CHPRC ADMINISTRATIVE DOCUMENT PROCESSING AND APPROVAL

DOCUMENT TITLE:	**OWNING ORGANIZATION/FACILITY:**
CH2M HILL Plateau Remediation Company Radiological Control Manual	SHS&Q/Radiation Protection

Document Number: CHPRC-00073 **Revision/Change Number:** 10/0

DOCUMENT TYPE *(Check Applicable)* [ ] Plan [ ] Report [ ] Study [ ] Description Document [X] Other

DOCUMENT ACTION *(Check One)* [ ] New [X] Revision [ ] Cancellation

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Does document contain controlled-use information	[ ] Yes	[X] No

("yes" requires information clearance review in accordance with PRC-PRO-IRM-184)

DOCUMENT REVISION SUMMARY

NOTE: Provide a brief description or summary of the changes for the document listed.

This revision includes: Corrected Title of Chapter 2; Corrected pagination issue with Chapter 3; added clarity to article 316.6 for posted PPE removal instructions; revised article 561.6 from "should" to "shall"; revised article 762 from "should" to "shall"; corrected administrative error is article 631.2; updated Articles 421 and 422 to reflect DOE O 458.1 terminology (Clearance vs. release); removed reference to Hanford ALARA Center in article 452; Updated Article 452.2 to clarify when leak testing is required for HEPA filtered vacuum cleaners and portable air-handling equipment based on DOE-STD-1098-2008; added text to Appendix 4A to more closely match 10 CFR 835 verbiage; modified Article 551.2 to reflect DOE O 458.1 terminology (Clearance vs. release); modified Article 551.4 to require annual review of monitoring programs based on DOE-STD-1098-2008; added MSA dosimetry technical basis document references to reflect new HNF document numbering in Chapter 5; and addition of Transuranic definition in the Glossary.

REVIEWERS **Others**

Name *(print)*	Organization
NA	NA

APPROVAL SIGNATURES

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A-6005-184 (REV 2)

Date Received for Clearance Process (MM/DD/YYYY)
12/10/2013

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- [ ] Journal Article
- [ ] Summary
- [ ] Internet
- [ ] Visual Aid
- [ ] Software
- [ ] Full Paper
- [ ] Report
- [x] Other _____

B. Document Number CHPRC-00073 Revision 10

C. Title
CH2M HILL Plateau Remediation Company Radiological Control Manual

D. Proposed Internet Address

E. Required Information (MANDATORY)

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Oldfield, Brian Approved via IDMS data file
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2. Group Sponsoring _____
3. Date of Conference _____
4. City/State _____
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6. Will Material be Handed Out? (●) No ( ) Yes

H. Information Owner/Author/Requestor
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APPROVED
By Shauna Adams at 1:56 pm, Dec 12, 2013

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A-6001-401 (REV 5)

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CHPRC-00073
Revision 10
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CH2M HILL Plateau Remediation Company Radiological Control Manual

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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CHPRC-00073
Revision 10
Copy No. _____

CH2M HILL Plateau Remediation Company Radiological Control Manual

Program/Project: CH2M HILL

K. W. McLain
CH2M HILL Plateau Remediation Company

Date Published
January 2014

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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CHPRC-00073

Summary of Changes

PIR #	Summary
Summary of changes to CHPRC-00073, Revision 0 Change 1	
PRC-0909-PIR-0022	Revised Figure 1-1; revised Article 141.1; deleted Article 141.3; editorial corrections to Table 2-0 and 2-1; revised Article 313.4; clarified intent of Article 411.2.a; removed SARP and replaced with PSSD in Article 423.3.a; clarified intent of Article 554.1.d.1; editorial corrections to Glossary.
PRC-0909-PIR-0024	Deleted Article 561.9
PRC-0909-PIR-0025	Added definition of "weekly" to Glosssary
PRC-0909-PIR-0027	Revised Article 238.1
Summary of changes to CHPRC-00073 Revision 1	
PRC-0911-PIR-0032	Revise CHPRC-00073 to fully implement 2007 10 CFR 835 amendment
PRC-0911-PIR-0037	Revised Article 413.4
Summary of changes to CHPRC-00073 Revision 2	
PRC-1001-PIR-0042	Additional changes to dosimetric terms, delete Article 422.4, remove course numbers from Article 653.2.
Summary of changes to CHPRC-00073, Revision 3	
PRC-0903-CDMP-0008	Revised Table 2-2 for HTD exemption
09-SED-0020	Revised Table 4-1 for authorized limit on HTD
PRC-1005-PIR-0052	Revised Article 653.1 to remove invalid reference to article 311.3
PRC-1003-PIR-0048	Revised Article 555.5b to change airflow instrument calibration to +/- 10% of full scale.
PRC-1003-PIR-0047	Revised glossary definition of radiological work to line up with HSD definition.
PRC-1001-PIR-0044	Revise Article 522.4 to remove restrictive language and bring in line with HSD.
Editorials	Corrected minor editorial errors from previous revisions, formatting.
PRC-1007-PIR-0059	Revised article 423.12 to provide an additional statement that only allows implementation of this exception if a procedure or process exists to ensure consistent application
PRC-1007-PIR-0060	Revised Table 2-0 note "b" to align with current management expectations for ACL approvals
PRC-1007-PIR-0061	Revised Article 337.5 to identify Appendix 3C as generic instructions which may be modified based on work and instrument selection. Revised Appendix 3C to specify use of lowest scale for frisking and specifying the instructions as recommended.
PRC-1008-PIR-0065	Revised Table 3-4, "Summary of Requirements for Unescorted Access" note "e" to align with DOE/RL-2002-12, Hanford Radiological Health and Safety Document, (HSD).
PRC-1003-PIR-0045	Revised Article 312 to incorporate new airborne trigger levels (In coordination with PRC-1003-PIR-0047).
Summary of changes to CHPRC-00073, Revision 4	
PRC-1104-PIR-0072	Applies contamination controls to all re-usable safety equipment
PRC-1105-PIR-0074	Removes definition of "Controlled sealed radioactive source" from glossary

Summary of Changes

PIR #	Summary
PRC-1106-PIR-0077	Remove term "Limiting condition" from glossary; add terms "Radiological work permit Action Level" and "Radiological Work Permit Void Limit" to glossary; Modify 321.4h to remove term "Limiting"
NA	Minor editorial/corrections (article 317) "Engineering" to "Engineered"
Summary of changes to CHPRC-00073, Revision 5	
PRC-1108-PIR-0081	Adds definitions of intrusive activity, soil intrusive activity and previously inaccessible to the glossary
PRC-1111-PIR-0088	Editorial correction to 316.10; Removes extraneous words “without a”.
PRC-1111-PIR-0088	Editorial correction to 555.1; Removes “-“ between “air” and “monitoring”
PRC-1111-PIR-0088	Modified Article 233.3 to reflect actual HSD language, E.3
PRC-1111-PIR-0088	Artice 141: Modified for new organizational structure, replaced whole article
PRC-1111-PIR-0088	Article 142 and 142.1a: Modified for new organizational structure
PRC-1111-PIR-0088	Table 6-0: Modified for new organizationalstructure
PRC-1111-PIR-0088	Article 651: Modified for new organizational structure
PRC-1111-PIR-0088	Article 116: Modified for new organizational structure
PRC-1111-PIR-0088	Article 612.2: deleted and marked "Reserved"
Summary of changes to CHPRC-00073, Rev. 6	
PRC-1203-PIR-0094	Modify TOC entry for article 116 from " Radiation Protection Center of Expertise" to "Hanford Radiological Control Forum". Correct to reflect actual article title. Article 113.3, Bullet 2: Add " Radiation Protection Director" to current language of "Radiation Protection Program Manager" as an additional approval to align with new organizational structure. Article 125.1.i and 125.1.i.1: Change term "quality factor" to "radiation weighting factor". Keeps consistant terms with 10CFR835. Table 2-0, note b: Modify note (b) from "…Radiation Protection Programs Manager." to "…Radiation Protection Director." Modifies for new organizational structure. Gloassary, "Engineering Controls": Change title to "Engineered Controls"; Modify definition to "A special form of physical design feature in which components and systems, such as piping, containments, ventilation, filtration, or shielding, are used to reduce airborne radioactivity, radiation levels, and the spread of contamination." Changes term to match current nomenclature and definition to match DOE-STD-1098-2008, Radiological Control, definition of engineering controls. Table 5-1: Update calculated values to use most restrictive ALI, used in PRC-0904-CDMP-0011, Rev. 3, Appendix D. Table calculations made in accordance with PRC-0911-PIR-0035.

Summary of Changes

PIR #	Summary
PRC-1203-PIR-0095	Revise Article 655 to: 1. Radiation Generating Device Operators should have radiological worker training as described in Article 632, Radiological Worker I, or Article 633, Radiological Worker II, as applicable and appropriate training on the type of equipment used and the source of radiation involved. 2. Radiographers should have training commensurate with the level described in 10 CFR 34.43(g) when using sealed sources to perform radiography operations. 3. Well logging equipment operators should have training commensurate with the level described in 10 CFR 39.61 when using sealed radioactive sources meeting the glossary term of a Radiation Generating Device to perform well logging operations.
PRC-1202-PIR-0093	Modify CHPRC-00073, Article 555.8 to read: "Preliminary field assessments of special air samples meeting criteria of 555.9,should be performed promptly upon removal. In situations where background levels of radon and thoron daughters interfere with evaluation of alpha air samples, prompt field assessments may not be possible. Prompt field assessments are not required for fixed-location, portable, or personal air samples used to routinely sample the individual's breathing environment unless upset conditions are identified or suspected"
PRC-1204-PIR-0102	Article 114.1: Delete 2nd sentence. Removes COE references. Article 114.1.a: Changes "COE" to "Director" Removes COE references. Article 114.1.b: Modify current to read "Changes that alter the requirements or revise the intent of the requirements (e.g., changes to Administrative Control Levels in Article 211) will be approved by the CHPRC Radiation Protection Program Manager and CHPRC Radiation Protection Director." Removes COE referneces and updates for organizational structure. Article 122.1: Change term "5480.19" to "422.1". Modify title of DOE O 422.1 to "Conduct of Operations" Order changes. Article 125.1.e: Change "5400.5: to "458.1". Order changes Article 212.1.a: Change "Radiation Protection Program Manager" to "Radiation Protection Director". Update for organizational structure. Table 2-0: Modify Level 2 approval from "…Radiation Protection Program Manager." to "…Radiation Protection Director." Modifies for new organizational structure. Appendix 2A: Remove extraneous period in paragraph. Remove 2nd word "Limit" from table header row for dose limit. Article 237.1.a: Delete. Keep consistant with HSD. Article 346.1: Change "CP" to "CP, or equivalent,…" Allows use of other dose rate instruments.

Summary of Changes

PIR #	Summary
PRC-1204-PIR-0102	Article 346.1: Change "CP" to "CP, or equivalent,..." Article 421.6: Change "5400.5" to "458.1". Order change. Article 512.3.a and 3.b: Added "*" after "dose equivalent" and added "*The use of the term "dose equivalent" is consistant with PNL-MA-842 technical basis." Identifies differences in terms between 10CFR835 and the Hanford External Dosimetry Technical Basis. Article 514.2 and 514.3: Change word "should" to "may". Consistant with DOE-STD-1098-2008. Article 521.10 and 10.a: Changed word "Engineering" to "Engineered". Keep terminology consistant. Article 554.4: Replaced entire with "Swipe surveys for removable contamination should be recorded in units of disintegrations per minute per 100 cm2 (dpm/100 cm2). For swipe surveys of small items covering less than 100 cm2, the results should be recorded in units of dpm per area swiped. If contamination levels exceed the range of the available count rate meters, the swipes should be analyzed by holding an appropriate exposure rate meter within one half inch and the results should be recorded in units of millirad or rad per hour." Consistant with DOE-STD-1098-2008. Article 615.3: Delete "Program Manager" insert "Director
PRC-1204-PIR-0102	Article 655.2: Modify change as authorized by PRC-1203-PIR-0095 to read "…sealed radioactive sources, meeting the glossary term of a Radiation Generating Device,…". For clarity. Article 655.3: Added commas after "sources" and "Device". For clarity.
PRC-1204-PIR-0102	Article 337.1:Replace 1st sentence with "Individuals should perform a whole body frisk immediately upon entry into an uncontaminated area after exiting contamination, high contamination, or airborne radioactivity areas. Individuals should also perform a whole body frisk as directed by the RWP or the radiological control organization."… Bring in line with DOE-STD-1098-2008; Article 613.8: Change 2nd sentence to read "Such training provided for individuals subject to the requirements of Articles 613.6.a and 613.6.b shall [835.901(e)] include successful completion of an examination. [RPP #200]"
PRC-1204-PIR-0100, Rev 1	Move Instructor training, RGD training, RC staff training from 724.4 to 724.3

Summary of Changes

PIR #	Summary
Summary of changes to CHPRC-00073, Rev. 7	
PRC-1207-PIR-0113	Article 223.2: Change word "engineering" to "engineered"; Article 512.1.c: Change "PNL-MA-842" to "MSA-MA-842"; Article 512.4: Change "PNL-MA-842" to "MSA-MA-842"; Article 515.7: Change "PNL-MA-842" to "MSA-MA-842"; Table 5-2: Change "PNL-MA-552" to "MSA-MA-552";Article 521.10.c: Change "engineering" to "engineered";Article 522.3.b: Change "PML-MA-552" to "MSA-MA-552";Change "PNNL-MA-860" to "MSA-MA-860";Article 555.3.a: Change "engineering" to "engineered"
Summary of changes to CHPRC-00073, Rev. 8	
PRC-1212-PIR-0121	This change generalizes Table 2-0 terminology. The table was generalized by removing the words "effective" and "equivalent" since the terms add no value in use of the table. These terms are important in the monitoring and recording of the dose which is set by the external dosimetry technical basis and other articles.; Article 238.2: The current article is a re-worded version of the HSD E.5.b requirement. It has led to some confusion in the field as to how it is implemented. The actual HSD E.5.b requirement is clear. Replace Article 238.2 with identical language from HSD E.5.b. ; Other changes: Font corrections and some punctuation and spacing fixes.
PRC-1212-PIR-0119	Article 414.11:Revise to clarify requirement “Storage of flammable or combustible material adjacent to a Radioactive Material Areas is discouraged; when necessary ensure it is stored in accordance with current Hanford Site requirements relative to flammable and combustible storage.”
Summary of changes to CHPRC-00073, Rev. 9	
PRC-1303-PIR-0123	Article 211.2 changed to "The CHPRC Administrative Control Levels shall not exceed 2,000 mrem TED [HSD C.2]"; New article 312.3: "For routine tasks, such as tours and radiological or operational surveillances, the radiological screening may be conducted as part of the radiological work permit (RWP) process described in Article 322.2. No additional review or documentation will be needed outside of the RWP."; Article 322.3: Corrected double negative in sentence.; Article 322.5.c: Added word "is" between "that" and "likely".; Article 337.8: Revised to allow RCT instruction as an alternative to posted frisking instructions; Article 421.4: Added line space at end.; Table 5-2: Corrected "5 mg.m3" to " 5 mg/m3" in note e.; Article 512.a & b: Corrected terminology; Article 651.c: Replaced "Radiation Protection Program Manager" with "Radiation Protection Director".; Article 722.4.a: Removed reference to RPP #148.

Summary of Changes

PIR #	Summary
	Summary of changes to CHPRC-00073 Rev 10
	Corrected Title of Chapter 2; Corrected pagination issue with Chapter 3; added clarity to article 316.6 for posted PPE removal instructions; revised article 561.6 from "should" to "shall"; revised article 762 from "should" to "shall"; corrected administrative error is article 631.2; updated Articles 421 and 422 to reflect DOE O 458.1 terminology (Clearance vs. release); removed reference to Hanford ALARA Center in article 452; Updated Article 452.2 to clarify when leak testing is required for HEPA filtered vacuum cleaners and portable air-handling equipment based on DOE-STD-1098-2008; added text to Appendix 4A to more closely match 10 CFR 835 verbiage; modified Article 551.2 to reflect DOE O 458.1 terminology (Clearance vs. release); modified Article 551.4 to require annual review of monitoring programs based on DOE-STD-1098-2008; added MSA dosimetry technical basis document references to reflect new HNF document numbering in Chapter 5; added transuranic definition to Glossary.

CHAPTER 1
EXCELLENCE IN RADIOLOGICAL CONTROL

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PART 1 - Scope of CHPRC Radiological Control Program

This Manual satisfies the minimum requirements established by the *Occupational Radiation Protection Final Rule, 10 CFR 835* and the commitments made in the *CH2M HILL Plateau Remediation Company Radiation Protection Program,* CHPRC-00072. This Manual also implements the requirements of the Hanford Radiological Health and Safety Document (here-after referred to as HSD) and provides the basis for consistent and uniform implementation of radiological control requirements for the Plateau Remediation Contractor (PRC) Projects/Activities as defined by contract DE-AC06-08RL14788.

111 Radiological Control Policy

A fundamental principle underlying this Manual, from the *Radiation Protection Guidance to the Federal Agencies for Occupational Exposure* approved by President Reagan on January 20, 1987, is that:

> *"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."*

This fundamental principle is also applicable to radiological releases and exposures to the public. Therefore, the As-Low-As-Reasonably-Achievable (ALARA) process of reducing radiological releases and radiation exposures is a fundamental requirement of every radiological control program. There is considerable leeway in determining how far is reasonable. Reducing radiological releases and exposures is desirable because of the direct relation to the health and safety of workers and the public and the protection of the environment. Reducing radiological releases and radiation exposures improves the quality of the workplace and the environment, the protectiveness of the public, and in the long run saves resources.

CHPRC RADIOLOGICAL CONTROL POLICY
ALARA

CHPRC is fully committed to implementing radiological control and ALARA programs of the highest quality, and that all activities shall be performed according to the basic ALARA tenet: to ensure radiation exposures to workers and the public, and releases of radioactivity to the environment, are maintained below regulatory limits and deliberate efforts are taken to further reduce exposures and releases as low as reasonably achievable.

The anticipated occupational exposure to general employees will not exceed the limits established in Article 213. Radiological releases and exposures to the public will not exceed limits established in applicable DOE directives such as DOE O 5400.5.

OWNERSHIP

It is the responsibility of each person performing radiological work to identify, evaluate, control, and communicate any potential hazards and radiological risks during work operations or tasks. Feedback and continuing improvement is an essential component in maintaining excellence in radiological control.

EXCELLENCE

ALARA excellence is self-evident and realized when radiological releases, radiation exposures and radioactive contamination are maintained ALARA.

112 Manual Applicability and Control

This Manual is applicable to any radiological activity performed within the scope of contract DE-AC06-08RL14788. Following the course of action delineated in this Manual will result in achieving and, in some cases, surpassing related statutory or regulatory requirements. CHPRC Projects/Activities should view the provisions of this Manual as the minimum acceptable techniques, methods, or solutions for fulfilling their roles and responsibilities.

The Manual is not a substitute for regulations; it is intended to be consistent with all relevant statutory and regulatory requirements and should be revised whenever necessary to ensure such consistency.

This Manual is a living document. CHPRC personnel, and subcontractors, are encouraged to forward recommendations to correct or improve the CHPRC Radiological Control Manual to the CHPRC Radiation Protection Program Manager.

1. This Manual implements the commitments made in the CHPRC Radiation Protection Program (RPP) and contract DE-AC06-08RL14788.

