA

- Methods for defining Radiation Areas and for controlling access to these areas

- Access control devices, including interlocks
- Warning devices
- Fixed and portable monitoring devices
- Applicable personnel monitoring devices
- Operating, transporting, calibrating, and maintaining Radiation-Generating Devices in the installation
- Methods for inspecting Radiation-Generating Device installations
- Methods used for radiological surveys of the Radiation-Generating Device installations and adjacent areas
- Maintaining logs and records
- Minimum actions and persons to be contacted in the event of response to abnormal operations.

d. Radiological Control Organization

The Radiological Control Manager shall appoint Radiological Control Organization staff to oversee each Radiation-Generating Device installation.

The Radiological Control Organization shall review and approve specifications and engineered radiation safety features of proposed Radiation-Generating Devices.

The Radiological Control Organization staff assigned to each Radiation-Generating Device installation should:

- Conduct pre-operational, annual, and unscheduled inspections
- Conduct pre-operational, annual, and unscheduled radiological surveys
- Conduct pre-operational radiological surveys after maintenance has been performed
- Periodically review logs and records.

e. Hanford Patrol personnel who operate baggage inspection x-ray devices shall not be considered Radiation-Generating Device operators, however, they shall receive job-specific training in the safe operation of baggage inspection x-ray devices annually.

2. The Radiological Control Organization shall approve the procurement of a Radiation-Generating Device. The Radiological Control Organization and Qualified Expert should be involved in the development of specifications

and designs at the earliest practical phase of projects involving a Radiation-Generating Device.

3. The Radiological Control Organization shall approve requirements for the design of Radiation-Generating Device installations, engineered safety features, periodic inspections and tests, and operation and maintenance records are contained in Appendix G.

4. Open radiography operations shall be conducted in accordance with the requirements contained in Appendix H.

5. Devices for medical use shall be registered with the appropriate regulatory agency.

6. Electron beam welders and electron microscopes shall be surveyed by the Radiological Control Organization following maintenance activities. These devices shall be exempt from the other requirements of this Article.

7. Onsite operations conducted by offsite contractors shall be approved by line management in coordination with the site Radiological Control Organization. This process shall ensure the contractor has a valid NRC or Agreement State license and that the operational and emergency procedures are current and available.

8. A physical radiation survey shall be conducted during or immediately following activities that could alter the effectiveness of the shielding used to protect personnel from Radiation-Generating Devices.

Part 7 Construction and Restoration Projects

Construction and restoration projects, including decontamination and decommissioning (D&D), remedial action, or other actions involving materials that contain low levels of radioactivity may present special problems and require site-specific or program-specific control methods. Health and Safety Plans are normally developed to specify controls for all types of restoration programs, including Formerly Utilized Sites Remedial Action Program (FUSRAP), Uranium Mill Tailings Remedial Action (UMTRA) and other restoration projects.

371 Requirements

Radiological operations and work activities at construction and environmental restoration projects shall be conducted in accordance with the HSRCM. In light of the special nature of these activities, which typically involve low levels of radioactive material and the use of heavy construction or earth-moving equipment, these projects require some radiological considerations that are different from other activities governed by the HSRCM.

Twelve specific subject areas for which radiological considerations are different, are listed below. For these subject areas, the radiological requirements of the HSRCM may be modified by the limited application of the provisions of Article 113.3. The Hanford Radiation Protection Forum is authorized to change mandatory "shall" requirements to "should" to facilitate

implementation of radiological controls in these specific subject areas. The contractor has the responsibility to document the technical equivalency of alternative solutions. The specific subject areas are

- Performance goals and indicators appropriate to remedial activities
- Personal Protective Equipment requirements and practices to accommodate other hazards on the site
- Use of respiratory protection equipment as normal conduct of operation due to lack of engineering controls and temporary nature of the work
- Use of Contamination Reduction Corridors to accommodate movement of personnel and heavy equipment through a variety of decontamination stations
- Methods to obtain representative samples for release of equipment and material from the work areas
- Surveying of materials released from Soil Contamination Areas that exhibit significant contamination transfer properties
- Precedence of government (Washington State or Federal) mandated soil cleanup criteria over surface contamination criteria that otherwise apply
- Monitoring and survey frequency for inactive facilities or large areas that are infrequently occupied
- Outdoor storage of uncontained, bulk radioactive materials such as contaminated soil
- Posting of privately owned and adjacent property
- Evaluation of outdoor air monitoring methodologies that take into account dust loading, environmental factors, and supplemental breathing zone sampling
- Criteria for suspension of operations under adverse environmental conditions, such as wind or rain.

372 Environmental Conditions

Because adverse environmental conditions may disrupt radiological controls, the following actions should be considered:

- The use of covers, wind screens and runoff collection basins to preclude the inadvertent spread of radioactive material
- Provisions for worksite personnel to assemble and be monitored prior to release or reestablishment of work
- Evaluation of work areas to determine if modified work controls or decontamination are needed.

373 Other Workplace Hazards

Radiological controls should be implemented in a balanced way to ensure that protection from all workplace hazards can be implemented. Other hazards to consider include the following:

- General construction hazards
- Confined spaces
- Flammable materials
- Reactive chemicals
- Heat stress and hypothermia
- Chemical exposures
- Energized electrical equipment
- Biological hazards
- Rotating equipment
- Noise and vibration
- Excavations.

Exhibit 3-1 Checklist for Reducing Occupational Radiation Exposure.

Preliminary Planning and Scheduling

- Plan in advance
- Delete unnecessary work
- Determine expected radiation levels
- Estimate collective dose
- Sequence jobs
- Schedule work
- Select a trained and experienced work force
- Identify and coordinate resource requirements

Preparation of Technical Work Documents

- Include special radiological control requirements in technical work documents
- Perform an ALARA pre-job review
- Evaluate potential accident scenarios and develop contingency plans
- Plan access to and exit from the work area
- Provide for service lines (air, welding, ventilation)
- Provide communication (sometimes includes closed-circuit television)
- Remove or shield sources of radiation
- Plan for installation of temporary shielding
- Decontaminate
- Work in lowest radiation levels
- Perform as much work as practicable outside Radiation Areas
- State requirements for standard tools
- Consider special tools, including robots
- State staging requirements for materials, parts and tools
- Incorporate Radiological Control Hold Points
- Minimize discomfort of workers
- Revise estimates of collective dose
- Prepare RWPs.

Temporary Shielding

- Design shielding to include stress considerations
- Control installation and removal of shielding by written procedure
- Inspect shielding after installation
- Conduct periodic radiation surveys of shielding
- Prevent damage caused by heavy lead temporary shielding
- Balance radiation exposure received in installation against exposure saved by installation
- Shield travel routes
- Shield components with abnormally high radiation levels early in the maintenance period.

Exhibit 3-1 (continued)

- Shield the position occupied by worker
- Perform directional surveys to improve the design of shielding by locating the source of radiation
- Use mock-ups to plan temporary shielding design and installation
- Consider use of water-filled shielding.

Rehearsing and Briefing

- Rehearse
- Use mock-ups to duplicate working conditions
- Use photographs and videotapes
- Have supervisors conduct briefings of workers.

Performing Work

- Stage tools and equipment before starting work
- Comply with technical work documents and RWPs
- Post radiation levels
- Keep excess personnel out of Radiation Areas
- Minimize radiation exposure
- Have supervisors and workers keep track of radiation exposure
- Have workers assist in radiation and radioactive material measurements
- Delegate radiological control monitoring responsibilities
- Evaluate use of fewer workers
- Reevaluate reducing radiation exposures
- Compare the actual collective dose against the pre-job estimate
- Review work practices to see if changes will reduce dose
- Coordinate personnel at the job site to reduce nonproductive time.

Exhibit 3-2. Hanford Radiological Work Permit.

HANFORD RADIOLOGICAL WORK PERMIT | CONTRACTOR:

General ☐ Job Specific ☐	Tech. Document No.	Location Code	EAN	RWP Number

Start Date	End Date	Termination Date Extended To:	By:

Responsible Organization

Job Location

Job Description and Type of Area:

Primary Isotope(s): ☐ — MFP ☐ — MAP ☐ — Cs ☐ — Sr ☐ — H-3 ☐ — U ☐ — Pu ☐ — Other

Radiation Emitted	Estimated Dose Rates	Contamination Levels	Radiological Worker Training Req.
☐ Alpha ☐ Beta ☐ Photons ☐ Neutrons	General Area:..... mrem/h Maximum Contact:..... mrem/h	Beta-gamma:..... dpm/100 cm^2 Alpha:..... dpm/100 cm^2	I..... ☐ II..... ☐

Internal Dosimetry Requirements (for routine work under the RWP, except those entering for observation only)
☐ — Annual Whole Body Count ☐ — Lung Count ☐ — Urinalysis Isotopes to Test for (if any):

MINIMUM RADIOLOGICAL PROTECTION REQUIREMENTS	SPECIAL INSTRUCTIONS (SI)
Note: The requirements contained in this block may be in the form of a bullet list or check-boxes.	

ALARA Review: | Pre-job Briefing: YES ☐ NO ☐ | Post Job ALARA Review Required YES ☐ NO ☐

RWP Prepared By: | Phone: | RCT Phone:

Line Management	Phone	Date
RCT Supervisor	Phone	Date
Facility Management	Phone	Date
Acknowledged By:		Date:
RWP Change Approvals:		Date:

HSRCM-RWP

Page 1 of 3

Exhibit 3-3. Hanford Radiological Work Permit, Addendum.

HANFORD RADIOLOGICAL WORK PERMIT

Radiation Work Permit #

Page 2 of 3

ADDENDUM

9413199.1597

Exhibit 3-4. Hanford Radiological Work Permit, Acknowledgement/Review.

HANFORD RADIOLOGICAL WORK PERMIT

Radiation Work Permit # _____

Supplemental Page ____ of ____

ACKNOWLEDGMENT/REVIEW

Staff Member Signature	Payroll Number	Date

DO NOT remove or dispose of this page, it MUST be posted with the RWP it pertains to. Return this form to Radiological Control, MSIN ___-___ when this RWP expires, is voided, or is replaced with a new revision.

Exhibit 3-5. Physical Access Controls for High and Very High Radiation Areas.

1. One or more of the following features should be used for each entrance or access point to a High Radiation Area and shall be used for each entrance or access point to a High Radiation Area where radiation levels are such that a person could exceed a whole body dose of 1 rem in 1 hour:

   - A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a High Radiation Area

   - A device that functions automatically to prevent use or operation of the radiation source or field while personnel are in the area

   - A control device that energizes a conspicuous visible or audible alarm signal so that the person entering the High Radiation Area and the supervisor of the activity are made aware of the entry

   - Entryways that are locked, except during periods when access to the area is required, with positive control over each entry

   - Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

2. In addition to the above requirements, additional measures shall be implemented to ensure that personnel are not able to gain access to Very High Radiation Areas when dose rates are in excess of the posting requirements of Table 2-4.

3. Physical access controls over High and Very High Radiation Areas shall be established in a way that does not prevent a person from promptly leaving the area.

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*Articles marked with an asterisk indicate WHC Addendums are included.

Part 0 Summary of Responsibilities

402* Line Management

- Designate radioactive material and sealed source custodians (Article 414.5; 431.3).
- Conduct periodic reviews of radioactive material storage areas (Article 414.5).
- Maintain accountability records for sealed sources (Article 431)
- Coordinate procurement of radioactive sources with the Radiological Control Organization (Article 431.2).
- Direct facility decontamination efforts (Article 463.7).

Article 402 WHC Addendum

Line management shall also be responsible for obtaining written approval from the radiological control organization before bringing radioactive sources onsite (Article 431.4).

403 Radiological Control Manager

- Develop response and notification procedures for loss of radioactive material (Article 411.4).
- Approve the establishment of radioactive material storage areas (Article 414.4).
- Approve procedures for onsite transfers of radioactive material (Article 424.3).
- Provide prior written approval for radiography sources brought onsite (Article 431.9).

407* Employees

- Notify the Radiological Control Organization if radioactive material is lost (Article 411.4).
- Carry an emergency response plan or emergency response information when operating a vehicle making radioactive material shipments (Article 424.12).
- Notify the Radiological Control Organization if engineering controls that prevent worker exposure to airborne radioactivity, such as barriers, gloveboxes, and glovebags, are compromised (Article 453.2).

Article 407 WHC Addendum

Source custodians shall also

- Notify the radiological control organization of changes in use, storage, transfer, disposal, loss, or leaking of a sealed source (Article 431).
- Conduct physical inventory of radioactive sources every six months in conjunction with integrity testing (Article 431).

Part 1 Radioactive Material Identification, Storage and Control

For the purposes of this manual, radioactive material is any material, equipment, or system component determined to be contaminated with radioactive material. Items located in known or suspected Contamination, High Contamination, or Airborne Radioactivity Areas are considered radioactive material. Radioactive material also includes activated material, sealed and unsealed sources, and materials that emit radiation. Controls for sealed sources are described in Article 431.

411 Requirements

1. Materials in Contamination, High Contamination, or Airborne Radioactivity Areas shall be considered radioactive material until they are surveyed and released.

   NOTE: These survey and release requirements do not apply to Airborne Radioactivity Areas where only gaseous, short-lived (half-life of 1 hour or less) activation products are present.

2. Except for sealed and unsealed sources, radioactive material located within Contamination, High Contamination, or Airborne Radioactivity Areas shall not require specific labeling or packaging.

3. Radioactive material may be capable of generating a High Radiation Area. These areas shall have special controls in accordance with Article 334.

4. The Radiological Control Organization shall develop response and notification requirements associated with a loss of radioactive material, including searches, internal investigations, documentation, and reporting. The Radiological Control Organization shall be notified if radioactive material is lost.

412* Radioactive Material Labeling

1. Radioactive material outside Contamination, High Contamination, or Airborne Radioactivity Areas shall be labeled in accordance with Table 4-1.

2. The following shall not be subject to labeling requirements:

   - Material surveyed and determined to have contamination levels lower than Table 2-3 values
   - Radioactive material or containers packaged and labeled for offsite shipment in accordance with Department of Transportation regulations
   - Personal Protective Equipment and Clothing
   - Radiological control samples such as air, process, and soil samples or contamination survey media that are in the custody of the Radiological Control Organization or personnel properly trained in the handling, packaging, and transport of these samples
   - Equipment or installed system components undergoing maintenance covered by a RWP
   - Portable tools and equipment with fixed contamination permanently marked with yellow or magenta and maintained in a contaminated tool crib or storage and distribution area
   - Installed system components located within an area, whose entrance is posted in accordance with Table 2-5
   - Nuclear weapon components
   - Historical items, such as uranium hexafluoride cylinders and large items used in demonstration projects, located within a Radioactive Material Area; such items shall be properly labeled when they are removed from a Radioactive Material Area.

3. Labels shall contain the standard radiation symbol colored magenta on a yellow background, unless there is a documented basis for using black, i.e., excessive fading.

4. Labels shall include contact radiation levels, removable surface contamination levels (specified as alpha or beta/gamma radiation), dates surveyed, surveyor's name, and description of items.

5. Labels on packaged radioactive material should be visible through the package or affixed to the outside.

6. Labels used in outdoor applications shall be securely attached and protected against harsh environmental conditions such as wind, rain, and snow.

Table 4-1. Labeling Requirements for Radioactive Materials.

Item/Material	Required Labeling
Equipment, components, and other items that are radioactive, potentially radioactive, or have been exposed to radioactive contamination or activation sources	CAUTION RADIOACTIVE MATERIAL
Sealed and unsealed radioactive sources or associated storage containers	CAUTION RADIOACTIVE MATERIAL or standard radiation symbol
Equipment, components, and other items with actual or potential internal contamination	CAUTION INTERNAL CONTAMINATION or CAUTION POTENTIAL INTERNAL CONTAMINATION
Components, equipment, or other items with fixed contamination	CAUTION FIXED CONTAMINATION

Article 412 WHC Addendum

Identifying Radioactive Material

All radioactive material outside of a surface contamination area shall have a radioactive material tag (known as a RAM tag) attached to the item, container or package.

Identifying Internally Contaminated Items

Items known to be or that have the potential to be contaminated on inner surfaces shall be labeled with a "Caution Internally Contaminated" sticker or sign.

Identifying Radioactive Waste Containers

Containers for collection and disposal of solid radioactive waste or transuranic waste shall be labeled as "Radioactive Waste" or "Transuranic Waste" respectively.

1. Rectangular waste containers shall be marked on the top and the four sides.

2. Cylindrical containers shall be marked on the top and 180° apart on the curved surface.

3. Health Physics shall determine the labeling required for other container styles.

413* Radioactive Material Packaging

1. Radioactive material that is outside Contamination, High Contamination, or Airborne Radioactivity Areas and is confirmed or suspected of having removable radioactive contamination levels greater than Table 2-3 values shall be securely wrapped in plastic or placed in a container.

2. Radioactive material with sharp edges or projections should be taped or additionally protected to ensure package integrity.

3. Radioactive material with removable or potentially removable contamination levels in excess of 100 times Table 2-3 values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.

4. Yellow plastic wrapping material should be used for packaging radioactive material. Yellow plastic sheets or bags should not be used for nonradiological purposes.

5. The amount of combustible material used in packaging should be minimized.

Article 413 WHC Addendum

Marking and Packaging Radioactive Material

1. Containers used for storage of radioactive material shall be approved by Health Physics.

   a. Metal containers should be used for radioactive material storage unless the waste is otherwise packaged in accordance with the applicable safety analysis review for packaging (SARP).

   b. Glass containers used for radioactive material storage shall be placed in secondary rubber, plastic, or metal containers that are chemically compatible with the stored material. Health Physics may approve the use of plastic-coated glass containers instead of secondary containers.

2. Radioactive materials shall be packaged for disposal as radioactive waste unless Health Physics approved plans provide for the use of the material within 12 months of the time the material is stored.

3. Radioactive material packages shall not be opened in radioactive material storage areas without prior approval by Health Physics.

414* Radioactive Material Storage

1. Radioactive material should be stored in a designated Radioactive Material Area.

2. Long-term (more than 60 days) storage of radioactive material should be in a specially designated Radioactive Material Area.

3. Where appropriate, radioactive material should be decontaminated or disposed of rather than kept in long-term storage.

4. Each Radioactive Material Area should be approved in writing by the Radiological Control Manager.

5. A custodian should be assigned responsibility for each Radioactive Material Area and may have responsibility for more than one storage area.

   a. The custodian should conduct walk-through tours of Radioactive Material Areas to check container integrity.

   b. The custodian should conduct annual or more frequent reviews of each Radioactive Material Area, with emphasis on decontamination, movement of material to long-term storage locations, and disposal of unneeded material.

6. Nonradioactive material should not be stored in a Radioactive Material Area unless specifically authorized by the Radiological Control Manager.

7. Radioactive material except contaminated soil, should not be stored outdoors unless specifically authorized in writing by the Radiological Control Manager.

   a. In cases where outdoor storage is necessary, the integrity of containers used shall be ensured to prevent degradation from weathering and subsequent release of radioactive material.

   b. The custodian should check container integrity monthly at outdoor Radioactive Material Areas.

8. Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged. The use of cardboard boxes shall require approval by the Radiological Control Organization and records of such approval shall be maintained by the custodian.

9. Flammable or combustible materials should not be stored adjacent to Radioactive Material Areas.

10. Fire protection measures, such as smoke detectors, water sprinklers and fire extinguishers, should be considered when establishing a Radioactive Material Area.

Article 414 WHC Addendum

Temporary Storage of Radioactive Materials

Radioactive materials temporarily stored overnight or through the weekend at an active worksite, and materials staged for work to be performed within seven days are exempt from storage requirements if:

1. The container or item has no removable surface contamination, and

2. The worksite is posted as a radiologically controlled area.

Outdoor Storage of Radioactive Material

1. Radioactive material packaged and awaiting shipment in accordance with WHC-CM-2-14 may be exempt from outdoor storage area requirements for up to one year with the approval of the Health Physics area manager and the facility manager. This exemption may be reapproved annually.

2. The responsible facility management shall prepare plans for reducing outdoor area storage of radioactive material and include such plans as part of the annual facility ALARA goals. Reduction plans shall consider disposal and the construction or transfer to indoor storage facilities.

3. Existing storage areas should be fenced on all sides and posted in accordance with Chapter 2 of this manual.

4. Radioactive liquids shall not be stored outdoors without the approval of Health Physics.

Part 2 Release and Transportation of Radioactive Material

421* Release Survey Methodology

1. Objects that have never been used or stored in a Contamination Area, High Contamination Area, or Airborne Radioactivity Area, and that have never come into contact with unsealed radioactive sources may be released based on their history alone.

   a. These objects are not considered to be radioactive material and a contamination survey is not required unless specified by the Radiological Control Organization.

   b. A Material History Release form (Exhibit 4-1) shall be used to document the release of objects that are known to be free of radioactive contamination by their history.

2. A statistical survey methodology shall be used to perform release surveys for materials that are to be released to Radiologically Controlled Areas and for materials that are to be released for uncontrolled use.

3. Objects that are likely to be free of contamination, but that cannot be released based on history alone, may be released based on the results of a 95% statistical contamination survey.

4. Objects that have been decontaminated by non-aggressive techniques, may be released based on the results of a 100% contamination survey.

5. Inaccessible surfaces are those that cannot be accessed by survey instruments to satisfy the necessary source-to-detector geometry. Objects with inaccessible surfaces may be released if

   - There is no reasonable mechanism for contamination to be transported to the inaccessible surfaces of the object (i.e., the object has no internal fans or flow-through openings.

   - The object is determined to be free of contamination on its accessible surfaces by a 95% statistical survey before any decontamination efforts are undertaken.

Article 421 WHC Addendum

Material Release from Exempt Facilities

WHC-managed facilities that are free of radiological controls and that are not expected to have any contaminated materials or equipment present may be designated an "exempt facility" by the manager of Health Physics, provided no radioactive materials are brought into these facilities.

The following release controls are established for use in exempt facilities:

1. The manager of Health Physics shall maintain a current list of the exempt facilities and, for each one, a list of the individuals authorized to approve material releases from the facility.

   a. Health Physics shall update this list at least annually and when notified that a change has occurred either in designated personnel or in building status.

   b. The manager of Health Physics shall approve all changes to the list of exempt facilities.

2. To release materials from an exempt facility, one of the authorized individuals listed for that facility shall approve the release in writing.

3. Intercontractor transfer documentation shall accompany all materials or equipment being transferred or returned to the loan pool.

422 Release to Radiologically Controlled Areas

1. Material in Contamination, High Contamination, or Airborne Radioactivity Areas shall be surveyed for removable and fixed radioactive contamination prior to its release.

   a. Materials released to Radiologically Controlled Areas shall be demonstrated to have radioactive contamination levels less than Table 2-3 values.

   b. Material to be released to uncontrolled areas shall be surveyed in accordance with Article 423.

2. Material with radioactive contamination levels greater than Table 2-3 values shall be labeled and packaged prior to being released to Radiologically Controlled Areas. A flow diagram of the statistical survey methodology is shown in Figure 4-1.

3. Material not immediately released after being surveyed shall be controlled to prevent recontamination while awaiting its release.

4. Records for release of potentially contaminated materials should describe

   - The property
   - Date of last survey
   - Identity of the person who performed the survey
   - Type and identification number of the survey instrument used
   - Survey results.

5. Material released to Radiologically Controlled Areas shall be labeled using the Radiation Release label shown in Figure 4-2.

423 Release to Uncontrolled Areas

1. Radioactive material in Radiologically Controlled Areas or Radioactive Material Areas shall be surveyed for radioactive contamination prior to release to uncontrolled areas.

2. DOE 5400.5 (1990b) describes criteria for releasing radioactive material to uncontrolled areas. Radioactive material being released shall also be evaluated for contamination under any coatings.

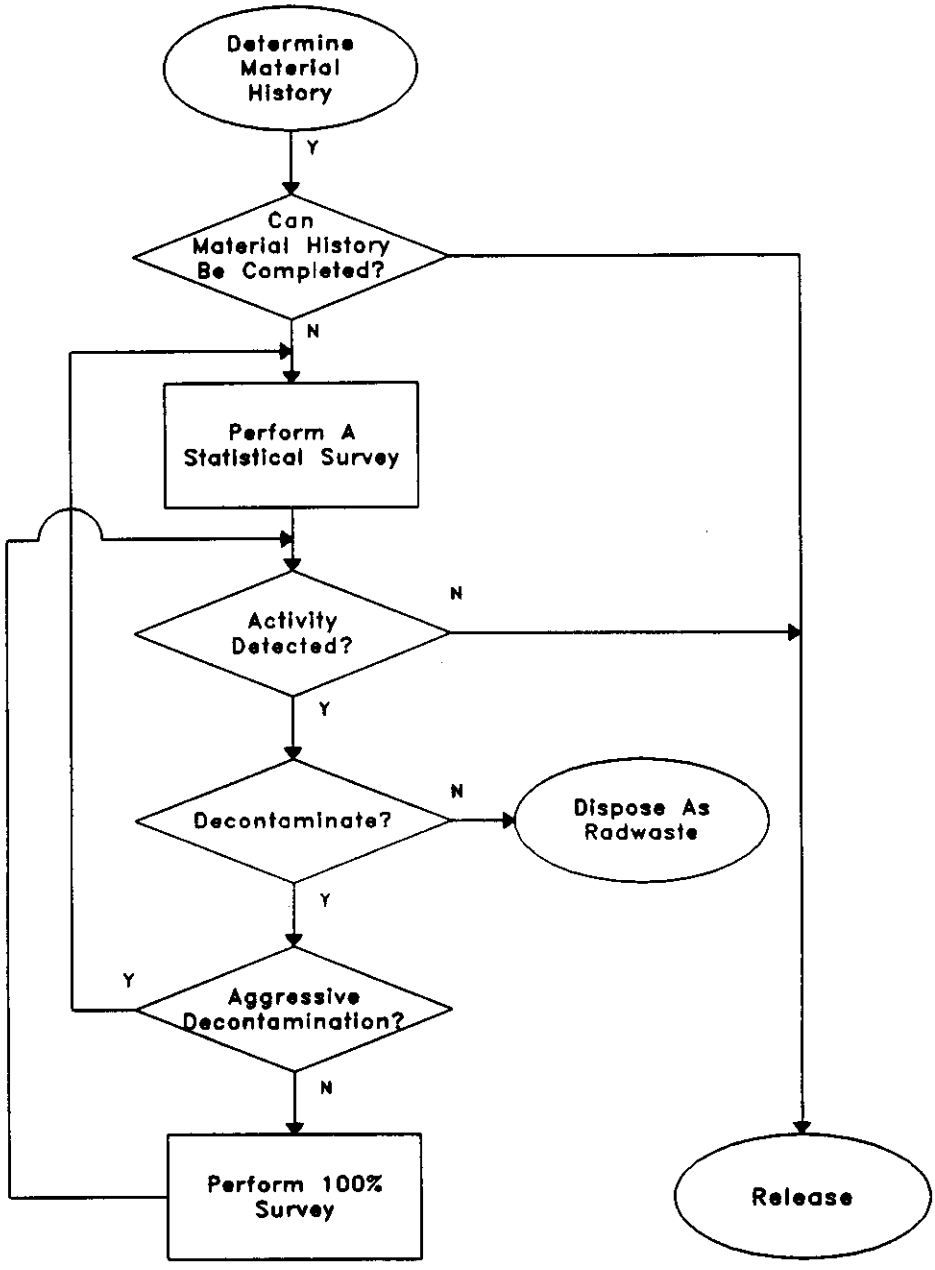
3. DOE 5400.5 describes criteria for releasing radioactive material that has been contaminated in depth or volume, such as activated material or smelted contaminated material.

4. Material not immediately released after being surveyed shall be controlled to prevent radioactive contamination while awaiting release.

5. Material released to uncontrolled areas shall be labeled using the Radiation Release label shown in Figure 4-2.

6. Radiological labels shall be removed or defaced prior to releasing the material for unrestricted use.

Figure 4-1. Statistical Contamination Survey Flow Diagram.



424* Transportation of Radioactive Material

49 CFR 170 through 180 describe requirements for inspecting and surveying packages, containers, and transport conveyances prior to offsite transport.

1. The 49 CFR 173 contamination values shall be used as controlling limits for offsite shipments transported by non-DOE conveyances. These limits shall apply to onsite transfers of shipments by non-DOE conveyances received from or destined to offsite locations.

2. The removable contamination values in Table 2-3 shall be used as controlling limits for onsite and offsite transportation when using a DOE conveyance. When a shipment is received from an offsite destination, by a non-DOE conveyance, the 49 CFR contamination values shall be used when transfers are made by a DOE conveyance from the onsite receiving location to the ultimate onsite destination.

3. Onsite transfers over non-public thoroughfares or between facilities on the same site shall be performed in accordance with written procedures using pre-approved routes. The procedures shall include requirements to ensure appropriate monitoring and control of the radioactive material and should be approved by the Radiological Control Organization.

4. Onsite transfers over public thoroughfares shall be performed in accordance with Department of Transportation, state and local shipping requirements, and pre-approved agreements.

5. Offsite shipments of radioactive material, including subcontractors' handling of offsite shipments, shall be controlled and conducted in accordance with this manual and applicable Federal, state, and local regulations.

6. Before shipment, and upon receipt of a radioactive shipment, a visual inspection of packages should be performed to ensure that packages are not damaged. The inspection should identify dents, flaking paint, debris, package orientation, and any indication of leakage.

7. Before shipment, and upon receipt of a radioactive shipment, a comparison of package count to the shipping manifest should be made to ensure accountability.

8. Transport conveyances should be visually inspected prior to loading to ensure that the trailers are acceptable for the intended use.

9. Commercial transport conveyances should be radiologically surveyed before entering the Hanford Site.

   a. Commercial transport conveyances shall be radiologically surveyed prior to loading

   b. Unloaded conveyances shall be surveyed before leaving the Hanford Site.

10. Transport of large volumes of radioactive material by non-DOE motor vehicles should be "exclusive use" to prevent commingling of DOE and other commercial shipments.

11. The site emergency plan should describe appropriate responses for potential onsite radioactive material transportation accidents.

12. Drivers of DOE and non-DOE motor vehicles should have a copy of their emergency response plan, or the emergency response information required by 49 CFR 172.600, during transport onsite or during offsite transportation.

Article 424 WHC Addendum

Controls for Regulated Vehicles

1. The use and movement of regulated vehicles shall be limited to areas permitted by the radiological work permit or work controlling documents as determined by Health Physics.

2. Contamination throughout the cab, tires, wheels, and all accessible areas shall not exceed the values shown in Table 2-3.

3. The cargo area shall not be used when dose rates from fixed contamination exceed 0.5 mrem/hr.

Part 3 Radioactive Source Controls

431* Radioactive Source Controls

The following provisions apply to sealed and unsealed sources:

1. Sealed sources shall be controlled and maintained in accordance with DOE N 5400.9 (DOE 1991a), which specifies requirements for receipt, inventory, storage, transfer, disposal, and integrity testing. Unsealed sources shall be controlled and maintained in a similar manner except that integrity testing is not required.

2. Procurement of radioactive sources shall be coordinated with the Radiological Control Organization.

3. Receipt surveys of radiological material shipments shall be performed by the Radiological Control Organization.

4. Radioactive sources, including radiography sources, shall not be brought onsite by external organizations without the prior written approval of the Radiological Control Organization.

Article 431 WHC Addendum

Radioactive Source Controls

Health Physics shall appoint a coordinator as the source control point of contact to establish programs for radioactive source accountability. Implementing guidance is addressed in WHC-SD-GN-RD-30007, *Radioactive Source Controls*. These or other technical specifications approved by Health Physics Radiological Engineering shall be used for source control.

Source Accountability

Accountability of radioactive sources requires designation of a trained custodian to be responsible for inventory, use, and control of sources, and maintenance of records in each facility/organization that uses sources.

Labeling and Storage of Sources

All sources shall be clearly marked as radioactive material with a durable label or tag and other identifying information. If the source cannot be readily removed from a container or device, or is an integral part of the device, labeling may be placed on the storage container or holding device.

Storage rooms, cabinets, or areas that contain sources shall be:

- Kept locked and posted in accordance with the Article 236 WHC Addendum.
- Isolated from occupied areas or located in radiological areas
- Designated to ensure exposure to adjacent areas does not exceed 0.5 mrem per hour.

Article 431 WHC Addendum (cont.)

Source Integrity

1. A test of sealed source integrity shall be made every six months or whenever damage may have occurred.

2. Sealed sources in storage for periods longer than six months need only have their integrity determined when they are removed from storage or before they are used.

3. An integrity test is not required if the sealed source contains:

   - A radioactive material with a half-life of less than 30 days
   - Gaseous tritium or a noble gas
   - A radionuclide with an activity less than an exempt quantity.

4. Appropriate methods for integrity testing should be used to preserve source accuracy and minimize radiation exposure to personnel.

5. The reporting criteria for sources that fail integrity testing is 5 nCi for RL and 1 nCi for WHC administrative report limit.

6. Lost sources shall be reported to the Health Physics source control point of contact.

Exemption From Source Controls

Health Physics may exempt the following from the controls of this article:

- Consumer products (such as luminescent exit signs, static eliminators and smoke detectors)

- Fission chambers

- Process materials

- Activated shielding materials

- Liquid and gaseous sources.

Part 4 Solid Radioactive Waste Management

441 Requirements

1. DOE 5820.2A (DOE 1988b) describes how solid radioactive waste is treated, packaged, stored, transported, and disposed of.

2. Radiological operations generating radioactive waste should be designed and developed to permit segregation, monitoring, treatment, storage, and disposal.

3. Radioactive waste minimization goals and practices should be developed and implemented.

442 Waste Minimization

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste and the spread of contamination from Contamination, High Contamination, or Airborne Radioactivity Areas. The following practices should be instituted to support waste minimization:

1. Restrict material entering Radiological Buffer Areas to those needed for performance of work.

2. Restrict quantities of hazardous materials, such as paints, solvents, chemicals, cleaners, and fuels entering Radiological Buffer Areas and take measures to prevent inadvertent radioactive contamination of these materials.

3. Substitute recyclable or incineratable items in place of disposable ones and reuse equipment when practical.

4. Select consumable materials such as protective coverings and clothing that are compatible with waste-processing systems, volume reduction, and waste form acceptance criteria.

5. Reserve an assortment of tools primarily for use in Contamination, High Contamination, or Airborne Radioactivity Areas.

   a. Tools should be maintained in a designated storage or distribution area or a contaminated tool crib.

   b. Controls should be established for tool issuance and use.

6. Survey potentially contaminated material from Radiological Buffer Areas to separate uncontaminated materials from contaminated materials.

7. Segregate known uncontaminated waste from potentially contaminated waste.

8. Segregate reusable items, such as protective clothing, respirators, and tools, at the step-off pad.

9. Minimize the number and size of Radioactive Material Areas.

10. Emphasize training in waste reduction philosophies, techniques, and improved methods.

443 Mixed Waste

Requirements specified in the Resource Conservation and Recovery Act (RCRA 1976) and Toxic Substances Control Act (TSCA 1976) apply to waste that contains both radioactive and hazardous materials. DOE 5400.3 and DOE 5820.2A (DOE 1989; 1988b) describe controls for mixed waste. DOE 5400.3, DOE 5820.2A, and Article 442, describe how mixed waste generation should be minimized.

1. Technical and administrative controls should be established to minimize the volume of mixed waste generated and the amount of radioactive material in such waste. Volume reduction methods include process optimization, materials substitution and new technology development.

2. Materials suspected of being mixed waste should be identified and segregated as soon as practical in the generating process to avoid combining mixed waste with other waste forms.

3. The most stringent regulatory requirements for the types of waste present should be applied to waste classification and disposal.

Part 5 Control of Radioactive Liquids and Airborne Radioactivity

451 Minimization and Control of Radioactive Liquid Wastes

DOE 5820.2A (DOE 1988b) provides criteria for minimizing the generation of radioactive liquid waste.

1. Waste minimization should include evaluating operational requirements to reduce liquid usage and maximize recycling activities.

2. A water management program should be maintained to identify, trend, and eliminate unnecessary sources of radioactive liquid waste. This program should include aggressive measures to identify and repair leaks.

3. Activities that produce radioactive liquid waste should be suspended unless sufficient processing, collection, and storage capacity is available to accommodate the waste.

DOE 5400.5 (DOE 1990a) provides radioactive liquid waste discharge requirements.

4. Radioactive liquid waste discharges should be controlled on a batch basis to enhance monitoring capability and to reduce the potential for inadvertent release.

5. Radioactive liquid waste discharges should be analyzed prior to their release and monitored during release, and the release shall be terminated before exceeding predetermined limits.

6. Radioactive liquid waste that cannot be discharged shall be solidified and disposed of as solid radioactive waste.

452 Control of Radioactive Drains

Radioactive drain systems are designed to transport radioactive liquids, but their improper use may cause an environmental release.

1. Radioactive drain systems should not discharge to the environment nor be used for the disposal of nonradioactive liquids unless an National Pollution Discharge Elimination System (NPDES) permit has been issued authorizing such disposal.

2. Existing radioactive drains should be evaluated to ensure the following:

   - Verification of the existing radioactive drain piping configuration
   - Installation of flow-indicating devices in leak-off lines
   - Use of plugs to prevent nonradioactive input
   - Consideration of alternative work controls before systems are drained for maintenance
   - Controls prohibiting unauthorized use of drains.

3. Modifications to the design or operation of existing radioactive drain systems should be controlled to include:

   - design considerations that prevent nonradioactive drain connections into radioactive drains
   - procedural and design controls to prevent cross-connections of radioactive drains with nonradioactive systems
   - management review of subsequent changes to the design of radioactive drain systems or radioactive drain controls
   - management controls to restrict the introduction of hazardous wastes into radioactive drain systems.

453 Control of Airborne Radioactivity

1. Processes and activities that have the potential to produce airborne radioactivity shall include engineering controls to limit releases.

2. The Radiological Control Organization shall be notified when engineering controls that prevent worker exposure to airborne radioactivity, such as barriers, gloveboxes and glovebags, are compromised.

   a. An evaluation should be made of continuing operations with compromised engineering controls.

   b. Short-term engineering controls that provide a commensurate level of worker protection should be implemented prior to resuming work.

   c. The use of respiratory protection devices as a substitute for compromised degraded engineering controls should be prohibited except as specifically authorized by the Radiological Control Manager.

3. Preventive maintenance and surveillance procedures shall be established to ensure that equipment controls are maintained in an operable condition for containment of airborne radioactivity.

Part 6 Support Activities

461 Personal Protective Equipment and Clothing

Sites and facilities are encouraged to 1) apply the latest techniques and instrumentation to detect contamination on Personal Protective Equipment and Clothing below Table 2-3 total contamination values, and 2) continue efforts to reduce contamination levels on reusable Personal Protective Equipment and Clothing.

1. Protective clothing designated for radiological control use shall be specifically identified by color, symbol, or appropriate labeling.

2. Protective clothing designated for radiological control use shall not be used for nonradiological work.

3. Personal Protective Equipment and Clothing shall not be stored with personal street clothing.

4. Cleaned Personal Protective Equipment, such as face shields and respirators, that comes into contact with the wearer's face and company-issued non-personal protective clothing shall be surveyed.

   a. This survey should be capable of detecting contamination levels equivalent to Table 2-3 total contamination values prior to reuse.

   b. The use of statistically representative sampling is acceptable.

5. Laundered protective clothing should be surveyed using statistically representative sampling and should meet the following criteria prior to reuse:

   - Beta/gamma radioactivity less than 10,000 dpm/100 cm^2
   - alpha radioactivity less than 1,000 dpm/100 cm^2 for transuranic elements and other alpha emitters in the same Table 2-3 category, and less than 10,000 dpm/100 cm^2 for uranium.

462 Laundry

1. Clothing and equipment should be laundered according to facility, color, type, and level of contamination.

2. Laundry activities should be performed using processes that minimize both potential worker exposure and the volume of waste generated.

3. Clothing and equipment should be screened before they are laundered to segregate those that are damaged, present special handling problems, or require disposal.

4. Waste streams that contain soaps, detergents, solvents, or other materials that could interfere with processing large-volume liquid waste streams should be segregated for separate processing.

5. Cleaned Personal Protective Equipment and laundered protective clothing shall be inspected prior to use. Clothing should be free of tears, separated seams, deterioration and damage, or repaired in a manner that provides the original level of protection.

463 Decontamination

1. RWPs or technical work documents shall include provisions to control contamination at the source to minimize the amount of decontamination needed.

2. Pre-work planning shall include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.

3. Decontamination activities shall be controlled to prevent the spread of contamination.

4. Water and steam should normally be used as decontamination agents. Other cleaning agents should be selected based upon their effectiveness, hazardous properties, amount of waste generated, and ease of disposal.

5. Decontamination methods should be used to reduce the number of contaminated areas.

6. Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated.

7. Facility line management should be responsible for directing decontamination efforts.

464 Vacuum Cleaners and Portable Air-Handling Equipment

Improper use of vacuum cleaners and portable air-handling equipment may result in the generation of airborne radioactive material, removable contamination, or high dose rates.

1. Vacuum cleaners and portable air-handling equipment used in Contamination, High Contamination, Airborne Radioactivity, Radioactive Material, or Radiological Buffer Areas shall have high-efficiency particulate air (HEPA) filtered exhaust, a prefilter, and an internal catch container if used for dry pickup.

2. An RWP shall be required for the use of vacuum cleaners within radiological areas.

3. New HEPA-filtered vacuum cleaners shall not be used until they have been tested, inspected, and approved by the DOE Filter Test Station operated by the HEHF.

4. After initial installation or replacement of the HEPA filters, vacuum cleaners or portable blowers shall be leak tested before their first use and annually thereafter.

5. Replacement HEPA filters for controlled vacuum cleaners and portable air-handling units shall be inspected, tested, and approved by the DOE Filter Test Station.

6. HEPA filters installed on vacuum cleaners and portable air-handling units shall be sealed with a label that indicates when the HEPA filter was tested and the date that the test expires. The seal shall be designed so that it must be broken in order to gain access to the filter.

7. If there is reason to believe that the HEPA filter or its seal could have been compromised, the vacuum cleaner or portable blower shall be removed from service and shall be leak-tested and certified prior to reuse. Equipment that fails the leak test shall not be used until a satisfactory leak test result is obtained.

8. Test records for the HEPA-filtered vacuum cleaner and portable air-handling unit shall be maintained by the organization performing testing.

9. HEPA-filtered vacuum cleaners and portable air handling units shall not be purchased without prior review and approval of the Radiological Control Organization.

10. Vacuum cleaners shall not be used for fissile material without the prior approval of the contractor criticality safety representative.

11. Radiation and contamination surveys shall be performed periodically for vacuum cleaners in use and labels on these units shall be updated. The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.

12. Airborne radioactivity levels shall be monitored when a vacuum cleaner is used in a highly contaminated area.

13. Any collection of liquids in HEPA-filtered vacuum cleaners not specifically designed for that purpose shall void the filter integrity test for that HEPA filter.

14. Vacuum cleaners used for radiological work shall be uniquely marked and labeled and controlled to prevent their unauthorized use.

Exhibit 4-1. Material History Release Form.

Under Development

Use existing contractor form/format until new form is available.

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Part 0 Summary of Responsibilities

502 Line Management

- Require termination bioassay monitoring when personnel terminate employment or conclude work that required participation in a bioassay monitoring program (Article 522.4).

503 Radiological Control Manager

- Specifically authorize personnel taking dosimeters offsite as necessary (Article 511.5a).
- Perform and document reviews of the adequacy of sampling and monitoring systems (Article 551.4).

507 Employees

- Notify the Radiological Control Organization and their management if assigned dosimeters are exposed to security x-ray devices, excessive heat, or medical sources of radiation (Article 511.7).
- Upon discovering the loss, damage, or contamination of a dosimeter, secure work, exit the area, and report the occurrence to their management and Radiological Control Organization (Article 511.9).
- Participate in bioassay monitoring programs as directed by the Radiological Control Organization (Article 521.4).
- Be clean-shaven in the respirator seal area prior to using respiratory protection devices (Article 533).
- Immediately notify the nearest co-worker, exit the area, remove personal protective equipment, notify supervisor, and rest in a cool area if experiencing heat illness (Article 534.4).
- Notify the Radiological Control Organization if skin or clothing contamination is detected (Article 541.2).

Part 1 External Dosimetry

511 Requirements

1. Personal dosimetry shall be required for personnel who are expected to receive an annual external whole body dose greater than 100 mrem or an annual dose to the extremities, lens of the eye, or skin greater than 10% of the corresponding limits specified in Table 2-2. Neutron dosimetry shall be provided when a person is likely to exceed a 100-mrem whole body dose from neutron radiation in a year.

2. Dosimeters shall be issued only to personnel formally instructed in their use and shall be worn only by those to whom the dosimeters were issued.

3. To minimize the number of personnel in the dosimetry program, the issuance of dosimeters to personnel other than those entering radiological areas is discouraged.

4. Personnel shall return dosimeters for processing as scheduled or upon request, and should be restricted by line management from continued radiological work until dosimeters are returned.

5. Personnel shall wear their primary dosimeters in the chest area, between the waist and the neck, in the manner prescribed by dosimetry personnel.

   a. It shall be permissible for TLDs that are part of the Hanford security credential to be removed from the site as part of an employee's routine travel to and from work.

   b. Other dosimeters shall be stored in locations specified by the Radiological Control Organization.

6. Personnel shall notify line management and the Radiological Control Organization of pending offsite work involving exposures to radiation or radioactive material.

7. Personnel shall not wear dosimeters issued at their resident site while being monitored by a dosimeter at another site. Personnel shall not expose their dosimeters to security x-ray devices, excessive heat, or medical sources of radiation.

8. For work at offsite facilities that will involve exposure to radiation or radioactive materials the Radiological Control Organization may specify the use of a special Hanford dosimeter during the work.

9. A person whose dosimeter is lost, damaged, or contaminated should place work activities in a safe condition as appropriate and shall immediately exit the area and report the occurrence to the Radiological Control Organization. Reentry of the person into Radiologically Controlled Areas should not be made until a review has been conducted, a new dosimeter has been assigned, and management and the Radiological Control Organization has approved reentry.

512 Technical Requirements for External Dosimetry

DOE 5480.15 (DOE 1987) specifies the requirements for accreditation of personnel external dosimetry monitoring programs by the DOE Laboratory Accreditation Program (DOELAP).

1. A Hanford technical basis document shall describe the external dosimetry program.

   a. The Hanford external dosimetry technical basis document shall either be a single document that states all of the performance requirements of the program or a series of documents and procedures that accomplishes the same purpose. In the latter case a summary document that identifies all documents and procedures that are a part of the program shall be written.

   b. The technical basis document shall include performance requirements for dosimeters monitoring radiation outside the scope of DOELAP, such as dosimetry associated with high-energy accelerators, and dosimeters used for measuring extremity exposure and other dosimeters used for special exposure situations.

   c. The technical basis document should describe the conditions that warrant the use of multiple dosimeters and the methodology used in determining the dose of record when these are used.

2. The use of multiple dosimeters should be approved by the Radiological Control Organization and their use shall be specified in the RWPs.

3. Hanford personal dosimeters shall include but are not limited to TLDs, track-etch dosimeters, and neutron-sensitive film.

4. A dose assessment shall be performed for each instance of a lost, damaged, or contaminated personal dosimeter.

   a. The dose assessment shall be performed by the Radiological Control Organization.

   b. Concurrence of the Hanford External Dosimetry Program staff shall be obtained in the case of a damaged or contaminated dosimeter.

5. Personal exposures to the skin, whole body, and extremities shall be reported separately for Hanford Occupational Workers. Exposure to the lens of the eye shall be reported when monitored.

6. No special measurement or correction shall be required if the anticipated whole body dose is less than 100 mrem/yr.

7. The Hanford dosimetry program should participate in external dosimetry intercomparison studies.

By definition a non-uniform radiation field exists when the dose to a portion of the whole body will not be properly measured by the whole body dosimeters and will exceed the dose to the primary dosimeter by more than 50% and the anticipated whole body dose is greater than 100 mrem.

513 Pocket and Electronic Dosimeters

Self-reading pocket and electronic dosimeters, hereafter called supplemental dosimeters, are used to provide real-time indication of exposure to radiation and assist in maintaining personnel doses less than Administrative Control Levels.

1. Supplemental dosimeters shall be issued to personnel prior to their entry into a Very High Radiation Area; entry into a High Radiation Area when a person could exceed 10% of an Administrative Control Level from external radiation in 1 work day; and entry into any open radiography operation.

   a. The requirement for use of these dosimeters shall be included in the RWP.

   b. Pocket dosimeters should be selected with the lowest range applicable (typically 0 to 200 mR) for anticipated personal exposures.

2. Supplemental dosimeters shall be worn simultaneously with the primary dosimeter and shall be located in accordance with Article 511.5 or as specified in the RWP for special exposure situations.

3. Supplemental dosimeters shall be read periodically while in use and pocket dosimeters should not be allowed to exceed 75% of full scale. The dose measured by the supplemental dosimeters shall be recorded on the daily log when the work is complete.

4. Routine work permitted by RWP shall be stopped when supplemental dosimeter readings indicate total exposure or rate of exposure substantially greater than planned. The Radiological Control Organization shall be consulted prior to continuation of work.

5. Only supplemental dosimeters, that have been tested (e.g., for energy dependence, stability, linearity) in accordance with the Hanford Instrument Evaluation Program and concurred in by the Hanford External Dosimetry Program staff should be used.

6. Use of electronic dosimeters should be considered for entry into High Radiation Areas or when planned doses greater than 100 mrem in 1 work day are expected. (An electronic dosimeter provides an early warning of elevated doses through the use of alarm set points at specified dose or dose rates.)

7. When the dose results from the supplemental dosimeters differs by more than 50% from the primary dosimeter result and the primary dosimeter

result is greater than 100 mrem, an investigation should be initiated to explain the difference.

514 Area Monitoring Dosimeters

Establishment and maintenance of a comprehensive area dosimeter monitoring program may minimize the number of areas requiring the issuance of personal dosimeters and demonstrate that doses outside Radiological Buffer Areas are negligible.

1. Area monitoring dosimeters shall be used to record and document radiation levels in routinely occupied areas adjacent to Radiologically Controlled Areas. This monitoring requirement does not apply when the radiation arises solely from low-energy beta sources (e.g., Carbon-14 or tritium).

2. Area monitoring dosimeters should be used in Radiologically Controlled Areas to supplement existing monitoring programs and to provide data in the event of an emergency.

3. Area monitoring dosimeter results may be used to support dosimetry investigations where personnel express concerns about their work environments and exposure to ionizing radiation.

515 Nuclear Accident Dosimeters

DOE 5480.11 (DOE 1988a) specifies the requirements for a nuclear accident dosimetry program when sufficient quantities and kinds of fissile material exist to potentially constitute a critical mass as defined in DOE 5480.5 (DOE 1986b) and where exposure of personnel to radiation from a nuclear accident is possible. The use and placement of Hanford Nuclear Accident Dosimeters shall be as stated in the Hanford Nuclear Accident Dosimeter Manual[a] and shall be cross-referenced in the Hanford External Dosimetry Program Technical Basis Document.

Part 2 Internal Dosimetry

521 Requirements

1. Personnel who enter Radiologically Controlled Areas shall participate in a bioassay program when they are likely to receive intakes in a year resulting in a committed effective dose equivalent of 100 mrem or more.