2. ***Except as discussed in Article 213.1, the requirements of this Manual shall [835.1(b) not apply to:***

   a. Activities that are regulated through a license by the Nuclear Regulatory Commission or a State under an Agreement with the Nuclear Regulatory Commission, including activities certified by the Nuclear Regulatory Commission under section 1701 of the Atomic Energy Act;

b. Activities conducted under the authority of the Deputy Administrator for Naval Reactors as described in Public Law 98-525 and 106-65;

c. Activities conducted under the Nuclear Explosives and Weapons Surety Program relating to the prevention of accidental or unauthorized nuclear detonations;

d. DOE activities conducted outside the United States on territory under the jurisdiction of a foreign government to the extent governed by occupational radiation protection requirements agreed to between the United States and the cognizant government;

e. Background radiation, radiation doses received as a patient for the purposes of medical diagnosis or therapy, or radiation doses received from participation as a subject in medical research programs.

f. Radioactive material on or within material, equipment, and real property which is approved for release when the radiological conditions of the material, equipment, and real property have been documented to comply with the criteria for release set forth in a DOE authorized limit which has been approved by a Secretarial Officer in consultation with the Chief Health, Safety and Security Officer.

g. Radioactive material transportation not performed by DOE or a DOE contractor. [RPP #2]

3. The provisions of this Manual apply to CHPRC contractors or subcontractors performing work in support of contract DE-AC06-08RL14788.

113 Compliance

1. ***Nothing in this Manual shall [835.3(d)] be construed as limiting actions that may be necessary to protect health and safety. [RPP #11]***

   With respect to a particular DOE activity, CHPRC management shall [835.3(b)] be responsible for compliance with the requirements of 10 CFR 835. [RPP #9]

   No person or DOE personnel shall [835.3(a)] take or cause to be taken any action inconsistent with the requirements of:

   (1) 10 CFR 835; or
   (2) Any program, plan, schedule, or other process established by 10 CFR 835. [RPP #8]

   For those activities that are required by Articles 131, 431.3, 431.4, and 613.8, the time interval to conduct these activities may be extended by a period not to exceed 30 days to accommodate scheduling needs [835.3(e)]. [RPP #12]

2. The word "shall" when followed by [835.xxx] identifies those elements that are a Federal Occupational Radiation Protection requirement and where CHPRC has made an implementation commitment in the RPP. (Text is also highlighted in bold-italic font.) Compliance with the requirement is mandatory unless the CHPRC Radiation Protection Program Manager obtains a 10 CFR 835 exemption.

[HSD xxx] identifies those elements that are contractual requirements established by the Hanford Radiological Health and Safety Document (DOE/RL-2002-12). Compliance with the requirement is mandatory unless DOE-RL provides a contract modification.

3. The word "should" means the CHPRC has the responsibility of following the provision, or of demonstrating compliance through a technical equivalency or appropriate alternative solution. The use of "should" recognizes that there may be CHPRC site-wide or Project/Activity rationale that warrants another approach. The following actions are required prior to implementation of an equivalent or alternative method of compliance.

   - The solution should be documented, with supporting technical basis, analysis and justification to demonstrate continued compliance. Requests for developing a technical basis for a "should" may be prepared with the assistance of the CHPRC 10 CFR 835 Interpretive Authority.

   - Before implementation, the approval of the CHPRC Radiation Protection Program Manager and CHPRC Radiation Protection Director is required.

   - The Project/Activity or company level senior line manager responsible for operations should approve documents that impact the line organization or require additional resources from the line organization.

   - The Project/Activity Rad Con Manager or line manager, as appropriate, is responsible for implementation, and training (if required).

114 CHPRC Radiological Controls Manual

1. This Manual should be kept current. The CHPRC 10 CFR 835 Interpretive Authority is responsible for configuration management of this manual.

   a. If the change is for the correction of spelling, reference updates, punctuation, grammar, or errors in the transmission of data that does not alter the intent of this Manual or areas of Hanford program consistency, the change may be made without approval of the CHPRC Radiation Protection Director. These changes are called editorial or administrative changes and will be approved by the CHPRC Radiation Protection Program Manager.

   b. Changes that alter the requirements or revise the intent of the requirements (e.g., changes to Administrative Control Levels in Article 211) will be approved by the CHPRC Radiation Protection Program Manager and CHPRC Radiation Protection Director.

115 Application of Requirements

1. This Manual assumes that most CHPRC Projects/Activities have organizations in place that satisfy the requirements presented in this Manual. It is not the intent of this Manual to unnecessarily create new or separate organizations if those functions can be incorporated into existing ones.

2. A graded approach is applied to define the CHPRC Radiation Protection Program scope and associated administrative process commensurate with the radiological hazards and appropriate nuclear safety requirements. For example, a CHPRC Project/Activity with an annual collective

dose of one person-rem or less, that works with small quantities of unsealed radioactive material, would not be expected to have an ALARA program as complex as an activity with an annual collective dose of 20 person-rem. Brief policy statements for lower risk activities may satisfy some program elements.

116 Hanford Radiological Control Forum

1. RESERVED

2. When the CHPRC Radiation Protection Director or Radiation Protection Program Manager determines, radiological site consistency and policy issues may be reviewed with the Hanford Radiological Control Forum. Examples of topics that the Forum might be informed of are:

   - Review of radiological control consistency issues.
   - Review of Hanford radiological problems and successes.
   - Proposed Exemption Requests.

PART 2 - Leadership in Radiological Control

121 Management Commitment

1. Senior managers have established high standards for the performance of radiological control and their commitment to the radiological control program. These standards and management expectations are a part of the CHPRC Integrated Safety Management System/Environmental Management System.

2. Prevention of the spread of radioactivity is less costly than remediation. Management should be willing to accept controls that will reduce the potential for contamination spread and improve radiological controls. The use of engineered and administrative barriers should be evaluated in accordance with Part 1 of Chapter 3.

122 Conduct of Radiological Operations

1. This Manual is consistent with the guidance in DOE O 422.1, "*Conduct of Operations*". The concepts of all chapters of DOE O 422.1 apply to the conduct of radiological control.

2. ***Written procedures shall [835.104] be developed and implemented as necessary to ensure compliance with 10 CFR 835, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards. [RPP #31]***

123 Improving Worker Awareness of Radiological Conditions

1. Workers should be familiar with the area radiological conditions and be aware of the possibility that changes may occur due to unforeseen reasons. Unplanned work or unforeseen changes in radiological conditions should be reassessed.

2. Although the conduct of radiological monitoring is the traditional role of Radiological Control Technicians, experience has shown that properly trained and qualified workers are capable of performing supplemental radiological monitoring in the course of work. This process results in work efficiency, exposure savings and improved contamination control. Specific examples of monitoring that may be effectively performed by workers and result in exposure reductions include self-monitoring during Radiation Area entries and the monitoring of tools and equipment for contamination as a qualitative check during work in Contamination Areas.

3. The performance of legal record monitoring such as radiological monitoring to satisfy requirements or radiological release surveys is the responsibility of the Radiological Control Organization.

124 Critiques

A formal critique process should be followed to obtain pertinent facts following an unusual radiological situation or at the satisfactory conclusion of a new or unusual operation involving radiological controls.

125 Facility Modifications and Radiological Design Considerations

1. ***The following radiological control design criteria are provided for new facilities and for modifications to existing facilities:***

   a. ***Optimization methods shall [835.1002(a)] be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls. [RPP #205]*** The graded approach is applied to determining the performance of optimization activities.

   b. ***The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) shall [835.1002(b)] be to maintain exposure levels below an average of 0.5 mrem (***5 µSv***) per hour[RPP #206] and as far below this average as is reasonably achievable. [RPP #207] The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall [835.1002(b)] be ALARA and shall [835.1002(b)] not exceed 20 percent of the applicable standards in Table 2-1. [RPP #208]***

c. ***Regarding the control of airborne radioactive material, the design objective shall [835.1002(c)] be, under normal conditions, to avoid releases to the workplace atmosphere and [RPP #209] in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall [835.1002(c)] normally be used. [RPP #210]***

d. ***The design or modification of a facility and the selection of materials shall [835.1002(d)] include features that facilitate operations, maintenance, decontamination, and decommissioning. [RPP #211]***

e. DOE O 458.1 should be used for requirements applicable to public and environmental radiation protection standards and control practices.

f. Control of contamination should be achieved by elimination of the source or containment of radioactive material.

g. Components should be selected to minimize the buildup of radioactivity and include ALARA considerations for maintenance, repair, and decommissioning.

h. Support facilities should be provided for donning and removal of protective clothing and for personnel monitoring, when required.

i. A neutron radiation weighting factor of 20 for conditions of unknown spectra (or doubling of the neutron radiation weighting factor associated with known neutron energies) should be used for design purposes.

    1. Design analyses based on these neutron radiation weighting factors are intended to be used to estimate the additional construction cost that would result if the neutron radiation weighting factor is increased.
    2. The results of these analyses should be used to ascertain the economic feasibility for incorporating such modifications in the final design.

2. Facility designs should not have office space, lunchrooms, or eating areas within Radiation Areas, High and Very High Radiation Areas, Contamination and High Contamination Areas, Airborne Radioactivity Areas, Radioactive Material Areas and Radiological Buffer Areas.

126 Worker Responsibilities

Trained personnel should recognize that their actions directly affect contamination control, personnel radiation exposure and the overall radiological environment associated with their work. The following radiological control rules are applicable to each person in the workplace. A poster that displays the worker responsibilities listed in Figure 1-1 should be produced and displayed at appropriate access points and work areas.

Figure 1-1, Worker Responsibilities

TO MINIMIZE YOUR RADIATION EXPOSURE AND CONTROL RADIOACTIVE MATERIAL, OBSERVE THE FOLLOWING RULES:

OBEY

- 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.

DO NOT

- Loiter in radiation areas.
- Smoke, eat, drink, or chew in Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas.

BE SURE TO

- 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 radiological Administrative Control Levels.
- Wear Personal Protective Equipment and Clothing properly whenever required by Radiological Work Permits or postings.
- 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 off-site occupational radiation exposures so that worker dosimetry records can be updated.
- Notify radiological control personnel of any medical use of radioactive material which could interfere with personnel contamination controls or dosimetry.

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.
- Have necessary materials and equipment on hand to complete your task, thereby minimizing time and exposure.
- Notify radiological control personnel of the presence of open wounds, sores, or rashes before entering an area where contamination exists and exit immediately if a wound occurs while in such an area.

UPON LEAVING AREA

- Properly remove Personal Protective Equipment and Clothing to minimize the spread of contamination.
- Frisk or be frisked for contamination when entering an uncontaminated area after exiting posted Contamination, High Contamination or Airborne Radioactivity Areas and associated Radiological Buffer Areas and notify radiological control personnel when contamination is found.

PART 3 - Radiological Assessments

131 Assessments

1. ***Internal audits of the Radiation Protection Program, including examination of program content and implementation, shall [835.102] be conducted through a process that ensures that all functional elements are reviewed no less frequently than every 36 months. [RPP #29]***

PART 4 - Radiological Control Organization

141 Radiological Control Organization

1. Radiological control organizations have been established to provide support to line managers and workers.

    a. To effectively function, the Project/Activity radiological control organization should be independent of the line organizational element responsible for production, operation or research activities and should have an equivalent reporting level.

    b. The senior line manager responsible for operations at a facility, project, or activity should have assigned radiological control personnel dedicated to the facility.

    c. It is not the intent of this Manual to duplicate organizations but to use personnel in a more effective manner in workplace situations.

2. Radiological control personnel should monitor adherence to this Manual and be available to the Project/Activity Line Manager for radiological support to the work force. To effectively function in this capacity, they should receive their day-to-day priorities from Project/Activity Line Managers.

3. The CHPRC Radiation Protection Director heads and is responsible for the CHPRC Radiological Control Organization. The Director should establish a high quality Radiological Control Program.

4. ***CHPRC shall [835.103] identify positions that develop and implement measures necessary to comply with 10 CFR 835. At a minimum, this includes those individuals filling the following positions:***

    - ***Rad Con Technicians,***
    - ***First Line Rad Con managers,***
    - ***Senior Rad Con technical staff,***
    - ***Facility/Project Rad Con technical staff,***
    - ***Facility/Project Rad Con Managers,***
    - ***Radiation Protection Director***
    - ***Radiation Protection Program Manager***
    - ***RWP Preparers,***
    - ***Lead Radiological Assessor,***

- ***Managers (including lead workers) with the authority and responsibility for radiological work and/or program oversight,***
- ***Selected individuals will be trained as source custodians, containment installer and/or inspectors. [RPP # 30]***

5. ***Staffing of the radiological control organization shall be adequate to ensure safe operations. [HSD B.4]***

142 Radiological Control Manager

1. ***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. [HSD B.2].*** This requirement applies to the positions of CHPRC Radiation Protection Director, Radiation Protection Program Manager, Project/Activity Rad Con Manager, Facility/Activity Rad Con Manager and individuals assigned as Radiological Control First Line Managers (Rad Con Supervisors). Refer to Article 651 of this manual for manager training requirements

    a. The CHPRC Radiation Protection Director, Radiation Protection Program Manager and Project/Activity Rad Con Managers require extensive professional knowledge and experience within the area of radiological control. Knowledge of the Radiation Protection Program from the point of implementation through long range program planning is essential. A clear understanding of company goals and objectives including performance incentives is mandatory. These positions work extensively with all levels of management and staff both within the radiation protection organization, and with facility and/or project staff.

    b. The Facility/Activity Radiological Control Manager requires knowledge and experience within the areas of Facility Radiological Control and Facility Operations, combined with the ability to lead and direct. This position interacts both within and outside the radiation protection organization and must effectively work with all other disciplines within a facility or organization.

    c. The Radiological Control Supervisor or First Line Manager requires knowledge and experience within the area of facility radiological control combined with the ability to lead and direct. Where this position primarily interacts within the radiological control organization, effectively working with other disciplines within a facility is also critical to the Radiation Protection Program's success within the facility.

143 Radiological Control Organization Functions and Staffing

1. The radiological control organization should include health physicists and other professionals with four-year degrees in science or engineering.

    a. Personnel should be provided continuing training to ensure that job proficiency is maintained.

    b. Pursuit of certification by the American Board of Health Physics for senior and professional staff members is encouraged.

2. Radiological control senior, technical and support personnel provide health physics and radiological engineering, dosimetry, bioassay, independent oversight, instrumentation and calibration functions. These personnel should have technical qualifications pertinent to their assigned duties.

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CHAPTER 2
RADIOLOGICAL STANDARDS

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PART 1 - Administrative Control Levels and Dose Limits

CHPRC Projects/Activities should maintain challenging numerical Administrative Control Levels that are below the regulatory limits in order to administratively control and help reduce individual and collective radiation dose. In general, efforts to reduce individual dose should not be allowed to cause a concurrent increase in collective dose. These control levels are multi-tiered with increasing levels of authority required to approve higher Administrative Control Levels.

Unless otherwise indicated, administrative, lifetime and special control levels and dose limits are stated in terms of the sum of the doses received from internal and external sources.

211 Administrative Control Level

1. ***CHPRC has established a maximum Administrative Control Level of 2,000 mrem per year per person. Approval by the DOE-RL Site Manager shall be obtained prior to allowing a person to exceed 2,000 mrem. [HSD C.1]***

2. ***The CHPRC Administrative Control Levels shall not exceed 2,000 mrem TED. [HSD C.2]***

3. Each Project/Activity Administrative Control Level initially is 500 mrem TED.

4. No person should be allowed to go above the CHPRC Project/Activity Administrative Control Level(s) without the prior approvals as specified in Table 2-0.

5. The approved Administrative Control Level in one year does not preclude choosing a different level in a subsequent year.

212 Lifetime Control Level

1. A Lifetime Control Level of N rem is established where N is the age of the person in years. Use of a Lifetime Control Level is documented through the use of Administrative Control Levels (See Article 211).

    a. Individuals whose cumulative annual effective dose exceeds N should not exceed an Administrative Control Level of 500 mrem in a year without the CHPRC Radiation Protection Director approval.

2. ***Cumulative total effective dose shall [835.702(c)(5)(iii)] be recorded. [RPP # 157]***

    a. The internal contribution to lifetime occupational dose should continue to be reassessed as further bioassay results and improved methods for assessing internal dose become available.

Administrative Control Levels
Table 2-0

Maximum Dose (Annual), mrem				
TED	**Dose to the Skin and Extremity[(b)]**	**Dose to the Lens of Eye[(b)]**	**Any Organ[(b)]**	**Approval Required to Exceed This Level**
500	15,000	4,500	15,000	Level 3 Project/Activity Line Manager & RCM[(a)]
1,000	22,500	6,750	22,500	Level 2 Project/Activity Line Manager & CHPRC Radiation Protection Director
1,500	30,000	9,000	30,000	CHPRC VP of SHS&Q
2,000				DOE-RL Site Manager
Age x 1,000 = lifetime total effective dose (TED)				Level 1 Line Manager & RCM

(a) RCM = Project Radiological Control Manager with concurrence of the CHPRC Radiation Protection Director.
(b) The values are based on the deterministic limit and are calculated as committed doses.

213 Occupational Dose Limits

1. ***Occupational dose limits are provided in Table 2-1 and shall [835.202(a), 835.206(a) & 835.207] not be exceeded. Except for planned special exposures conducted consistent with Article 213.3 and emergency exposures authorized in accordance with Article 213.4, the occupational dose received by general employees shall [835.202(a)] be controlled such that the limits in Table 2-1 are not exceeded in a year. [RPP #32-35; 57 & 60 (1st sentence only)]***

   a. ***Occupational doses received as a result of excluded activities and radioactive material transportation, as listed in Article 112.2 (a-d and g) of this Manual, shall [835.1(c)] be included to the extent practical when determining compliance with the occupational dose limits in Table 2-1 and Article 215. [RPP # 3]***

   b. ***All occupational doses received during the current year, except doses resulting from planned special exposures conducted in compliance with Article 213.3 and emergency exposures authorized in accordance with Article 213.4, shall [835.202(b)] be included when demonstrating compliance with Table 2-1, occupational dose limits for general employees and minors. [RPP # 3 & 36]***

2. Radiological workers from other DOE or DOE contractor facilities may receive occupational exposure as a radiological worker if they:

   a. Provide record of current Radiological Worker I or II standardized core training;

   b. Receive site-specific Radiological Worker I or II training at the facilities where they will be working, and
   c. Provide their radiation dose records for previous years and written estimates in accordance with Article 722.1.c.