   To assist with applying the criterion, the following shall apply:

   a. Bioassay monitoring is required if the work involves use of a respiratory protection device.

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[a] Pacific Northwest Laboratory. Hanford Nuclear Accident Dosimeter Manual. PNL-MA-583, Richland, Washington (internal publication).

b. Bioassay monitoring is required if the work occurs in a High Contamination Area and involves contact with or disturbance of the contamination.

c. Bioassay monitoring is required for work with unencapsulated radioactive material at or exceeding values listed in Table 5-1. If the task does not involve working with the material, such as observing or supervising from a distance or entering a room where the material is stored but not contacting the material itself, bioassay monitoring is not required unless workplace monitoring indicates that a loss of control of the material occurred. (See criteria for special bioassay, Article 521.3.)

d. Bioassay monitoring is required for work with contaminated soil at or exceeding values listed in Table 5-2.

e. Bioassay monitoring is required for exposure to low-level airborne activity below posting requirements such that the total exposure for a year would exceed 40 DAC-hours.

Bioassay monitoring to satisfy the requirements may be routine, periodic monitoring, or may be bioassay conducted at the end of the work assignment if the work period is shorter than the routine bioassay period.

In general, overly conservative use of bioassay monitoring (at levels less than those indicated above), is discouraged; however, if the above guidance does not appear to adequately apply to a particular task, the company internal dosimetry organization shall be contacted for specific guidance.

Table 5-1. Amount of Radioactive Material Requiring Bioassay Monitoring[a].

Type of Material[b]	Activity Requiring Bioassay (μCi)		
	Bench Top	Fume Hood	Glovebox
Pu, Am-241, Pu mixtures with Am	0.1	1.0	10
Uranium, very soluble, class D	300 mg	3E3 mg	3E4 mg
Uranium, moderate to insoluble, class W or Y	1.	10	100
Mixed fission/activation products	4E2	4E3	4E4
Strontium-90, insoluble, class Y	80	800	8000
Radioiodines, half-life >1 day <1 yr	8E3	8E4	8E5
I-129	2E3	2E4	2E5
Tritium (HTO and HT) (nucleotide precursors)	1E4	1E5	1E6

(a)Involves actually working with or contact with the material. Not intended to include occasional observation, unrelated work in the same room, or other activities involving much less risk of contamination.
(b) For other types of radioactive material, other containments, or unique situations, consult with company internal dosimetry organization for guidance.

2. Broad scope bioassay programs shall be established for rotational worker groups (e.g., Radiological Control Technicians) potentially exposed to many radionuclides or mixtures of radionuclides in a year because of rotational work assignments.

   a. Participation in the broad scope bioassay program should be based on consideration of all work assignments expected in a year, not on task-specific RWPs.

   b. For a worker in a broad scope program, ending-work bioassay measurements are not required until the worker transfers out of rotational work assignments or terminates employment.

3. Personnel shall participate in special bioassay monitoring when their routine bioassay results indicate an unexpected intake in the current year or anytime resulting in a committed effective dose equivalent of 100 mrem or more.

Table 5-2. Criteria for Bioassay Monitoring for Work Involving Exposure to Contaminated Soil[a].

Nuclide, Form[b]	Soil Concentration (pCi/g)[c] Acute[d]	Chronic[e]
Uranium - Total[f]		
class D or W	40,000	1,000
class Y	3,000	70
Pu-α class W	400	20
Th-232 class W	60	2
Th-228 class W	600	20
Sr-90 class D	1E+06	4E+04
Cs-137 class D	2E+07	4E+05
Co-60 class Y	2E+06	5E+04
Tritium in groundwater[g]	5,000 μCi/L	1,000 μCi/L

(a) Criteria are established for two potential scenarios. "Acute" implies normally not exposed to contamination but potential exists for a single, heavy exposure. "Chronic" implies frequent exposure to less dusty conditions. Bioassay would be required if either scenario applied to a worker.
(b) For other nuclides or chemical forms, consult with company internal dosimetry organization for guidance.
(c) Units apply to uniform concentrations representative of the soil being disturbed, not to small spotty contamination.
(d) Assumes a 360-mg inhalation intake of dust in a single exposure.
(e) Assumes a 48-mg/day inhalation intake rate for 250 working days/year.
(f) Natural, U-234, U-235, or U-238 in any combination. Based on recycled uranium common at Hanford. Same numbers apply for uranium in units of ppm or μg/g soil.
(g) Assumes consumption of one cup (acute) or one cup per day of groundwater at indicated contamination.

4. Personnel shall submit bioassay samples, such as urine or fecal samples, and participate in in vivo monitoring, such as whole body or lung counting, at the frequency specified in the technical basis document for internal dosimetry program at Hanford (Sula, Carbaugh, and Bihl 1991).

5. Line Management, the Radiological Control Organization, and the affected worker shall be notified promptly of unplanned positive bioassay results and the results of dose assessments and subsequent refinements. Dose assessment results shall be provided in units of rem or mrem. In the context of this requirement, "positive" means at levels not likely due to non-occupational sources.

522 Technical Requirements for Internal Dosimetry

DOE plans to implement accreditation programs for bioassay measurements and internal dose assessment and to provide supplemental technical guidance on the implementation of internal dosimetry programs. Until these accreditation

programs are available, this manual provides the technical guidance to implement the Hanford Internal Dosimetry Program. The program shall meet or exceed DOE requirements and performance standards and recommendations from authoritative bodies.

1. A Hanford technical basis document shall describe the Hanford Internal Dosimetry Program. The Hanford internal dosimetry technical basis document shall either be a single document that states all of the performance requirements of the program or a series of documents and procedures that accomplishes that same purpose. In the latter case, a summary document that identifies all documents and procedures that are a part of the program shall be written.

2. For personnel who are likely to perform work requiring bioassay monitoring according to Article 521.1, a history of the employee's exposure to radionuclides shall be obtained and reviewed.

   a. Baseline bioassay measurements shall be obtained if the worker has had previous exposure to radionuclides relevant to future work at Hanford or if the exposure history is missing or inconclusive.

   b. Baseline bioassay measurements shall also be obtained if a worker is going to work with radioactive material that is frequently detectable in bioassay from nonoccupational sources (e.g., uranium in urine), regardless of prior occupational exposure.

3. Routine bioassay monitoring methods and frequencies shall be established for personnel who are likely to receive intakes in a year resulting in a committed effective dose equivalent greater than 100 mrem. The technical basis for the methods and frequency of bioassay monitoring should be documented in the Hanford internal dosimetry technical basis document.

4. Termination or ending-work bioassay monitoring shall be required when a person who participated in the bioassay program or qualified for bioassay monitoring under Article 521.1 terminates employment or concludes work involving the potential for internal exposure.

   a. If a baseline bioassay measurement was obtained, a termination or ending-work bioassay measurement shall also be obtained, unless it is documented in the worker's radiation exposure file that the worker was not potentially exposed to unencapsulated radioactive material in the workplace.

   b. The number of persons who fail to be monitored shall be reviewed periodically and shall be used to determine whether further efforts to get cooperation are warranted.

5. Workers shall participate in a special bioassay program when any of the following conditions unexpectedly occur (unless they were caused by radon daughters):

   - Facial contamination is detected that indicates a potential for intake of radioactive materials.
   - Nasal contamination is detected.
   - Air monitoring indicates the potential for intakes resulting in a committed effective dose equivalent exceeding 100 mrem.
   - Upon direction of the Radiological Control Organization when an intake is suspected.

6. Levels of intakes that warrant the consideration of medical intervention shall be established for site-specific radionuclides. Bioassay results shall be used in documenting the effectiveness of medical intervention, such as blocking or chelating agents.

7. A preliminary assessment of any intake detected should be conducted prior to permitting an employee to return to radiological work.

8. The radionuclide standards used for bioassay measurements in the Hanford Internal Dosimetry Program and the Whole Body Counting Program should be traceable to the National Institute of Standards and Technology (NIST).

9. The Hanford Internal Dosimetry Program, including the whole body counting and bioassay, should participate in the DOE Intercomparison Studies and should use the DOE Phantom Library.

10. Bioassay monitoring is not required, regardless of the above requirements, if it is technically not feasible, such as for work involving radionuclides with short effective half-lives. In such cases, other means may be necessary to estimate internal dose.

See Article 336 for visitor bioassay requirements.

523 Technical Requirements for Dose Assessment

1. Interpretations of bioassay results and subsequent dose assessments should be documented and included in the person's radiological exposure history file.

2. Documentation should include the following to the extent known:

   - Characteristics of the radionuclide(s), such as chemical and physical form(s)
   - Bioassay results and the person's previous exposure history

- Exposure information, such as route of intake(s), time(s), and duration(s) of exposure
- Biokinetic models used for dosimetry of radionuclides
- Models to estimate intake or deposition and to assess dose
- Medical intervention if used.

3. Dose equivalent to the embryo/fetus from intakes(s) by the mother should be for the duration of the pregnancy. An assessment of the 50-year committed dose in not appropriate. However, it shall be permissible to use as a simplifying assumption if it is less than 50 mrem.

Part 3 Respiratory Protection Program

Respiratory protection equipment includes respirators with particulate or gas-filtering cartridges, supplied air respirators, self-contained breathing apparatuses, and airline supplied-air suits and hoods.

531 Requirements

1. Use of respiratory protection devices shall be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactive materials at the source.

2. The Hanford Respiratory Protection Program and associated training of personnel shall be consistent with requirements in ANSI Z88.2 (ANSI 1980) and 29 CFR 1910.134 as mandated by DOE 5480.4 (DOE 1984a).

3. Respirators shall be issued only to personnel who are trained, fitted, and medically qualified to wear that specific type of respirator. Training and qualification testing shall be performed annually.

4. Positive controls shall be maintained for the issue, use, and return of respirators to ensure that only qualified personnel wear suitable respirators.

5. DOE 5480.4 mandates that breathing air meet the specifications of ANSI/CGA G-7.1 (ANSI 1989c) Grade D breathing air as specified in 29 CFR 1910.134.

   a. Compressed air supplied to respirators shall be tested quarterly.

   b. Compressors shall be of the breathing air type and shall not allow oil or other chemicals and fumes to enter the breathing air supply. Special attention shall be focused on the location of compressor air supply intakes and on the prevention of cross-connections to other compressed gas systems.

6. Credit for the use of respiratory protection for routine work involving potential exposure to airborne radioactive materials should not be taken in facility safety analyses. Radioactive materials should be controlled at the source through engineered systems, so that the need for respiratory protection can be reduced.

532 Medical Assessment

Each prospective respirator wearer shall have a medical assessment prior to being fit-tested. The medical assessment shall determine if an employee's medical condition precludes the use of respirators and should follow the guidance in ANSI Z88.6 (ANSI 1984) on frequency and content of the examination. The ability of an employee to accommodate the additional stress placed on the body when working in a respirator is part of this assessment.

533 Use of Respiratory Protection

Personnel using respiratory protection shall:

- Be issued respirators only upon verification of medical approval, training, and fit-testing.
- Perform fit checks of their respirators to ensure a proper seal before entering areas requiring respirator use.
- Be clean shaven in the area of the fit.
- Use corrective lenses, if needed, that are approved for respirators.
- Be instructed to leave the work area when experiencing respirator failure.
- Be instructed to remove their respirators to avoid life-threatening situations when exiting an area after respirator failure.

534 Heat Stress

Heat stress may result from working in areas of high heat, humidity, and radiant heat; working in protective clothing; and using respirators, particularly where other protective equipment is required. Heat stress has occurred at ambient temperatures less than 70°F when multiple sets of protective clothing or plastic suits were in use or strenuous work was involved.

1. Heat stress controls should be addressed in the planning stages for work.
2. Recommended work time limits and use of body cooling devices shall be considered to reduce heat stress.
3. Job supervisors should inform their personnel of heat stress precautions prior to work on job assignments where heat stress may be a factor.

4. If a person begins to feel symptoms of heat illness, the person should immediately notify the nearest co-worker, exit the area, remove personal protective equipment, notify the supervisor, and rest in a cool area. In such cases, medical assistance should be provided.

535 Half-Face Respirators

The Hanford policy prohibiting the use of half-face respirators for work with any radioactive materials is consistent with the current revision of 10 CFR 20, which states that half-face respirators are ". . . not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentrations to reach instantaneous values greater than 10 times the . . . (DAC values)."

1. Half-face respirators shall not be used at the Hanford Site as a precautionary measure for protecting workers from potential airborne radioactive materials. Half-face respirators are undesirable because their seal with the face is more likely to fail than with full-face respirators, particularly during heavy work. As a result, their permitted protection factor is low and unpredictable.

2. The use of half-face respirators in situations where intakes of radioactive material will be low, (e.g., a few mrem), and where industrial and safety considerations warrant, (e.g., during the operation of heavy equipment) should be permitted only if there is no other practical solution. This special use shall be approved by line management, the Radiological Control Organization, and after the Hanford Internal Dosimetry Program staff are notified so that special bioassay analysis may be performed as appropriate.

Part 4 Handling Radiologically Contaminated Personnel

541 Skin Contamination

1. Survey techniques shall be established to determine the extent of skin contamination.

2. When personnel detect skin contamination, they shall notify the Radiological Control Organization.

3. The extent of skin contamination should be determined prior to initiating decontamination procedures and shall be recorded on Skin Contamination Form 54-3000-XXX (see Exhibit 5-1).

4. Skin decontamination methods should be consistent with approved techniques established for Hanford.

   a. Skin abrasion should be avoided during the decontamination process.

b. Intrusive decontamination methods, such as tissue removal, shall be performed only by HEHF staff.

5. The Hanford External and Internal Dosimetry Program Technical Basis Documents should include levels of skin contamination that trigger the need for dose assessments. These trigger levels should not exceed a 100-mrem dose to the skin.

6. Personnel with skin contamination that triggers the need for dose assessment should be informed of the initial external dose estimate for their skin as soon as practicable, preferably prior to the end of their work day.

7. Personnel with skin contamination for which dose assessment was not performed should be informed of the nature of the contamination and an upper estimate on the potential dose (such as less than 10 mrem) as soon as practicable, preferably prior to the end of their work day.

8. An assessment of skin exposure requires time to conduct a detailed evaluation. Assessments shall be conducted in accordance with Exhibit 2-3 and the results should be explained to the person(s) affected promptly after completion of the assessments.

9. Assessment of internal exposure, as necessary, resulting from skin contamination shall be performed using special bioassay measurements. The results of this assessment shall be made available to the affected person(s) within the time frame identified in the Hanford Internal Dosimetry Program Manual.[a]

542 Contaminated Wounds

1. Emergency medical care should be administered immediately for injuries involving radioactive materials in accordance with Report 65 of the National Council on Radiation Protection and Measurements (NCRP 1980). Medical treatment of injuries takes precedence over radiological considerations.

2. Response to potentially contaminated wounds shall be promptly coordinated between the Radiological Control Organization, HEHF, and the Hanford Internal Dosimetry Program. The treatment of contaminated injuries should include the following:

   - Treatment of contaminated wounds by medically qualified personnel
   - Monitoring of wounds and associated bandages for contamination, including alpha-emitters if applicable
   - Identification of the radionuclides involved

[a] Pacific Northwest Laboratory. Hanford Internal Dosimetry Program Manual. PNL-MA-552, Richland, Washington (internal document).

- Medical determination of the need for therapeutic intervention such as blocking or chelating agents
- Initiation of appropriate bioassay monitoring
- Determination of need for work restrictions.

3. An injured person should be counseled promptly on the medical and radiological significance of contaminated wounds that could result in internal doses greater then 2% of the Table 2-2 limits. The counseling should be performed by senior Radiological Control Organization personnel and HEHF medical professionals.

4. The Radiological Control Organization, the Hanford Internal Dosimetry Program, and HEHF shall cooperate in evaluating doses that may require medical intervention.

543 Exposures to Airborne Radioactive Materials

Potential intakes of radioactive material are suspected when personnel without respiratory protection are exposed to airborne radioactive materials or when respiratory protection has been compromised. If suspected intakes of radioactive material could result in a committed effective dose equivalent greater than 100 mrem, the following actions should be taken (see Sula, Carbaugh, and Bihl 1991):

1. Identify personnel potentially exposed to airborne radioactive materials.

2. Obtain nasal smears for qualitative indication of intakes and characterization of the contamination, where appropriate.

3. Analyze air samples to determine the airborne radioactive materials concentration and integrated exposure where appropriate. Note whether respiratory protection was used, the applicable protection factor, and whether respiratory protection was compromised.

4. Determine the duration of potential exposure to airborne radioactive material.

5. Provide Hanford Internal Dosimetry Program staff with all the above information.

6. Perform special bioassay analyses as required for the radionuclides involved.

7. Assess the potential dose prior to permitting the worker to return to radiological work. This preliminary dose should be based on conservative assumptions and need not be formally documented.

8. The Radiological Control Organization, the Hanford Internal Dosimetry Program, and HEHF shall cooperate in evaluating doses that may require medical intervention.

Part 5 Radiological Monitoring and Surveys

551 Requirements

1. Radiological monitoring of radiation exposure levels, contamination, and airborne radioactive material shall be conducted to characterize workplace conditions and to identify areas requiring postings.

2. Monitoring shall be performed only by trained and qualified personnel using properly calibrated, maintained, and response-checked instruments.

3. Surveys for radiation, contamination, and airborne radioactive materials shall be performed as specified in the RWP or technical work document.

4. The Radiological Control Organization shall study and document the adequacy of sampling and monitoring systems as part of any facility or operational changes affecting radiological control. In the absence of such changes, a documented study should be conducted annually.

5. Instruments used to perform radiation surveys shall be response-checked daily or prior to operation.

   a. When response-checks are not within ±20% of the expected value, the instrument should be taken out of service.

   b. When response-checks are not feasible, such as with instruments used to measure neutrons or tritium, compensatory actions should be established to ensure continued proper instrument performance.

6. Assessment of radiological conditions should include a sufficient number of sampling points to characterize the radiation present and to verify boundaries.

7. Surveys should be performed before, during, and at the completion of work that has the potential for causing changes in levels of radiation and airborne radioactive materials.

8. Survey frequencies should be established based on potential radiological conditions, the probability of change in these conditions, and area occupancy factors.

9. Monitoring results should be reviewed by the cognizant Radiological Control Organization management. The review should ensure that all required surveys have been performed and that the documentation is accurate and complete.

10. Results of current surveys or survey maps should be conspicuously posted whenever possible to inform personnel of the radiological conditions. If not possible, a discussion during the pre-job briefing of the radiological conditions should be undertaken.

11. Monitoring results should be made available to management and used in support of pre- and post-job evaluations, ALARA planning, contamination control, and management of radiological control operations.

12. Monitoring data in each building or area should be compiled and reviewed at least quarterly. Trends should be noted and corrective actions assigned as appropriate.

552 Radiation Exposure Surveys

1. In addition to the requirements of Article 551, routine radiation surveys should be performed in accordance with the following minimum frequencies:

   - Weekly, in office space located in Radiological Buffer Areas where the potential exists for external radiation exposure

   - Monthly, in routinely occupied Radiological Buffer Areas and Radiation Areas

   - Monthly during continuing operations in High Radiation Areas or upon entry into High Radiation Areas, if entries are less frequent and when levels are expected to change or have changed in High Radiation Areas

   - Monthly, for operating HEPA-filtered ventilation units

   - Weekly, for temporary Radiation Area boundaries to ensure that Radiation Areas do not extend beyond posted boundaries

   - Monthly, or upon entry, if entries are less frequent than monthly for Radioactive Material Areas

   - Quarterly, for potentially contaminated ducts, piping, and hoses used outside radiological facilities and prior to breaching the line or duct.

2. The survey frequencies listed immediately above under item 1 shall be increased where data from trend analyses suggest that radiological conditions are not stable or are not predictable.

3. Radiation surveys should include dose rate measurements of the general area, dose rates at a distance of 30 cm from a source or surface of interest (to evaluate potential whole body exposures) and contact for sources of radiation where there is a potential for hands-on work.

4. Surveys should be conducted whenever operations are being performed that might result in personnel being exposed to small intense beams of radiation, such as those generated by shielded x-ray devices or due to removal or alteration of shielding. Either the approved correction factors for Hanford instruments shall be used or a special study shall be performed to document alternate factors.

553 Area Radiation Monitors

1. In addition to the requirements of Article 551, area radiation monitors (not to include area monitoring dosimeters discussed in Article 514) should be installed in frequently occupied locations that have the potential for unexpected significant increases in dose rates and in remote locations where there is a need for local indication of dose rates prior to personnel entering remote locations.

2. Area radiation monitors should not be substituted for radiation exposure surveys in characterizing workplace conditions.

3. The need and placement of area radiation monitors should be documented and assessed when changes to facilities, systems, or equipment occur.

4. Area radiation monitors should be maintained and calibrated at least annually at the Hanford Radiological Calibration Facility and should be tested at least quarterly to verify audible alarm system operability and audibility under ambient working conditions and operability of visual alarms when so equipped. The results of the quarterly test shall be documented.

5. When installed instrumentation is removed from service for maintenance or calibration, a radiation monitoring program providing at least equal detection capability should be maintained, consistent with the potential for unexpected increases in radiation dose rates.

6. Where an area radiation monitor is incorporated into a safety interlock system the circuitry shall be installed so that a failure of the monitor shall either prevent entry into the area or prevent operation of the radiation producing device.

554 Contamination Surveys

1. In addition to the requirements of Article 421 and 551, routine contamination surveys should be conducted as follows:

   - Prior to transfer of contaminated equipment and radioactive material from one Radiologically Controlled Area to another, as defined in Part 1 of Chapter 4

   - Prior to transfer of contaminated equipment and radioactive material from highly contaminated areas within Radiological Buffer Areas

unless precautions such as bagging or wrapping are taken prior to transfer as defined in Part 1 of Chapter 4

- Daily, at contamination area control points, change areas, or step-off pads when in use, or per shift in high-use situations
- Weekly, in office space located in Radiological Buffer Areas
- Daily, in lunchrooms or eating areas near Radiological Buffer Areas
- Monthly, in routinely occupied Radiological Buffer Areas
- Monthly, or upon entry if entries are less frequent, in areas where radioactive materials are handled or stored
- Monthly, or upon entry if entries are less frequent, where contamination boundaries or postings are located
- During initial entry into a known or suspected contamination area, periodically during work, at completion of job, or as specified in a RWP
- After a leak or spill of radioactive materials.

2. The survey frequencies listed in Article 554.1 shall be increased where data from trend analyses suggest that the radiological conditions are not stable or are not predictable.

3. Survey requirements for the release of radioactive materials shall be conducted in accordance with Articles 421, 422, and 423.

4. Contamination surveys should incorporate techniques to detect both removable and fixed contamination.

5. Items with inaccessible surfaces that were located in posted contamination areas should be treated as potentially contaminated and subject to Administrative Controls. The Radiological Control Manager may exempt certain categories of equipment with inaccessible surfaces, such as radiological survey instruments and electronic test equipment, from the disassembly requirement provided that controls are established to prevent internal contamination.

6. The requirements specified in DOE 5400.5 (DOE 1990a) for assessing representative samples of bulk material, such as sand, sweeping compounds, or plate steel, which are not suitable for normal loose and fixed contamination-level assessment techniques, should be used.

7. Contamination surveys for removable contamination shall be reported in units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). For surveys of small items covering less than 100 cm^2, the results shall be reported in units of dpm per area surveyed.

8. Large area smearable surveys, which are encouraged, should be used to supplement standard survey techniques in areas generally assumed not to be contaminated, such as entrances to Radiological Buffer Areas. If an evaluation indicates that an area surveyed is contaminated, a thorough contamination survey should be performed.

9. Areas identified as either contaminated or potentially contaminated with "hot particles" (as defined in Article 348) should be surveyed at least daily during periods of work that may result in the generation of hot particles. During non-work periods, the boundaries of such areas should be surveyed at least weekly. Appropriate survey techniques such as the use of tape and large smear media should be used.

555 Airborne Radioactive Material Monitoring

1. In addition to the requirements of Article 551, airborne radioactive material monitoring equipment should be used in situations where airborne radioactive material levels can fluctuate and early detection of radioactive material could prevent or minimize inhalation of radioactive material by personnel. Selection of air monitoring equipment should be based on the specific job being monitored. Air monitoring equipment includes portable and fixed air sampling equipment and continuous air monitors.

2. Air sampling equipment shall be used in occupied areas where, under normal operating conditions, a person is likely to receive an annual intake of 2% or more of the specified Annual Limit of Intake (ALI) values (40 DAC-hours). An intake of 2% of a specified ALI generally represents a committed effective dose equivalent to a person of approximately 100 mrem.

3. Continuous air monitoring equipment should be installed in occupied areas where a person without respiratory protection is likely to be exposed to a concentration of radioactive material in air exceeding 1 DAC over a prolonged period of time or where there is a need to alert potentially exposed workers to significant increases in the level of airborne radioactive material levels, which could result in 40 DAC-hours in a typical work shift. A person exposed continuously to a concentration of radioactive material in air of 1 DAC for 1 work week would generally receive a committed effective dose equivalent of approximately 100 mrem. The same thing is true for 40 DAC-hours in one shift.

4. Air sampling equipment shall be positioned to collect air samples that are representative of concentrations to which persons are exposed. If this cannot be achieved, a program of personal breathing-zone air sampling should be considered. The Hanford Internal Dosimetry Program staff shall be contacted where conditions exist that exceed current sampling capability to provide a reasonable estimate of potential worker exposure.

5. Air monitoring equipment shall be routinely calibrated and maintained at a frequency of at least once per year. Continuous air monitors should be capable of measuring 1 DAC when averaged over 8 hours (8 DAC-hours) under laboratory conditions.