3. Planned special exposure

   a. ***A planned special exposure may be authorized for a radiological worker to receive doses in addition to and accounted for separately from the doses received under the limits for general employees specified in Table 2-1, provided that each of the following conditions is satisfied:***

      - ***The planned special exposure is considered only in an exceptional situation when alternatives that might prevent a radiological worker from exceeding the limits in Table 2-1 are unavailable or impractical; [RPP # 40]***

      - ***The contractor management (and employer, if the employer is not the contractor) specifically requests the planned special exposure, in writing; [RPP # 41]***

      - ***Joint written approval is received from the appropriate DOE Headquarters program office and the Secretarial Officer responsible for environment, safety and health matters. [RPP # 42]***

   b. ***Prior to requesting an individual to participate in an authorized planned special exposure, the individual's dose from all previous planned special exposures and all doses in excess of the occupational dose limits shall [835.204(b)] be determined. [RPP # 43]***

   c. ***An individual shall [835.204(c)] not receive a planned special exposure that, in addition to the doses determined in Article 213.3.b, would result in a dose exceeding the following:***

      - ***In a year, the numerical values of the dose limits established at Table 2-1 for general employees; and [RPP # 44]***

      - ***Over the individual's lifetime, five times the numerical values of the dose limits established at Table 2-1 for general employees. [RPP # 45]***

   d. ***Prior to a planned special exposure, written consent shall [835.204(d)] be obtained from each individual involved. [RPP # 46] Each such written consent shall [835.204(d)] include:***

      - ***The purpose of the planned operations and procedures to be used; [RPP # 47]***

      - ***The estimated doses and associated potential risks and specific radiological conditions and other hazards which might be involved in performing the task; and [RPP # 48]***

      - ***Instructions on the measures to be taken to keep the dose ALARA considering other risks that may be present. [RPP # 49]***

   e. ***Records of the conduct of a planned special exposure shall [835.204(e)] be maintained [RPP # 50] and a written report submitted within 30 days after the planned special exposure to the approving organizations identified in Article 213.3(a). [RPP # 51]***

f. ***The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under Table 2-1, but is to be included in records and reports required by this Manual. [RPP # 52]***

4. The following provisions apply to emergency exposure situations:

a. ***A general employee whose occupational dose has exceeded the numerical value of any of the limits specified in Table 2-1 as a result of an authorized emergency exposure may be permitted to return to work in radiological areas during the current year providing that all of the following conditions are met [835.1301(a)]:***

- ***Approval is first obtained from the CHPRC Radiation Protection Program Manager and the Head of the responsible DOE field organization (DOE-RL Manager); [RPP #233]***

- ***The individual receives counseling from radiological protection and medical personnel regarding the consequences of receiving additional occupational exposure during the year; and [RPP #234]***

- ***The affected employee agrees to return to radiological work. [RPP #235]***

b. ***All doses exceeding the limits specified in Table 2-1 shall [835.1301(b)] be recorded in the affected individual's occupational dose record. [RPP #236]***

c. ***When the conditions under which a dose was received in excess of the General Employee occupational dose limits specified in Table 2-1, except those doses received in accordance with the planned special exposure provisions in Article 213.3, have been eliminated, operating management shall [835.1301(c)] notify the Head of the responsible DOE field organization (DOE-RL Manager). [RPP #237]***

d. ***Operations which have been suspended as a result of a dose in excess of the General Employee occupational dose limits specified in Table 2-1, except those received in accordance with the planned special exposure provisions in Article 213.3, may be resumed only with the approval of DOE. [RPP #238]***

e. Emergency exposure limits are not Planned Special Exposure limits. The following apply to emergency situations***:***

- ***The risk of injury to those individuals involved in rescue and recovery operations shall [835.1302(a)] be minimized. [RPP #239]***

- ***Operating management shall [835.1302(b)] weigh actual and potential risks against the benefits to be gained. [RPP #240]***

- ***No individual shall [835.1302(c)] be required to perform a rescue action that might involve substantial personal risk. [RPP #241]***

- ***Each individual authorized to perform emergency actions likely to result in occupational doses exceeding the values of the General Employee occupational dose limits provided in Table 2-1 shall [835.1302(d)] be trained in accordance with Article 613.6 and briefed before hand on the known or anticipated hazards to which the individual will be subjected. [RPP #242]***

- Guidelines for emergency exposures are provided in Appendix 2A.

5. General employee dose limits are provided in Table 2-1. General employees who have not received Radiological Worker I or II training are not expected to exceed 100 mrem in a year.

214 Member of the Public Dose Limit

1. The total effective dose limit for members of the public exposed to radiation and/or radioactive material during access to a controlled area is [835.208] 0.1 rem (0.001 Sv) in a year. [RPP #61]

2. Access by minors to Project/Activities requires compliance with the following: [HSD D.1]

a. ***Minors are prohibited access to Contamination Areas, High Contamination Areas, Radiation Areas, High Radiation Areas, Very High Radiation Areas, Airborne Radioactivity Areas, and Soil Contamination Areas. [HSD D.1.a]***

b. ***Minors are permitted access to Radiologically Controlled Areas, Underground Radioactive Material Areas, Radiological Buffer Areas, and Radioactive Material Areas under the following conditions: [HSD D.1.b]***

1. ***The purpose for access to radiological areas is for education or Project/Activity sponsored family days (e.g., tours of B Reactor, shadow days, "take your daughter/son to work" days). [HSD D.1.b.1]***

2. ***Written consent (e.g., parental consent and hold harmless clause) is granted by parent/guardian and paperwork requiring the minor's signature is also reviewed and signed by the parent/guardian. [HSD D.1.b.2]***

3. ***Minors entering Radiological Buffer Areas and Radioactive Material Areas have completed the required orientation for escorted access. [HSD D.1.b.3]***

4. ***Minors are escorted by personnel trained in accordance with 10 CFR 835 and Table 6-1 of this Manual (GERT or HGET, Radiological Worker I or II) as applicable. [HSD D.1.b.4]***

5. ***Hanford dosimeters are issued for entries to Radiological Buffer Areas and Radioactive Material Areas to document radiation dose in accordance with approved procedures. [HSD D.1.b.5]***

6. ***For entry into a RBA for contamination control, the Project/Activity will take action to stop work that could spread contamination to the RBA during the visit and verify the accessible portion of RBA is uncontaminated prior to entry by the visitors. [HSD D.1.b.6]***

7. ***Handling or touching radioactive material labeled or controlled per 10 CFR 835 by the minor is prohibited. [HSD D.1.b.7]***

8. ***Access to Radiological Buffer Areas and Radioactive Material Areas is prohibited in areas where exposure rates exceed 0.5 mR/hr. [HSD D.1.b.8]***

c. The managing Project/Activity may impose more restrictive limitations for access by minors. Non-CHPRC personnel are required to comply with the additional limitations.

Summary of Dose Limits [RPP # 36]
Table 2-1

TYPE OF EXPOSURE	ANNUAL LIMIT
General Employee : Total effective dose [RPP # 32]	***5 rems (0.05 Sv)***
General Employee: Equivalent dose to the lens of eye [RPP # 34]	***15 rems (0.15 Sv)***
General Employee: The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity [RPP # 35]	***50 rems (0.5 Sv)***
General Employee: The sum of the effective dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye [RPP # 33]	***50 rems (0.5 Sv)***
Declared Pregnant Worker: Equivalent Dose to the Embryo/Fetus [RPP # 57]	***0.5 rem per gestation period***
Minors occupationally exposed: Total effective dose [RPP # 60]	***0.1 rem***
Minors occupationally exposed: Equivalent Dose to the Lens of the eye, skin, and extremities [RPP # 60]	***10% of General Employee Limits***

Notes:

1. ***Internal dose to the whole body shall [835.203(a)] be calculated as committed effective dose. The committed effective dose is the resulting dose committed to the whole body from internally deposited radionuclides over a 50-year period after intake. [RPP # 38] Determinations of the effective dose shall [835.203(b)] be made using the radiation and tissue weighting factor values provided in the Glossary. [RPP # 39]***
2. ***The annual limit of dose to "any organ or tissue" is based on the committed equivalent dose to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any equivalent dose to that organ from external exposures during the year. [RPP # 33]***
3. ***Doses from background, therapeutic and diagnostic medical radiation, and participation as a subject in medical research programs shall [835.202(c)] not be included in dose records or in the assessment of compliance with the occupational dose limits. [RPP # 37]***
4. ***Non-uniform exposures of the skin from X-rays, beta radiation, and/or radioactive material on the skin shall [835.205] be assessed as specified in Appendix 2C. [RPP # 35 & 53]***
5. ***The total effective dose during a year shall [835.203(a)] be determined by summing the effective dose from external exposures and the committed effective dose from intakes during the year. [RPP # 38]***

215 Embryo/Fetus Dose Limits

1. ***After a female worker voluntarily notifies her employer in writing that she is pregnant, for the purposes of fetal/embryo dose protection, she is considered a declared pregnant worker. [RPP # 172]***

2. Written declarations of pregnancy, including the estimated date of conception, and revocations of declarations of pregnancy will be maintained in accordance with Article 723.2.

3. ***This declaration may be revoked, in writing, at any time by the declared pregnant worker. [RPP # 172]***

4. CHPRC and its subcontractors should provide the option of a mutually agreeable assignment of work tasks, without loss of pay or promotional opportunity, such that further occupational radiation exposure is unlikely.

5. ***For a declared pregnant worker who chooses to continue working as a radiological worker:***

   a. ***The equivalent dose limit for the embryo/fetus from the period of conception to birth, as a result of occupational exposure of a declared pregnant worker, is 0.5 rem (0.005 Sv) [835.206(a)]. [RPP #57]***

   b. ***Substantial variation above a uniform exposure rate that would satisfy the limits provided in Table 2-1 shall [835.206(b)] be avoided. [RPP #58]***

   c. ***Measures shall be taken to avoid substantial variation about the uniform exposure rate necessary to meet the 0.5 rem limit for the gestation period. Efforts shall be made to avoid exceeding 50 mrem per month to the declared pregnant worker. [RPP #58]***

6. ***If the equivalent dose to the embryo/fetus is determined to have already exceeded 0.5 rem (0.005 Sv) by the time the worker declares her pregnancy, the declared pregnant worker shall [835.206(c)] not be assigned to tasks where additional occupational exposure is likely during the remaining gestation period. [RPP # 59]***

PART 2 - Contamination Control and Control Levels

221 Personnel Contamination Control

1. ***Individuals exiting Contamination Areas, High Contamination Areas, Airborne Radioactivity Areas*** or Radiological Buffer Areas established for contamination control ***shall [835.1102(d)] be monitored, as appropriate, for the presence of surface contamination. This does not apply to personnel exiting areas containing only radionuclides, such as tritium, that cannot be detected using hand-held or automatic frisking equipment. [RPP #224]***

2. Monitoring for contamination should be performed using frisking equipment that can detect total contamination of at least the values specified in Table 2-2. Use of automatic monitoring units that meet the above requirements is encouraged.

3. Personnel found with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, should be promptly decontaminated as described in Article 541.

222 Contamination Control Levels

1. A contaminated surface exists if either the removable or total radioactivity is detected above the levels in Table 2-2. ***A contaminated area shall [835.602(a)] be posted as specified in Article 235 or controlled in accordance with Article 231.9. [RPP #125] Any area in which contamination levels exceed the values specified in Table 2-2 shall [835.1102(b)] be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels. [RPP #220]***

2. Surfaces exceeding the values of Table 2-2 for total contamination may be covered with a fixative coating to prevent the spread of contamination.

3. A fixative coating should not be applied without the documented approval of the facility Radiological Control Manager.

4. ***Areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in Table 2-2, shall [835.1102(c)] be controlled as follows when located outside Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas: [RPP #221]***

   a. ***The area shall [835.1102 (c)(1)] be routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in Table 2-2. [RPP #222]***

   b. Project/Activities should maintain a formal inventory of Fixed Contamination Areas.

   c. ***The area shall [835.1102 (c)(2)] be conspicuously marked to warn individuals of the contamination status. [RPP #223]***

      1. Markings should be kept legible. See Article 238 for areas meeting the Soil Contamination Area definition.

      2. Markings will include the standard radiation warning trefoil in black or magenta imposed upon a yellow background, and should be clearly visible from all directions and contrast with the colors of the surface coatings as discussed in Article 231.

      3. Posting criteria are contained in Article 235.

d. Surfaces exceeding the values of Table 2-2 for total contamination may be covered with a fixative coating to prevent the spread of contamination. Contamination should be reduced as much as reasonably achievable before a fixative coating is applied.

e. For waste storage or operational facilities when a fixative coating is used, the fixed contamination should be covered with two layers of fixative coatings having different colors.

f. For waste storage or operational facilities additional coating should be applied when the bottom color appears.

5. A Fixed Contamination Area may be located outside Controlled Areas unless unrestricted access is likely to result in a dose greater than 100 mrem in a year to any person.

6. A Fixed Contamination Area is exempt from the general posting requirements of Article 231 and entry and exit requirements of Chapter 3.

223 Airborne Radioactivity Control Levels

1. ***The derived air concentration (DAC) values given in 10 CFR 835 Appendices A and C shall [835.209(a)] be used in the control of occupational exposures to airborne radioactive material. [RPP # 62]***

2. Personnel should not be unnecessarily exposed to airborne radioactivity. Use of engineered 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.

3. ***Any area, accessible to individuals, where: 1) the concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in appendix A or appendix C of 10 CFR 835; or 2) an individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week shall [835.2] be posted as an Airborne Radioactivity Area. [RPP #5 and 124] CHPRC and its subcontractors shall [835 App. A & C] comply with the content of 10 CFR 835, Appendix A and C. [RPP #248 to 263]***

   a. Occupied areas with airborne concentrations of radioactivity greater than or potentially greater than 20 percent of a DAC should be posted as an Airborne Radioactivity Area.

   b. Project/Activities should develop a TED in accordance with Article 113 prior to performing work activities in an area not posted as an airborne radioactivity area for conditions greater than or potentially greater than a 20% of a DAC, but less than 1 DAC or 12 DAC-hours in a week.

      1. The workers should be informed of the airborne radiological conditions in the area and posting criteria in use (normally through the RWP or pre-job brief).

      2. With the exception of posting, all of the requirements of this Manual for monitoring and control of Airborne Radioactivity Areas; control of access to these areas; and monitoring of personnel should be implemented.

Summary of Surface Contamination Values[1] in dpm/100 cm^2
Table 2-2 [RPP #270]

Radionuclide	*Removable[2,4]*	*Total (Fixed+ Removable)[2,3]*
U-nat, U-235, U-238, and associated decay products	*[7]1,000*	*[7]5,000*
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 and below[5]	*1,000*	*5,000*
Tritium and STCs[6]	*10,000*	*See Footnote 6*
C-14, Fe-55, Ni-59, Ni-63, Se-79, Tc-99, Pd-107, Eu-155	*10,000*	*50,000*

Notes

1 *The values in this table, with the exception noted in footnote 6 below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently [835, App. D, Note 1]. [RPP #271]*

2 *As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation [835, App. D, Note 2]. [RPP #272]*

3 *The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall [835, App. D, Note 3] be considered to be above the surface contamination value if: (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value. [RPP #273]*

4 *The amount of removable radioactive material per 100 cm^2 of surface area shall be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall [835, App. D, Note 4] be based on the actual area and the entire surface shall [835, App. D, Note 4] be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination. [RPP #274]*

5 *This category of radionuclides includes mixed fission products, including the Sr-90, which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched [835, App. D, Note 5]. [RPP #275]*

6 *Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall [835, App. D, Note 6] consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply. In certain cases, a "Total" value of 10,000 dpm/100 cm^2 may be applicable either to metals, of the types which form insoluble special tritium compounds that have been exposed to tritium; or to bulk materials to which insoluble special tritium compound particles are fixed to a surface. [RPP #276]*

7 *These limits only apply to the alpha emitters within the respective decay series [835, App. D, Note 7] . [RPP #277]*

PART 3 - Posting

231 Posting Requirements

Each access point to radiological areas and radioactive material areas (as defined in the Glossary of this Manual) shall [835.603] be posted with conspicuous signs bearing the wording provided in this Part. [RPP #120]

This section reflects the Hanford Site consistency criteria approved by the Hanford Radiological Control Forum and directed by the CHPRC Radiation Protection Program Manager. [HSD E.1]

1. Radiological posting is 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.

    a. CHPRC signs should conform and support consistency throughout the Hanford Site.

    b. The examples of signs and labels given in Appendix 2D should be used to ensure consistency through the CHPRC. The Project Rad Con Manager can approve signage that combines radiological hazards providing the most restrictive hazard control from each of the individual radiological hazard signs presented in Appendix 2D is selected.

    c. The addition of descriptive language to signs is allowed provided that the signs are consistent in content, form, and style with the examples shown in Appendix 2 D.

    d. Signs, as described in Radiological Training, should be used where practicable.

2. ***Except as otherwise provided in Articles 231.8 and 232.2, signs shall [835.601(a)] contain the standard radiation symbol colored magenta or black imposed upon a yellow background. [RPP #113]*** It is recommended that lettering be either magenta or black. Magenta is the preferred color over black.

3. ***Signs shall [835.601(b)] be clearly and conspicuously posted, and may include radiological control instructions. [RPP #114]***

NOTE: Exceptions to posting of Radioactive Material Areas are contained in Article 236.

    a. Signs posted for radiological purposes should be placed approximately every 30 meters when no physical barrier is required (e.g., Radiologically Controlled Areas, Underground Radioactive Material Areas, and Soil Contamination Areas).

    b. Radiological postings should be displayed only to signify actual or potential radiological conditions.

    c. Signs used for training should be clearly marked, such as “For Training Purposes Only.”

    d. Postings should be maintained in a legible condition.

    e. Postings should be removed or modified when documented radiological monitoring results indicate that the radiological condition no longer exists.

4. Except as specified in this article, if more than one radiological condition (such as contamination and high radiation) exists in the same area, each condition should be identified.

5. Entrance points to areas of ongoing work activities controlled for radiological purposes should provide basic entry requirements, such as dosimetry, Radiological Work Permit (RWP) and respirator required (See Appendix 2D for examples).

    a. Posting of doors should be such that the postings remain visible when doors are open or closed.

    b. 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."

6. Rope, tape, chain and similar barriers used to designate the boundaries of interior posted areas should be yellow and magenta in color.

    a. In outside areas, weather resistant barrier material should be used.

    b. As an aid to workers, use of yellow and magenta barriers in outside areas is encouraged in areas of high traffic, as temporary posting, or as directed by the Project/Activity Radiological Control Organization.

7. Physical barriers should be placed so that they are clearly visible from all entry approaches. ***These barriers shall [835.501(e) and 835.502(d)] be set up such that they do not impede the intended use of emergency exits or evacuation routes. [RPP #107]***

8. ***The posting requirements in this Manual may be modified to reflect the special considerations of DOE activities conducted at private residences or businesses. [RPP # 115] Such modifications shall [835.601(c)] provide the same level of protection to individuals as the existing provisions in this Manual. [RPP #116]***

9. ***Areas may be excepted from the posting requirements of this Manual for periods of less than 8 continuous hours when placed under continuous observation and control of an individual knowledgeable of, and empowered to implement, required access and exposure control measures [835.604(a)]. [RPP #128]***

10. ***Areas containing only packages received from radioactive material transportation labeled and in non-degraded condition need not be posted in accordance with Articles 234, 235, and 236 until the packages are monitored in accordance with Article 423[835.604(c)] . [RPP #132]***

232 Posting Controlled Areas

1. ***Each access point to a controlled area shall [835.602(a)] be posted whenever radiological areas or radioactive material areas exist in the area. [RPP #117]***

   a. ***Individuals who enter only controlled areas without entering radiological areas or radioactive material areas are not expected to receive a total effective dose of more than 0.1 rem (0.001 Sv) in a year. [RPP #118]***

NOTE: The identification of Controlled Area for the CHPRC was revised to Radiologically Controlled Area to identify the reason for which control is established. This terminology substitution applies to all instances where "Controlled Area" is used in this Manual. This clarification is consistent with other Hanford contractors.

2. ***Signs used for Controlled Areas may be selected by CHPRC to avoid conflict with local security requirements. [RPP #119]***

233 Posting Radiological Buffer Areas

Radiological Buffer Areas should be established within the Controlled Area to provide secondary boundaries to minimize the potential for spread of contamination and to limit doses to general employees who have not been trained as radiological workers. Radiological Buffer Areas are not required around inactive or secured Contamination Areas.