6. Continuous air monitoring equipment required by Article 555.3 shall have alarm capability and sufficient detection capability to alert personnel that immediate action is necessary in order to minimize or terminate inhalation exposures.

7. The operation of continuous air monitoring equipment shall be checked regularly.

   a. The proper operation of continuous air monitoring equipment should be verified weekly by performing an operational check. Operational checks should include positive airflow indication, non-zero response to background activity, internal check sources, and 60-Hz electronic checks (when available).

   b. Continuous air monitoring equipment should be verified monthly by checking for instrument response with a check source or with ambient levels of radon and thoron daughters.

   c. Continuous air monitoring equipment shall be maintained and calibrated at least annually.

8. Preliminary assessments of air samples using field survey instruments should be performed promptly upon removal. It should be noted that in situations where background levels of radon and thoron daughters exist, prompt field assessment of alpha air samples may not be possible.

9. Air sample results should be analyzed as quickly as practicable for evaluation of the need for respiratory protection, area evacuation, worker intake, and worker relief from respirator use.

Part 6 Instrumentation and Calibration

561 Standardization

1. Radiation measurement instrumentation used at Hanford for protecting the worker and the environment shall be standardized using commercially available radiological instrumentation (where practical) based on recommendations of the Hanford Instrument Evaluation Committee and approval by the Hanford Test and Evaluation Program.

2. All such instruments used at Hanford shall be evaluated through the Hanford Test and Evaluation Program.

562 Inspection, Calibration, and Performance Tests

1. Radiological instruments shall be used only to measure the radiation for which their calibrations are valid. Requirements contained in ANSI N323 (ANSI R1983) for radiological instrumentation calibration as mandated by DOE 5480.4 (DOE 1984) and performance requirements in ANSI N42.17 A, B, and C (ANSI 1989d)shall be used in defining the requirements for any new instruments to be purchased at Hanford. The calibration program shall be relatable to NIST through the use of traceable sources or transfer instruments.

2. The calibration procedures for portable instruments defined in the PNL document Radiological Calibration Procedures[a] should be used for each of those instrument types. For fixed or semi-portable instruments (e.g., hand and shoe counters) maintained and calibrated by WHC. The procedures shall be documented and followed until changes are formally made and approved. These procedures shall be reviewed and approved by the Hanford Calibration Program personnel as being compatible with procedures used by PNL for similar instruments. In addition to stating the calibration frequency, these procedures shall include frequency of calibration and precalibration, primary calibration, periodic calibration, and maintenance requirements. Requirements for periodic performance testing and information describing instrument operating characteristics are described in the PNL Radiation Protection Instrument Manual.[b]

3. Pocket and electronic dosimeters and area radiation monitors should be calibrated at least annually and in accordance with Article 562.1 and the Radiological Calibration Procedure.

4. Radiation instrumentation response to interfering ionizing and non-ionizing radiation and environmental conditions should be considered prior to its use, and appropriate controls or correction factors shall be adopted where errors in excess of ±20% of the value could occur.

5. Functional tests used to assess designs for instrumentation used at Hanford that include alarms or that involve a process control should include a test of all components involved in an alarm or trip function. These functional tests shall be performed at least annually.

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[a] Pacific Northwest Laboratory (PNL). Radiological Calibration Procedures. PNL-MA-563, Richland, Washington (internal document).

[b] Pacific Northwest Laboratory (PNL). Radiation Protection Instrument Manual. PNL-MA-562, Richland, Washington (internal document).

6. In unusual and limited situations it may be necessary to use an instrument in an application other than that envisioned by the manufacturer. Special calibrations should be performed at the Hanford Radiological Calibration Facility for use of instrumentation outside manufacturer's specifications.

   a. The instrument should be adjusted, calibrated, and clearly labeled to identify the special conditions under which the instrument may be used.

   b. The specially calibrated instruments shall not be used for other purposes.

7. Instruments should bear a label or tag with the date of calibration and date calibration is due.

8. The Radiological Control Organization shall be notified when instrument "as found" readings indicate that the instrument was out of calibration by ±50%. The Radiological Control Organization should review surveys performed with the instrument while it was out of calibration.

563 Maintenance

1. A Hanford program for preventive and corrective maintenance of radiological instrumentation shall be applicable to all radiation measuring instruments used to protect the worker or the environment.

2. Preventive and corrective maintenance should be performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument and shall meet the requirements of the Hanford maintenance program.

3. Radiological instruments shall be calibrated prior to use following any preventive or corrective maintenance or any adjustment other than zero adjustment. A battery change shall be performed for pool instruments only at the Hanford Radiological Calibration Facility.

564 Calibration Facilities

1. The Hanford Radiological Calibration staff should continue to perform inspections, calibrations, performance tests, use calibration equipment and perform quality assurance in accordance with the recommendations of ANSI N323 (ANSI R1983) and PNL's Radiological Calibration Procedures[a] guidelines. Under the program

   - All activities are located in a manner to minimize radiation exposure to operating personnel and to personnel in adjacent areas

[a] Pacific Northwest Laboratory (PNL). Radiological Calibration Procedures. PNL-MA-563, Richland, Washington (internal document)

- Sources of interference, such as backscatter and non-ionizing radiation, are minimized during the calibration of instrumentation and corrections for interferences are made, as necessary

- The program itself is maintained current with the referenced standards and recommendation of authoritative bodies

- Records of calibration, functional tests, and maintenance are generated in accordance with ANSI N323 (ANSI R1983), ANSI N42.17 A, B, and C (ANSI 1989d), ANSI N13.6 (ANSI R1989b) and DOE 1324.2A (DOE 1988c).

2. Any contracted special calibration service should be performed in accordance with the referenced standards and the procedures and calibration data shall be documented in the Hanford Calibration or Radiation Protection Program Records.

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Exhibit 5-1. Skin Contamination Form.

Under development

Use existing contractor form/format until new form is available.

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Part 0 Summary of Responsibilities

603 Radiological Control Manager

- Concur in site-generated radiological training material (Article 612.5).
- Verify the effectiveness of radiological control training (Article 613.6).
- Concur with alternate training methods or escorts (Article 613.9)
- Designate members and Chair of Oral Examination Board (Article 615.2).

Part 1 General Requirements

611 Purpose

This chapter establishes the requirements to ensure that personnel have the training to work safely in and around radiological areas and to maintain their individual radiation exposure and the radiation exposures of others ALARA. Training requirements in this chapter apply to personnel entering the Hanford Site.

612 Standardization

Standardized core courses and training materials shall be used to achieve consistency DOE-wide. In establishing local training programs, the standardized core courses shall be presented and Hanford Site-specific information shall be added. For example, training for workers at accelerator facilities should expand course content for high-energy radiation and activation products. Training at plutonium facilities should expand the course content for alpha contamination control. Training for workers involved in waste management activities should expand the course content on minimizing the production of mixed wastes. In all cases, the standardized core course materials should be fully implemented.

Standardized core course training material developed and maintained by DOE-EH consists of lesson plans, viewgraphs, student handbooks, qualification standards, question banks, and wallet-sized training certificates. The standardized core course training materials were based on ASTM E 1168 87, *Standard Guide for Radiological Protection Training for Nuclear Facility Workers* (ASTM 1987), and were developed using the principles of performance-based training according to DOE 5480.20 (DOE 1991c). The standardized core course for the Radiological Control Technicians partially fulfills DOE training accreditation requirements of DOE 5480.18A (DOE 1991b).

1. Standardized core course training material shall be used for General Employee Radiological Training, Radiological Worker I and II training, and Radiological Control Technician training.

2. Wallet-sized training certificates that identify current training status should be provided.

3. Successful completion of the standardized courses for General Employee Radiological Training, Radiological Worker I and II, and Radiological Control Technician at one DOE site shall be recognized by other DOE sites. However, the Hanford Site-specific aspects of the radiological training shall be completed. Hanford Site-specific training for General Employee Radiological Training and Radiological Worker I and II training may be included with other site orientation training.

4. At sites where there are multiple facilities, the training may be facility-specific if personnel access is limited to those facilities for which training has been completed.

5. The site Radiological Control Manager or a designee shall concur in site-generated radiological training material.

613 Requirements

1. Examinations for General Employee Radiological Training, Radiological Worker I and II Training, and Radiological Control Technician qualification shall be used to demonstrate satisfactory completion of theoretical and classroom material. Examinations should be written, however alternatives may be used to accommodate special needs. The examination process should require that

   - A minimum passing score be established
   - True/false questions not be included
   - Questions used be randomly selected from the question bank
   - The student's participation in a post-examination review be acknowledged by signature
   - Competence in required skills be measured using performance-based examinations
   - Remedial actions for failure be used to meet the minimum score
   - Questions be selected to test what the student is expected to remember months after the training rather than to test short-term memory of theoretical material.

2. Training should address both normal and abnormal situations in radiological control.

3. General Employee Radiological Training shall be completed every 2 years. Changes to the program should be incorporated as they are identified and a decision made if retraining prior to the 2 year period is needed. In the alternate year when full retraining is not completed, the latest General Employee Radiological Training Handbook (Student Guide) should be distributed for self-guided study.

4. Radiological Worker I and II retraining shall be completed every 2 years. In the alternate year when retraining is not performed, refresher training shall be completed.

5. Hanford Site-specific training and refresher training shall include changes in requirements and updates of lessons learned from operations and maintenance experience and occurrence reporting, for the site, and across the DOE complex.

6. Verification of the effectiveness of radiological control training should be accomplished by surveying a limited subset of former students in the workplace. This verification is in addition to performance evaluations routinely performed by training departments. This evaluation should include observation of practical applications, discussions of the course material, and may include written examinations. The survey should be performed by Radiological Control Managers and supervisors, quality assurance personnel or senior instructors after the former student has had the opportunity to perform work for several months. The results should be documented.

7. Requirements for respiratory protection training are included in Article 531.

8. Training programs developed for radiological control should meet the requirements for performance-based training and, when applicable, training accreditation.

9. Reading and comprehension skills in the English language are generally necessary for General Employee Radiological Training, Radiological Worker Training, and Radiological Control Technician Training. The Radiological Control Manager is authorized to approve alternative training methods for those lacking reading and comprehension skills in the English language. Visitor orientation and the use of trained escorts can be an alternative to training with the concurrence of the Radiological Control Manager.

10. Additional requirements for personnel training at Category A reactors and nuclear facilities are stated in DOE 5480.18A and 5480.20 (DOE 1991b; 1991c).

11. Training records and course documentation shall meet the requirements of Article 725.

614 Qualification Standards for Radiological Control Technicians

1. Qualification Standards define the requirements for demonstrating completion of training. Signatures on the forms in Qualification Standards shall document satisfactory proficiency.

2. Qualification Standards from the standardized core course shall be used.

3. The Qualification Standards from the standardized core course shall be supplemented to include Hanford Site-specific elements.

4. Qualification Standards for the Radiological Control Technician position shall include on-the-job training to provide hands-on experience that is directly applicable to the job.

5. On-the-job trainees shall be under the control of qualified personnel. Before performing a job function without direct supervision, a trainee with partially completed qualifications shall have completed the qualifications for that task.

615 Oral Examination Boards

1. An Oral Examination Board shall determine the qualification of candidates for Radiological Control Technician and Supervisor positions.

2. The Radiological Control Manager shall designate the Board members and appoint a Chairperson.

3. The Board constituted to evaluate Radiological Control Technician qualification should be composed of at least three persons, including a Radiological Control Technician Supervisor, Radiological Control Organization staff member, and line management operations department supervisors and staff personnel, as applicable. Radiological Control Technician Instructors may participate as nonvoting members.

4. The Board should assess the candidate's response to normal and emergency situations. Questions should be of the type that are not normally covered in a written examination.

5. The Board constituted to evaluate the qualification of the Radiological Control Technician Supervisor should not include peers or subordinates as voting members.

616 Instructor Training and Qualifications

1. All instructors should be qualified in accordance with the contractor's site Instructor Qualification Program or possess equivalent qualifications.

2. Instructors should have the technical knowledge, experience, and instructional skills required to fulfill their assigned duties.

3. Instructors-in-training shall be monitored by a qualified instructor.

4. Subject matter experts without instructor qualification may provide training in their areas of expertise. However, these subject matter experts should be trained as instructors when this occurs routinely.

Part 2 General Employee Radiological Training

621 Site Personnel

It is recommended that all employees receive General Employee Radiological Training, which may be incorporated into existing General Employee Training Programs. Information may be communicated by classroom lecture, videotape, or other applicable methods. The expected time to complete the standardized core and Hanford Site General Employee Radiological Training is approximately 1 hour.

1. Personnel who may routinely enter the Controlled Area and encounter radiological barriers, signs or labels, or radioactive materials shall receive General Employee Radiological Training.

   a. General Employee Radiological Training shall include the standardized core course training materials.

   b. This training shall be successfully completed prior to assigning employees to work in ares where there is potential for occupational radiation exposure.

2. Standardized core General Employee Radiological Training shall be expanded to include Hanford Site-specific information, such as site-specific radiation types, alarm responses, and Hanford Site and contractor policies.

3. Additional training beyond General Employee Radiological Training is necessary for unescorted entry into Radiological Buffer Areas or areas posted for radiological control.

622 Radiological Orientation for Visitors

1. Visitors who enter the Radiologically Controlled Area shall receive a radiological safety orientation that should include the following topics:

   - Basic radiation protection concepts
   - Risk of low-level occupational radiation exposure, including cancer and genetic effects
   - Risk of prenatal radiation exposure
   - Radiological protection policies and procedures

- Visitor and management responsibilities for radiation safety
- Adherence to radiological signs and labels
- Applicable emergency procedures
- Training for issuance of dosimeters, where applicable.

2. Information may be communicated by videotape or handout to personnel entering a site. An examination is not required unless required by DOE 5480.18A [DOE 1991a]).

3. Records of the orientation shall be maintained. Visitor sign-in logs may be used as orientation records.

4. The orientation for continuously escorted individuals or groups should be commensurate with the areas to be visited. Records of orientation for such individuals or groups should be retained.

Part 3 Radiological Worker Training

631 Requirements

Radiological Worker training is broken down into two levels: Radiological Worker Training I and II. General employee radiological training is not a prerequisite for Radiological Worker training. Radiological Worker I training is not a prerequisite for Radiological Worker II Training. Radiological Worker I and Radiological Worker II Training are each self-contained courses. Radiological Worker II Training includes all of the requirements of Radiological Worker I Training and expands on the topic of hands-on work with radioactive materials. Radiological Worker II Training prepares the worker to deal with radiological work where additional risks may be encountered.

1. Radiological Workers shall complete Radiological Worker I Training prior to entering Radiological Buffer Areas and Radiation Areas without a qualified escort.

2. Radiological Workers shall complete Radiological Worker II Training prior to entering areas listed in Table 6-1. Additional training is required for special job functions with potential radiological consequences.

3. Workers may challenge Radiological Worker I or II standardized core knowledge requirements by passing a comprehensive examination. If unsuccessful in one attempt, the entire standardized core Radiological Worker I or II Training shall be completed. Challenges do not apply to the Hanford Site-specific portions, where program changes and operational experience are updated.

632 Radiological Worker I

The expected time to complete the standardized core course and Hanford Site-specific Radiological Worker I Training is approximately 8 hours.

1. Workers whose job assignments require access to Radiological Buffer Areas and Radiation Areas shall complete DOE standardized core Radiological Worker I Training and Hanford Site-specific Radiological Worker I Training before being permitted to enter these areas without a qualified escort.

2. Radiological Worker I Training shall use the DOE standardized core course training materials and shall emphasize Hanford Site-specific information.

Table 6-1. Radiological Worker Entry Training Requirements.

Areas	Radiological Worker I	Radiological Worker II
Entry into Radiological Buffer Areas	YES	YES
Entry into Radiation Areas (<100 mrem/h)	YES	YES
Entry into High or Very High Radiation Areas (≥ 100 mrem/h)[a]	NO[b]	YES
Entry into Contamination Areas and High Contamination Areas	NO	YES
Entry into Soil Contamination Areas (to perform work that disturbs soil)	NO	YES
Entry into Airborne Radioactivity Areas	NO	YES[c]

(a) Entry requirements further restricted by Articles 334 and 336.

(b) Entry restricted unless trained in accordance with Article 632.5.

(c) Requires respiratory protection qualification (see Article 531).

3. As a minimum, Radiological Worker I Training should encompass the following Hanford Site-specific practical factors:

- Entering and exiting simulated Radiological Buffer Areas and Radiation Areas
- Performance of survey for personnel contamination, as applicable
- Verification of instrument response and source check

- Anticipated response to alarm situations.

4. Unescorted worker access to High or Very High Radiation Areas is permitted upon successful completion of Radiological Worker 1 Training and specialized High Radiation Area Training. Specialized High Radiation Area Training material shall be approved by DOE-HQ (EH) and completion of this specialized training does not authorize access to Contamination, High Contamination, Soil Contamination, or Airborne Radioactive Areas.

633 Radiological Worker II

The expected time to complete the standardized core and Hanford Site-specific Radiological Worker II Training is approximately 16 hours.

1. Workers shall complete Radiological Worker II Training if their job assignments involve

   - Entry into High and Very High Radiation Areas, Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas

   - Potential contact with hot particles or use of gloveboxes with high contamination levels.

   - Radiological Worker II Training is not required for access limited to High or Very High Radiation Areas for workers trained in accordance with Article 632.4.

2. Radiological Worker II Training shall use the standardized core course training materials and shall emphasize Hanford Site-specific information.

3. As a minimum, Radiological Worker II Training shall encompass the following Hanford Site-specific practical factors:

   - Donning of protective clothing

   - Entering a simulated Radiological Buffer Area, Contamination Area, and High Radiation Area to perform a task

   - Anticipated response to simulated abnormal situations

   - Anticipated response to simulated alarms or faulty radiological control equipment

   - Removing protective clothing and equipment and subsequently exiting the simulated area

   - Performance of survey for personnel contamination

   - Verification of instrument response and source check

   - Enhanced controls for High Radiation and Very High Radiation Areas.

634 Specialized Radiological Worker Training

Specialized Radiological Worker training is provided in addition to Radiological Worker II Training, and shall be completed for nonroutine operations

- Work in areas with changing radiological conditions
- Jobs involving personnel planning, preparation, and performance that have the potential for high radiological consequences.

Such jobs may involve special containment devices, the use of mock-ups, and ALARA considerations.

Part 4 Radiological Control Technician Qualification

641 Requirements

1. Radiological Control Technicians and their immediate supervisors shall be trained and qualified in routine operations and in recognizing and handling situations in both normal and changing radiological conditions.
2. To foster their development, newly qualified technicians and those still in training should be given the opportunity to work with qualified, experienced technicians.

642 Radiological Control Technician

Radiological Control Technician qualification consists of the standardized core course training material, on-the-job training according to the Qualification Standards, and passing both a final comprehensive written examination and a final oral examination by the Oral Examination Board. Radiological Control Technician candidates who have prerequisite knowledge, such as college credit, operational experience, or related qualifications, may satisfy individual sections of the standardized core course training requirements by passing comprehensive challenge examinations.

1. Radiological Control Technician training shall use the standardized core course training materials and should emphasize Hanford Site-specific information.
2. Entry-level prerequisites shall be established to ensure that Radiological Control Technicians meet standards for physical condition and education. As a minimum, these standards should include the following:
   - High school education or equivalency
   - Fundamentals of mathematics, physics, chemistry, and science
   - Systems and fundamentals of process, operations, and maintenance

- Reading and comprehension level sufficient to follow procedures, write permits, prepare survey maps, write reports, and prepare shipping and transfer permits

- Ability to work in a support role, including communicating verbal instructions to others

- Physical requirements to handle Personal Protective Equipment, other equipment, and assist others in work locations, commensurate with assignment.

3. Radiological Control Technicians are encouraged to pursue registration by the National Registry of Radiation Protection Technologists (NRRPT).

4. Sites are encouraged to give credit toward completion of standardized core training requirements for NRRPT registration.

643 Continuing Training

1. After successful completion of standardized core course requirements including practical training, the Radiological Control Technician to receive final qualification shall pass both a comprehensive written examination and an oral one by the Oral Examination Board.

2. After Oral Examination Board qualification, the Radiological Control Technician should begin a 2-year cycle of continuing training required for re-qualification. Every re-qualification requires completion of practical training, a comprehensive written examination, and a final oral examination by the Board.

3. Continuing training shall

   - Provide continued improvement in the knowledge and skills of the Radiological Control Technician

   - Include Hanford Site-specific and DOE-wide changes in requirements and updates of lessons learned from operating experience and industry events

   - Include written examinations, as applicable, demonstrations of proficiency controlled by qualification standards and written and oral examinations to prepare for the comprehensive biennial re-qualification

Infrequently performed tasks, such as those for emergency response, may require annual training. Other tasks may require retraining prior to initiation of a task.

Personnel who maintain qualifications as a Radiological Control Technician satisfy the requirements of Radiological Worker II Training.

644 Radiological Control Technician Supervisors

1. Radiological Control Technician Supervisors shall have qualified as Radiological Control Technicians and should participate in the continuing radiological training programs.

2. Radiological Control Technician Supervisors should

   - Have supervisory and leadership capabilities to direct the work of technicians

   - be able to effectively interact with craft personnel, line supervisors, professional staff, and other managers

   - Be able to respond and direct others in emergency and abnormal situations.

3. Radiological Control Technician Supervisors shall be re-qualified every 2 years through comprehensive Oral Examination Boards in accordance with Article 615.

4. Oral Examination Boards should focus on the ability to analyze situations and supervise subordinates. The Radiological Control Technician Supervisor's depth of knowledge should exceed that expected of a Radiological Control Technician.

645 Subcontracted Radiological Control Technicians

1. Subcontracted Radiological Control Technicians should have the same knowledge and qualifications required of facility technicians performing the same duties. As a minimum, the training and qualification program should include the following:

   - Review of resumes to identify technicians with experience in jobs similar to those for which they will be employed

   - Written examination and oral evaluation to verify the technician's appropriate knowledge level

   - Identification of the duties technicians will be authorized to perform

   - Training in facility procedures and equipment associated with the authorized duties

   - Training in recent operating experience

   - Observation of on-the-job performances by the Radiological Control Technician Supervisor.

2. Subcontracted technicians who work at the facility for extended time periods (more than 6 months) should receive continuing training

commensurate with their assigned duties. This should include successful completion of an oral examination.

Part 5 Other Radiological Training

651 Management Training

1. Line managers (DOE and contractors) who manage, supervise, or provide oversight of radiological control programs shall be trained in the principles of this manual.

2. Training should be based on DOE's standardized core course training materials supplemented by Hanford Site procedures and be completed by new management personnel within 6 months of formally assuming line supervision and management responsibilities.

3. Incumbents shall participate in continuing training, which should emphasize self-assessment and external evaluations, including performance indicators, root causes, and lessons learned based on operational experience.

652 Technical Support Personnel

1. Appropriate technical support personnel (engineers, schedulers, procedure writers) should be trained in the principles of ALARA, basic ALARA techniques, and dose reduction techniques. Technical support personnel should also participate in selected portions of job-specific and specialized training, particularly in situations using mock-ups.

653 Planners

1. Planners who develop detailed work plans involving or associated with radiation or radioactive materials should have Radiological Worker II Training.

654 Radiological Control Personnel

1. Radiological Control technical staff and management should have

   - A combination of education and experience commensurate with their job responsibilities

   - Continuing training based on an assessment of job responsibilities to maintain and enhance their proficiency

   - Continuing training to remain cognizant of changes to the facility, operating experience, procedures, regulations, and quality assurance requirements.

2. Radiological support personnel include but are not limited to dosimetry technicians, instrument technicians, medical personnel, records clerks, whole body counter technicians, and laboratory personnel.

3. Radiological support personnel should have

   - Training on standardized core course topics from Radiological Worker I and II and Radiological Control Technician training, and additional job-specific topics, as applicable

   - Training appropriate to the tasks to be performed

   - Continuing training to provide continued improvement in knowledge and skills.

4. Radiological support personnel who are responsible for implementing the site ALARA program shall receive ALARA training.

5. Certification and involvement with professional industry organizations should be encouraged.

655 Radiographers

1. Radiographers shall be provided with initial training that includes the topics in Exhibit 6-1.

2. In addition to the safe work practice observation requirements in Appendix H, Radiographers shall be provided with annual refresher training that addresses the topics in Exhibit 6-1.

3. Records of this training shall be maintained as part of the Radiological Records.

656 Radiation-Generating Device Operators and Radiation-Generating Device Custodians

1. Radiation-Generating Device Operators and Radiation-Generating Device Custodians shall be provided with initial training that includes the topics in Exhibit 6-2.

2. Radiation-Generating Device Operators and Radiation-Generating Device Custodians shall be provided with annual refresher training that addresses the topics presented in Exhibit 6-2.

657 Emergency Response Personnel

The fact that emergency response personnel, from both onsite and offsite, may be required to work in Radiological Control Areas must be considered when planning appropriate emergency response measures.

1. Provisions shall be in place to accommodate rapid site and Radiological Control Area access by onsite and offsite emergency workers such as fire fighters, medical personnel, and security personnel.

2. Emergency response personnel shall receive special Radiological Worker training commensurate with the situations they are likely to encounter.

   a. Such training should be based on the Radiological Worker standardized core course and Hanford Site-specific training materials.

   b. Training shall make it clear that lifesaving has priority over radiological controls.

   c. If emergency response personnel are not trained, trained escorts should be assigned.

   d. Records of this training should be maintained.

658 Training for Tour Groups and Visiting Dignitaries, Scientists and Specialists

1. The orientation and use of trained escorts shall be considered an alternative to training with the concurrence of the Radiological Control Manager.

2. Hanford Contractors should establish radiological control training for tour groups and visiting dignitaries, scientists, and specialists commensurate with the areas they are to enter.

   a. Such training should be based on the Radiological Worker standardized core course and Hanford Site-specific training materials.

   b. If visiting scientists or specialists are to do hands-on radiological work, consideration should be given to providing full Radiological Worker I or II training.

   c. In any event, training should be commensurate with the work to be performed.

   d. If limited training is provided for limited tasks, methods should be established to limit the approved work and make other staff members aware of the limitation, such as posting a signed-off training card.

   e. Records of this training should be maintained.

Part 6 Training For Special Applications

661 Plutonium Facilities

The following topics should be considered in addition to standardized core training requirements at plutonium facilities:

- Properties of plutonium
- Special radiological surveys and techniques

- External exposure control (neutrons)
- Internal exposure control
- Containment and glovebox operations and procedures
- Special instruments and measurement techniques
- Personnel protection
- Inventory control and accountability
- Criticality safety
- Biological effects.

662 Uranium Facilities

The following topics should be considered in addition to standardized core training requirements at uranium facilities:

- Properties of uranium
- Special radiological surveys and techniques
- External exposure control
- Toxicological properties and behavior of uranium
- Release of uranium-contaminated materials
- Instruments and measurement techniques
- Personnel protection
- Inventory control and accountability
- Criticality safety
- Biological effects.

663 Tritium Facilities

The following topics should be considered in addition to standardized core training requirements at tritium facilities:

- Properties of tritium
- Sources of tritium
- Exposure pathways and forms of tritium
- Exposure control
- Tritium containment
- Special instruments and measurement techniques
- Personnel protection
- Inventory control and accountability
- Airborne tritium measurement
- Airborne tritium controls
- Effluent recovery systems
- Tritium releases
- Bioassay program
- Biological effects.

664 Accelerator Facilities

The following topics should be considered in addition to standardized core training requirements at accelerator facilities:

- Activation products
- Special radiological surveys and techniques
- Component source terms

- Interlock and warning devices and systems
- Access to beam and beam containment
- Special instruments and measurement techniques
- Biological effects.

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Exhibit 6-1. Training Requirements for Radiographers.

1. Fundamentals of Radiation Safety

   a. Characteristics of gamma radiation .
   b. Units of radiation dose and radioactivity
   c. Hazards of exposure to ionizing radiation
   d. Levels of radiation associated with radiography sources
   e. Methods of controlling radiation dose:

      - Working time
      - Working distance
      - Shielding.

2. Radiation Survey Instruments Used in Radiography

   a. Use of gamma radiation survey instruments:

      - Operation
      - Calibration
      - Limitations.

   b. Survey techniques

   c. Use of personnel monitoring equipment:

      - Thermoluminescent dosimeters
      - Pocket dosimeters
      - Alarm ratemeters
      - Extremity dosimeters.

3. Radiographic Exposure Equipment to be Used

   a. Remote handling equipment
   b. Radiographic exposure devices
   c. Storage containers.

4. Inspection and Maintenance Performed by Radiographers

5. Normal and Emergency Procedures

6. Case Histories of Radiography Accidents.

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Exhibit 6-2. Training Requirements for Radiation-Generating Device Operators and Radiation-Generating Device Custodians.

1. Fundamentals of Radiation Safety

   a. Units of radiation dose and radioactivity

   b. Hazards of exposure to ionizing radiation

   c. Characteristics and levels of radiation produced by Radiation-Generating Devices

   d. Methods of controlling radiation dose:

      - Working time
      - Working distance
      - Shielding.

2. Radiation Survey Instruments Used in Radiation-Generating Device Installations

   a. Use of gamma radiation survey instruments:

      - Operation
      - Calibration
      - Limitations.

   b. Survey techniques

   c. Use of personnel monitoring equipment:

      - Thermoluminescent dosimeters
      - Pocket dosimeters
      - Alarm ratemeters
      - Extremity dosimeters.

3. Engineered Safety Features of Radiation-Generating Devices

   a. Safety interlocks
   b. Normal and emergency control systems
   c. Status indications and warning devices
   d. Beam-limiting devices
   e. Access-control devices.

4. Operating Procedures and Practices

   a. Principles of Radiation-Generating Device operation
   b. Inspection
   c. Operating procedures
   d. Emergency procedures
   e. Maintenance
   f. Logs and conduct of operations
   g. Wiring diagrams and schematic drawings
   h. Modifications and changes to Radiation-Generating Device operations.

5. Nonradiological Hazards Associated with Radiation-Generating Devices

   a. High voltage power supplies
   b. Ozone.

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Part 0 Summary of Responsibilities

702 Line Management

- Document radiological safety measures used to protect personnel (Article 711).

703 Radiological Control Manager

- Maintain a file of names, signatures, and initials for future identification of the person who signed or initialed a record (Article 713.3).

709 Support Organizations

- Maintain a cross-reference to the location of all radiological control records (Article 721.1).
- Meet DOE 1324.2A requirements for implementation, records inventory, disposition schedule, and provisions for transfer of records (Article 712.3).

Part 1 Requirements

711 Purpose

This chapter contains requirements for preparing and retaining radiologically related records that are part of the Hanford Radiological Records Program (HRRP). Radiological control records that are needed to demonstrate the effectiveness of the overall program are a part of the HRRP. The work force and management are required to use records to document radiological safety afforded to personnel onsite. Records of radiological programs may be required to support worker health studies and future disputes or claims. Therefore, the following requirements apply:

1. These records should be of high quality, readily retrievable, and managed for the prescribed retention period.
2. Related records should be cross-referenced to aid retrievability.
3. Records should be handled so that personal privacy is protected.

712 Records Management Program

1. The radiological records program at Hanford shall be operated to ensure that auditable records and reports are controlled through the stages of creation, distribution, use, arrangement, storage, retrieval, media conversion (if applicable), and disposition. The HRRP shall maintain a cross-reference to the location of all radiological control records. This records management program should include the following:

   - Radiological Policy Statements

- Radiological Control Procedures
- Individual Radiological Doses
- Internal and External Dosimetry Policies and Procedures (including Bases Documents)
- Personnel Training (course records and individual records)
- ALARA records
- Radiological Instrumentation Test, Repair, and Calibration Records
- Radiological Surveys
- Area Monitoring Dosimetry Results
- RWPs and Procedures
- Radiological Performance Indicators and Assessments
- Radiological Safety Analysis and Evaluation Reports
- Quality Assurance Records
- Radiological Incident and Occurrence Reports (and Critique Reports, if applicable)
- Accountability records for sealed sources
- Records for release of material
- Reports of loss of radioactive material.

2. Where radiological services (e.g., dosimetry and laboratory analyses) are purchased, the contractual agreement regarding records responsibility during performance of the service should clearly show that records of results should also reside in the custody of the originating contract organization and copies of procedures used by the services contractor shall be included in the HRRP records management system.

3. The HRRP shall meet DOE 1324.2A (DOE 1988c) requirements for implementation, records inventory, disposition schedules, and provisions for the transfer of records.

4. The conduct of the HRRP shall meet the Privacy Act of 1974 requirements to protect the privacy of individual records.

713 Recordkeeping Standards

1. Radiological control records shall be accurate and legible. The records should include the following:

   - Identification of the facility, specific location, function, and process
   - Signature or other identifying code of the preparer and date
   - Legible entries in black ink
   - Corrections identified by a single line-out, initialed, and dated
   - Supervisory signature to indicate review and proper completion of the forms.

2. The Radiological Control Organization shall maintain a file of names, signatures, and initials for future identification of the person who signed or initialed a record. The location of these files shall be recorded in the HRRP.

3. Radiological control records should not include records that

   - Were corrected using opaque substances
   - Contain shorthand or other nonstandardized terms.

4. Procedural standards should be established for computerized records.

Part 2 Employee Records

721 Employment History

Records detailing an employee's preemployment and employment occupational radiation exposure history shall be maintained. Where practical, the association between the radiation dose and job function should be preserved for trend analyses and future worker health studies. The following information should be maintained:

- Previous work history detailing radiological work assignments, to the extent practical, and yearly doses at other DOE and non-DOE facilities. The Personal Radiation Exposure History form 54-3000-467 (08/90) shall be used to identify this information (see Exhibit 7-1).
- NRC Form 4 (or equivalent) that documents previous occupational radiation doses

- Ongoing work history documenting work assignments and radiation doses; the facility and occupational codes defined in DOE 5484.1 (DOE 1984) should be used for this process

- Previous and ongoing radiation doses.

722 Personnel Radiological Records

1. Occupational Radiation Dose Records shall be maintained for all contractor, subcontractor, and Federal employees who are part of the personnel dosimetry program at the Hanford Site.

2. Occupational Radiation Dose Records shall contain information sufficient to identify each person, including social security or employee number. For foreign nationals, the passport numbers or a suitable alternate shall be used.

3. Routine and special records related to radiation doses shall be retained for each person monitored. This shall include records of zero dose, procedures, data, and supporting information (as defined in Chapter 5 and appropriate Implementation Guides and Orders) to reconfirm a person's dose at a later date.

4. External dose records should include the following:

   - Extremity, skin, eye, and whole body dose results measured with personnel dosimeters, including all multiple dosimeter badging results

   - Evaluations and dose reconstruction resulting from anomalous dose results such as unexpected high or low doses

   - Dose reconstruction from a lost or damaged dosimeter, or for non-badged workers (as appropriate)

   - Evaluation of nonuniform radiation doses.

5. Internal dose records should include the following:

   - In vivo measurements results including whole body, wound, and lung counting and chest wall thickness measurements (where applicable)

   - Urine, fecal, and specimen analyses

   - Dose assessment, as required

   - Reference to any decorporation therapy that was performed.

6. Counseling of persons about radiological concerns should be documented and this documentation shall be retained.

   a. The counseled person should sign the documentation to acknowledge participation.

b. These documents shall be kept in the employee's personnel file.

7. Records of authorization to exceed Administrative Control Levels shall be retained on the Authorization to Increase Dose Equivalent Limit form (54-000-XXX [12/92] [see Exhibit 2-1]).

723 Other Personnel Radiological Records

1. The complete records of radiological incidents and occurrences involving personnel dose shall be retained in the Radiological Exposure (REX) System. (Occupational Radiological Exposure [ORE] System until REX becomes operational.)

2. Records of employee radiological safety concerns that have been formally investigated and documented shall be maintained in the REX System.

724 Medical Records

1. Preemployment medical records, if available, and reports of periodic medical examinations should be maintained.

2. Physical examination reports and fit-testing results for respirator use should be maintained for respirator users.

3. Medical evaluations and treatment performed in support of the radiological program should be documented.

4. Maintenance of records of nonoccupational radiation doses, such as therapeutic or large amounts of diagnostic radiation doses for medical purposes, is encouraged. Where practical, maintenance of records of preemployment nonoccupational radiation doses is encouraged.

725 Radiological Training and Qualification Records

1. Under the HRRP, records of training and qualification in radiological control shall be maintained or cross-referenced to where they are permanently maintained to demonstrate that a person received appropriate information to perform the work assignment in a safe manner. Qualification standard records shall be retained for on-the-job and practical factor training as well as for formal classroom training.

2. Formal records of training and qualification shall be readily available to first-line supervision and management of involved personnel to aid in making work assignments.

3. Under the HRRP, personnel training records shall be controlled and retained, or cross-referenced. As a minimum, these records shall include the following:

   - Course title
   - Attendance sheets with instructor's name

- Employee's name, identification number, and signature
- Date of training
- Identification of the examination or evaluation form, including sufficient data to identify which test each person completed
- Verification document or record confirming satisfaction of the training requirement
- Documentation related to exceptions for training requirements and extensions of qualification
- Quizzes, tests, responses, and acknowledgements of training, with the date and signature of the person trained
- Special instructions to females, their supervisors, and co-workers concerning prenatal radiation dose, acknowledged by the worker's signature.

4. Records shall be retained for the following types of training:

- General employee radiological training
- Radiological Worker training
- Periodic retraining
- Respiratory protection training
- Training of radiological control personnel
- Instructor training
- Qualifications for special tests or operations
- Orientation and training of visitors
- Training of emergency response personnel
- Training of Radiographers and Radiation-Generating Device operators.

5. The following instructional materials shall be maintained for each contractor in chronological order in the HRRP historical records or their locations shall be cross-referenced:

- Course name, with revision, and approval date
- Instructor's manuals, course content, or lesson plans containing topical outlines
- Video and audio instructional materials, including the dates, and lessons for which they were used
- Handouts or other materials retained with the master copy of the course
- Job-specific training documents, such as instrument use, radiological procedures, RWP special training requirements, pre-job briefings and mock-up training.

6. Documentation of training and qualification received at another DOE location need not be duplicated. Such records should be provided to the employee's supervisor for retention under the HRRP.

Part 3 Visitors

731 Record Requirements

For visitors entering an area where radiation monitoring is required, the following records shall be maintained by the HRRP:

- documentation of completion of Radiological Orientation
- radiation dose records, including zero dose.

732 Reports

1. All non-zero radiation doses shall be reported within 30 days of the dose determination, but no later than 90 days after the end of the visit, to each visitor who received a dose.

2. Reports should be provided to all visitors who receive zero dose.

3. Zero dose reports shall be provided to those visitors who request a report.

Part 4 Radiological Control Procedures

741 Policies, Procedures, and RWPs

1. Historical records of the Radiological Control Program that become a part of the HRRP should consist of policy statements, procedures, RWPs, and supporting data.

2. The records should be maintained in a chronological sequence that will allow correlation with the corresponding support information. For example:

   a. Procedures for performing radiation surveys should be identifiable with the survey results.
   b. The survey results shall be reported on a Radiological Survey form.

   c. RWPs shall be prepared on a Hanford Radiological Work Permit form (see Exhibit 3-2) and should be retained as part of the HRRP records or be cross-referenced to indicate where they are permanently maintained.

742 ALARA Records

1. Records of ALARA plans and goals shall be maintained as part of the HRRP historical records to demonstrate the adequacy of the ALARA Program.

2. These records should include the minutes of ALARA and other committee meetings where radiological safety issues are formally discussed.

743 Quality Assurance Records

Records of quality assurance reviews and audits developed for Radiological Control functions shall be retained to ensure that sufficient records are specified, prepared, reviewed, approved, and maintained to accurately reflect completed work. DOE 5700.6C (DOE 1990d) provides additional information regarding quality assurance records.

Part 5 Radiological Surveys

751 Requirements

Radiological Control Programs include the performance of radiation, airborne radioactive material and contamination surveys to determine existing conditions in a given location.

1. Maps with sufficient detail to permit identification of original survey and sampling locations should be maintained.

2. Records should contain sufficient detail to be meaningful even after the originator is no longer available.

3. These records shall be cross-referenced in the HRRP as to where they are permanently stored.

4. Radiological surveys should be recorded on an approved contractor form and shall include the following common elements:

   - Date, time, and purpose of the survey
   - General and specific location of the survey
   - Name and signature of the surveyor and supervisor
   - Pertinent information needed to interpret the survey results
   - Reference to a specific RWP if the survey is performed to support the permit.

752 Radiation Surveys

In addition to the elements provided in Article 751, as a minimum, records of radiation surveys shall include the following information:

- Instrument model and serial number
- Results of the measurements of area dose rates.

753 Airborne Radioactive Materials

In addition to the elements provided in Article 751, as a minimum, records of airborne radioactive materials shall include the following information:

- Model and serial number of the sampler and laboratory counting instrument; locations of fixed samplers may be used as identifiers where model and serial numbers are not available
- Air concentrations in general airborne areas and breathing zones
- Supporting parameters, including collection efficiency, flow rate, duration of sampling, correction factors, and filter medium

754 Contamination Surveys

In addition to the elements required by Article 751, as a minimum, records of contamination surveys shall include the following information:

- Model and serial number of instruments used including counting equipment
- Contamination levels (using appropriate units) and reference to appropriate supporting parameters including counting efficiency, counting time, correction factors, type of radiation, and whether the contamination was fixed or removable
- Location of areas found to contain hot particles or high concentrations of localized contamination in excess of 100 times the values in Table 2-3
- Follow-up survey results for decontamination processes cross-referenced to the original survey.

Part 6 Instrumentation and Calibration Records

761 Calibration and Operational Checks

1. Calibration records for fixed, portable, and laboratory radiation measuring equipment shall be maintained. These shall include frequencies, method, dates, personnel, training, and traceability of calibration sources to NIST or Secondary Laboratory Standards.

2. Calibration records should be maintained for the following equipment:

   - Portable survey instruments
   - Bioassay measurement equipment
   - Laboratory, counting room, and fixed radiation measuring equipment
   - Process and effluent monitors and sampling equipment
   - Radiation area monitors
   - Portal monitors and other personnel contamination monitors
   - Pocket and electronic dosimeters
   - Air sampling equipmentsampling equipment

- Tool and waste monitoring equipment
- Protective clothing and equipment monitors.

3. Documentation of instrument operational checks should be maintained for a period not less than the calibration period of the instrument.

4. Maintenance histories for each instrument (including the nature of any defects and corrective actions taken) and calibration results (both as found and as returned) should be created and retained.

762 Special Calibration Records

1. Records of additional tests and checks of instrumentation used in conjunction with a suspected overexposure, questionable indication, or unusual occurrence should be retained.

2. Records of special instrument calibrations and modifications made in accordance with Article 562.6 should be retained.

Part 7 Records Management

771 Media

1. A combination of recordkeeping media may be used under the HRRP.

2. For records that have long-term retention requirements and are stored on media subject to degradation or obsolescence, the records program shall include provisions for conversion to a more stable media.

3. All records shall be stored in a manner that ensures their integrity, retrievability, and security.

772 Microfilm

Records may be microfilmed if the resulting film copy is capable of producing a clear, legible copy after storage for the specified period. The following controls shall be administered:

- Verification that the resultant copy is legible
- Confirmation that printed sides are copied
- Periodic quality audits of the final filmed copy.

773 Computerization of Records

1. Records may be transferred to magnetic storage media if certain precautions are taken to ensure that the information is maintained in a retrievable configuration.

2. Controls for the use and handling of magnetic storage media should include the following:

   - A master index of documents on the magnetic storage media

- A program to ensure back-up and retrievability of information
- Quality control during data entry and analysis
- An index identifying software applications used in conjunction with the data
- Software validation and verification
- Periodic quality audits of software
- Prevention of unauthorized manipulation of data
- Assurance that previously stored information is retrievable and useable after system modifications.

3. It shall be permissible to use optical disks to archive records if the system using optical disks:

   - Is a reliable system to prevent overwriting or erasure of records
   - Has software and user controls consistent with Article 773.2
   - Incorporates manufacturer recommendations relating to software control, disk life expectancy, environmental storage conditions, and maintenance into policies and procedures
   - Has quality controls on the copying and imaging processes consistent with Article 772.

774 Retention

1. The records retention period under the HRRP shall be based on the requirements stated in DOE 1324.2A and DOE 5480.11 (DOE 1988c; 1988a).

2. Once a record has been created, reviewed, and signed by appropriate supervision, the record should be considered complete and shall not be modified. Subsequent errors identified in a completed record should be corrected by creating a supplemental record that includes traceability for the correction.

775 Physical Protection of Records

1. Methods for protecting HRRP records shall include vaults, file rooms with fixed fire suppression, fire-rated cabinets, duplicate storage, or combinations of these.

2. In identifying storage arrangements, physical damage that could be caused by temperature extremes, moisture, infestation, electromagnetic fields, excessive light, stacking, theft, and vandalism should be addressed.

3. As a minimum, records should be protected from

   - Exposure to fire, equivalent to an Underwriters Laboratories, Inc., 1.5-hour (or greater) fire-resistance rating
   - Exposure to water damage caused by a 100-year flood
   - Exposure to windstorm velocities of 100-year recurrence.

Part 8 Radiological Reporting

781 Reports to Individuals

1. Personnel who are monitored by the personnel dosimetry program and are active employees at calendar year end shall be given an annual report of their dose. This requirement shall not apply to visitors covered by Article 732.

2. Upon request, a person should receive a current radiation dose record; Privacy Act requirements shall be met.

3. Terminating employees shall be given a report, within 90 days of the last day of employment; the report shall summarize radiation dose for the total period of employment at the reporting facility.

782 Annual Radiation Report

The reporting requirements in DOE 5484.1 (DOE 1984b) shall be followed for the Annual Radiation Dose Summary. This report shall include internal and external radiation dose results for monitored DOE and DOE contractor employees, and for monitored visitors (if their records are maintained at Hanford).

Exhibit 7-1 Personal Radiation Exposure History Form

Employer

RADIATION PROTECTION RECORDS
PERSONAL RADIATION EXPOSURE HISTORY

Name (Last) (First) (Middle) (Maiden)	Social Security No or Passport No	Birthdate	Birthplace (City and State)	Sex

Residence or Mail Address	Work Location	Supervisor	Employment Date	Payroll
	Org Code	Phone		
	Job Title		Occupation Code	Facility Code

1. Have you previously been employed by a Hanford contractor? ☐ Yes ☐ No
2. Have you ever worked with radioactive material other than sealed sources? ☐ Yes ☐ No
   If the answer is Yes, please specify the radioactive material you have worked with
   _____
3. Have you ever worn a radiation dosimeter (include: University, Military Services, Industry)? If so, include exact dates for all employment, etc. and in the case of Military, if prior to 1973, please include service number. ☐ Yes ☐ No
4. If you have worn a radiation dosimeter during this calendar year, please provide an estimate of your dose for this calendar year: _____ MREM.

– IF THE ANSWER IS YES TO ANY OF THE ABOVE, PLEASE PROVIDE THE FOLLOWING INFORMATION –

Employer for Work Indicated Above --- _____

Employer's Address (Include Zip Code) --- _____

Dates Employed: From: _____ To: _____

Employer for Work Indicated Above --- _____

Employer's Address (Include Zip Code) --- _____

Dates Employed: From: _____ To: _____

Employer for Work Indicated Above --- _____

Employer's Address (Include Zip Code) --- _____

Dates Employed: From: _____ To: _____

IF MORE ROOM IS NEEDED, ATTACH ADDITIONAL PAGES WITH INFORMATION

FOR RP USE ONLY

DOSIMETER	Routine (See PNL-MA-575)		Routine Bioassay		Concurrence
☐ None	Type	Frequency	Radionuclide	Frequency	
☐ Temp ☐ J ☐ T	(1)	(1)	(1)	(1)	
☐ TLD Basic					
☐ TLD Monthly	Type	Frequency			
☐ TLD Quarterly	(2)	(2)	(2)	(2)	Radiation Protection
☐ TLD Annual MP					

Remarks:

I Certify: (1) That the information provided herein is correct and complete to the best of my knowledge and (2) I have read the Privacy Act Statement on reverse.

_____
Signature

DISTRIBUTION: White and Pink - Personnel Dosimetry Services, PNL Yellow - Contractor Radiation Protection Organization 54-3000-467 (08/90)

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Appendix C Radiological Signs and Labels

This appendix provides examples of signs and labels (in Figures C.1 through C.10) to be used consistently at Hanford Site by the U.S. Department of Energy (DOE) and the DOE Contractors to meet radiological posting requirements. Six printed signs and a three-pocket sign and its inserts are described.

NOTE: The following signs are for illustration only and are not to scale.

The choice of the material and the size of the signs are up to the DOE contractors with the following constraints:

- For the signs shown in Figures C.1 through C.4 and C.7, the height-to-width ratio should be proportional to a minimum size sign whose dimensions are 7 x 10.25 inches.
- For the signs shown in Figures C.5 and C.6, the height-to-width ratio should be proportional to a minimum size sign whose dimensions are 5 x 7 inches.

The colors of the signs shall be as follows:

- Background is yellow
- Lettering is black or magenta
- Radiation symbol is magenta.

Figure C.1. Radiologically Controlled Area Sign

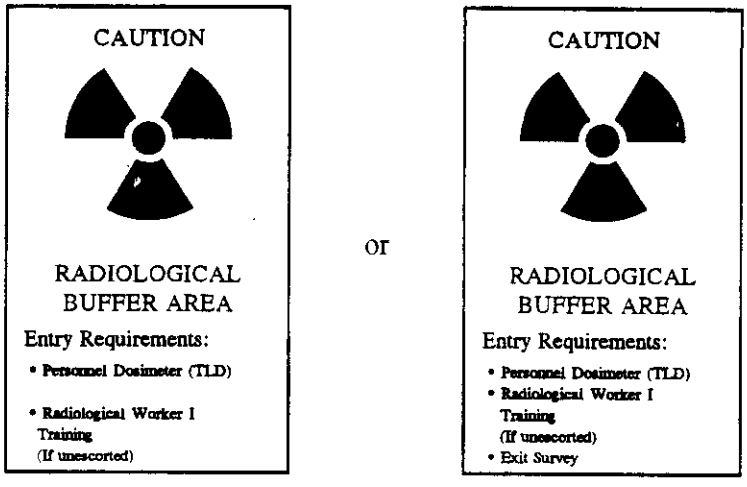

Figure C.2. Radiological Buffer Area Sign

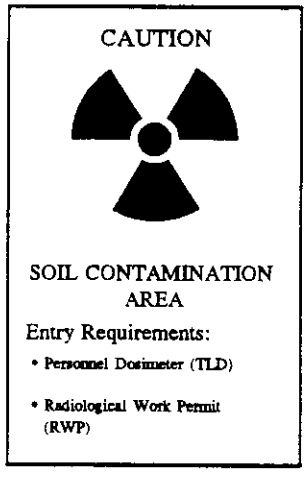

Figure C.3. Soil Contamination Area Sign

Figure C.4. Underground Radioactive Material Sign

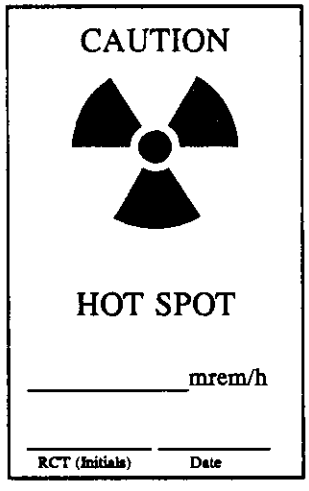

Figure C.5. Hot Spot Sign

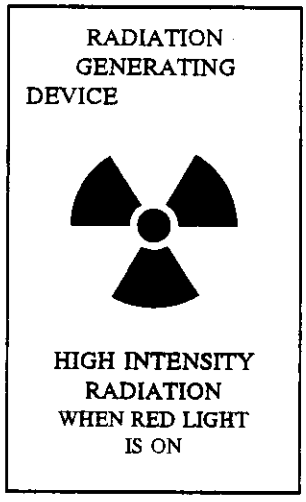

Figure C.6. Radiation-Generating Device (When Red Light is On) Sign

NOTE: A single sign is to be posted at each RGD red warning light. (See also the three-pocket RGD [Area] Sign.)