1. ***At a minimum, the Radiological Buffer Area shall include the area adjacent to any exit from and entrance to Contamination, High Contamination, and Airborne Radioactivity Areas. [HSD E.2]***

2. ***A Radiological Buffer Area is not required for High Contamination Areas or Airborne Radioactivity Areas that are completely within Contamination Areas, or for inactive contamination, high contamination or airborne radioactivity areas (i.e., areas to which entry has been prohibited by posting or barricades). [HSD E.2]***

3. A Radiological Buffer Area established to limit exposure to external radiation should surround Radiation, High Radiation, and Very High Radiation Areas.

   a. ***Radiological Buffer Areas shall be established, as necessary, to limit radiation doses to unmonitored individuals to less than 100 mrem per year. [HSD E.3]***

   b. Radiological Buffer Areas need not be posted for external exposure control if other posted boundaries provide equivalent employee protection.

4. Posting of Radiological Buffer Areas should be in accordance with Article 231 and should contain the wording "CAUTION, RADIOLOGICAL BUFFER AREA."

234 Posting Radiation Areas

1. ***Areas shall [835.603] be posted to alert personnel to the presence of external radiation in accordance with Table 2-3 and Article 231. [RPP #121-123]***

2. Contact readings should be used to determine the need for posting Hot Spots.
   a. Measures taken to identify sources of elevated general area radiation levels while conducting routine radiation surveys should be sufficient to identify hot spot locations.
   b. A label marking the location of the Hot Spot should be placed on or as near the spot as practical.
   c. Special surveys for the sole purpose of identifying hot spots should not be required.
   d. The provisions of Article 231.5 through 231.10 do not apply to the Hot Spot posting.
   e. Posting of Hot Spots is not required in areas with general area dose rates greater than 1 rem/hr.
   f. Containers (e.g., drums or shipping boxes) with stable radiological conditions do not require hot spot labeling or posting providing:
      1. Radiological posting or work controls inform workers of the potential hazard and
      2. Other posting and labeling requirements are met.

3. The requirement for personnel dosimetry should be included on the sign.

4. The requirement for an RWP should be included either on or in conjunction with the posting

5. Dose an individual could receive in an hour may be used as the criterion for posting (Column 2 of Table 2-3). In this table, the unit "rad" is associated with dose rates that pose an immediate danger.

Criteria for Posting Radiation Areas

Table 2-3

AREA	DOSE RATE CRITERIA	POSTING
Radiation Area	***> 0.005 rem/hr and ≤ 0.1 rem/hr at 30 cm. [RPP #121]***	***"CAUTION, RADIATION AREA"*** "Personnel Dosimeter Required for Entry"
High Radiation Area	***> 0.1 rem/hr at 30 cm and ≤ 500 rad/hr at 1 m. [RPP #122]***	***"DANGER, HIGH RADIATION AREA"*** "Personnel Dosimeter, Supplemental Dosimeter and RWP Required for Entry"*
Very High Radiation Area	***> 500 rad/hr at 1 m. [RPP #123]***	***"GRAVE DANGER, VERY HIGH RADIATION AREA"*** "SPECIAL CONTROLS REQUIRED FOR ENTRY"*
Hot Spot	5 times general area dose rate and > 0.1 rem/hr on contact	"CAUTION, HOT SPOT"

Note: * Access requirements may be deleted or modified if personnel access is specifically prohibited.

235 Posting Contamination, High Contamination and Airborne Radioactivity Areas

1. ***Areas shall [835.603(d-f)] be posted to alert personnel to contamination in accordance with Table 2-4 and Article 231. [RPP # 124-126; HSD E.5.a]***

2. The requirement for an RWP should be included either on or in conjunction with each posting as applicable.

3. Derived Air Concentration (DAC) values for use with Table 2-4 are found in 10 CFR 835.

4. Areas meeting the criteria for Fixed Contamination Areas specified in Table 2-4 and Article 222.4 do not have to be posted as Contamination or High Contamination Areas.

   a. The entrance to a FCA should be posted or specific spots of fixed contamination marked.

   b. When posting an entrance to a FCA or marking individual spots of fixed contamination, use the standard radiation symbol with the words "Caution Fixed Contamination," a unique identification number, and any applicable instructions.

   c. Individual spots of fixed contamination do not require marking when the entrance to a FCA is posted to identify the presence of a FCA(s).

Criteria for Radiologically Contaminated Areas
Table 2-4

AREA	CRITERIA	POSTING
Contamination	***Removable Contamination levels (dpm/100 cm^2) > 1 time but ≤100 times Table 2-2 values [RPP # 125]***	***"CAUTION, CONTAMINATION AREA"***
High Contamination	***Removable Contamination levels (dpm/100 cm^2) > 100 times Table 2-2 values [RPP # 126]***	***"DANGER HIGH CONTAMINATION AREA"*** "RWP Required for Entry"
Fixed Contamination	Removable contamination levels < Table 2-2 removable values and total contamination levels > Table 2-2 total values	"CAUTION, FIXED CONTAMINATION"
Soil Contamination	CHPRC-00073, Article 238 and the associated definition for a Soil Contamination Area provided in the glossary.	"CAUTION, SOIL CONTAMINATION AREA"
Airborne Radioactivity	***1 DAC or 12 DAC-hours/week [RPP #124]***	***"CAUTION, AIRBORNE RADIOACTIVITY AREA"*** "RWP Required for Entry"

NOTE: Occupied areas with airborne concentrations of radioactivity greater than or potentially greater than 20 percent of a DAC should be posted and will be controlled in accordance with Articles 223.1 & 223.3.

236 Posting Radioactive Material Areas

1. ***The words "Caution, Radioactive Material(s)" shall [835.603(g)] be posted at each radioactive material area. [RPP #127]***

2. Radioactive Material Areas should be located within Controlled Areas.

3. ***Areas may be excepted from the radioactive material area posting when [835.604(b)]:***

   a. Posted as a radiological area; [RPP #129] or

   b. Each item or container of radioactive material is labeled in accordance with this Manual such that individuals entering the area are made aware of the hazard; [RPP #130] or

   c. The radioactive material of concern consists solely of structures or installed components which have been activated (i.e., such as being exposed to neutron radiation or particles produced by an accelerator) [RPP #131]

4. The definition of radioactive material and the requirements for labeling radioactive material are contained in Chapter 4.

5. At the discretion of the Project/Activity Radiological Control Manager, signs can be posted at the entrances to buildings or rooms informing individuals that an area contains internally contaminated systems.

237 Posting Underground Radioactive Material Areas

1. ***Underground Radioactive Material Areas shall be established to indicate the presence of underground items that contain or are suspected to 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). [HSD E.4]***

2. Underground Radioactive Material Areas should be posted "CAUTION, UNDERGROUND RADIOACTIVE MATERIAL." Posting should include instructions or special warnings to workers such as "Consult with Radiological Control Organization Before Digging" or "Subsurface Contamination Exists." The posting should meet the applicable requirements of Article 231.

3. Underground Radioactive Material Areas may be located outside Controlled Areas unless access is likely to result in individual doses greater than 100 mrem in a year from underground radioactive material.

4. Underground Radioactive Material Areas are exempt from the entry and exit requirements of Chapter 3 when access is not likely to result in individual doses greater than 100 mrem in a year.

    a. The posting should meet the applicable requirements of Article 231, except for Articles 231.6 and 231.7.

    b. When access to an Underground Radioactive Material Area is likely to result in individual doses greater than 100 mrem in a year the entry requirements of Article 332.1 should be implemented.

    c. The posting should meet the applicable requirements of Article 231.

5. ***URMAs are exempt from the URMA posting requirements if all of the following are met[HSD E.7]:***

- ***The area meets the definition of a URMA as defined in the Glossary.***
- ***No accessible radiological hazards exist that would require other radiological posting.***
- ***The area has been released under an interim or final approved Record of Decision (ROD).***
- ***Appropriate institutional controls have been established for the area such as:***
    - ***Specific controls included in the ROD are in place; and***
    - ***The size, location and boundaries of the area are documented, maintained, and accessible.***

238 Soil Contamination Areas

1. ***Soil Contamination Areas (SCA) shall be established for outdoor areas with known or suspect soil contamination. [HSD E.4]***

2. ***If appropriate direct or indirect measurement demonstrates that there is no radioactive contamination within the top 15 cm of soil for an area in which a direct contamination reading (above background) of the soil surface exceeds the appropriate "total" contamination levels in Appendix D, 10 CFR 835, then the area need not be posted or controlled as a SCA. [HSD E.5.b]***

3. ***Soil Contamination Areas shall be posted "CAUTION, SOIL CONTAMINATION AREA." Posting shall include instructions or special warnings to workers such as "Consult With Radiological Control Organization Before Digging" or "Subsurface Contamination Exists." [HSD E.5]***

4. ***Soil Contamination Areas may be located outside Controlled Areas unless access is likely to result in unmonitored individuals receiving greater than 100 mrem/year in a year from the Soil Contamination Area. [HSD E.3]***

5. Entry into a Soil Contamination Area should be in accordance with Table 3-3 or Table 3-4 as applicable.

    a. Soil Contamination Areas are exempt from other entry and exit requirements of Chapter 3 when access is not likely to result in individual doses greater than 100 mrem in a year and entry is for non-intrusive purposes.

    b. Soil Contamination Area posting should meet the applicable requirements of Article 231, except for Articles 231.6 and 231.7.

c. Activities involving disturbing the soil within a SCA require qualification as RWII or support from a qualified escort.

6. ***An area, which would otherwise be classified as a SCA, need not be posted and controlled as a SCA if a layer of impervious material covers the area, e.g., asphalt, concrete. [HSD E.5.c]***

239 Intrusive Activities

1. ***Project/Activities shall ensure that any area within a soil contamination area or underground radioactive material area, in which an intrusive activity is performed, is posted as either a Radiological Buffer Area or a Contamination Area. [HSD E.6]***

2. ***Projects/Activities shall ensure that members of the public shall not perform any intrusive activities within an Underground Radioactive Material Area. [HSD E.7]***

Appendix 2A

Guidelines for Control of Emergency Exposures

In extremely rare cases, emergency exposure to radiation may be necessary to rescue personnel or to protect major property. ***Emergency exposures may be authorized in accordance with the provisions contained in Article 213.4. [RPP #242 & 251]*** Emergency doses are in addition to and accounted for separately from the doses received under the limits in Table 2-1. The dose limits for personnel performing these operations are listed below.

Dose Limit (Total Effective Dose)	Activity Performed
5 rem	All
10 rem	Protecting Major Property
25 rem	Lifesaving or protection of large populations
>25 rem	Lifesaving or protection of large populations

Notes:

1. The lens of the eye dose limit should be three times the listed values.

2. The equivalent dose limit to the skin of the whole body and the extremities is ten times the listed values.

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Appendix 2B

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Appendix 2C

Non-Uniform Exposure of the Skin

Non-uniform exposures of the skin from x-rays, beta radiation, and/or radioactive material on the skin, including hot particles ***shall [835.205] be assessed and recorded as specified in*** the table below ***[Appendix 2C]: [Restatement of RPP # 53]***

AREA OF SKIN IRRADIATED	***METHOD OF AVERAGING, ADDING TO OTHER DOSES RECEIVED, AND RECORDING NON-UNIFORM SKIN DOSE*** ***For the purposes of demonstrating compliance with §835.202(a)(4), assessments shall be conducted as follows:***
≥ 100 cm²	***The non-uniform equivalent dose received during the year shall [835.205(b)(1)] be averaged over the 100 cm² of the skin receiving the maximum dose, added to any uniform equivalent dose also received by the skin, and recorded as the equivalent dose to any extremity or skin for the year. [RPP # 54]***
≥ 10 cm² and < 100 cm²	***The non-uniform equivalent dose (H) to the irradiated area received during the year shall [835.205(b)(2)] be added to any uniform equivalent dose also received by the skin and recorded as the equivalent dose to any extremity or skin for the year. H is the equivalent dose averaged over the 1 cm² of skin receiving the maximum absorbed dose, D, reduced by the fraction, f, which is the irradiated area in cm² divided by 100 cm² (i.e., H=fD). In no case shall [835.205(b)(2)] a value of f less than 0.1 be used. [RPP # 55]***
< 10 cm²	***The non-uniform equivalent dose shall [835.205(b)(3)] be averaged over the 1 cm² of skin receiving the maximum dose. This equivalent dose shall [835.205(b)(3)]:*** ***a. Be recorded in the individual's occupational exposure history as a special entry; and*** ***b. Not be added to any other equivalent dose to any extremity or skin for the year. [RPP # 56]***

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Appendix 2D

Radiological Signs & Labels

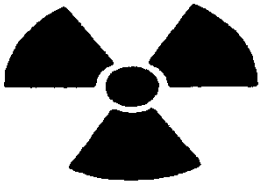
PART A – SIGNS

General Notes:

- Sign width and height should be proportional and approximately 7” x 10.25” in size.
- Labels and tags should be sized as needed by the Project/Activity.

1. <u>Radiologically Controlled Area</u>

CAUTION



RADIOLOGICALLY CONTROLLED AREA

Entry Requirements:

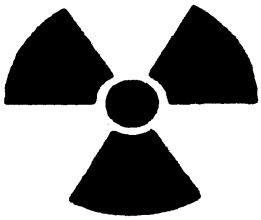
- **General Employee Radiological Training**

CAUTION

RADIOLOGICALLY CONTROLLED AREA

2. <u>Radiological Buffer Area</u>

CAUTION



RADIOLOGICAL BUFFER AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Worker 1 Training (if unescorted)**
- **Exit Survey**

CAUTION

RADIOLOGICAL BUFFER AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Worker 1 Training (if unescorted)**

2. Radiological Buffer Area (Continued)

CAUTION

RADIOLOGICAL BUFFER AREA

Entry Requirements:

- **Radiological Worker 1 Training (if unescorted)**
- **Exit Survey**

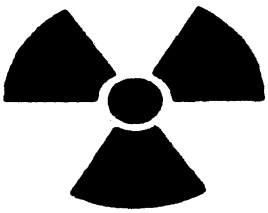
3. Internally Contaminated Systems

CAUTION

INTERNALLY CONTAMINATED SYSTEMS LOCATED WITHIN

CONTACT RADIOLOGICAL CONTROL PRIOR TO WORKING ON SYSTEM.

CAUTION



POTENTIAL INTERNALLY CONTAMINATED SYSTEMS LOCATED WITHIN

CONTACT RADIOLOGICAL CONTROL PRIOR TO WORKING ON SYSTEM

4. **Soil Contamination Area**

CAUTION

SOIL CONTAMINATION AREA

Entry Requirements:

Contact Rad Con prior to Soil Disturbing Activities

CAUTION

SOIL CONTAMINATION AREA

Entry Requirements:

- Soil Disturbing Activities Require RWP
- Contact Rad Con prior to Entry

5. **Underground Contamination Area**

CAUTION

UNDERGROUND RADIOACTIVE MATERIAL AREA

Entry Requirements:

Prior to excavating

Contact Radiological Control Organization

6. **Radiation Generating Device**

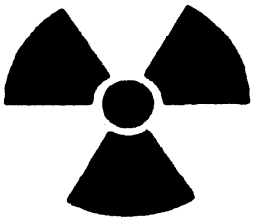
CAUTION

RADIATION GENERATING DEVICE

HIGH INTENSITY RADIATION WHEN RED LIGHT IS ON

7. **Radioactive Material Area**

CAUTION



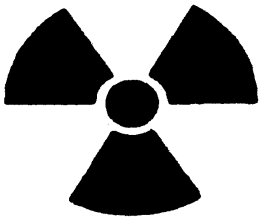
RADIOACTIVE MATERIAL AREA

Entry Requirements:

- **Radiological Worker I Training (if unescorted)**

8. **Radiation Area**

CAUTION



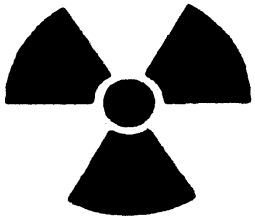
RADIATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**

9. **Radiation Area and Radioactive Material Area**

CAUTION



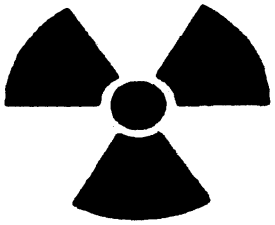
RADIATION AREA
and
RADIOACTIVE MATERIAL AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**

10. **Radiation Area, Contamination Area, Airborne Radioactive Area**

CAUTION



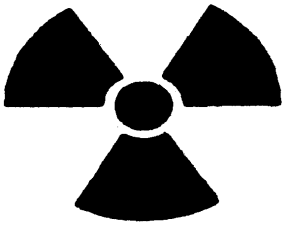
RADIATION AREA
CONTAMINATION AREA
AIRBORNE
RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

11. **Radiation Area and Contamination Area**

CAUTION



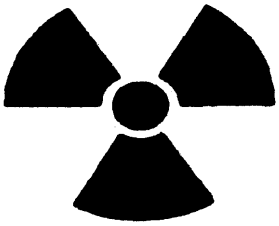
RADIATION AREA
and
CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**

12. **Radiation Area and High Contamination Area**

DANGER



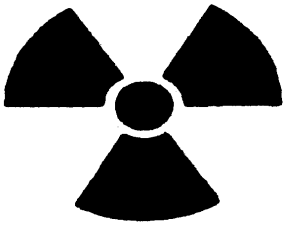
RADIATION AREA
and
HIGH CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

13. **Radiation Area and Airborne Radioactivity Area**

CAUTION



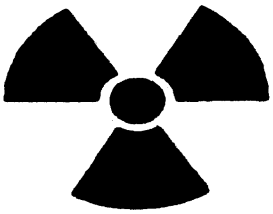
RADIATION AREA
and
AIRBORNE
RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

14. Radiation Area, High Contamination Area, Airborne Radioactivity Area

DANGER



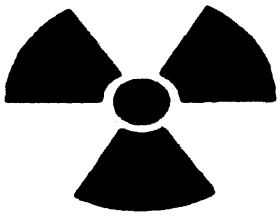
RADIATION AREA
HIGH CONTAMINATION AREA
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

15. High Radiation Area

DANGER



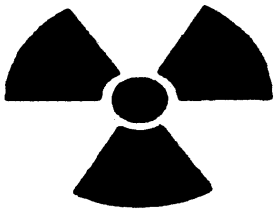
High Radiation Area

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**

16. High Radiation Area and High Contamination Area

DANGER



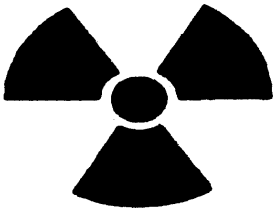
HIGH RADIATION AREA
and
CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**

17. High Radiation Area and High Contamination Area

DANGER



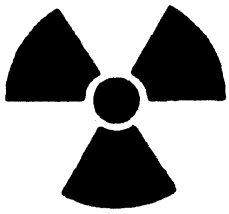
HIGH RADIATION AREA
and
HIGH CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

18. <u>High Radiation Area and Radioactive Material Area</u>

DANGER



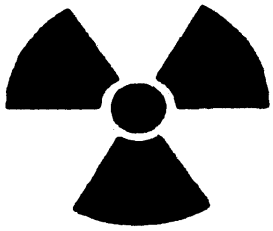
HIGH RADIATION AREA
and
RADIOACTIVE MATERIAL AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit**

19. <u>High Radiation Area and Airborne Radioactivity Area</u>

DANGER



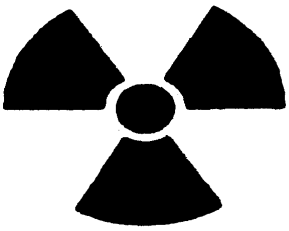
HIGH RADIATION AREA
and
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

20. <u>High Radiation Area, Contamination Area and Airborne Radioactivity Area</u>