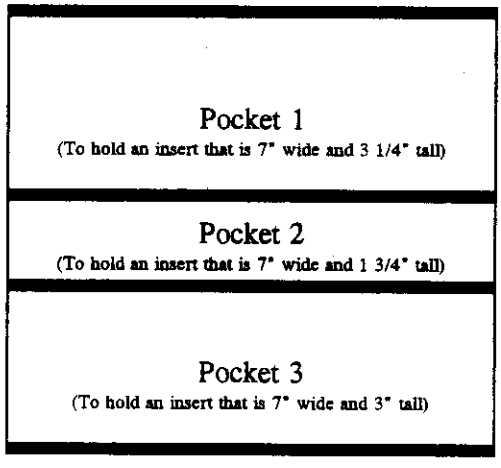

Figure C.7. Three Pocket Sign

The three-pocket sign shown in Figure C.7 is designed to hold inserts (see samples in Figure C.8). The inserts that slide into the pockets indicate various radiological conditions, work areas, or entry requirements. Inserts in Pocket 1 include the radiation symbol and word(s) to indicate the radiation danger level. Pocket 2 inserts specify the type of work area. Pocket 3 inserts list entry requirements or limitations. Each of the types of inserts are shown in Figures C.9 through C.11, and where appropriate their intended areas of use are also indicated.

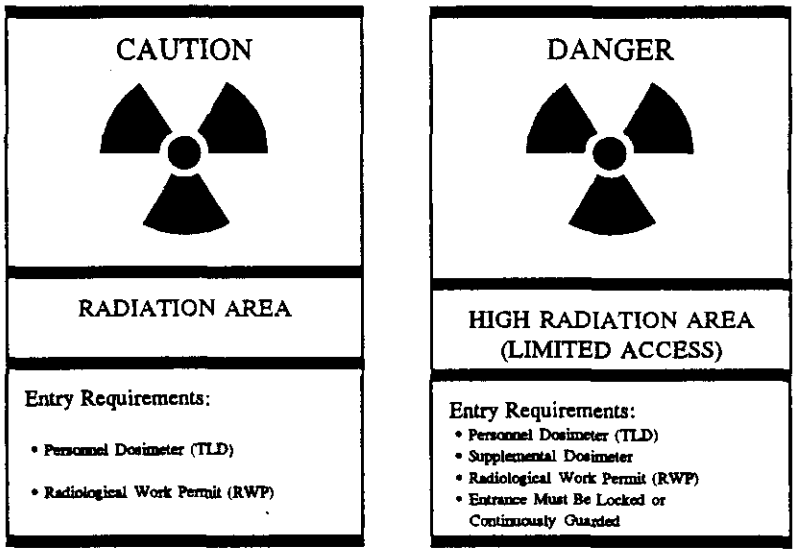

Figure C.8. Samples of Three Pocket Signs with Inserts in Place

	Sign	Intended Area of Use
1.		Radiation Area Dose rate criteria of ≥2 mrem/h but <100 mrem/h Contamination Area Soil Contamination Area Airborne Radioactivity Area Radioactive Material Area
2.		High Radiation Area Dose rate criteria of ≥100 mrem/h but <1 rem/h High Radiation Area (Limited Access) Dose rate criteria of ≥100 mrem/h but <500 rad/h High Contamination Area
3.		Very High Radiation Area (Prohibited Access) Dose rate criteria of ≥500 rad/h

Figure C.9. Pocket 1 Inserts

1. RADIATION AREA	2. HIGH RADIATION AREA	3. HIGH RADIATION AREA (LIMITED ACCESS)
4. VERY HIGH RADIATION AREA (LIMITED ACCESS)	5. VERY HIGH RADIATION AREA (PROHIBITED ACCESS)	6. CONTAMINATION AREA
7. HIGH CONTAMINATION AREA	8. AIRBORNE RADIOACTIVITY AREA	9. RADIOACTIVE MATERIAL AREA
10. RADIATION AREA and CONTAMINATION AREA	11. RADIATION AREA and HIGH CONTAMINATION AREA	12. RADIATION AREA and AIRBORNE RADIOACTIVITY AREA
13. HIGH RADIATION AREA and CONTAMINATION AREA	14. HIGH RADIATION AREA and HIGH CONTAMINATION AREA	15. HIGH RADIATION AREA and AIRBORNE RADIOACTIVITY AREA
16. HIGH RADIATION AREA (LIMITED ACCESS) and CONTAMINATION AREA	17. HIGH RADIATION AREA (LIMITED ACCESS) and HIGH CONTAMINATION AREA	18. HIGH RADIATION AREA (LIMITED ACCESS) and AIRBORNE RADIOACTIVITY AREA
19. VERY HIGH RADIATION AREA (LIMITED ACCESS) and CONTAMINATION AREA	20. VERY HIGH RADIATION AREA (LIMITED ACCESS) and HIGH CONTAMINATION AREA	21. VERY HIGH RADIATION AREA (LIMITED ACCESS) and AIRBORNE RADIOACTIVITY AREA
22. RADIATION AREA and RADIOACTIVE MATERIAL AREA	23. HIGH RADIATION AREA and RADIOACTIVE MATERIAL AREA	24. HIGH RADIATION AREA (LIMITED ACCESS) and RADIOACTIVE MATERIAL AREA
25. VERY HIGH RADIATION AREA (LIMITED ACCESS) and RADIOACTIVE MATERIAL AREA		

Figure C.10. Pocket 2 Inserts

	Sign	Intended Area of Use
1.	Entry Requirements: • Personnel Dosimeter (TLD) • Radiological Work Permit (RWP)	Radiation Area Dose rate criteria ≥2 mrem/h but <100 mrem/h Contamination Area High Contamination Area Soil Contamination Area Airborne Radioactivity Area Radioactive Material Area
2.	Entry Requirements: • Personnel Dosimeter (TLD) • Supplemental Dosimeter • Radiological Work Permit (RWP)	High Radiation Area Dose rate criteria ≥ 100 mrem/h but <1 rem/h
3.	Entry Requirements: • Personnel Dosimeter (TLD) • Supplemental Dosimeter • Radiological Work Permit (RWP) • Entrance Must Be Locked or Continuously Guarded	High Radiation Area (Limited Access) Dose rate criteria of ≥ 1 rem/h but <5 rem/h
4.	SPECIAL CONTROLS REQUIRED FOR ENTRY	Very High Radiation Area (Limited Access) Dose rate criteria of ≥5 rem/h but <500 rad/h
5.	NO ENTRY	Very High Radiation Area (Prohibited Access) Dose rate criteria of ≥ 500 rad/h

	Sign	Intended Area of Use
6.	SPECIAL CONTROLS REQUIRED FOR ENTRY WHEN RED LIGHT IS ON	Intermittent Radiation Areas with permitted excess
7.	NO ENTRY WHEN RED LIGHT IS ON	Intermittent Radiation Areas with prohibited excess

Figure C.11. Pocket 3 Inserts

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Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Hydrogen-3	1,000	Manganese-56	1,000
Beryllium-7	1,000	Iron-52	100
Beryllium-10	1	Iron-55	100
Carbon-11	1,000	Iron-59	10
Carbon-14	1,000	Iron-60	1
Fluorine-18	1,000	Cobalt-55	100
Sodium-22	10	Cobalt-56	10
Sodium-24	100	Cobalt-57	100
Magnesium-28	100	Cobalt-58m	1,000
Aluminum-26	10	Cobalt-58	100
Silicon-31	1,000	Cobalt-60m	1,000
Silicon-32	1	Cobalt-60	1
Phosphorus-32	10	Cobalt-61	1,000
Phosphorus-33	100	Cobalt-62m	1,000
Sulfur-35	100	Nickel-56	100
Chlorine-36	10	Nickel-57	100
Chlorine-38	1,000	Nickel-59	100
Chlorine-39	1,000	Nickel-63	100
Argon-39	1,000	Nickel-65	1,000
Argon-41	1,000	Nickel-66	10
Potassium-40	100	Copper-60	1,000
Potassium-42	1,000	Copper-61	1,000
Potassium-43	1,000	Copper-64	1,000
Potassium-44	1,000	Copper-67	1,000
Potassium-45	1,000	Zinc-62	100
Calcium-41	100	Zinc-63	1,000
Calcium-45	100	Zinc-65	10
Calcium-47	100	Zinc-69m	100
Scandium-43	1,000	Zinc-69	1,000
Scandium-44m	100	Zinc-71m	1,000
Scandium-44	100	Zinc-72	100
Scandium-46	10	Gallium-65	1,000
Scandium-47	100	Gallium-66	100
Scandium-48	100	Gallium-67	1,000
Scandium-49	1,000	Gallium-68	1,000
Titanium-44	1	Gallium-70	1,000
Titanium-45	1,000	Gallium-72	100
Vanadium-47	1,000	Gallium-73	1,000
Vanadium-48	1,000	Germanium-66	1,000
Vanadium-49	1,000	Germanium-67	1,000
Chromium-48	1,000	Germanium-68	10
Chromium-49	1,000	Germanium-69	1,000
Chromium-51	1,000	Germanium-71	1,000
Manganese-51	1,000	Germanium-75	1,000
Manganese-52m	1,000	Germanium-77	1,000
Manganese-52	100	Germanium-78	1,000
Manganese-53	1,000	Arsenic-69	1,000
Manganese-54	100	Arsenic-70	1,000

Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Arsenic-71	100	Strontium-85	100
Arsenic-72	100	Strontium-87m	1,000
Arsenic-73	100	Strontium-89	10
Arsenic-74	100	Strontium-90	0.1
Arsenic-76	100	Strontium-91	100
Arsenic-77	100	Strontium-92	100
Arsenic-78	1,000	Yttrium-86m	1,000
Selenium-70	1,000	Yttrium-86	100
Selenium-73m	1,000	Yttrium-87	100
Selenium-73	100	Yttrium-88	10
Selenium-75	100	Yttrium-90m	1,000
Selenium-79	100	Yttrium-90	10
Selenium-81m	1,000	Yttrium-91m	1,000
Selenium-81	1,000	Yttrium-91	10
Selenium-83	1,000	Yttrium-92	100
Bromine-74m	1,000	Yttrium-93	100
Bromine-74	1,000	Yttrium-94	1,000
Bromine-75	1,000	Yttrium-95	1,000
Bromine-76	100	Zirconium-86	100
Bromine-77	1,000	Zirconium-88	10
Bromine-80m	1,000	Zirconium-89	100
Bromine-80	1,000	Zirconium-93	1
Bromine-82	100	Zirconium-95	10
Bromine-83	1,000	Zirconium-97	100
Bromine-84	1,000	Niobium-88	1,000
Krypton-74	1,000	Niobium-89m (66 min)	1,000
Krypton-76	1,000	Niobium-89 (122 min)	1,000
Krypton-77	1,000	Niobium-90	100
Krypton-79	1,000	Niobium-93m	10
Krypton-81	1,000	Niobium-94	1
Krypton-83m	1,000	Niobium-95m	100
Krypton-85m	1,000	Niobium-95	100
Krypton-85	1,000	Niobium-96	100
Krypton-87	1,000	Niobium-97	1,000
Krypton-88	1,000	Niobium-98	1,000
Rubidium-79	1,000	Molybdenum-90	100
Rubidium-81m	1,000	Molybdenum-93m	100
Rubidium-81	1,000	Molybdenum-93	10
Rubidium-82m	1,000	Molybdenum-99	100
Rubidium-83	100	Molybdenum-101	1,000
Rubidium-84	100	Technetium-93m	1,000
Rubidium-85	100	Technetium-93	1,000
Rubidium-87	100	Technetium-94m	1,000
Rubidium-88	1,000	Technetium-94	1,000
Rubidium-89	1,000	Technetium-96m	1,000
Strontium-80	100	Technetium-96	100
Strontium-83	100	Technetium-97m	100
Strontium-85m	1,000	Technetium-97	1,000

Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Technetium-98m	10	Indium-110 (4.9 hr)	1,000
Technetium-99m	1,000	Indium-111	100
Technetium-99	100	Indium-112	1,000
Technetium-101	1,000	Indium-113m	1,000
Technetium-104	1,000	Indium-114m	10
Ruthenium-94	1,000	Indium-115m	1,000
Ruthenium-97	1,000	Indium-115	100
Ruthenium-103	100	Indium-116m	1,000
Ruthenium-105	1,000	Indium-117m	1,000
Ruthenium-106	1	Indium-117	1,000
Rhodium-99m	1,000	Indium-119m	1,000
Rhodium-100	100	Tin-110	100
Rhodium-101m	1,000	Tin-111	1,000
Rhodium-101	10	Tin-113	100
Rhodium-102m	10	Tin-117m	100
Rhodium-102	10	Tin-119m	100
Rhodium-103m	1,000	Tin-121m	100
Rhodium-105	100	Tin-121	1,000
Rhodium-106m	1,000	Tin-123m	1,000
Rhodium-107	1,000	Tin-123	10
Palladium-100	100	Tin-124	10
Palladium-101	1,000	Tin-125	10
Palladium-103	100	Tin-127	1,000
Palladium-107	10	Tin-128	1,000
Palladium-109	100	Antimony-115	1,000
Silver-102	1,000	Antimony-116m	1,000
Silver-103	1,000	Antimony-116	1,000
Silver-104m	1,000	Antimony-117	1,000
Silver-104	1,000	Antimony-118m	1,000
Silver-105	100	Antimony-119	1,000
Silver-106m	100	Antimony-120 (18 min)	1,000
Silver-106	1,000	Antimony-120 (5.76 day)	100
Silver-108m	1	Antimony-122	100
Silver-110m	10	Antimony-124m	1,000
Silver-111	100	Antimony-124	10
Silver-112	100	Antimony-125	100
Silver-115	1,000	Antimony-126m	1,000
Cadmium-104	1,000	Antimony-126	100
Cadmium-107	1,000	Antimony-127	100
Cadmium-109	1	Antimony-128 (10.4 min)	1,000
Cadmium-113m	0.1	Antimony-128 (9.01 hr)	100
Cadmium-113	100	Antimony-128	100
Cadmium-115m	10	Antimony-129	1,000
Cadmium-115	100	Antimony-130	1,000
Cadmium-117m	1,000	Tellurium-114	1,000
Cadmium-117	1,000	Tellurium-121m	10
Indium-109	1,000	Tellurium-121	100
Indium-110 (69.1 min)	1,000	Tellurium-123m	10

Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Tellurium-123	100	Cesium-134	10
Tellurium-125m	10	Cesium-135m	1,000
Tellurium-127m	10	Cesium-135	100
Tellurium-127	1,000	Cesium-136	10
Tellurium-129m	10	Cesium-137	10
Tellurium-129	1,000	Cesium-138	1,000
Tellurium-131m	10	Barium-126	1,000
Tellurium-131	100	Barium-128	100
Tellurium-132	10	Barium-131m	1,000
Tellurium-133m	100	Barium-131	100
Tellurium-133	1,000	Barium-133m	100
Tellurium-134	1,000	Barium-133	100
Iodine-120m	1,000	Barium-135m	100
Iodine-120	100	Barium-139	1,000
Iodine-121	1,000	Barium-140	100
Iodine-123	100	Barium-141	1,000
Iodine-124	10	Barium-142	1,000
Iodine-125	1	Lanthanum-131	1,000
Iodine-126	1	Lanthanum-132	100
Iodine-128	1,000	Lanthanum-135	1,000
Iodine-129	1	Lanthanum-137	10
Iodine-130	10	Lanthanum-138	100
Iodine-131	1	Lanthanum-140	100
Iodine-132m	100	Lanthanum-141	100
Iodine-132	100	Lanthanum-142	1,000
Iodine-133	10	Lanthanum-143	1,000
Iodine-134	1,000	Cerium-134	100
Iodine-135	100	Cerium-135	100
Xenon-120	1,000	Cerium-137m	100
Xenon-121	1,000	Cerium-137	1,000
Xenon-122	1,000	Cerium-139	100
Xenon-123	1,000	Cerium-141	100
Xenon-125	1,000	Cerium-143	100
Xenon-127	1,000	Cerium-144	1
Xenon-129m	1,000	Praseodymium-136	1,000
Xenon-131m	1,000	Praseodymium-137	1,000
Xenon-133m	1,000	Praseodymium-138m	1,000
Xenon-133	1,000	Praseodymium-139	1,000
Xenon-135m	1,000	Praseodymium-142m	1,000
Xenon-135	1,000	Praseodymium-142	100
Xenon-138	1,000	Praseodymium-143	100
Cesium-125	1,000	Praseodymium-144	1,000
Cesium-127	1,000	Praseodymium-145	100
Cesium-129	1,000	Praseodymium-147	1,000
Cesium-130	1,000	Neodymium-136	1,000
Cesium-131	1,000	Neodymium-138	100
Cesium-132	100	Neodymium-139m	1,000
Cesium-134m	1,000	Neodymium-139	1,000

Radionuclide	Quantity µCi
Neodymium-141	1,000
Neodymium-147	100
Neodymium-149	1,000
Neodymium-151	1,000
Promethium-141	1,000
Promethium-143	100
Promethium-144	10
Promethium-145	10
Promethium-146	1
Promethium-147	10
Promethium-148	10
Promethium-149	100
Promethium-150	1,000
Promethium-151	100
Samarium-141m	1,000
Samarium-141	1,000
Samarium-142	1,000
Samarium-145	100
Samarium-146	1
Samarium-147	100
Samarium-151	10
Samarium-153	100
Samarium-155	1,000
Samarium-156	1,000
Europium-145	100
Europium-146	100
Europium-147	100
Europium-148	10
Europium-149	100
Europium-150 (12.62 hr)	100
Europium-150 (34.2 yr)	1
Europium-152m	100
Europium-152	1
Europium-154	1
Europium-155	10
Europium-156	100
Europium-157	100
Europium-158	1,000
Gadolinium-145	1,000
Gadolinium-146	10
Gadolinium-147	100
Gadolinium-148	0.001
Gadolinium-149	100
Gadolinium-151	10
Gadolinium-152	100
Gadolinium-153	10
Gadolinium-159	100
Terbium-147	1,000

Radionuclide	Quantity µCi
Terbium-149	100
Terbium-150	1,000
Terbium-151	100
Terbium-153	1,000
Terbium-154	100
Terbium-155	1,000
Terbium-156m (5.0 hr)	1,000
Terbium-156m (24.4 hr)	1,000
Terbium-156	100
Terbium-157	10
Terbium-158	1
Terbium-160	10
Terbium-161	100
Dysprosium-156	1,000
Dysprosium-157	1,000
Dysprosium-159	100
Dysprosium-165	1,000
Dysprosium-166	100
Holmium-155	1,000
Holmium-157	1,000
Holmium-159	1,000
Holmium-161	1,000
Holmium-162m	1,000
Holmium-162	1,000
Holmium-164m	1,000
Holmium-164	1,000
Holmium-166m	1
Holmium-166	100
Holmium-167	1,000
Erbium-161	1,000
Erbium-165	1,000
Erbium-169	100
Erbium-171	100
Erbium-172	100
Thulium-162	1,000
Thulium-166	100
Thulium-167	100
Thulium-170	10
Thulium-171	10
Thulium-172	100
Thulium-173	100
Thulium-175	1,000
Ytterbium-162	1,000
Ytterbium-166	100
Ytterbium-167	1,000
Ytterbium-169	100
Ytterbium-175	100
Ytterbium-177	1,000

Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Ytterbium-178	1,000	Tungsten-181	1,000
Lutetium-169	100	Tungsten-185	100
Lutetium-170	100	Tungsten-187	100
Lutetium-171	100	Tungsten-188	10
Lutetium-172	100	Rhenium-177	1,000
Lutetium-173	10	Rhenium-178	1,000
Lutetium-174m	10	Rhenium-181	1,000
Lutetium-174	10	Rhenium-182 (12.7 hr)	1,000
Lutetium-176m	1,000	Rhenium-182 (64.0 hr)	100
Lutetium-176	100	Rhenium-184m	10
Lutetium-177m	10	Rhenium-184	100
Lutetium-177	100	Rhenium-186m	10
Lutetium-178m	1,000	Rhenium-186	100
Lutetium-178	1,000	Rhenium-187	1,000
Lutetium-179	1,000	Rhenium-188m	1,000
Hafnium-170	100	Rhenium-188	100
Hafnium-172	1	Rhenium-189	100
Hafnium-173	1,000	Osmium-180	1,000
Hafnium-175	100	Osmium-181	100
Hafnium-177m	1,000	Osmium-182	100
Hafnium-178m	0.1	Osmium-185	100
Hafnium-179m	10	Osmium-189m	1,000
Hafnium-180m	1,000	Osmium-191m	1,000
Hafnium-181	10	Osmium-191	100
Hafnium-182m	1,000	Osmium-193	100
Hafnium-182	0.1	Osmium-194	1
Hafnium-183	1,000	Irridium-182	1,000
Hafnium-184	100	Irridium-184	1,000
Tantalum-172	1,000	Irridium-185	1,000
Tantalum-173	1,000	Irridium-186	100
Tantalum-174	1,000	Irridium-187	1,000
Tantalum-175	1,000	Irridium-188	100
Tantalum-176	100	Irridium-189	100
Tantalum-177	1,000	Irridium-190m	1,000
Tantalum-178	1,000	Irridium-190	100
Tantalum-179	100	Irridium-192 (73.8 day)	1
Tantalum-180m	1,000	Irridium-192m (1.4 min)	10
Tantalum-180	100	Irridium-194m	10
Tantalum-182m	1,000	Irridium-194	100
Tantalum-182	10	Irridium-195m	1,000
Tantalum-183	100	Irridium-195	1,000
Tantalum-184	100	Platinum-186	1,000
Tantalum-185	1,000	Platinum-188	100
Tantalum-186	1,000	Platinum-189	1,000
Tungsten-176	1,000	Platinum-191	100
Tungsten-177	1,000	Platinum-193m	100
Tungsten-178	1,000	Platinum-193	1,000
Tungsten-179	1,000	Platinum-195m	100

Radionuclide	Quantity µCi	Radionuclide	Quantity µCi
Platinum-197m	1,000	Bismuth-201	1,000
Platinum-197	100	Bismuth-202	1,000
Platinum-199	1,000	Bismuth-203	100
Platinum-200	100	Bismuth-205	100
Gold-193	1,000	Bismuth-206	100
Gold-194	100	Bismuth-207	10
Gold-195	10	Bismuth-210m	0.1
Gold-198m	100	Bismuth-210	1
Gold-198	100	Bismuth-212	10
Gold-199	100	Bismuth-213	10
Gold-200m	100	Bismuth-214	100
Gold-200	1,000	Polonium-203	1,000
Gold-201	1,000	Polonium-205	1,000
Mercury-193m	100	Polonium-207	1,000
Mercury-193	1,000	Polonium-210	0.1
Mercury-194	1	Astatine-207	100
Mercury-195m	100	Polonium-211	10
Mercury-195	1,000	Radon-220	1
Mercury-197m	100	Radon-222	1
Mercury-197	1,000	Francium-222	100
Mercury-199m	1,000	Francium-233	100
Mercury-203	100	Radium-223	0.1
Thallium-194m	1,000	Radium-224	0.1
Thallium-194	1,000	Radium-225	0.1
Thallium-195	1,000	Radium-226	0.1
Thallium-197	1,000	Radium-227	1,000
Thallium-198m	1,000	Radium-228	0.1
Thallium-198	1,000	Actinium-224	1
Thallium-199	1,000	Actinium-225	0.01
Thallium-200	1,000	Actinium-226	0.1
Thallium-201	1,000	Actinium-227	0.001
Thallium-202	100	Actinium-228	1
Thallium-204	100	Thorium-226	10
Lead-195m	1,000	Thorium-227	0.01
Lead-198	1,000	Thorium-228	0.001
Lead-199	1,000	Thorium-229	0.001
Lead-200	100	Thorium-230	0.001
Lead-201	1,000	Thorium-231	100
Lead-202m	1,000	Thorium-232	100
Lead-202	10	Thorium-234	10
Lead-203	1,000	Thorium-natural	100
Lead-205	100	Protactinium-227	10
Lead-209	1,000	Protactinium-228	1
Lead-210	0.01	Protactinium-230	0.1
Lead-211	100	Protactinium-231	0.001
Lead-212	1	Protactinium-232	1
Lead-214	100	Protactinium-233	100
Bismuth-200	1,000	Protactinium-234	100

Radionuclide	Quantity μCi
Uranium-239	0.01
Uranium-231	100
Uranium-232	0.001
Uranium-233	0.001
Uranium-234	0.001
Uranium-235	0.001
Uranium-236	0.001
Uranium-237	100
Uranium-238	100
Uranium-239	1,000
Uranium-240	100
Uranium-natural	100
Neptunium-232	100
Neptunium-233	1,000
Neptunium-234	100
Neptunium-235	100
Neptunium-236 (1.15×10^3 yr)	0.001
Neptunium-236 (22.5 hr)	1
Neptunium-237	1.001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	0.001
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100

Radionuclide	Quantity μCi
Curium-240	0.1
Curium-241	1
Curium-242	0.01
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100

Selection of Protective Clothing

1. Workers should inspect their protective clothing prior to use for tears, holes, or split seams that would diminish protection. Any defective items should be replaced with intact protective clothing.

2. Protective clothing as prescribed by the Radiological Work Permit (RWP) should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. Table 3-1 provides general guidelines for selection. As referenced in the table, a full set and double set of protective clothing typically includes the following:

   - Full set of protective clothing

     - Coveralls
     - Surgeons gloves
     - Gloves
     - Shoe covers
     - Rubber overshoes
     - Hood

   - Double set of protective clothing

     - Two pairs of coveralls
     - Surgeons gloves
     - Two pairs of gloves
     - Two pairs of shoe covers
     - Rubber overshoes
     - Hood

   NOTE: Cotton glove liners may be worn inside standard gloves for comfort, but should not be worn alone or considered as a layer of protection.

3. Shoe covers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.

4. Use of hard hats in Contamination Areas should be controlled by the RWP. Hard hats designated for use in such areas should be distinctly colored or marked and should be treated like other protective clothing.

5. Shoe covers and gloves should be secured or taped at the coverall legs and sleeves when necessary to prevent worker contamination. Tape should be tabbed to permit easy removal.

6. Supplemental pocket or electronic dosimeters should be worn outside the protective clothing, in a manner accessible to the worker. Workers

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should protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.

7. Outer personal clothing should not be worn under protective clothing for entry to High Surface Contamination Areas or during work conditions requiring a double set of protective clothing.

Removal of Protective Clothing

Potentially contaminated protective clothing should be removed without spreading contamination and in particular without contaminating the skin. Workers should be instructed not to touch the skin or place anything in the mouth during protective clothing removal. Instructions for protective clothing removal comparable to the sequence presented below should be posted adjacent to the step-off pad in accordance with Article 325.6.

Example Sequence for Removing a Full Set of Protective Clothing at the Step-Off Pad

Before stepping out of the Contamination Area or Airborne Radioactivity Area to the step-off pad, the worker should do the following in sequence:

1. Remove exposed tape
2. Remove rubber overshoes
3. Remove outer gloves.
4. Remove hood from front to rear
5. Remove coveralls, inside out, touching inside only
6. Remove respiratory protection, as applicable
7. Take down barrier closure, as applicable
8. Remove tape or fastener from inner shoe cover
9. Remove each shoe cover, placing shoe onto clean step-off pad
10. Remove surgeons gloves and glove liners (if applicable).
11. Replace barrier closure, as applicable
12. Commence whole body surveying
13. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry depends upon where the dosimetry was worn and the potential for contamination.

Example Sequence for Removing a Double Set of Protective Clothing Using Two Step-Off Pads

Before stepping to the inner step-off pad, the worker should

1. Remove exposed tape
2. Remove rubber overshoes
3. Remove outer gloves
4. Remove hood from front to rear
5. Remove outer coverall, inside out, touching inside only
6. Remove respiratory protection, as applicable
7. Remove tape from inner coverall and sleeves

8. Remove each outer shoe cover, stepping on inner step-off pad as each is removed.

Before stepping to the outer step-off pad, the worker should

9. Remove inner coveralls, inside out, touching inside only
10. Remove inner rubber gloves
11. Take down barrier closure, as applicable
12. Remove tape or fastener from inner shoe cover
13. Remove each inner shoe cover, placing the shoe on clean outer step-off pad
14. Remove surgeons gloves and glove liners (if applicable).
15. Replace barrier closure, as applicable
16. Commence whole body survey
17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry depends where the dosimetry was worn and the potential for contamination.

Use of Multiple Step-Off Pads

Multiple step-off pads should be used to control exit from High Surface Contamination Areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:

1. The inner step-off pad should be located immediately outside the highly contaminated work area, but still within the posted area.

2. The worker should remove highly contaminated outer clothing prior to stepping on the inner step-off pad.

3. Additional secondary step-off pads, still within the posted area, may be used as necessary to restrict the spread of contamination out of the immediate area.

4. The final or outer step-off pad should be located immediately outside the Contamination Area.

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Comparable instructions to those presented here should be posted adjacent to monitoring instruments in accordance with Article 338.8.

General Requirements

1. Verify that the instrument is in service (e.g., turn the monitor on, check the battery and source response), set it to the proper scale so that the audio output can be heard during the survey.

2. Hold the probe less than 1/2 inch from the surface being surveyed for beta and gamma contamination, approximately 1/4 inch for alpha contamination.

3. Move the probe slowly over surface, approximately 2 inches per second.

4. If the count rate increases during survey, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.

5. If the count rate increases to a value greater than a preestablished contamination limit or the instrument alarms, remain in the area and notify radiological control personnel.

6. The whole body survey should take at least two to three minutes.

Performance of Monitoring

1. Survey the hands before picking up the probe.

2. Perform the survey in the following order:

   a. Head (pause at mouth and nose for approximately 5 seconds)
   b. Neck and shoulders
   c. Arms (pause at each elbow)
   d. Chest and abdomen
   e. Back, hips, and seat of pants
   f. Legs (pause at each knee)
   g. Shoe tops
   h. Shoe bottoms (pause at sole and heel)
   i. Personnel and supplemental dosimeters.

3. Return the probe to its holder and leave the area.

   NOTE: The probe should be placed so that the next person can survey their hands without touching the probe.

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Prior to routine operation, new and modified installations shall be inspected and surveyed to verify that the installation can and will be operated as designed. Approval for startup of routine operations is granted by the Qualified Expert and the Radiological Control Manager. If an installation is shut down by equipment modifications or failures, surveys and inspections shall be conducted before restarting operations at the installation.

1. Pre-Operational Inspections

   a. Review of Radiation Safety Procedures and Documentation

      (1) The manufacturer's design and construction diagrams of the Radiation-Generating Device and engineering diagrams, and the drawings showing the physical layout of the installation and electrical diagrams shall be reviewed to verify that the device and installation are accurately reflected by this documentation and adequately designed.

      (2) Discrepancies shall be documented and reported to the Radiological Control Manager.

      (3) Operating and emergency procedures shall be reviewed to ensure that procedures exist and are satisfactory for the intended use.

   b. Operational Factors

      (1) The present and expected occupancy of the areas adjacent to the installation and their radiation exposure levels shall be determined.

      (2) Equipment-use time, expected occupancy factors, and anticipated methods of operation shall be determined.

   c. Shielding

      The following aspects of installed shielding shall be reviewed to ensure proper documentation and consideration:

      - Shielding of assured quality, uniformity, and permanency is required to attenuate radiation levels outside the enclosure of protective, enclosed, and unattended installations. Lead barriers shall be mounted so that they do not cold-flow because of their weight. Joints between similar or different shielding materials shall be constructed so that the overall protection of the shield is not reduced

      - Temporary shielding shall be controlled in accordance with Article 314

- The thickness and type of shielding material, the arrangement of the shielding material and devices, the locations of concrete used for shielding, as well as the density and uniformity of the concrete aggregate determined from samples cast during construction

- The specified dimensions of shielding barriers or baffles

- The degree of overlap of primary shielding or between primary shielding and other shielding or barrier materials

- The shielding behind electrical boxes and lock assemblies

- The locations of shielded viewing windows and the thickness and densities thereof

- The locations and dimensions of penetrations in the shielding walls and doors.

d. Access and Control Devices

Access-control devices shall be provided to ensure that there are at least two independent means to prevent entry or to warn of a hazard. Except for field radiography, the access and control requirements specified in Exhibit 3-5 shall be implemented. In addition to the physical access controls for high and very high radiation areas specified in Exhibit 3-5, the controls listed below shall be implemented

(1) The proper location and proper functioning of access control switches, interlocks, and any system-control interlock (i.e., current, position, time, etc.) should be ensured. One or more control systems should be used for each access door or access panel to an Radiation-Generating Device installation.

(2) The control system governing the production of radiation should be equipped with a lock and key to prevent unauthorized use.

(3) The key used for one Radiation-Generating Device installation, Radiation-Generating Device, or Radiation-Generating Device storage facility should not provide access to another Radiation-Generating Device installation, Radiation-Generating Device, or Radiation-Generating Device storage facility. Locks can be used to control entry ways to Radiation-Generating Device installations, except when access is required, provided positive control is maintained over each entry.

(4) Interlocks used for personnel safety, control of time, position of the Radiation-Generating Device, current, etc., shall be fail-safe.

(5) At least one emergency shutdown control ("crash button") shall be installed inside each shielded enclosure of a Radiation-Generating Device installation that could be occupied by a person. The emergency shutdown control shall be in a location that can be readily observed and activated in the event of an emergency. The shutdown control shall provide an effective means of quickly interrupting the Radiation-Generating Device operational sequence prior to or during activation of the active beam or during the movement of a Radiation-Generating Device from a shielded to unshielded position. The use and function of the device shall be prominently labelled.

(6) Provisions for preventing the resumption of the irradiation cycle after an access control device has been tripped. It shall be possible to resume radiation generation only by manually resetting the controls at the position where the interlock was tripped and then resetting the controls at the main control console.

(7) Electrical diagrams and physical layout of fail-safe devices shall agree with the installation configuration.

e. Warning Devices

(1) The proper location and proper functioning of warning devices, both visual and audible, and interlocked warning lights shall be determined.

(2) Radiation-Generating Device warning lights shall be red. A sufficient number of lights shall be installed so that at least one light is easily visible from all reasonably occupied areas and from reasonable avenues of approach to such areas. At least one interlock shall be provided to ensure a fail-safe condition. The Radiation-Generating Device shall not be operable when the a warning light has failed.

(3) Warning lights activated by the beam or beam circuit shall incorporate a fail-safe circuit so that the beam or beam circuit is turned off when the warning device is inoperative. Operation of the device once the fail-safe circuit has been activated shall be possible only after resetting a switch on the control console.

f. Control Panel Configuration and Indicator Lights and Signs

The layout and proper functioning of control switches, indicator lights, and location of appropriate labels located on the control panel shall be determined.

g. Posting

Warning signs as specified in Appendix C shall be posted outside and within each Radiation-Generating Device installation. Warning signs shall be clearly visible to personnel outside, in the installation, and in the area adjacent to the installation.

In addition, the warning signs identified below are also required

(1) Operational Status. Warning signs are required to signify the presence of an intermittent radiation condition. The posting should also convey when the radiation field is present. An example of such a sign is:

CAUTION
RADIATION BEING PRODUCED WHEN RED LIGHT IS ON

(2) Maintenance Status. Any time an installation requires maintenance, including the bypassing of any fail-safe interlocks, the entrance to the area in which the installation is located and the inside of the installation shall be conspicuously posted to indicate the status of the installation. Posting is required

- During the performance of maintenance and alignment procedures if the procedures require activation of the Radiation-Generating Device
- Any time an inspection reveals an abnormal condition.

(3) Safety Device or Interlock Bypass. No individual shall be permitted to bypass a safety device or interlock unless approval has been obtained from line management and the Radiological Control Organization. Approvals shall be limited to a specified period of time. When a safety device or interlock has been bypassed, the entrance to the installation or the Radiation-Generating Device enclosure should be posted with a prominent sign bearing the following words:

SAFETY DEVICE NOT FUNCTIONING

or a similar warning.

h. Labelling

Labels are used on the Radiation-Generating Device, the Radiation-Generating Device installation control panel, and access panels or doors of the Radiation-Generating Device installation to indicate the operational status of the Radiation-Generating Device.

The types of labels and labelling requirements are identified below:

(1) A shutter status indicator shall be provided on Radiation-Generating Devices if the emission of the useful beam is controlled by shutters. The indicator may consist of two visible mechanical or electrical signals of contrasting color, or it may feature the message "on" and "off." The tube assembly shall also display the basic radiation symbol. The indicator and symbol should be readily observed by the operator to indicate the "on-off" position of Radiation-Generating Devices with shutter assemblies.

(2) A status label is required to indicate x-ray tube characteristics. The label shall indicate that the x-ray tube is shielded if the leakage radiation at a 1-m distance from the target does not exceed 1 rem in 1 hour when the tube is operated at any of its ratings. If it exceeds 1 rem/h, the tube should be labelled as non-shielded. The label should also indicate the rating of the x-ray tube.

(3) Sealed sources shall be labelled in accordance with Article 431.

(4) The Radiation-Generating Device should be labelled by the Radiological Control Organization indicating that the Radiation-Generating Device is operational and the date of the last survey.

(5) There should be a label stating that the Radiological Control Organization should be notified when the Radiation-Generating Device is to be moved, repaired, transferred, or altered. The phone number of the Radiological Control Organization should be included.

k. Personnel Dosimeters

Dosimeters (whole body and extremity) and their anticipated use shall be reviewed for appropriateness and compliance with the requirements of the U.S. Department of Energy Laboratory Accreditation Program (DOE 1987). The requirement for, and use of, direct-reading, integrating dosimeters shall be assessed.

1. Fixed and Portable Radiation Monitors

   Area radiation monitors or portable instrumentation and the appropriateness of the location(s) where they are placed shall be determined.

   The calibration and use of these monitors and instruments to perform their intended functions shall be assessed with respect to unique conditions associated with the Radiation-Generating Device.

2. Pre-Operational Radiation Surveys

Radiation surveys shall be conducted to determine and document the integrity and adequacy of the shielding and to verify that posting and access control requirements are satisfactory before the Radiation-Generating Device installation is turned over to the Radiation-Generating Device Installation Custodian for routine operation. The areas adjacent to the installation, including above and below, if occupiable, shall be vacated and surveyed when pre-operational surveys are performed.

Continuous monitoring by the Radiological Control Organization shall be performed during initial use of new or modified equipment until the integrity of shields, performance of interlocks, and operation of safety devices is proven. Potential hazards shall be identified and corrective actions approved.

Specifically, the surveys shall

- determine the exposure in units of dose rate or integrated dose received in any 1 hour as dependent upon the pulse capability of the Radiation-Generating Device
- be evaluated at the maximum value of applied voltage or current or at the maximum exposed position if a sealed source, Radiation-Generating Device(s) should be operated in steps of increasing beam strength until the highest values are achieved
- include the use of mechanical or electrical devices that restrict beam orientation and magnitude. Measurement of the degree of restriction shall be performed and documented with and without these restrictions
- detect and measure potential leaks in the shielding and barriers
- encompass all geometries in which the useful radiation beam can be directed
- be performed in accordance with Article 551.

3. Periodic Inspections and Radiation Surveys

Periodic and unscheduled inspections and radiation surveys shall be conducted to determine and document the continued integrity and adequacy of the shielding and to verify that posting and access-control requirements are satisfactory. Inspections and radiological surveys shall include the items listed in the previous two sections (1 and 2). Survey and inspection findings should be reviewed by the Radiological Control Manager. The inspections and surveys should identify potential hazards and deficiencies and should result in corrective actions.

Inspection and survey frequencies should be based on potential radiological conditions, probability of change in conditions and area occupancy factors. Survey frequencies, as a minimum, shall be as follows:

- Operational personnel working with fixed installations shall conduct and document inspections and radiological surveys at least every 6 months.

- For open installations, where irradiation configurations, Radiation-Generating Devices, and boundary configurations are likely to change frequently, radiation surveys shall be conducted in response to changing working parameters.

- Radiological Control Organization personnel shall conduct and document inspections annually and radiological surveys every 6 months.

- In addition Radiological Control Organization personnel shall conduct and document inspections and radiological surveys as follows:

  - during the performance of maintenance and alignment procedures if the procedures require the presence of a primary beam when any component in the system is disassembled or removed,

  - any time an inspection of the components in the system reveals an abnormal condition,

  - whenever personnel-monitoring devices show a significant increase over a previous monitoring period or are approaching administrative limits,

  - after any modification.

4. Radiation Survey Report

A radiation survey report shall be prepared following any radiation survey. Survey results should be recorded on appropriate standard forms. In addition to the requirements of Articles 751 and 752, the survey shall include:

- For a sealed source, identification of the Radiation-Generating Device by serial number, isotope and activity in curies, and expected rad/h; for an x-ray device, the potential voltage and current at which the Radiation-Generating Device was operated during the survey
- Classification of the installation
- The location of the generating source and orientation of the useful beam during each exposure measurement
- A description of mechanical and electrical limiting devices that restrict the orientation of the useful beam and the orientation of the Radiation-Generating Device
- Any restrictions upon the weekly workload, degree of occupancy, and the time that the useful beam may be directed at any installation shield
- Results of area dose rates. For open installations, this includes the locations that define the posting boundaries
- Statement of compliance or delineation of the actions necessary to achieve compliance.

5. Leak Testing

Sealed source leak tests shall be performed as required by Article 431.

6. Records

a. Operations Log

A log, including the details itemized here, shall be maintained for each Radiation-Generating Device installation.

(1) Entries shall reflect the dates of safety device operational checks, functional inspections, radiological surveys, findings, and corrective actions.

(2) Daily or scheduled entries should be made for each operation of the Radiation-Generating Device installation. Entries should be sufficiently descriptive to ensure tracking of all aspects of the operation, geometry, and quality of beam to reconstruct dose, if necessary.

(3) Periodic review of the log by line management and the Radiological Control Organization should be shown by sign-off.

(4) In open installations, the log shall include information on the installation layout and survey boundaries to demonstrate that the surveys have been conducted by operations staff to meet the requirement. However, the log need not contain all of the required survey report information as long as this is documented elsewhere.

(5) Records of procedures, Radiological Work Permits, and supporting data should be maintained in chronological sequence that will allow correlation with the corresponding support data.

(6) Records of quality assurance reviews and audits developed for Radiological Control functions shall be retained to ensure that sufficient records are specified, prepared, reviewed, approved, and maintained to accurately reflect the completed work.

b. Maintenance Log

All maintenance work shall be documented in a maintenance or combination operations/maintenance log.

The maintenance log and updated interlock schematic diagrams shall be maintained as a record by the responsible management or Radiation-Generating Device Custodian, along with instruction manuals, blue prints, or other pertinent information.

The log should include the following:

- A description of the specific maintenance conducted
- A description of any replacement part(s). Any replacement part installed in the device should be the part prescribed by the manufacturer, unless the written concurrence of the following individuals is obtained:
  - the cognizant Quality Assurance individual
  - responsible line management
  - the Radiological Control Organization.

Concurrences should be indicated in the log.

- Records of formal classroom, on-the-job, and job-specific training and qualification in radiological control shall be maintained to demonstrate that Radiation-Generating Device Custodians and Radiation-Generating Device Operators receive appropriate training to perform Radiation-Generating Device operation in a safe manner.

The maintenance logbook should show periodic review and sign-off by responsible line management and the Radiation-Generating Device custodian.

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An open installation is one that, because of operational requirements, cannot be provided with the inherent degree of protection specified for either protective, enclosed, or unattended installations defined in ANSI N543 (ANSI 1974). These additional requirements supplement other controls such as sealed source leak testing and inventory, posting and labeling, and personnel monitoring and address specific requirements of 10 CFR 34 not addressed elsewhere in the Hanford Site Radiological Control Manual (HSRCM).

1. Performance Observation Requirements

   a. Each radiographer and radiographer's assistant shall be observed by a Qualified Expert during an actual radiographic examination at intervals not to exceed 3 months. This observation shall determine the individual's conformance to written operating and emergency procedures.

   b. If a radiographer or radiographer's assistant has not participated in a radiographic examination for more than 3 months since the last observation, that individual's performance shall be observed and recorded the next time the individual participates in a radiographic observation.

2. Equipment Control

   a. Each radiographic exposure device and all associated equipment shall meet the requirements specified in ANSI N432 (ANSI 1980), *Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography*.

   b. In addition to the radioactive source controls in Article 431, each sealed source shall be engraved or bear a durable, legible label with the words:

      DANGER - RADIOACTIVE

   c. Radiographic exposure devices intended for use as Type B transport containers must meet the applicable requirements of 49 CFR 170 through 180.

   d. The coupling between the source assembly and the control cable shall be designed in such a manner that the source assembly will not become disconnected if cranked outside the guide tube. The coupling shall be designed such that it cannot be unintentionally disconnected under normal and reasonably foreseeable abnormal conditions.

   e. The device shall be designed to automatically secure the source assembly when it is cranked back into the fully shielded position within the device. The securing system shall be designed to release the source only upon deliberate operation of the exposure device.

f. The outlet fittings, lock box, and drive cable fittings shall be equipped with safety covers or plugs, which shall be installed during storage and transportation to protect the source assembly from water, mud, sand, or other foreign matter.

g. The guide tube shall have passed crushing and kinking tests as specified in ANSI N432 (ANSI 1980).

h. Guide tubes shall be used when moving the source out of the device.

i. An exposure head or similar device designed to prevent the source assembly from passing out of the end of the guide tube shall be attached to the outermost end of the guide tube during radiographic operations.

j. The guide tube exposure head connection shall be able to withstand the tensile test for control units specified in ANSI N432.

k. Source changers shall be designed to provide a system for assuring that the source will not be accidentally withdrawn from the changer when connecting or disconnecting the drive cable from a source assembly.

3. Limits on Levels Radiation for Radiographic Exposure Devices and Storage Containers

a. Radiographic exposure devices measuring less than 4 inches from the sealed source storage position to any accessible exterior surface of the device shall have no radiation level in excess of 50 mrem/h at 6 inches from any exterior surface of the device.

b. Radiographic exposure devices measuring a minimum of 4 inches from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources or for radiographic exposure devices, shall have no radiation level in excess of 200 mrem/h at any exterior surface, and 10 mrem/h at one meter from any exterior surface.

4. Locking of Radiographic Exposure Devices, Storage Containers, and Source Changers

a. Each radiographic exposure device, source changer, or storage container shall have a lock or outer locked container designed to prevent unauthorized or accidental removal of the sealed source from its shielded position.

b. Each radiographic exposure device, source changer, or storage container shall be locked or continuously attended.

c. Each radiographic exposure device, source changer, or storage container shall be secured to prevent tampering or removal by unauthorized personnel.

5. Utilization Logs

Line management shall maintain a current log of the following:

- A description (or make and model number) of the radiographic exposure device, storage container, or source changer in which the sealed source is located
- The identity of the radiographer to whom the source is assigned or the identity of the source custodian for sources that are in storage
- The plant or site where the source is used and the dates of usage.

6. Inspection and Maintenance of Radiographic Exposure Devices, Storage Containers, and Source Changers

a. The radiographer shall check for obvious defects in radiographic exposure devices, storage containers, or source changers prior to use each day the equipment is used.

b. Line management shall establish and conduct a program for inspection and maintenance of radiographic exposure devices, source containers and source changers at intervals not to exceed 3 months or prior to the first use thereafter to assure proper functioning of components important to safety.

7. Permanent Radiographic Installations

Permanent radiographic installations shall be subject to the requirements in Appendix 3F.

8. Operating and Emergency Procedures

a. Line management shall establish written operating and emergency procedures for all radiographic operations. These procedures shall include:

- Handling and use of sources such that no person is likely to be exposed to radiation in excess of the limits of the HSRCM
- Methods and occasions for conducting radiation surveys
- Methods for controlling access to areas where radiographic operations are conducted
- Methods and occasions for locking and securing radiographic exposure devices, storage containers, and source changers.
- Personnel monitoring and the use of personnel monitoring equipment
- Transporting sealed sources to field locations, including packing radiographic exposure devices and storage containers in

vehicles, posting vehicles, and controlling sealed sources during transportation

- Minimizing exposure of persons in the event of an accident
- The procedure for notifying proper persons in the event of an accident
- Maintenance of records
- The inspection and maintenance of radiographic exposure devices, storage containers, and source changers
- Steps that must be taken immediately by radiography personnel if a pocket dosimeter is found to be off-scale
- Procedures for identifying and reporting defects in radiography equipment.

9. Personnel Monitoring

a. During open radiographic operations, each individual who acts as a radiographer or radiographer's assistant shall wear a thermoluminescent dosimeter and a pocket dosimeter with a minimum range of 0 to 200 mrem (mR) and an alarm dose ratemeter.

b. Pocket dosimeters shall be

- Charged at the beginning of each shift and pocket dosimeter readings shall be logged at the end of each shift and prior to any subsequent recharging during the shift
- Calibrated in accordance with Article 562 or an equivalent program approved in a subcontractor's radiography license.

c. Each alarm dose ratemeter shall

- Be checked to ensure that the alarm functions properly (sounds) prior to use at the beginning of each shift
- Be set to give an alarm signal of a dose rate of 500 mrem (or mR)
- Require special means to change the preset alarm function
- Calibrated in accordance with Article 562 or an equivalent program approved in a subcontractor's radiography license.

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10. Security

    a. During each open radiographic operation the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area.

    b. No person shall enter the high radiation area produced by an open radiographic operation except:

        - To perform initial surveys to establish the high radiation area perimeter

        - As authorized in emergency procedures.

11. Posting

    The perimeter of each Radiation Area and High Radiation Area shall be conspicuously indicated and posted in accordance with Article 234.

12. Radiation Surveys

    a. At least one calibrated and operable radiation survey instrument shall be available whenever a radiographic operation is being performed and at a storage area whenever a source is placed into or removed from storage.

    b. A survey with a calibrated and operable radiation survey instrument shall be performed after each radiographic exposure to verify that the source has been returned to its shielded position. The entire circumference of the radiographic exposure device shall be surveyed. If the radiographic exposure device has a source guide tube the survey shall include the guide tube.

    c. A survey with a calibrated and operable radiation survey instrument shall be performed whenever a source is placed into or removed from storage to verify that the source is in the shielded position. The entire circumference of the radiographic exposure device shall be surveyed.

13. Supervision of Radiographer's Assistants

    Whenever a radiographer's assistant uses radiographic exposure devices, sealed sources, or related source handling equipment, or performs radiation surveys to determine that the a source has been returned to its shielded position, the radiographer's assistant shall be under the direct supervision of a radiographer.