DANGER



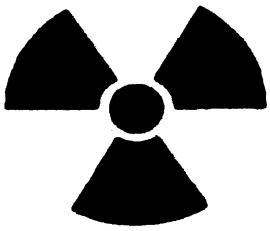
HIGH RADIATION AREA
CONTAMINATION AREA
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

21. <u>High Radiation Area, High Contamination Area, Airborne Radioactivity Area</u>

DANGER



HIGH RADIATION AREA
HIGH CONTAMINATION AREA
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Supplemental Dosimeter**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

22. Very High Radiation Area

GRAVE DANGER

VERY HIGH RADIATION AREA
(Prohibited Access)

NO ENTRY

GRAVE DANGER

VERY HIGH RADIATION AREA

NO ENTRY WHEN RED LIGHT IS ON

23. Very High Radiation Area and Contamination Area

GRAVE DANGER

VERY HIGH RADIATION AREA

SPECIAL CONTROLS REQUIRED FOR ENTRY

GRAVE DANGER

VERY HIGH RADIATION AREA
and
CONTAMINATION AREA

NO ENTRY

24. Very High Radiation Area and High Contamination Area

GRAVE DANGER

VERY HIGH RADIATION AREA
and
HIGH CONTAMINATION AREA

NO ENTRY

25. Very High Radiation Area and Radioactive Material Area

GRAVE DANGER

VERY HIGH RADIATION AREA
and
RADIOACTIVE MATERIAL AREA

NO ENTRY

26. Contamination Area

CAUTION

CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**

27. Contamination Area and Airborne Radioactivity Area

CAUTION

CONTAMINATION AREA
and
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

28. High Contamination Area

DANGER

HIGH CONTAMINATION AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

29. High Contamination Area and Airborne Radioactivity Area

DANGER

HIGH CONTAMINATION AREA
and
AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

30. Airborne Radioactivity Area

CAUTION

AIRBORNE RADIOACTIVITY AREA

Entry Requirements:

- **Personnel Dosimeter (TLD)**
- **Radiological Work Permit (RWP)**
- **Respiratory Protection (See RWP)**

31. Hot Spot

CAUTION

HOT SPOT

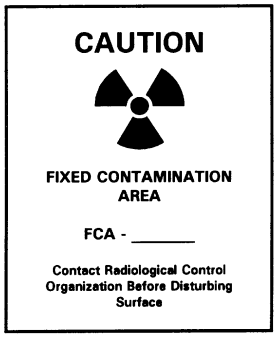
_____mrem/h

Part B Labels & Tags

General

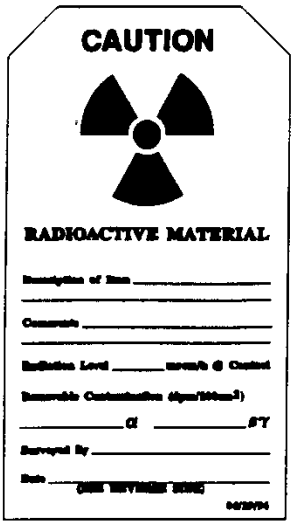
- All lettering is to be black or magenta.
- All labels must have a yellow background.
- Radiation symbol magenta (preferred) or black.

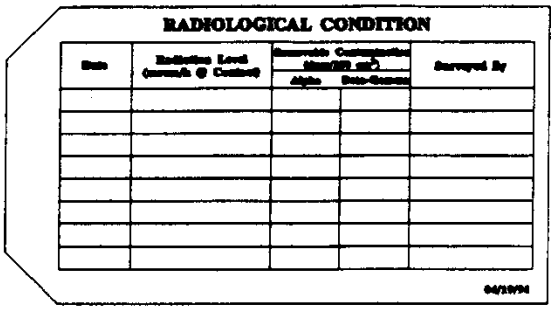
1. Fixed Contamination Area



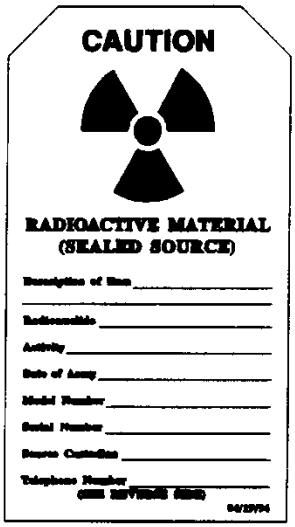
2. Radioactive Material Label

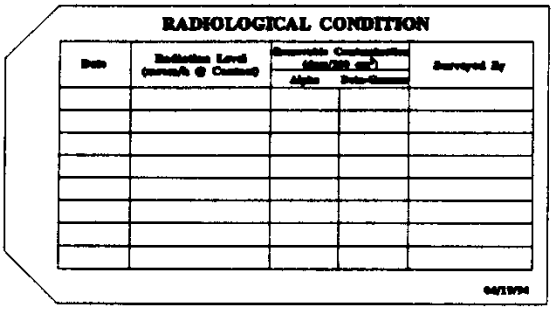
3. Radioactive Material Tag





4. Radioactive Material (Sealed Source) Tag





5. Radiation Symbol Label

6. Radioactive Material - Internally Contaminated Label

CAUTION RADIOACTIVE MATERIAL
INTERNALLY CONTAMINATED

Contact Radiological Control Technician Prior To Opening
This System And/Or Component

7. Radioactive Material - Potential for Internal Contamination Label

CAUTION RADIOACTIVE MATERIAL
POTENTIAL FOR INTERNAL CONTAMINATION

Contact Radiological Control Technician Prior To Opening
This System And/Or Component

8. Temporary Shielding Label

Temporary Shielding

DO NOT REMOVE WITHOUT PERMISSION FROM RADIOLOGICAL CONTROL

Shielding ID Number: _____

Date of Installation: _____

Responsible (Name): _____

Responsible (Phone#): _____

RCT Contact (Phone#): _____

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CHAPTER 3
Conduct of Radiological Work

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PART 1 - Planning Radiological Work

Radiological work planning is a part of the CHPRC Integrated Safety Management System. This part supports the CHPRC hazard identification and work management process. The material in this part provides the requirements for radiological hazard identification and the associated identification of radiological controls supporting performance of radiological work.

311 General Requirements

1. ***Measures shall [835.1001(a)] be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative control. [RPP #201]***

   a. The primary methods used shall [835.1001(a)] be physical design features (e.g., confinement, ventilation, remote handling, and shielding). [RPP #202]

   b. Administrative controls shall [835.1001(a)] be employed only as supplemental methods to control radiation exposure. [RPP #203]

2. ***During routine operations, the combination of engineered and administrative control shall [835.1003(a-b)] provide that: 1) the anticipated occupational dose to general employees shall [835.1003(a)] not exceed the limits established in Table 2-1 [RPP #212], and 2) the ALARA process is utilized for personnel exposures to ionizing radiation. [RPP #213]***

3. Radiological work activities meeting the CHPRC-00073 Glossary definition of radiological work should be reviewed by the Radiological Control Organization to identify and incorporate radiological requirements and radiological hazard controls.

4. Line management is responsible for ensuring adequate planning and control of radiological work activities.

312 Radiological Reviews

1. Work Activities should be screened early in the planning process, based on unmitigated hazards, to determine if they meet or potentially meet the definition of radiological work (see Glossary of this Manual).

   NOTE: Unmitigated radiological hazards are the actual (or potential) radiological conditions without regard to the effects of additional controls. Examples of additional controls include administrative actions in work documents/training, containment installation, decontamination, temporary ventilation system operation, temporary shielding, etc. Permanently installed facility systems controls are not considered an additional control.

2. Radiological work meeting the criteria below should be planned using a multi-disciplinary radiological work planning team to reduce the risk (medium/high radiological hazard work); work screened as high radiological hazard should be reviewed by the Hazard Review Board.

3. For routine tasks, such as tours and radiological or operational surveillances, the radiological screening may be conducted as part of the radiological work permit (RWP) process described in Article 322.2. No additional review or documentation will be needed outside of the RWP.

Table 3-1
Radiological Hazard Table

High Radiological Hazard Screening Criteria
Collective dose greater than 2,500 person-mrem.
Predicted airborne radioactivity concentrations exceeding 1,000 DAC or resulting in an integrated exposure of over 400 DAC-hours to any worker.
Work area* removable contamination levels greater than 1000 times Table 2-2 values.
Entry into areas where the whole body dose rates are greater than 1 rem/hr.
Medium Radiological Hazard Screening Criteria
Estimated collective dose exceeds 500 person-mrem in a year but less than or equal to 2,500 person-mrem.
Predicted airborne radioactivity concentrations exceeding 100 DAC or resulting in an integrated exposure of over 40 DAC-hours to any worker.
Work area* removable contamination levels greater than 100 times Table 2-2 values but less than or equal to 1000 times Table 2-2 values.
Entry into areas where the whole body dose rates are greater than 100 mrem/hr, but less than or equal to 1, 000 mrem/hr.
Potential for a release of radioactive material that exceeds Table 2-2 levels outside of a CA, HCA, or ARA.

* The work area is described in the job hazard analysis and typically includes the area transited and occupied to perform the work activity.

313 Minimization of Exposure

1. Internal Exposure – ***The minimization and control of internal exposure are conducted in accordance with the following hierarchy of requirements and hazard controls:***

   a. Engineered controls, including containment of radioactive material at the source wherever practicable, shall [835.1001(a) and 835.1002(c)] be the primary method of minimizing airborne radioactivity and internal exposure to workers. [RPP #209 & 210]

   b. For specific activities where use of engineered controls is demonstrated to be impractical, administrative controls shall [835.1001(b)] be used to maintain radiation exposures ALARA. [RPP #204]

   c. When engineered and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection should be used to limit internal exposures.

   d. Use of respiratory protection should be considered under the following conditions:

      1. Entry into areas with airborne radioactivity levels exceeding or potentially exceeding 0.2 DAC;

      2. Breach of contaminated systems or components;

3. Work in areas or on equipment with removable contamination levels greater than 100 times the values in Table 2-2;

4. Work on contaminated or activated surfaces with the potential to generate airborne radioactivity.

e. The selection of respiratory protection equipment should include consideration of worker safety, comfort and efficiency. The use of positive pressure respiratory protection devices is recommended wherever practicable to alleviate fatigue and increase comfort.

f. Alternate hazard control methods should be considered in specific situations when use of respiratory protection is not advised, due to physical limitations or the potential for significantly increased external exposure.

g. Alternate hazard controls when respiratory protection is not used should include the following:

1. Written authorization from the Project/Activity line organization manager and the Project/Activity Radiological Control Manager prior to incurring internal exposure;

2. 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;

3. Task and individual controls, such as stay time, specific working area and standby location controls to limit intake for the entry and radiological work activity;

4. Evaluation of workplace airborne radioactivity levels through the use continuous air monitors or personal air-samplers with expedited assessment and analysis of results.

2. External Exposure - for specific activities where use of engineered controls is demonstrated to be impractical, administrative controls shall [835.1001(b)] be used to maintain radiation exposures ALARA. [RPP #204]

3. Temporary Shielding

a. The installation, use and removal of temporary shielding should be controlled by procedure or technical work document.

b. 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.

c. Installed temporary shielding should be periodically inspected and surveyed to verify effectiveness, physical condition, and integrity. Entry for the sole purpose of temporary shielding inspection is not required. During active demolition of facilities and systems periodic inspection may be suspended providing the work document specifically identifies the temporary shielding location and provides direction for radiological monitoring to identify change or damage.

d. Radiation surveys should be performed during the alteration or removal of installed temporary shielding.

e. 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." Decommissioning activities can specify alternative controls in D&D documents.

f. Facility-specific documents may exempt the following types of shielding from the requirements of items Article 313.3.c through Article 313.3.e:

1. Short-term use of shielding (length of time determined by facility) when controlled by alternate methods;

2. Sample carriers, pigs, and other similar shields; and

3. Shielding used on bench tops, or on/within fume hoods or gloveboxes.

4. Shielding used to reduce background radiation levels for radiological counting instruments.

4. Other Safety Considerations

a. To minimize intakes of radioactive material by personnel, smoking, drinking, eating, or chewing should not be permitted within posted Contamination, High Contamination or Airborne Radioactivity Areas except as allowed by Article 313.4.b.

b. When a potential exists for personnel heat stress, drinking may be permitted within a Contamination Area under the following conditions and controls:

1. The potential for heat stress cannot be reasonably reduced by the use of administrative or engineering controls.

2. Drinking is from approved containers or sources.

3. At a minimum, worker's hands and faces are monitored for contamination prior to drinking.

4. Participating workers are monitored as part of the bioassay program.

5. The applicable requirements and controls are described in an approved procedure.

314 Reserved

315 Radiological Control Hold Point Criteria

1. As an additional administrative control, the Project/Activity Radiological Control Organization should consider the use of Radiological Control Hold Points. When used, Radiological Control Hold Points may be incorporated into technical work documents where the potential exists that incorrect implementation of radiological controls could exceed one or more of the following criteria.

a. Radiation exposures in excess of Administrative Control Levels,

b. high airborne radioactivity concentrations without protection or controls,

c. or the uncontrolled release of radioactive contamination.

316 Personal Protective Equipment (PPE)

1. ***Individuals shall [835.1102(e)] wear protective clothing during the following activities:***

   a. Handling of contaminated materials with removable contamination in excess of Table 2-2 levels

   b. Entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in Table 2-2. [RPP # 225]

   c. Personnel should use radiological PPE based on job hazard analysis, and as prescribed by the Technical Work Document, RWP or the Radiological Control Organization.

2. Personnel should be instructed in methods and techniques for donning, use, and removal of radiological PPE and clothing prior to use.

3. PPE dress-out areas should be established directly adjacent to the work area. Workers should proceed directly to the radiological work area after donning PPE.

4. PPE should be selected as prescribed by the technical work document or RWP. General guidelines for PPE selection and use are provided in Table 3-2.

5. The use of labcoats as radiological PPE is appropriate for limited applications where the potential for personal contamination should be limited to the hands, arms, and upper front portion of the body (such as a table top or work bench). Labcoats should not be used as PPE for performing vigorous physical work activities in Contamination, High Contamination or Airborne Radioactivity Areas.

6. Instructions for donning and removing PPE should be posted at the dress-out and step-off pad areas. When the Project/Activity Rad Con organization has exempted an area from posting requirements as described in Article 231.9 the instructions for donning and removing PPE may be provided by the assigned RCT. Additionally, undress assistance may be required by the RWP or an RCT may provide undress instructions to exiting workers. In these situations, posted PPE removal instructions are not required.

7. PPE should be inspected prior to each use. Clothing should be free of tears, separated seams, deterioration and damage, or repaired in a manner that provides the original level of protection.

8. Cotton glove liners may be worn inside standard gloves for comfort, but should not be worn alone or considered as a layer of protection

9. 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.

10. The Radiological Work Permit should control use of re-useable safety equipment in Contamination Areas. The items should be monitored in accordance with Article 422 or the items designated for repetitive use in a Contamination Area should be monitored prior to donning and verified to have no removable contamination. Safety equipment designated for reuse should be distinctly colored or marked.

11. Shoe covers and gloves should be secured or taped at the coverall legs and sleeves when specified in the Radiological Work Permit to prevent worker contamination.

    NOTE: It is recommended that tape be tabbed to permit easy removal.

317 Controlling the Spread of Contamination

The potential for changes in radiological conditions during work, including the spread of contamination, should be evaluated during work planning in accordance with the job hazard analysis process. The following measures are examples of techniques to prevent the spread of contamination across the boundary of Contamination Areas, High Contamination Areas and Airborne Radioactivity Areas:

1. Use solid barriers to enclose or cover areas of contamination.

2. Mark and secure items such as hoses and cords that cross the boundary.

3. Control and direct airflow from areas of lesser to greater removable contamination.

4. Consider the use of specialized tools and equipment to reduce or control radiological hazards.

5. Use engineered controls and containment devices such as localized ventilation, glovebags, fixatives, gloveboxes and tents.

318 Decontamination

1. Technical work documents should include provisions to control contamination at the source to minimize the amount of decontamination needed.

2. Work preplanning should include consideration of the handling, temporary storage and decontamination of materials, tools and equipment.

3. Decontamination activities should be evaluated and controlled to prevent the spread of contamination.

4. Water is a preferred decontamination agent. Other cleaning agents should be selected based upon their effectiveness, hazardous properties, and amount of waste generated and ease of disposal.

Guidelines for Selecting Radiological Personnel Protective Clothing (PPE)

Table 3-2

WORK ACTIVITY	REMOVABLE CONTAMINATION LEVELS		
	LOW (1 to 10 times Table 2-2 values)	**MODERATE** (10 to 100 times Table 2-2 values)	**HIGH** (> 100 times Table 2-2 values)
Routine	Full set of PPE	Full set of PPE	Full set of PPE, double gloves, double shoecovers
Heavy work	Full set of PPE, work gloves	Double set of PPE, work gloves	Double set of PPE, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PPE	Double set of PPE (outer set non-permeable), rubber boots	Double set of PPE and non-permeable outer clothing, rubber boots
Hot Work on radiological systems with flammability concerns	Full set of fire resistant PPE, fire fighter boots or equivalent footwear	Double set of PPE (outer set fire resistant), fire fighter boots or equivalent footwear	Double set of PPE with fire resistant as the outer and non-permeable as the inner set, leather fire fighter boots or equivalent footwear

NOTE: For hands-off tours or inspections in areas with removable contamination at levels 1 to 10 times the values in Table 2-2, a minimum of shoe covers and gloves is recommended.

PART 2 - Work Preparation

321 Radiological Work Permits

1. ***Written authorizations shall [835.501(d)] be required to control entry into and perform work within radiological areas. [RPP #105] These authorizations shall [835.501(d)] specify radiation protection measures commensurate with the existing and potential hazards. [RPP # 106]***

2. Radiological Work Permits (RWPs) or a technical work document with equivalent information should be used to provide written authorizations required in Article 321 and 322.

3. The RWP should be based on:

    a. current and anticipated radiological hazards and conditions of the workplace;

    b. most recent radiological surveys of the workplace;

    c. the planned radiological work;

    d. anticipated radiological hazards and conditions due to the planned radiological work activity

4. The RWP should, at a minimum, include the following information:

    a. Description of work;

    b. Initial and anticipated work area radiological conditions;

    c. Dosimetry requirements;

    d. Pre-job briefing requirements, as applicable;

    e. Radiological training requirements for entry;

    f. Protective clothing and respiratory protection requirements;

    g. Radiological Control coverage requirements and stay time controls, as applicable;

    h. Radiological conditions that, if encountered, could result in either:

        1. Exceeding an RWP action level, or

        2. Exceeding a RWP void limit.

    i. Exposure control and reduction requirements;

    j. Contamination control and reduction requirements;

    k. Entry control requirements;

l. Technical work document number or equivalent *, as appropriate ;

m. Unique identifying number;

n. Date of issue and expiration;

o. Authorizing line management and Project/activity Radiological Control signatures.

** The equivalent process must be documented in a Project/Facility procedure.*

322 Use of Radiological Work Permits

1. RWPs should be used to control the following activities:

   a. Entry into High and Very High Radiation Areas

   b. Entry into High Contamination Areas

   c. Entry into areas with airborne radioactivity levels exceeding or potentially exceeding 0.2 DAC

   d. Entry into Radiation Areas

   e. Entry into Contamination Areas

   f. Handling of materials with removable contamination that exceed the values of Table 2-2.

2. General RWPs should be used for well-characterized areas with stable radiological conditions to support:

   a. tours;

   b. routine or repetitive activities, inspections or skill-based work activities.