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ALARA	as low as reasonably achievable
ALI	Annual Limit on Intake
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
DAC	derived air concentration
DIL	derived investigation level
DOE	U.S. Department of Energy
DOELAP	DOE Laboratory Accreditation Program
EH	Environment, Safety, and Health (Division)
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEHF	Hanford Environmental Health Foundation
HEPA	high-efficiency particulate air (filtration)
HQ	headquarters
HRRP	Hanford Radiological Records Program
HSRCM	Hanford Site Radiological Control Manual
IL	investigation level
KEH	Kaiser Engineers Hanford Company
NIST	National Institute of Standards and Technology
NPDES	National Pollution Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRRPT	National Registry of Radiation Protection Technologists
ORE	Occupational Radiation Exposure (System)
PC	protective clothing
PNL	Pacific Northwest Laboratory
PSO	Program Secretarial Officer
RadCon	Radiological Control (Manual)
RCO	Radiological Control Organization
REX	Radiological Exposure (System)
RL	DOE Richland Field Office
RWP	Radiological Work Permit
SI	International System (of units)
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
UMTRA	Uranium Mill Tailings Remedial Action
WHC	Westinghouse Hanford Company

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The number in parentheses shows the page on which the definition appears.

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airborne radioactivity area (4)

ALARA Committee (4)

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activation

Process of producing a radioactive material by bombardment with neutrons, protons, or other nuclear particles.

administrative control level

Level of radiation exposure established well below regulatory limits by management to help reduce individual and collective radiation dose.

airborne radioactivity

Radioactive material in any chemical or physical form that is present in ambient air, above natural background.

airborne radioactivity area

Area where the measured concentration of airborne radioactivity, above natural background, exceeds either: 1) 10% of the derived air concentration (DAC) averaged over 8 hours or 2) a peak concentration of 1 DAC. DAC values are contained in Attachment 1 of DOE 5480.11 (DOE 1988).

ALARA Committee

A multidisciplined forum that reviews and advises management on improving progress toward minimizing radiation exposure and radiological releases.

annual limit on intake (ALI)

The quantity of a single radionuclide which, if inhaled or ingested in 1 year, would irradiate a person (represented by reference man as defined in Publication 23 of the International Commission on Radiological Protection [ICRP 1974]) to the limiting value for control of the workplace. In DOE 5480.11, DACs instead of ALIs are given for controlling exposures.

as low as reasonably achievable (ALARA)

An approach to radiological control whereby exposures (individual and collective) to the work force and to the general public are managed and controlled to be at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this manual, ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable controlling limits as is reasonably achievable.

assessment

Evaluation or appraisal of a process, program, or activity to estimate its acceptability.

background radiation

Radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of a source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include radiation from a source, byproduct, or special nuclear materials.

baseline bioassay

An appropriate bioassay measurement obtained from a bioassay program participant prior to beginning or resuming work with the given radioactive material.

becquerel (Bq)

The International System (SI) unit for activity of radioactive material. One becquerel is the quantity of radioactive material that undergoes one nuclear transition per second.

bioassay

The measurement of the amount or the concentration of radioactive material in the body or in biological material excreted or removed from the body. Examples of bioassay are 1) measurement of radionuclides in urine, feces, hair, blood, or sputum, and 2) direct counting of the whole body or portions of the body (chest, abdomen, neck) using external detectors.

breathing zone (BZ) air monitoring

Monitoring means actions intended to detect and quantify radiological conditions. The monitoring of air from the general volume of air breathed by the worker, usually at height of 1 to 2 m. See **personal air monitoring.**

collective effective dose equivalent

The sum of the effective dose equivalent of all individuals in an exposed population. Collective effective dose equivalent is expressed in units of person-rem (or person-sieverts).

committed dose equivalent ($H_{50,T}$)

The calculated dose equivalent projected to be received by tissue or organ T over a 50-year period after an intake of radionuclides into the body. It does not include contributions from external dose. Committed dose equivalent is expressed in dose equivalent units.

committed effective dose equivalent ($H_{E,50}$ or CEDE)

The sum of the committed dose equivalent to various tissues in the body, each multiplied by its weighting factor. It does not include contributions from external dose. Committed effective dose equivalent is expressed in dose equivalent units.

company-issued clothing

Clothing provided by the company, such as work coveralls and shoes. For radiological control purposes, company-issued clothing shall be considered the same as personal clothing.

confirmed retained quantity

A retained quantity of radioactive materials in the body or an organ or tissue verified by bioassay results.

containment device

Barrier, such as a glovebag, glovebox, or tent, for inhibiting the release of radioactive material from a specific location.

contamination area

Area where contamination levels are greater than the values specified in Chapter 2, Table 2-3 of this manual, but less than or equal to 100 times those levels.

contamination reduction corridor

A defined pathway through a hazardous waste site Contamination Reduction Zone where decontamination occurs.

contamination survey

Use of swipes or direct instrument surveys to identify and quantify radioactive material on personnel, on equipment, or in areas.

continuing training

Training scheduled over a specified time, such as over a 2-year period, for the purpose of maintaining and improving technical knowledge and skills.

continuous air monitor (CAM)

Instrument that continuously samples and measures the levels of airborne radioactive materials on a "real-time" basis and has alarm capabilities at preset levels.

contractor senior site executive

The person at a U.S. Department of Energy (DOE) contractor-operated facility or site who has final onsite corporate authority and is often called president, general manager, site manager, or director. At the Hanford Site, the contractor senior site executives are the President, Westinghouse Hanford Company; Director, Pacific Northwest Laboratory; General Manager, Kaiser Engineers Hanford Company; and the President, Hanford Environmental Health Foundation.

counseling

Advice, information exchange, and guidance provided to employees on radiologically related topics, such as dose perspectives, potential health effects from radiation exposure, skin contaminations, contaminated wounds, internally deposited radioactivity, pregnancy, and radiation exposure. This advice and guidance is normally provided by knowledgeable, senior professionals from the radiological control organization and other organizations, such as medical, as appropriate.

critical mass

The smallest mass of fissionable material that will support a self-sustaining chain reaction under specified conditions.

critique

Meetings of personnel involved in or knowledgeable about an event (either a success or an abnormal event) to document a chronological list of the facts.

cumulated activity

The number of radioactive transitions that have occurred in the organ or tissue and are evaluated as the integral activity in a source organ or tissue over a specified period of time. One transition is 1 Bq·1 s. Other common units are the microcurie-day ($1\ \mu Ci \cdot d = 3.197 \times 10^9$ transitions) and microcurie-hour ($1\ \mu Ci \cdot h = 1.332 \times 10^8$ transitions).

cumulative annual effective dose equivalent (CAEDE)

The sum of the annual effective dose equivalents recorded for an individual for each year of employment at a DOE or DOE contractor facility since the effective date of DOE 5480.11, January 1, 1989.

cumulative effective dose equivalent

This term appears in DOE 5480.11 9(n): "The cumulative effective dose equivalent is the sum of the annual effective dose equivalents recorded for each year of employment since the effective date of the Order." It also appears in the Implementation Guide and Technical Manual. Throughout this document, cumulative effective dose equivalent is taken to mean CAEDE.

declared pregnant worker

A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

decontamination

The process of removing radioactive contamination and materials from personnel, equipment, or areas.

deep dose

The dose equivalent from external radiation determined at a tissue depth of 1 cm.

derived air concentration (DAC)

The concentration of a radionuclide in air that, if breathed over the period of a work year, would result in the ALI for that radionuclide being reached. The DAC is obtained by dividing the ALI by the volume of air breathed by an average worker during a working year (2400 m^3).

derived investigation level (DIL)

A value of organ or body content or excretion rate of radioactive materials that corresponds to a dose of one investigation level (1 IL). The DIL at time t is given by

$$DIL(t) = IL \cdot m(t) .$$

Here, m(t) is the measurement value per unit intake that would result at time t following an intake, as predicted by appropriate biokinetic models. For example, for IL = 100 mrem and m(10 days) = 30 $pCi \cdot L^{-1} \cdot mrem$, then DIL(10 days) = 3000 $pCi \cdot L^{-1}$.

detection limit

The extreme of quantification for the radiation of interest by the instrument as a whole or an individual readout scale or decade. The lower detection limit is the minimum quantificable instrument response or readings.

direct bioassay (in vivo)

The assessment of radionuclides in the body by detection of radiations emitted using external detector and analyzer systems.

disintegrations per minute (dpm)

The unit of activity determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

dose assessment

The process of determining radiological dose and uncertainty included in the dose estimate, through the use of exposure scenarios, bioassay results, monitoring data, source term information, and pathway analysis.

dose equivalent (H)

The product of absorbed dose (D) in rads (or grays) in tissue, a quality factor (Q), and other modifying factors (N), i.e., H = DQN. Dose equivalent is expressed in rem (if D is in grays, H is in sieverts [Sv]; 1 rem = 0.01 Sv). N is generally taken to be 1 and has been dropped in recent ICRP publications (ICRP 1990).

embryo/fetus

A developing human organism from conception until birth; same as unborn child.

engineering controls

Use of components and systems to reduce airborne radioactivity and the spread of contamination by using piping, containments, ventilation, filtration, or shielding.

extremities

The hands and feet, arms below the elbow, and legs below the knee.

eye dose equivalent

This applies to the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

facility

As defined in 29 CFR 1910.120, facility means 1) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or 2) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise comes to be located; but does not include any consumer product in consumer use or any water-borne vessel.

facility complex

One functional unit. A facility complex may be a building, structure, or activity such as a tank farm, waste complex, the Plutonium Finishing Plant or the Fast Flux Test Facility, etc. If the identity of the facility complex is in question, the contractor shall specify the buildings, structures, activities, etc. that make up the facility complex being reported.

filter integrity test

A test performed on high-efficiency particulate air filters to identify any damage to the filter or leakage around the filter. Techniques used to conduct the test are described in ANSI/UL 586, *High-Efficiency Particulate Air Units* (ANSI 1990).

fixed contamination

Radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, sweeping, or washing.

flash x-ray unit

Any device that is capable of generating pulsed x-rays.

gestation period

The time from conception to birth, approximately 9 months.

gray (Gy)

The SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

group of radionuclides

Two or more radionuclides that are contained in a matrix such that an individual could not have an intake of one without simultaneously having an intake of all.

high contamination area

An area where contamination levels are greater than 100 times the values specified in Chapter 2, Table 2-3 of this manual.

high-efficiency particulate air (HEPA) filter

A throwaway extended pleated medium dry-type filter with 1) a rigid casing enclosing the full depth of the pleats, 2) a minimum particle removal efficiency of 99.97% for thermally generated monodisperse dioctyl phthalate (DOP) smoke particles with a diameter of 0.3 μm, and 3) a maximum pressure drop of 1.0 inch w.g. when clean and operated at its rated airflow capacity.

high radiation area

An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

hot particle

Fuel, activated corrosion product, or other particles of small size that have a high specific activity as a result of nuclear fission or neutron activation.

hot spot

A localized source of radiation or radioactive material normally within facility piping or equipment. The radiation levels of Hot Spots exceed the general area radiation level by more than a factor of 5 and are greater than 100 mrem (1 mSv) per hour on contact.

indicator or tracer radionuclides

In a radioactive mixture, such as in a high-level waste tank, some nuclides are more easily detected than others. The intake of hard-to-detect radionuclides can be inferred from the assessment of an intake of indicator nuclides in the mixture that are easily detected. In a mixture containing greater ^{90}Sr activity than ^{241}Am activity, the former may serve as an indicator nuclide for the latter, even though the latter may result in a greater CEDE per unit intake of the mixture.

infrequent or first-time activities

Radiological work activities or operations that require special management attention and consideration of new or novel radiological controls. The designation of infrequent or first-time activities is specifically applicable to facilities that conduct routine and recurring process operations, and is not applicable to facilities that routinely conduct first-time activities, such as experimental or research facilities.

in vivo (direct bioassay)

The direct measurement of radionuclides in the body.

in vitro (indirect bioassay)

The measurement or analysis of radionuclides in excreta or other biological samples removed from the body.

lifetime occupational dose

The sum of all total effective dose equivalent values over an individual's entire occupational history.

low-level waste

Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in Section 11e(2) of the Atomic Energy Act, as amended. Test specimens of fissionable material irradiated only for research and development and not for production of power or plutonium may be classified as low-level waste if the concentration of transuranic activity is less than 100 nCi/g.

mixed waste

Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resources Conservation and Recovery Act, respectively.

monitoring

Actions intended to detect and evaluate radiological conditions.

non-employee occupational worker

An individual who is either a subcontractor to DOE or a DOE contractor who performs work for or in conjunction with DOE <u>and</u> whose occupational exposure records are maintained by DOE or the DOE contractor.

nuclear criticality

A self-sustaining chain reaction, i.e., the state in which the effective neutron multiplication constant of system of fissionable material equals or exceeds unity.

occupational dose

The dose received by a person during employment in which the person's assigned duties involve exposure to radiation or to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

occupational worker

An individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or an individual who visits to perform work for or in conjunction with DOE or uses DOE facilities.

performance test

A test of instrument response to a reference check source (see ANSI N323; R1983).

personal air monitoring

The monitoring of air for radioactive particles in the immediate vicinity of an individual radiation worker's nose and mouth, usually by a portable sampling pump and collection tube (such as a lapel sampler) worn on the body. Personal air monitoring is a special case of breathing zone air monitoring.

personal dosimetry

Devices, such as film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers, designed to be worn by a single person for the assessment of dose equivalent.

personal protective equipment

Equipment such as respirators, face shields and safety glasses used to protect workers from excessive exposure to radioactive or hazardous materials.

personnel monitoring

A systematic and periodic estimate of radiation dose received by personnel during working hours. Also, the monitoring of personnel, their excretions, skin, or any part of their clothing to determine the amount of radioactivity present.

planned special exposure

Planned, infrequent exposure to radiation, separate from and in addition to the annual dose limits.

prefilter

Filter that provides first-stage air filtration to remove larger particulates and prolong the efficient use of a HEPA filter.

prenatal radiation exposure

The exposure of an embryo/fetus to radiation.

primary dosimeter

A dosimeter worn on the body used to formally record the whole body radiation dose received by a worker.

protective clothing

Clothing provided to personnel to minimize the potential for contamination of the skin, personal, and company-issued clothing contamination.

qualification standard

A document that states and defines the required physical attributes and the technical, academic, and practical knowledge and skills developed through training, education, and on-the-job performance for the successful completion of a training program.

qualified expert

A person having the knowledge and training to measure ionizing radiation, to evaluate safety techniques, to design radiation installations, and to provide advice on radiation protection needs. (Where guidance is needed as to the competence of an individual to discharge the responsibilities of a qualified expert, it may be obtained from organizations such as the American Board of Health Physics, the American Board of Radiology, or the American Board of Industrial Hygiene.)

quality factor (Q)

A modifying factor used to derive dose equivalent from absorbed dose (DOE 5480.11, paragraph 9f[5]). Quality factors are called "radiation weighting factors" in the 1990 Recommendations of the ICRP.

rad

A unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gr or 0.01 joules/kg (0.01 gray).

radiation area

An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 cm from the source or from any surface that the radiation penetrates.

radiation survey

A measurement with instrumentation to evaluate and assess the presence of radioactive materials or other sources of radiation under a specific set of conditions.

radiation worker

See **radiological worker**.

radioactive material

For the purposes of this manual, radioactive material includes any material, equipment, or system component determined to be contaminated or suspected of being contaminated. Radioactive material also includes activated material, sealed and unsealed sources, and material that emits radiation.

radioactive materials area

An area or structure where radioactive materials are used, handled, or stored.

radioactive waste

Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act, as amended, and is of negligible economic value considering the cost of recovery.

radioactivity

A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower-energy state of the same element.

radiography

Examination of the structure of materials by nondestructive methods, using a radioactive source or a radiation-generating device.

radiological buffer area (RBA)

An intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure. The area surrounds or is contiguous with contamination areas, high contamination areas, airborne radioactivity areas, radiation areas, or high radiation areas.

radiological posting

Sign or label that indicates the presence or potential presence of radiation or radioactive materials.

radiological work

Any work that requires the handling of radioactive material or that requires access to radiation areas, high radiation areas, contamination areas, high contamination areas, or airborne radioactivity areas.

radiological work permit (RWP)

A permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological conditions.

radiological worker

A worker whose job assignment requires work on, with, or in the proximity of radiation-producing machines or radioactive materials. A radiological worker has the potential of being exposed to more than 0.1 rem (1 mSv) per year, which is the sum of the dose equivalent from external irradiation and the committed effective dose equivalent from internal irradiation. A Radiological Worker may also be referred to as a "radiation worker" or a "radworker."

radiological control hold point

Cautionary step in a technical work document requiring the radiological control organization to perform some action or verification. The radiological control hold point requirements should be satisfactorily completed before the work is continued.

radiologically controlled area

Any area to which access is controlled in order to protect personnel from exposure to radiation and radioactive materials.

refresher training

Training scheduled on the alternate year when full retraining is not completed for Radiological Worker I and Radiological Worker II personnel.

release to uncontrolled areas

A release of material from administrative control after confirming that the residual radioactive material meets the guidelines in DOE 5400.5 (DOE 1990a).

rem

A unit of dose equivalent. Dose equivalent in rem is numerically equal to the absorbed dose in rads multiplied by a quality factor (1 rem = 0.01 Sv).

removable contamination

Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

respiratory protective equipment

Equipment used to protect personnel from inhalation of radioactive or hazardous materials.

routine bioassay monitoring

This refers to a bioassay measurement made on a predetermined, periodic schedule, to establish a worker's internal exposure status relative to previous periods of time.

routine monitoring program

Routinely scheduled monitoring by air samples and bioassay.

Senior Nuclear Managers Group

The forum for senior DOE executives involved in nuclear activities to discuss items of mutual concern. Membership includes the Program Secretarial Officials for the Offices of Nuclear Energy, Defense Programs, Energy Research, Civilian Radioactive Waste Management, Environmental Restoration and Waste Management, Environment Safety and Health; the Directors for the Offices of Nuclear Safety and New Production Reactors; and the DOE's Defense Nuclear Facility Safety Board representative. The group has no additional authority beyond that possessed by individual members.

sensitivity (of a measuring assembly)

For a given value of the measured quantity, the ratio of the variation of the observed variable to the corresponding variation of the measured quantity. (This is not to be used in place of detection limit.)

shallow dose equivalent

The dose equivalent from external radiation determined at a tissue depth of 0.007 cm.

sievert (Sv)

The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rem).

site

An area managed by DOE where access can be limited for any reason. The site boundary encompasses controlled areas.

source, sealed

Radioactive material that is contained in a sealed capsule, sealed between layers of nonradioactive material, or firmly fixed to a nonradioactive surface by electroplating or other means. The confining barrier prevents dispersion of the radioactive material under normal and most accidental conditions related to use of the source.

special monitoring program

Non-routine monitoring by air samples and bioassay, usually initiated in response to a known incident or a bioassay result above 0.1 DIL.

step-off pad

A transition area between contaminated and non-contaminated areas that is used to allow personnel to exit and equipment to be removed.

standard radiation symbol

Symbols designed and proportioned as illustrated in accordance with ANSI N2.1 (ANSI 1989a) for radiation symbols and ANSI N12.1 (ANSI 1989b) for fissile material.

sticky pad

A step-off pad provided with a tacky surface to reduce the potential for inadvertently tracking contamination out of a contaminated area.

survey or surveying

Survey means an evaluation of the radiation status incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. Surveying can be performed with hand-held survey instruments, automated monitoring devices, or by a radiological control technician.

technical work document

A term used to generically identify formally approved documents that direct work, such as procedures, work packages, or job or research plans.

termination bioassay

Bioassay measurement performed for the purpose of documenting the retention of radioactive materials in the body due to occupational exposure either upon termination of employment or upon the cessation of potential exposure to a specific nuclide.

total dose equivalent

The sum of the external dose equivalent and the committed dose equivalent to organs or other tissues.

total effective dose equivalent (TEDE)

The sum of effective dose equivalent (or deep dose equivalent) for external exposures and the CEDE for internal exposures. *Total effective dose equivalent does not include effective dose equivalent contributions from intakes in prior years.*

transuranic waste

Without regard to source or form, waste that is contaminated with alpha-emitting transuranic radionuclides having half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

thermoluminescent dosimeter (TLD)

A radiation-monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

unusual occurrence

A nonemergency occurrence that has significant impact or potential for impact on safety, environment, health, security, or operations. Examples of the types of occurrences that are to be categorized as unusual occurrences are contained in DOE 5000.3A (DOE 1990b).

uptake

The amount of a radionuclide absorbed into extracellular fluid or taken up by the systemic compartment of the body, (e.g., by injection into blood, by absorption from compartments in the respiratory tract or the gastrointestinal tract, or by absorption through the skin or through wounds in the skin); or the amount of a radionuclide taken up from the systemic compartment by a tissue or organ.

very high radiation area

An area, accessible to personnel, in which radiation levels could result in a person receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 m from a radiation source or from any surface that the radiation penetrates.

very high radiation area (limited access)

An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent of 5 rem (50 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

very high radiation area (prohibited access)

An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent of 500 rads (5 grays) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

visitor

A person who has not been trained to the level required to permit unescorted access, but has requested access to radiologically controlled areas.

weighting factor (w_T)

This is used in the calculation of annual and CEDE to equate the risk arising from the irradiation of tissue T to the total risk when the whole body is uniformly irradiated.

whole body dose

The sum of the annual deep dose equivalent for external exposures and the CEDE for internal exposures.

workplace monitoring

Monitoring means actions taken to detect and quantify radiological conditions. Workplace monitoring refers to the measurement of radioactive material or direct radiation levels in areas that could be routinely occupied by workers.

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Attachment 7

Unit Managers Meeting
4843 ALKALI METAL STORAGE FACILITY
740 STVCN, RM 1600
Richland, Washington

Meeting Held December 14, 1993
From 8:00 am to 10:00 am

TITLE - 4843 AMSF RADIOLOGICAL SURVEY AND POSSIBLE DECONTAMINATION SCENARIOS

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4843 AMSF Radiological Survey
and
Possible Decontamination Scenarios

December 14, 1993

Current Radiological Condition of the 4843 AMSF. The current (December 1993) condition of the 4843 Alkali Metal Storage Facility (AMSF) is that it is a radiologically controlled area (RCA) containing a radiation area. The radiation area has been established due to sealed containers of radioactive material. At this time there are no contaminated surfaces within the radiation zone, inside the building, or on the exterior of the building.

Radiation Release Survey. Upon removal of the remaining waste stored in the 4843 AMSF, it is planned to conduct a radiological survey of the building. The radiological survey would determine whether or not any radiological contamination is present. The survey would include the building exterior and interior.

If no radiological contamination is found, then the building can be unconditionally released and the radiation posting removed. The 'de-posting' would be done by Health Physics according to established procedures. RL/WHC expects that this will be the result of the survey.

If the planned survey locates any radiological contamination in interior of the 4843 AMSF, there are three general radiological decontamination scenarios. These scenarios address three types of contamination: areas of minor radiological contamination; areas of major fixed radiological contamination; and a combination of the two. However, radiological contamination on the building exterior is not expected.

Minor Radiological Decontamination. If radiological contamination in the 4843 AMSF is identified as localized areas of smearable contamination on the floor or interior metal walls of the building, then FFTF Operations has the capability to conduct this type of radiological decontamination. This scenario is considered to be the most probable if radiological contamination is present.

This type of scenario is similar to the radiological decontamination that occurred when the two containers at 4843 AMSF leaked ('spilled'). The radiological decontamination of smearable areas is a standard procedure and is done routinely within the various Hanford plants.

Because this is a storage facility to be closed under RCRA, the radiological decontamination would be handled so that any RCRA issues would be addressed. Ecology would be kept informed and involved in this type of clean-up. However, this type of radiological decontamination would be considered as part of the operation of the 4843 AMSF.

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Major Radiological Decontamination. If a major clean-up effort for radionuclides is required, then WHC Decontamination & Decommissioning (D & D) would be needed to conduct the radiological decontamination and disposal. This effort would include decontamination for both radiological and dangerous waste contamination. It would address both the requirements of RCRA and the Atomic Energy Act. This type of radiological decontamination would be part of the closure activities for the 4843 AMSF. This scenario is considered to have a low probability of occurring.

For example, D & D would become involved if the floor of the radiation area contained 'fixed' (i.e., imbedded in the concrete and not removable by scrubbing) radiological contamination that required the removal of some or all of the concrete floor slabs. Also, D & D would become involved if radiological contamination was discovered in the wall insulation.

Combined Effort for Radiological Decontamination. It is possible that both of the above could occur. The situation for this scenario is that there are hot spots or areas of smearable radiological contamination combined with fixed radiological contamination that requires the involvement of D & D. However, this scenario is also considered to have a low probability of occurring.

This situation would result in the smearable contamination being dealt with immediately by FFTF to eliminate any imminent hazard or potential threat to human health and the environment. The remaining fixed radiological contamination would be handled by D & D during the clean-up of both radiological and dangerous waste contamination as described above.

Summary. The 4843 AMSF contains a radiation zone, but does not have any contaminated surfaces at this time (December 1993).

After the waste stored in the 4843 AMSF, a radiological survey is planned.

If no contamination is found by the radiological survey, the building will be released and the radiation posting removed. RL/WHC consider this to be the most likely result of the survey.

If radiological contamination is found, then decontamination will be initiated. Any smearable radiological contamination it would be decontaminated by FFTF Operations. If fixed radiological contamination were present, it would be decontaminated and/or disposed of by D & D. If both were present, then FFTF will decontaminate the smearable contamination and D & D would decontaminate/dispose of the fixed contamination. However, due to the current radiological condition of the 4843 AMSF, radiological contamination is not expected to be found.

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