3. General RWPs should not be approved for periods exceeding 12 months.

4. Review of work activities governed by general RWPs should be reviewed at least annually, to ensure adequacy of RWPs.

5. Job-specific RWPs should be used to support:

   a. Infrequent or first-time activities or;

   b. work in areas with changing radiological conditions or;

   c. work that is likely to result in changing radiological conditions.

6. Job-specific RWPs should remain in effect only for the duration of the job, not to exceed 12 months.

7. RWPs should be revised if radiological conditions change to the extent that radiological requirements and controls need modification.

8. RWPs should be posted at the access point to the applicable radiological work area or at the available access control point.

9. Workers should acknowledge by signature or through electronic means where automated access systems are in place that they have read, understand and will comply with the RWP prior to initial entry to the area and after any revisions to the RWP.

10. Worker pocket or electronic dosimeter readings should be recorded in a format that identifies and provides linkage to the applicable RWP.

323 Radiological Work Permit Preparation

1. The RWP should be based on current radiological conditions and anticipated radiological conditions.

2. RWPs should be approved by:

   a. The line supervisor responsible for the work and

   b. The Radiological Control Supervisor responsible for supporting the activity.

3. Revisions or extensions to RWPs should be subject to the same approval process.

324 Pre-Job Briefings

1. Planning and work coordination should be completed prior to the start of the pre-job briefing.

2. At a minimum, pre-job briefings should be held prior to the conduct of radiological work anticipated to meet or exceed the criteria of Table 3-1, or when specified on the Radiological Work Permit. This documentation should be maintained as a radiological record in accordance with Article 742 using an approved pre-job briefing documentation.

3. A pre-job brief should, at a minimum, include:

   a. Scope of work to be performed;

   b. Current and anticipated radiological hazards and conditions of the workplace;

   c. Anticipated radiological hazards and conditions due to the planned radiological work;

   d. Identification of specific actions and/or activities in the controlling Technical Work Document that will (or have the potential to) create a change in radiological conditions when initiated or completed;

   e. Technical Work Document requirements;

f. RWP requirements;

g. Radiological Control Hold Points and the actions required to complete the Hold Point before proceeding with the next work step;

h. Communications and coordination with other groups;

i. Provisions for housekeeping and final cleanup;

j. Emergency response provisions.

PART 3 - Entry and Exit Requirements

330 General Requirements

The following are general requirements for an entry control program:

1. ***Personnel entry control shall [835.501(a)] be maintained for each radiological area. [RPP #102]***

2. ***The degree of control shall [835.501(b)] be commensurate with existing and potential radiological hazards within the area. [RPP # 103]***

3. ***One or more of the following methods shall [835.501(c)] be used to ensure control:***

   a. Signs and barricades;

   b. Control devices on entrances;

   c. Conspicuous visual and/or audible alarms;

   d. Locked entrance ways; or

   e. Administrative controls. [RPP # 104].

4. ***No control(s) shall [835.501(e)] be installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions. [RPP # 107]***

5. ***Appropriate controls shall [835.1102(a)] be maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside radiological areas under normal operating conditions. [RPP # 219]***

6. ***Project/Activities shall ensure that individuals meet the applicable minimum radiation safety training requirements in Tables 3-3 and 3-4 for access to areas requiring control for radiological health and safety. [HSD I.4]***

SUMMARY OF REQUIREMENTS FOR ESCORTED ACCESS
Table 3-3

Areas	Hanford Dosimeter	GERT	Qualified Escort[c]	Exit Contamination Survey	Protective Clothing
Radiologically Controlled Area			X		
Radiological Buffer Area	X[a]	X	X	X[b]	
Radioactive Materials Area	X[a]	X	X		
Radiation Area	X	X	X		
Contamination Area	X[a]	X	X	X	X
Soil Contamination Area	X[d]	X[e]	X[e]	X[d]	X[d]
Underground Radioactive Material Area					

Note:
(a) The Project/Activity Radiological Control Organization will determine the need for a dosimeter.
(b) For Radiological Buffer Areas surrounding Contamination, High Contamination, and Airborne Radioactivity Areas.
(c) The escort must satisfy the requirements of Table 3-4 for the area to be entered.
(d) If required by an applicable RWP.
(e) Entry requires GERT or Hanford Site Visitor Orientation and a Qualified Escort.

331 Controlled Areas

1. ***Successful completion of General Employee Radiological Training is required for unescorted entry into Controlled Areas. [RPP # 185]***

2. ***GERT training shall be consistent with the approved Hanford Radiological Control Forum direction for site radiological orientation and use of escorts. [HSD I.6]***

3. Additional training (beyond GERT) is not required when being escorted by a qualified individual (see Article 635 and Table 3-3). Table 3-4 summarizes general employee unescorted access requirements.

332 Radiological Buffer Areas

1. Minimum requirements for entry into Radiological Buffer Areas should include the following:

   a. Radiological Worker I training (if unescorted), GERT (with a qualified escort).

   b. Personnel dosimetry required if RBA was established to limit exposure to external radiation.

2. Personnel who exit a Radiological Buffer Area established for contamination control (e.g.; containing Contamination Areas, High Contamination Areas, or Airborne Radioactivity Areas) should monitor as specified in Article 337.

333 Radioactive Material Areas

Radiological Worker I training should be required for unescorted entry into Radioactive Material Areas. The minimum training required for individuals entering with a qualified escort is GERT (see Article 635).

Summary of Requirements for Unescorted Access [a]
Table 3-4

Area	Minimum Training			Personnel Dosimetry	RWP	Supplemental Dosimetry	Exit Contamination Survey	Personnel Protective Clothing (PPE)
	GERT	Radiological Worker I	Radiological Worker II					
Radiologically Controlled Area	X							
Radiological Buffer Areas		X		X[g]			X[c]	
Posted Radioactive Material Areas		X		X[b]				
Radiation Areas		X		X	X			
High Radiation Areas			X	X	X	X		
Very High Radiation Areas			X	X	X	X		
Contamination Areas			X	X[b]	X		X	X
High Contamination			X	X[b]	X		X	X
Airborne Radioactivity [d]			X	X	X		X	X
Soil Contamination	X		X[f]	X[b] [f]	X [e]		X[f]	X[f]
Underground RMA			X[e]	X[f]	X [e]		X[f]	X[f]

Notes:

a. Trained escorts may be required to comply with other safety and health requirements.
b. The Project/Activity Radiological Control Organization will determine the need for a dosimeter.
c. For Radiological Buffer Areas established for contamination control (e.g.; surrounding Contamination, High Contamination, and Airborne Radioactivity Areas).
d. Respirator required for access to airborne areas when specified on the RWP. Respirator fit and pulmonary function test required prior to receipt of respirators.
e. Radiological Worker II and RWP required for an intrusive activity (see Glossary).
f. If required by an applicable RWP.
g. Required if RBA was established to limit exposure to external radiation.

334 Radiation, High Radiation and Very High Radiation Areas

1. Minimum requirements for entry into Radiation Areas should include the following:

    a. Radiological Worker I training (if unescorted), GERT (with a qualified escort)

    b. Worker's signature on the Radiological Work Permit (RWP), as applicable

    c. Personnel dosimetry.

2. Physical controls to prevent inadvertent or unauthorized access to High and Very High Radiation Areas shall be maintained in accordance with Appendix 3A where radiation levels exist such that an individual could exceed an equivalent dose to the whole body of 1 rem (0.01 sievert) in any one hour at 30 centimeters from the source or from any surface the radiation penetrates.

3. Each entry into High Radiation Areas should include the following:

    a. Radiological Worker II training (or Radiological Worker I with High/Very High Radiation Area access training in accordance with Article 632.3).

    b. Worker's signature on the RWP**.**

    c. A survey meter or dose rate-indicating device should be available at the work area.

    d. ***The following measures shall [835.502(a)] be implemented for each entry into a High Radiation Area:***

        1) The area shall [835.502(a)(1)] be monitored as necessary during access to determine the dose rates to which the individuals are exposed; and [RPP #108]

        2) Personnel dosimeters shall be worn and each individual shall [835.502(a)(2)] be monitored by a supplemental dosimetry device or other means capable of providing an immediate estimate of the individual's integrated equivalent dose to the whole body during the entry. [RPP # 109]

4. In addition to the requirements of Article 334.3, entry requirements into High and Very High Radiation Areas where dose rates exist such that a worker could exceed an equivalent dose to the whole body of 1 rem in one hour should include a determination of the worker's current exposure, based on primary and supplemental dosimeter readings and should include the following:

    a. Pre-job briefing, as applicable;

    b. Review and determination by the Radiological Control Organization regarding the required level of Radiological Control Technician coverage.

5. ***Minimum requirements for entry into Very High Radiation Areas shall [835.502(c)] include the controls specified in Articles 334.3. Radiological instrumentation/equipment shall [835.502(c)] be used to verify the very high radiation field has been terminated prior to the first entry into a Very High Radiation Area after the source has been deenergized, secured or shielded. [RPP #111]***

6. The Project/Activity Radiological Control Organization should maintain an inventory of High and Very High Radiation Areas.

7. The number, issue and use of keys should be strictly controlled where locked entryways are used to control access to High and Very High Radiation Areas ≥ 1 Rem/hr.

8. Weekly inspections of the physical access controls to High and Very High Radiation Areas should be made to verify controls are adequate to prevent unauthorized entry. For stand-by or inactive facilities inspection of the perimeter physical controls is adequate providing, upon entry, the internal physical access controls are verified.

9. Administrative procedures should be developed as necessary to implement area access controls. These procedures should address measures implemented to ensure the effectiveness and operability of entry control devices, such as barricades, alarms, and locks.

335 Contamination, High Contamination and Airborne Radioactivity Areas

1. Minimum requirements for entry into Contamination Areas should include the following:

   a. Radiological Worker II training (if unescorted), GERT (with a qualified escort);

   b. Worker's signature on the RWP, as applicable;

   c. Personnel dosimetry, as appropriate;

   d. Protective clothing, as required by the governing RWP (see Article 316.1).

2. Minimum requirements for entry into High Contamination or Airborne Radioactivity Areas should include the following:

   a. Radiological Worker II training

   b. Worker's signature on the RWP

   c. Pre-job briefing for High Contamination or Airborne Radioactivity Areas, as applicable

   d. Respiratory protection when specified by the RWP

   e. Personal dosimetry, as appropriate

   f. Protective clothing, as required by the governing RWP (see Article 316.1).

3. Personnel exiting Contamination, High Contamination or Airborne Radioactivity Areas should remove protective clothing and perform a whole body frisk to detect personnel contamination in accordance with Article 337.

4. ***Exit points from Contamination, High Contamination or Airborne Radioactivity Areas shall [835.1102(a)] include the following:***

    a. ***Step-off pad located outside the exit point, contiguous with the area boundary***

    b. ***Step-off pads maintained free of radioactive contamination***

    c. ***Contamination monitoring equipment located as close to the step-off pad as background radiation levels permit. [RPP #219]***

    d. Labeled containers inside the area boundary for the collection of protective clothing and equipment

5. Multiple step-off pads should be used at the exits from High Contamination Areas. Use of multiple step-off pads is described in Appendix 3B.

6. ***Tools or equipment being removed from areas posted for surface or airborne radioactivity control shall [835.1101(a)] be monitored for release in accordance with Article 421[RPP #219]*** or for retention in the contaminated tool crib in accordance with Article 441.1. For the purposes of this requirement, storage of contaminated tools in a Radiological Area or Radioactive Material Area is equivalent.

7. Administrative procedures should be developed as necessary to implement area access controls. These procedures should address measures implemented to ensure the effectiveness and operability of entry control devices, such as barricades, alarms, and locks.

336 Member of the Public Entry Requirements

1. Members of the public 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:

    a. Radiological Buffer Areas

    b. Radiation Areas

    c. Contamination Areas

    d. Radioactive Material Areas.

2. Members of the public should be prohibited access to Very High Radiation Areas, High Radiation, High Contamination and Airborne Radioactivity Areas.

3. Training requirements for members of the public are identified in Articles 622.

4. Requirements for minors are given in Article 214.2.

5. Members of the public should comply with the area entry requirements as specified in Articles 331 through 335.

337 Monitoring for Personnel Contamination

1. Individuals should perform a whole body frisk immediately upon entry into an uncontaminated area after exiting contamination, high contamination, or airborne radioactivity areas. Individuals should also perform a whole body frisk as directed by the RWP or the radiological control organization. ***For activities where tritium, in oxide or elemental form, may be present additional emphasis shall be placed on worker bioassay programs and routine contamination monitoring and air sampling programs. [RPP # 224]***

2. In addition to the above, personnel exiting a Radiological Buffer Area established for contamination control (e.g.; containing Contamination, High Contamination or Airborne Radioactivity Areas) should, at a minimum, perform a hand and foot frisk. This frisk is optional if the Radiological Buffer Area exit is adjacent to the location where the exiting worker has already performed a whole body frisk.

3. Where frisking cannot be performed at the exit from Contamination Areas, High Contamination Areas or Airborne Radioactivity Areas due to high background radiation levels, personnel should:

   a. Remove all protective equipment and clothing at the exit;

   b. Proceed directly to the nearest designated monitoring station;

   c. Conduct a whole body frisk.

4. Perform personnel frisking after removal of protective clothing and prior to washing or showering.

5. Perform personnel frisking using instruments that meet the minimum detection requirements of Article 221.2. Recommended instructions for personnel frisking are provided in Appendix 3C. Instructions should be posted at the frisking location.

6. The use of automated personnel contamination monitors is encouraged.

7. Personal items, such as notebooks, papers and flashlights, should be subject to the same frisking requirements as the person carrying them.

8. Instructions for personnel frisking should be posted adjacent to personnel frisking instruments or monitors. As an alternative, the RCT may perform the personnel frisking or instruct personnel on frisking requirements. In these situations, posted instructions are not required.

9. The personnel frisking requirements contained in this Article are not applicable at those facilities that contain only radionuclides, such as tritium, that cannot be detected by currently available hand-held or automated frisking instrumentation. At such facilities, additional emphasis should be placed on worker bioassay programs and routine contamination and air sampling programs.

PART 4 - Radiological Work Controls

341 Requirements

1. ***Radiological work activities shall [835.501(d)] be conducted as specified by the controlling technical work document and Radiological Work Permit. [RPP #105]***

342 Work Conduct and Practices

1. Contamination levels caused by ongoing work should be monitored and maintained ALARA.

2. Work should be curtailed and decontamination performed at pre-established levels (e.g. action level), taking into account worker exposure.

3. Upon identification of radiological concerns, such as unplanned radiological conditions, inappropriate work controls or procedural deficiencies, workers should immediately report the concern to Project/Activity Line Supervision or the Project/Activity Radiological Control Organization.

343 Review of Work in Progress

1. Project/Activity Radiological Control personnel should conduct frequent tours of the workplace to review the adequacy of radiological work practices, posting and area controls for on-going work activities.

344 Stop Radiological Work Authority

1. Any worker has the authority and responsibility to stop radiological work activities for any of the following reasons:

    a. Inadequate radiological controls;

    b. Radiological controls not being implemented;

    c. Radiological Control Hold Point not being satisfied.

2. Stop radiological work authority should be exercised in a justifiable and responsible manner.

3. Once radiological work has been stopped, it should not be resumed until proper radiological control has been reestablished.

4. Resumption of radiological work requires the approval of the Project/Activity Line Manager responsible for the work and the Project/Activity Radiological Control Manager.

345 Response to Abnormal Situations

1. This Manual establishes minimum requirements for alarm response procedures. If CHPRC Project/Activity alarm response procedures are used they should address the general actions in Articles 345.2 through 345.6.

2. Response to a Continuous Air Monitor alarm should include the following actions:

   a. Stop work activities;

   b. Immediately exit the area;

   c. Notify Project/Activity 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. Stop work activities;

   b. Alert others;

   c. Affected personnel immediately exit the area;

   d. Notify Project/Activity Radiological Control personnel.

4. Response to a criticality alarm should include the following actions:

   a. Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring;

   b. Report to designated assembly area.

5. Response to a personnel contamination monitor alarm should include the following actions:

   a. Re-perform automatic monitoring after the first alarm clears.

   b. If 2nd alarm occurs remain in the immediate area, otherwise monitoring is complete;

   c. Notify Project/Activity Radiological Control personnel;

   d. Take actions that may be available to minimize cross-contamination, such as putting a glove on a contaminated hand;

   e. 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 Project/Activity Radiological Control personnel.

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 Hanford Fire Department and Project/Activity Radiological Control personnel.

346 Controls for Hot Particles

Hot particles are small, discrete, highly radioactive particles capable of causing 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. CHPRC defines hot particles as small, generally insoluble particles with an activity in excess of 10 μCi and establishes an open window, uncorrected indication with a CP, or equivalent, of more than 100 mrem/hr as an acceptable screening criterion. A technical basis should be developed if an alternate screening criterion for hot particle activity is used.

2. Measures for controlling hot particles, as identified in items 3 through 7 of this Article, should be implemented under the following conditions:

    a. Upon identification of hot particles;

    b. During new or non-routine operations with a high potential for hot particles, based on previous history;

    c. Upon direction of the Project/Activity Radiological Control Organization.

3. Areas or operations with the potential for hot particle contamination should be surveyed in accordance with 554.6.

4. Contamination Area posting should be annotated to specifically identify the presence of hot particles.

5. Access to hot particle areas should be controlled by a job-specific RWP. The following controls should be considered for inclusion on the RWP:

    a. Periodic personnel monitoring during the work activity, at a frequency based on the potential magnitude of skin exposure;

    b. Additional Personal Protective Equipment and Clothing;

    c. Direct Radiological Control coverage during work or assistance during protective clothing removal;

    d. Use of sticky pads or multiple step-off pads.

6. Personal Protective Equipment and Clothing used in hot particle areas should be segregated from other radiological protective equipment and clothing during laundering and surveyed prior to reuse.

7. Response to hot particle skin contamination of personnel should include the following:

    a. Immediate removal and retention of the hot particle for subsequent analysis

    b. Analysis of the particle

    c. Assessment of worker dose

    d. 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. 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.

351 Post-Job Reviews

Performance should be reviewed after completion of non-routine radiological work. Criteria established to trigger the conduct of a formal post-job review include:

- An actual collective equivalent dose of 5 person-rem or greater
- Actual doses for a task are outside the range of ±25% of the pre-job estimates when estimates are at least 1000 person-mrem TED and/or 100 mrem TED per person for the task
- Use of the stop radiological work authority
- A task results in a reportable radiological occurrence.

- For identification of significant lessons learned.

PART 6 - Special Applications

361 Radiation Generating Devices

Formal operating procedures should be used to control the operation and maintenance of radiation-generation devices (RGD). ***Project/Activities shall maintain a current listing of RGDs. This listing shall identify the responsible individual for each listed RGD. [HSD K.1]*** Special considerations associated with the use of radiation generating devices include the presence of extremely high dose rates and the potential for uncontrolled exposures. Operation of these devices requires stringent physical and administrative controls to prevent overexposure to operating and support personnel and those in adjacent work areas.

1. The "formal operating procedures" mentioned in Article 361 should consist of a CHPRC-wide procedure(s) listing requirements for all RGDs supplemented by Project/Activity procedures for specific types of RGDs as needed. During development of the RGD procedures, applicable requirements from industry standards for RGDs (e. g., ANSI 43.2, 43.3, and 43.5, 10 CFR 34, and 21 CFR 1020.40) should be considered for implementation.

2. ***On-site operations conducted by off-site contractors shall be coordinated with the Project/Activity Radiological Control Organization to ensure the contractor has a valid Nuclear Regulatory Commission or Agreement State license and that the operational and emergency procedures are current and available. [HSD K.2]***

3. A check-list or procedure (with log book entry) should be developed and used at fixed RGD installations to ensure that radiation producing equipment, warning devices, interlocks and emergency stop switches are inspected for proper operation, prior to use, on each day that the RGD is used. "Fixed installation" means an exposure room and does not include exempt shielded installations, certified cabinet x-ray systems, unattended installations, electron microscopes, x-ray diffraction units, fluorescence units, electron beam welders, radioactive soil density gauges, or sources that are not accessible and that inaccessibility is not dependent upon safety devices.

4. ***CHPRC shall establish the radiological control and operational requirements for incidental electronic RGD devices such as electron microscopes, electron beam welders and field x-ray diffraction devices. [HSD K.3]***

Appendix 3A

Physical Access Controls for High and Very High Radiation Areas

1. ***One or more of the following controls shall [835.502(b)] be used for each entrance or access point to a High Radiation Area where radiation levels exist such that an individual could exceed an equivalent dose to the whole body of 1 rem (0.01 Sv) in any one hour at 30 centimeters from the source or from any surface the radiation penetrates:***

   a. A control device that prevents entry to the area when high radiation levels exist or that, upon entry, causes the radiation level to be reduced below the level that defines a High Radiation Area;

   b. A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area;

   c. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the High Radiation Area and the supervisor of the activity are made aware of the entry;

   d. Entryways are locked. During periods when access to the area is required, positive control over each entry is maintained;

   e. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry;

   f. A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source. [RPP #110]

2. ***In addition to the above requirements, additional measures shall [835.502(c)] be implemented to ensure individuals are not able to gain unauthorized or inadvertent access to Very High Radiation Areas. [RPP #111]***

3. ***No control(s) shall [835.502(d)] be established in a High or Very High Radiation Area that would prevent rapid evacuation of personnel. [RPP #112]***

Appendix 3B

Personnel Contamination Control Practices

Selection of Personnel Protective Clothing (PPE)

Radiological protective clothing is a hazard control established as an integral part of the ISMS. Appropriate protective clothing is identified through the ISMS activity establishing work controls to mitigate or eliminate identified hazards. Use of identified clothing is a basic tenet of conduct of operations.

It is recommended that Radiological protective clothing be selected based on the job hazard analysis and knowledge of the radiological conditions. The adequacy of the designated protective clothing should be reevaluated if the radiological conditions change during the work activity. Protective clothing is specified in the Radiological Work Permit or work documents and is not modified without concurrence from the Project/Activity Radiological Control Organization.

Removal of Protective Clothing

Removal of potentially contaminated protective clothing is performed without spreading contamination and, in particular, without contaminating the skin. Contact with the skin or mouth/nose area is avoided.

Sequence for Removing a Full Set of Protective Clothing at the Step-Off Pad

The following are examples. Facility or work activity specific needs may modify the selected radiological protective clothing.

Single Set

1. Remove rubber overshoes.
2. Remove outer gloves.
3. Open hood from bottom and remove from front to rear.
4. Remove respiratory protection, as applicable.
5. Remove all exposed tape.
6. Remove supplemental dosimetry and make sure overall pockets are empty, as applicable.
7. Take down barrier closure, as applicable.
8. Pull down coveralls, turning them inside out.
9. Remove shoe covers, placing shoes onto step-off pad.
10. Replace barrier closure, as applicable.
11. Remove surgeon’s gloves and liners, as applicable.
12. Obtain or perform a whole body survey.
13. Obtained release survey of supplemental dosimetry and other materials.

Example Sequence for Removing a Double Set of Protective Clothing using Two Step-Off Pads

Before stepping to the inner step-off pad:

1. Remove exposed tape
2. Remove rubber overshoes
3. Remove outer gloves
4. Remove hood from front to rear
5. Remove respiratory protection, as applicable
6. Remove outer coverall, inside out, touching inside only
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:

9. Remove inner rubber gloves
10. Remove inner coveralls, inside out, touching inside only
11. Take down barrier closure, as applicable
12. Remove tape or fastener from inner shoe cover
13. Remove each inner shoe cover, placing shoe on clean outer step-off pad
14. Remove cotton glove liners
15. Replace barrier closure, as applicable
16. Commence whole body frisking
17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Use of Multiple Step-Off Pads

1. Multiple step-off pads are normally used to control exit from High Contamination Areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:

    a. The inner step-off pad is normally located immediately outside the highly contaminated work area, but still within the posted area.

    b. Remove highly contaminated outer clothing prior to stepping on the inner step-off pad.

    c. Additional secondary step-off pads, still within the posted area, may be utilized as necessary to restrict the spread of contamination out of the immediate area.

    d. The final or outer step-off pad is normally located immediately outside the Contamination Area.

Appendix 3C
Recommended Instructions for Personnel Contamination Self Survey With Hand-Held Survey Instruments

FOR LOCATIONS THAT REQUIRE ALPHA SELF SURVEY:

1. Verify that the instrument is on, set to the lowest scale, and the audio output can be heard.

2. Frisk hands.

3. Perform response check of the instrument.(if no response is noted notify RCT)

4. Frisk the whole body 2”/second at 1/4 distance. A minimum whole body survey takes at least two minutes.
   - Pause at mouth and nose, and
   - Areas of high probability.

5. If the audible count rate increases during frisk, pause for 5 seconds over the affected area and
   - 0 or 1 audible count is noted continue whole body frisk, or
   - $\geq$ 2 audible counts are noted notify RCT.

6. Return probe to the holder.

7. Resurvey hands.

8. Exit the area or perform addition whole body frisk as required.

FOR LOCATIONS THAT REQUIRE BETA/GAMMA SELF SURVEY:

1. Verify that the instrument is on, set to the lowest scale, and the audio output can be heard.

2. Frisk hands.

3. Perform response check of the instrument. (if no response is noted notify RCT)

4. Frisk the whole body 2”/second at 1/4 distance. A minimum whole body frisk takes at least two minutes.
   - Pause at mouth and nose, and
   - Areas of high probability.

5. If the audible count rate increases during frisk, pause for 5 seconds over the affected area and
   - No audible increase is noted, continue whole body frisk, or
   - If audible increase is noted, notify RCT.
6. Return probe to the holder.

7. Resurvey hands.

8. Exit the area or perform additional whole body frisk as required.

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CHAPTER 4
RADIOACTIVE MATERIALS

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PART 1 - Radioactive Material Identification, Storage and Control

411 Requirements

1. Materials and equipment should be evaluated for potential contamination when it may have been exposed to unconfined radioactive material above background as a consequence of past operations or activities. This evaluation should consider the potential of radioactive material being present in both accessible and inaccessible areas. Items that are determined to be potentially contaminated shall be surveyed prior to release from the Hanford Site.

2. ***Items and containers of radioactive material that are used, handled, or stored within Radioactive Material, Radiation, High Radiation, Very High Radiation, Contamination, High Contamination, or Airborne Radioactivity Areas do not require specific labeling (so long as sufficient information is provided to permit individuals to take precautions to avoid or control exposures). [RPP #135]***

    a. Due to the types of activities performed by CHPRC, one or more of the following methods should be used to control and prevent the potential for inadvertent removal of radioactive material from Radioactive Material, Radiation, High Radiation, and/or Very High Radiation Areas:

        1. Managed as Special Nuclear Material (SNM) or;
        2. Bear a durable, clearly visible standard radiation warning trefoil and the words "Caution Radioactive Material" or "Danger, Radioactive Material," or;
        3. The outer containers in the area is labeled as described in Articles 412.3, 412.4 and 412.5 or labeled in accordance with Article 431.10 or;
        4. The access or access controls to the Radioactive Material Area inform the individuals entering of the container radiation levels and that radiological controls are required for removal of any item from the area.

3. Radioactive material may be capable of generating a High Radiation Area. These areas have special controls as described in accordance with Article 334.

4. The CHPRC Radiation Protection Program Manager should be notified in the event of a loss of radioactive material.

412 Radioactive Material Labeling

1. ***Except as provided in Article 411.2 and 412.2, each item or container of radioactive material shall [835.605] bear a durable, clearly visible label bearing the standard radiation warning trefoil and the words "Caution, Radioactive Material" or "Danger, Radioactive Material". [RPP #133] The label shall [835.605] also provide sufficient information to permit individuals handling, using, or working in the vicinity of the items or containers to take precautions to avoid or control exposures. [RPP #134]***

2. ***Items and containers may be excepted from the radioactive material labeling requirements of Article 412.1 when [835.606(a)]:***

a. The quantity of radioactive material is less than one-tenth of the values specified in Appendix 4A of this Manual and less than 0.1 Ci; [RPP #136] or

b. Packaged, labeled, and marked in accordance with the regulations of the Department of Transportation or DOE Orders governing radioactive material transportation; or [RPP #137]

c. Inaccessible, or accessible only to individuals authorized to handle or use them, or to work in the vicinity; or [RPP #138]

d. Installed in manufacturing, process, or other equipment, such as reactor components, piping, and tanks, or [RPP #139]

e. The radioactive material consists solely of nuclear weapons or their components. [RPP #140]

3. ***Except as otherwise provided in Article 412.6, labels shall [835.601(a)] include the standard radiation warning trefoil in black or magenta imposed upon a yellow background. [RPP #113] Lettering should be magenta or black. Magenta is the preferred color. Radioactive material labels applied to sealed radioactive sources may be excepted from these color specifications [835.606(b)]. [RPP #141]***

4. Labels should include contact radiation levels, removable surface contamination levels (specified as alpha or beta-gamma), date surveyed, surveyor's name and description of items. Items, which are too small to be labeled with all of the stated information, should be labeled, at a minimum, with the words "CAUTION RADIOACTIVE MATERIAL" or "DANGER RADIOACTIVE MATERIAL" and the standard radiation symbol. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism.

5. Packaged radioactive material should have the label visible through the package or affixed to the outside.

6. ***The labeling requirements of this Manual may be modified to reflect the special considerations of DOE activities conducted at private residences or businesses. [RPP #115] Such modifications shall [835.601(c)] provide the same level of protection to individuals as the existing provisions in this Manual. [RPP #116]***

413 Radioactive Material Packaging

1. Radioactive material that is located outside Contamination, High Contamination or Airborne Radioactivity Areas and is confirmed or suspected of having removable radioactive contamination levels greater than Table 2-2 values should be controlled in accordance with Article 421. For example, the item should 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 2-2 values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.

4. Yellow plastic wrapping material (or clear plastic wrapping or bags that are properly marked) should be used for packaging radioactive material. Yellow plastic sheets or bags should not be used for non-radiological purposes.

5. The amount of combustible material used in packaging should be minimized.

414 Radioactive Material Storage

1. Radioactive material should be stored in a designated Radioactive Material Area unless excepted in Article 231.10 or Article 236.3.

2. Decontamination or disposal of radioactive material is the preferred alternative to establishing Radioactive Material Areas.

3. The Project /Activity Radiological Control Manager should approve each Radioactive Material Area.

4. A custodian should be assigned responsibility for each Radioactive Material Area. A custodian may have responsibility for more than one storage area.

5. The custodian should conduct walkthroughs of Radioactive Material Areas to check container integrity. At a minimum, the custodian should check container integrity monthly at outdoor Radioactive Material Areas.

6. The custodian should conduct annual or more frequent reviews of each Radioactive Material Area, with emphasis on decontamination and disposal of unneeded material.

7. Storage of non-radioactive material in a Radioactive Material Area is discouraged.

8. Outdoor storage of radioactive material is discouraged. In cases where outdoor storage is necessary, the integrity of containers used should be ensured to prevent degradation from weathering and subsequent release of radioactive material.

9. Project/Activity Rad Con Organization should specify storage and monitoring controls for debris or soils not placed in containers.

10. Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged.

11. Storage of flammable or combustible material adjacent to a Radioactive Material Area is discouraged; when necessary ensure it is stored in accordance with current Hanford Site requirements relative to flammable and combustible storage.

12. Fire protection measures, such as smoke detectors, water sprinklers and fire extinguishers, should be considered when establishing an indoor Radioactive Material Area.

PART 2 - Clearance and Transportation of Radioactive Material

421 Clearance of Personnel Property and Release of Material and Equipment

1. In addition to the requirements of Article 411.1, potentially contaminated material and equipment removed from a Contamination, High Contamination, or Airborne Radioactivity Areas should be evaluated to determine its radiological status prior to removal from the area. This evaluation should consider both radioactive material deposited on the surface of the object as well as internal contamination and radioactivity contained in depth or volume. ***Except as provided in 421.2 and 421.3, material and equipment in Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas shall [835.1101(a)] not be released to a controlled area if:***

   a. Removable surface contamination levels on accessible surfaces exceed the removable surface contamination values specified in Table 2-2; or [RPP #214]

   b. Prior use suggests that the removable surface contamination levels on inaccessible surfaces are likely to exceed the removable surface contamination values specified in Table 2-2. [RPP #215]

2. ***Material and equipment with fixed contamination levels that exceed the total surface contamination values specified in Table 2-2 may be released for use in controlled areas outside of radiological areas only under the following conditions:***

   a. Removable surface contamination levels are below the removable surface contamination values specified in Table 2-2; and [RPP #217]

   b. The material or equipment is routinely monitored and clearly marked or labeled to alert personnel of the contaminated status. [RPP #218] These items should be identified, stored and controlled in accordance with Part 1 of this Chapter.

3. ***Material and equipment exceeding the removable surface contamination values specified in Table 2-2 may be conditionally released for movement on-site from one radiological area or radioactive material area for immediate placement in another radiological area or radioactive material area only if appropriate monitoring is performed and appropriate controls for the movement are established and exercised [RPP #216].*** Controls should be established to ensure no unmonitored individual is likely to exceed an equivalent dose that would require monitoring in accordance with Article 511 or 521.

4. Unless the Project/Activity Rad Con organization establishes procedures for management of material and equipment released to controlled areas the CHPRC clearance program applies the more restrictive clearance requirements listed in Table 4-1 for clearances to both controlled areas and uncontrolled areas. Therefore, no additional radiological clearance of material and/or equipment is required when moving cleared items from a controlled area to an uncontrolled area.

5. ***The results of monitoring for the release and control of material and equipment shall [835.703(c)] be documented and maintained [RPP #167]*** and should describe

- the property,
- date of last monitoring,
- identity of the person who performed the monitoring,
- type and identification number of the monitoring instruments used, and
- monitoring results.

6. Volumetrically contaminated material and equipment is not authorized for clearance from the Hanford Site unless DOE approved authorized limits are obtained (See DOE O 458.1).

422 Clearance Requirements

1. Facilities with unconfined radioactive materials due to DOE activities should have a technical evaluation to identify nuclides present in the facility, and the required instrumentation and procedure to detect them. This evaluation should be reviewed whenever processes change that could affect the nuclide source mix and at least annually.

2. Evaluation studies must be sensitive enough to identify the presence of individual nuclides that cannot be detected with standard portable instrumentation and if they are present in sufficient quantity and of sufficient energy to be of concern.

3. Surveys must be performed for both total and removable contamination using instrumentation and techniques capable of detecting values of at least those specified in Table 4-1.

4. ***A radiological clearance (release) program shall be established to assure that real property, personal property, materials and equipment released from the Hanford Site fully comply with regulations and DOE requirements prior to radiological release of this property to the public. [HSD E.9]***

5. ***Methods used to survey personal property, equipment and material for uncontrolled release must support a minimum statistical confidence of 67% for items determined unlikely to be contaminated and 95% for items determined likely to be contaminated. [HSD E.10]***

6. Radiological labeling should be removed from or defaced on material prior to clearance for unrestricted use.

7. The RP staff may use process knowledge to determine if material and equipment is potentially contaminated. Only potentially contaminated items are required to be monitored in accordance with the CHPRC radiological clearance process.

8. DOE has instituted a moratorium on the clearance of potentially contaminated metals for recycling. If metal has been located in a radiological area, as defined in 10 CFR 835, and was not appropriately released from the area prior to July 13, 2000, it may not be cleared for recycling. Metal, which had been in a radiological area that has been appropriately down-posted and is no longer subject to 10 CFR 835 radiological controls, may be cleared for unrestricted use. The posting cannot be removed for the purpose of clearing the metal. Metal may be cleared provided it will continue to be used in its

current form, or transferred as radioactive material to a licensed individual. Metals with potential volumetric contamination cannot be cleared without application of DOE approved authorized release limits.

9. The Project RCM is responsible for ensuring that the clearance is in accordance with the DOE moratorium on recycling potentially contaminated metals.

Table 4-1 *[HSD E.11]*
Allowable Total Residual Surface Contamination (dpm/100cm2)[1]

Radionuclides [2]	Average [3,4]	Maximum [4,5]	Removable [4,6]
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228, Th-230, Pa-231.	100	300	20
Th-Natural, Sr-90, I-126, I-131, I-133, Ra-223, Ra-224, U-232, Th-232.	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters.	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above and below. [7]	5,000	15,000	1,000
Tritium[8]			10,000
C-14, Fe-55, Ni-59, Ni-63, Se-79, Tc-99, Pd-107, Eu-155	50,000	150,000	10,000

NOTES:

1) As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
2) Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exist, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.
3) Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.
4) The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.
5) The maximum contamination level applies to an area of not more than 100 cm^2.
6) The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.
7) This category of radionuclides includes mixed fission products, including the Sr-90, which is present in them. It does not apply to Sr-90, which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.
8) Property recently exposed or decontaminated, should have measurements (smears) at regular time intervals to ensure that there is not a build-up of contamination over time. Because tritium typically penetrates material it contacts, the surface

guidelines in group 4 are not applied to tritium. DOE has reviewed the analysis conducted by the DOE Tritium Survey Contamination, and has assessed potential doses associated with the release of property containing residual tritium. DOE recommends the use of the stated guideline as an interim value for removable tritium. Measurements demonstrating compliance of the removable fraction of tritium on surfaces with this guideline are acceptable to ensure that non-removable fractions and residual tritium in mass will not cause exposures that exceed DOE dose limits and constraints.

423 Transportation and Receipt of Radioactive Material

1. 49 CFR 171 through 180 describe requirements for inspecting and surveying packages, containers, and transport conveyances prior to off-site transport. These regulations apply to shipments transported by non-DOE conveyances including on-site transfers of shipments by non-DOE conveyances received from or destined to off-site locations.

2. Radioactive material transportation does not include preparation of materials for shipment, packaging, and labeling, or performance of surveys required for occupational radiation protection. Therefore, these activities should be conducted in accordance with the provisions of this Manual.

3. Table 2-2 removable contamination values are more limiting than 49 CFR requirements. Except as specified below, Table 2-2, removable contamination values should be used as controlling limits for on-site and off-site transportation when using a DOE conveyance.

    a. For any shipment using a container that requires an on-site Package Specific Safety Document (PSSD) or other safety analysis document, 49 CFR 173 contamination values may be used.

    b. When a shipment is received from an off-site destination, by a non-DOE conveyance, the 49 CFR 173 contamination values should be applicable for all subsequent on-site transfers to the ultimate on-site destination.

    c. On-site transfers over nonpublic thoroughfares or between facilities on the same site should be performed in accordance with written procedures using pre-approved routes. The procedures should include requirements to ensure appropriate monitoring and control of the radioactive material and should be approved by the Project/Facility Radiological Control Organization.

4. On-site transfers over public thoroughfares should be performed in accordance with Department of Transportation, state and local shipping requirements and pre-approved agreements.

5. Off-site shipments of radioactive material, including CHPRC project or activity handling of off-site shipments, should be controlled and conducted in accordance with this Manual and applicable Federal, state and local regulations.

6. Transport conveyances should be radiologically surveyed before loading, especially when using commercial carriers specializing in radioactive transport.

7. 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.

8. ***If packages containing quantities of radioactive material in excess of a Type A quantity (as defined at 10 CFR 71.4) are expected to be received from radioactive material transportation, arrangements shall [835.405(a)] be made to either:***

    a. Take possession of the package when the carrier offers it for delivery; or

    b. Receive notification as soon as practicable after arrival of the package at the carrier's terminal and to take possession of the package expeditiously after receiving such notification. [RPP #94]

9. ***Upon receipt from radioactive material transportation, external surfaces of packages known to contain radioactive material shall [835.405(b)] be monitored if the package:***

    a. Is labeled with a Radioactive White I, Yellow II, or Yellow III label (as specified at 49 CFR 172.403 and 172.436-440); or [RPP #95]

    b. Has been transported as low specific activity material (as defined at 10 CFR 71.4) on an exclusive use vehicle (as defined at 10 CFR 71.4); or [RPP #96]

    c. Has evidence of degradation, such as packages that are crushed, wet, or damaged. [RPP #97]

10. ***The monitoring required by Article 423.9 of this Manual shall [835.405(c)] include:***

    a. Measurements of removable contamination levels, unless the package contains only special form (as defined at 10 CFR 71.4) or gaseous radioactive material; and [RPP #98]

    b. Measurements of the radiation levels, unless the package contains a Type B quantity (as defined at 10 CFR 71.4) of radioactive material. [RPP #99]

11. ***The monitoring required by Article 423.9 shall [835.405(d)] be completed as soon as practicable following receipt of the package, but no later than 8 hours after the beginning of the working day following the receipt of the package. [RPP #100]***

    a. The monitoring required by Article 423.9 should include, at a minimum, monitoring of the accessible surfaces of the package so long as appropriate monitoring is performed during package unloading and subsequent handling activities to satisfy Article 551.1.

    b. For purposes of implementation of Article 423.11 a working day is considered to be the interval of time within each 24 hour period during which the building or area is routinely occupied or available for operations other than emergency activities.

12. ***The monitoring required by Article 423.9 is not required for packages transported on a DOE site which have remained under the continuous observation and control of a DOE employee or DOE contractor employee who is knowledgeable of and implements required exposure control measures [835.405(e)]. [RPP # 101]*** This exception should only be implemented using an approved procedure to ensure consistent application.

13. ***The requirements of 10 CFR 835 subparts F and G (refer to RPP requirements 102 – 141) do not apply to radioactive material transportation by DOE or a DOE contractor conducted [835.1(d)]:***

    a. Under the continuous observation and control of an individual who is knowledgeable of and implements required exposure control measures, or
    b. In accordance with Department of Transportation regulations or DOE orders that govern such movements. [RPP # 4]

PART 3 - Radioactive Source Controls

431 Radioactive Source Controls

1. Sealed radioactive sources shall [835.1201] be used, handled, and stored in a manner commensurate with the hazards associated with the operations involving the sources. [RPP #226]

2. Written procedures should be established and implemented to control accountable sealed radioactive sources. These procedures should establish requirements for source acquisition, receipt, storage, transfer, inventory, leak testing, and usage.

3. ***Each accountable sealed radioactive source shall [835.1202(a)] be inventoried at intervals not to exceed six months. This inventory shall [835.1202(a)]:***

    a. Establish the physical location of each accountable sealed radioactive source,

    b. Verify the presence and adequacy of associated postings and labels, and

    c. Establish the adequacy of storage locations, containers, and devices. [RPP #227]

4. ***Except for sealed radioactive sources consisting solely of gaseous radioactive material or tritium, each accountable sealed radioactive source shall [835.1202(b)] be subject to a source leak test upon receipt, when damage is suspected, and at intervals not to exceed six months. Source leak tests shall [835.1202(b)] be capable of detecting radioactive material leakage equal to or exceeding 0.005 µCi. [RPP #228]***

5. ***Notwithstanding the requirements of Article 431.4, an accountable sealed radioactive source is not subject to periodic source leak testing if that source has been removed from service [835.1202(c)]. [RPP #229] Such sources shall [835.1202(c)] be stored in a controlled location and subject to periodic inventory in accordance with Article 431.3 and subject to leak testing prior to being returned to service. [RPP #230]***

6. ***Notwithstanding the requirements of Articles 431.3 and 431.4, an accountable sealed radioactive source is not subject to periodic inventory and source leak testing if that source is located in an area that is unsafe for human entry or otherwise inaccessible [835.1202(d)]. [RPP #231]*** When the conditions that restrict access to the area have been terminated, the sealed radioactive source should be inventoried and either leak tested as described in Article 431.4 or removed from service before allowing uncontrolled access to the area.

7. ***An accountable sealed radioactive source found to be leaking radioactive material shall [835.1202(e)] be controlled in a manner that minimizes the spread of radioactive contamination. [RPP #232]*** These controls should include wrapping or containing the source, applying appropriate labels, and removing the source from service. A minimum detection threshold of equal to or less than 0.005 μCi will be used.

8. Procurement and disposal of radioactive sources should be coordinated with the Project/Activity Radiological Control Organization.

9. Sealed radioactive sources should not be brought on-site by external organizations without the prior knowledge and approval of the Project/Activity Radiological Control Organization. (See Article 361 for RGDs.)

10. ***Accountable sealed sources and all other sealed sources having activities exceeding one tenth of the values listed in Appendix 4A, or their storage containers, shall [835.605] be labeled with the radiation symbol and "Caution, Radioactive Material" or "Danger, Radioactive Material". [RPP # 133]*** The label should also provide sufficient information to permit individuals handling, using, or working in the vicinity of the items or containers, to take precautions to avoid or control exposures. The label should include information such as the radionuclide, the quantity of radioactive material, the date of quantity estimate, serial number of the source or device, and a method for identifying the source custodian. However, such labels are exempt from the normal color scheme of magenta or black on yellow. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism.

PART 4 - Solid Radioactive Waste Management

441 Waste Minimization

1. Reserve an assortment of tools primarily for use in Contamination, High Contamination, or Airborne Radioactivity Areas. Tools should be maintained in a designated storage or distribution area or a contaminated tool crib. Controls should be established for tool issuance and use.

PART 5 - Support Activities

451 Personal Protective Equipment and Clothing

1. Personal Protective Clothing designated for radiological control use should be specifically identified by color, symbol, or appropriate labeling.

    a. Non-radiological Personal Protective Equipment (PPE) may be designated for radiological control use with the concurrence of the Project/Activity Radiological Control Manager.

    b. Disposable or single use protective clothing that is designated for radiological control use need not be identified by color, symbol, or appropriate labeling.

2. Personal Protective Clothing designated for radiological control use should not be used for non-radiological work.

3. Previously used Personal Protective Equipment and Clothing should not be stored with personal street clothing.

4. Cleaned Personal Protective Equipment that are designated for radiological control use, such as face shields and respirators, that come into contact with the wearer's face and company issued non-personal protective clothing should be monitored. Contamination levels must meet the requirements of Article 422.

   At Hanford, the DOE-RL provided laundry contractor does not receive potentially contaminated respirators unless special arrangements are made in advance (Contract Section C.6.14).

5. Laundered protective clothing should be monitored as required by DOE contract DE-AC06-04RL14540, Section C requirements as discussed in Article 453.

452 Vacuum Cleaners and Portable Air-Handling Equipment

Improper use of vacuum cleaners and portable air-handling equipment may result in the generation of airborne radioactivity, loose surface contamination or high dose rates.

1. Vacuum cleaners and portable air-handling equipment used in areas established to control removable surface contamination or airborne radioactivity (except areas where only tritium is present) should be equipped with High-Efficiency Particulate Air (HEPA) filters. If the material to be vacuumed is wet enough to preclude resuspension, then HEPA filters are not necessary.

2. HEPA filters used in vacuum cleaner and portable air-handling equipment should meet the efficiency and construction requirements for HEPA filters.

   The maximum flow rate of the device should not exceed the flow rate at which the HEPA filter was efficiency tested. At a minimum devices should be leak tested prior to initial use, when units have undergone any type of service that may compromise the integrity of the HEPA filter or its sealing surfaces, and annually. Leak tests are conducted by injecting DOP or equivalent aerosols into the inlet of the device and measuring the DOP concentration at the inlet and outlet of the device. In addition, devices with integral filter assemblies should be efficiency tested when units have been opened. DOE HDBK-1169-2003, Section 8.6.1 provides additional information on in-place testing of HEPA filters. For those HEPA devices that are specifically designed to be serviced to allow debris removal without compromising the HEPA filter seal (e.g., the Nilfisk GS-80 and the Euroclean "HEPA filtered Portable Dust Collection System") do not have to be leak tested every time they are opened. If, however, the HEPA filter seal is affected during debris removal or servicing, then an efficiency test should be performed. Additional requirements for efficiency testing are contained in the applicable radioactive air emissions notice of construction and ERDA 76-21, Section 8.3.1.

3. Vacuum cleaners and portable air-handling equipment identified in Article 452.1 should be:

   a. Uniquely marked and labeled,
   b. controlled by an RWP,
   c. controlled to prevent unauthorized use,

d. designed to ensure HEPA filter integrity under conditions of use, and
e. designed to prevent unauthorized or accidental access to the inner surfaces of the vacuum.

4. Radiation and contamination surveys should be performed periodically for vacuum cleaners in use and labels on these units should be updated. The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.

5. Airborne radioactivity levels should be monitored when a vacuum cleaner is used in a high contamination area.

6. A nuclear safety review should be performed and documented before the use of a vacuum cleaner for fissile material.

453 Contract Laundry

A contracted radiological laundry service is provided by RL. The following radiological laundered protective clothing requirements should be performed by Project/Activities in support of the laundry contract:

1. In conjunction with performing the annual review of the facility characterization or when facility characterization changes occur Project/Activities should update the requested laundry radiological monitoring (Beta only, Alpha only, or both Alpha-Beta monitoring).

2. Clean laundered radiological protective clothing will be maintained in approved storage areas (normally a Radioactive Material Area).

3. CHPRC Projects/Activities should designate closed loop pick-up/delivery locations. Pickup and delivery schedules will be communicated to the facilities. Laundry bags are provided by the laundry contractor and are labeled or stenciled by the laundry contractor. PFP laundry bags will not have metal grommets.

4. Work planning should include actions, when appropriate, that provide confidence that clothing with more than 100,000 dpm/100 cm^2 Alpha on each article are not submitted to the laundry contractor. Laundry bags will be maintained below 10 mrem/hr on external contact of each bag. Contamination levels on the exterior of laundry bags should be below 1,000 dpm/100 cm^2 Beta-Gamma and 20 dpm/100 cm^2 Alpha removable contamination.

Appendix 4A

Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements

Use the data presented in Appendix 4A for identifying accountable sealed radioactive sources and radioactive material areas as those terms are defined in the glossary of this Manual. The data are also to be used when establishing the need for radioactive material area posting in accordance with Article 236, and establishing the need for radioactive material labeling in accordance with Article 412. [RPP #278-280]

Nuclide	Activity (µCi)	Nuclide	Activity (µCi)	Nuclide	Activity (µCi)
H-3	1.5E+08	Zr-88	1.1E+02	Te-127m	8.0E+02
Be-7	3.1E+03	Zr-93	9.3E+04	Te-129m	2.3E+03
Be-10	1.4E+05	Zr-95	1.9E+02	I-125	3.5E+02
C-14	4.6E+06	Nb-91	6.9E+01	I-129	1.8E+02
Na-22	1.9E+01	Nb-91m	3.6E+02	Cs-134	2.6E+01
Al-26	1.5E+01	Nb-92	1.8E+01	Cs-135	1.3E+06
Si-32	4.9E+04	Nb-93m	4.4E+02	Cs-137	6.0E+01
S-35	2.4E+06	Nb-94	2.3E+01	Ba-133	5.1E+01
Cl-36	5.2E+05	Nb-95	3.4E+02	La-137	2.7E+05
K-40	2.7E+02	Mo-93	7.7E+01	Ce-139	2.4E+02
Ca-41	9.3E+06	Tc-95m	1.3E+02	Ce-141	2.4E+03
Ca-45	1.1E+06	Tc-97	8.1E+01	Ce-144	1.4E+03
Sc-46	6.2E+01	Tc-97m	3.5E+02	Pm-143	1.3E+02
Ti-44	1.5E+02	Tc-98	2.5E+01	Pm-144	2.9E+01
V-49	1.0E+08	Tc-99	8.4E+05	Pm-145	2.6E+02
Mn-53	7.5E+07	Ru-103	4.4E+02	Pm-146	4.4E+01
Mn-54	6.5E+01	Ru-106	2.5E+02	Pm-147	7.7E+05
Fe-55	2.9E+06	Rh-101	8.7E+05	Pm-148m	1.0E+02
Fe-59	1.9E+02	Rh-102	3.0E+05	Sm-145	2.4E+06
Fe-60	8.1E+03	Rh-102m	6.4E+05	Sm-146	4.0E+02
Co-56	3.9E+01	Pd-107	9.3E+06	Sm-151	2.5E+05
Co-57	2.3E+02	Ag-105	3.3E+06	Eu-148	1.1E+06
Co-58	1.3E+02	Ag-108m	1.8E+01	Eu-149	1.1E+07
Co-60	1.7E+01	Ag-110m	2.2E+01	Eu-152	3.1E+01
Ni-59	3.2E+06	Cd-109	1.6E+02	Eu-154	3.1E+01
Ni-63	1.3E+06	Cd-113m	2.0E+04	Eu-155	3.6E+02
Zn-65	1.1E+02	Cd-115m	1.0E+04	Gd-146	5.1E+05
Ge-68	5.6E+02	In-114m	7.7E+02	Gd-148	9.0E+01
As-73	5.3E+02	Sn-113	3.1E+02	Gd-151	2.9E+06
Se-75	6.3E+01	Sn-119m	3.3E+02	Gd-153	2.1E+02
Se-79	8.7E+05	Sn-121m	8.1E+05	Tb-157	2.5E+03
Rb-83	9.1E+01	Sn-123	1.3E+04	Tb-158	9.0E+04
Rb-84	2.0E+02	Sn-126	1.8E+02	Tb-160	1.2E+02
Sr-85	1.2E+02	Sb-124	9.1E+01	Dy-159	1.0E+07
Sr-89	4.8E+05	Sb-125	6.7E+01	Ho-166m	2.1E+01
Sr-90	3.5E+04	Te-121m	1.8E+02	Tm-170	8.4E+03
Y-88	3.3E+01	Te-123m	2.8E+02	Tm-171	2.8E+04
Y-91	5.0E+04	Te-125m	4.4E+02	Yb-169	5.5E+02

Nuclide	Activity (µCi)	Nuclide	Activity (µCi)	Nuclide	Activity (µCi)
Lu-173	1.8E+06	Pb-205	9.0E+01	Pu-241	4.6E+03
Lu-174	9.3E+05	Pb-210	9.2E+01	Pu-242	8.7E+01
Lu-174m	1.0E+06	Bi-207	1.7E+01	Pu-244	9.0E+01
Lu-177m	5.8E+01	Bi-208	1.5E+01	Am-241	7.2E+01
Hf-172	7.3E+04	Bi-210m	1.2E+03	Am-242m	1.1E+02
Hf-175	3.0E+06	Po-209	6.3E+03	Am-243	7.3E+01
Hf-178m	8.7E+03	Po-210	1.2E+03	Cm-241	1.0E+05
Hf-181	3.4E+02	Ra-226	2.2E+02	Cm-242	6.2E+02
Hf-182	7.5E+03	Ra-228	1.5E+03	Cm-243	4.8E+01
Ta-179	9.3E+06	Ac-227	4.2E+00	Cm-244	1.5E+02
Ta-182	7.3E+01	Th-228	8.4E+01	Cm-245	5.0E+01
W-181	1.0E+03	Th-229	3.1E+01	Cm-246	1.0E+02
W-185	3.9E+06	Th-230	5.4E+00	Cm-247	8.5E+01
W-188	6.3E+04	Th-232	9.3E+01	Cm-248	2.8E+01
Re-183	5.3E+02	Pa-231	3.0E+01	Cm-250	5.4E+00
Re-184	2.6E+02	U-232	1.0E+02	Bk-247	6.0E+01
Re-184m	1.5E+02	U-233	3.9E+02	Bk-249	2.7E+04
Re-186m	3.4E+05	U-234	2.9E+02	Cf-248	4.4E+02
Os-185	1.3E+02	U-235	6.7E+01	Cf-249	5.5E+01
Os-194	6.4E+04	U-236	3.1E+02	Cf-250	1.2E+02
Ir-192	1.3E+02	U-238	3.5E+02	Cf-251	5.3E+01
Ir-192m	1.4E+05	Np-235	1.1E+02	Cf-252	5.2E+00
Ir-194m	2.7E+01	Np-236	2.1E+01	Cf-254	1.2E+02
Pt-193	8.7E+07	Np-237	4.9E+01	Es-254	6.3E+01
Au-195	4.8E+02	Pu-236	2.0E+02	Es-255	8.8E+03
Hg-194	5.2E+04	Pu-237	3.3E+02	Fm-257	5.1E+02
Hg-203	4.9E+02	Pu-238	9.0E+01	Md-258	6.1E+02
Tl-204	2.2E+04	Pu-239	8.4E+01		
Pb-202	1.9E+05	Pu-240	8.4E+01		

Any alpha emitting radionuclide not listed above and mixtures of alpha emitters of unknown composition have a value of 10 µCi. [RPP # 281]

With the exception that any type of STC has a value of 10 Ci, any radionuclide other than alpha emitting radionuclides not listed above and mixtures of beta emitters of unknown composition have a value of 100 µCi. [RPP # 282]

Note: Where there is involved a combination of radionuclides in known amounts, derive the value for the combination as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the value otherwise established for the specific radionuclide when not in combination. If the sum of such ratios for all radionuclides in the combination exceeds unity (1), then the accountability criterion has been exceeded. [RPP # 283]

CHAPTER 5
RADIOLOGICAL HEALTH SUPPORT OPERATIONS

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PART 1 - External Dosimetry

511 Requirements

1. ***For the purpose of monitoring individual exposures to external radiation, personnel dosimeters shall [835.402(a)] be provided to and used by:***

   a. ***Radiological workers who, under typical conditions, are likely to receive one or more of the following:***
      - ***An effective dose of 0.1 rem (0.001 Sv) or more in a year; [RPP #74; HSD F.5]***
      - ***An equivalent dose to the skin or to any extremity of 5 rems (0.05 Sv) or more in a year; [RPP #75; HSD F.5]***
      - ***An equivalent dose to the lens of the eye of 1.5 rems (0.015 Sv) or more in a year. [RPP #76; HSD F.5]***

   b. ***Declared pregnant workers who are likely to receive from external sources an equivalent dose to the embryo/fetus in excess of 10 percent of the applicable limit at Table 2-1; [RPP #77]***

   c. ***Occupationally exposed minors likely to receive a dose in excess of 50 percent of the applicable limits at Table 2-1 in a year from external sources; [RPP #78]***

   d. ***Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit at Article 214 in a year from external sources; [RPP #79] and***

   e. ***Individuals entering a high or very high radiation area. [RPP #80]***

2. ***The Project/Activity shall ensure that neutron dosimetry (DOELAP accredited) is provided to and used whenever an individual is likely to meet or exceed any of the criteria in 10 CFR 835.402(a), and 10% or more of the dose is likely to be due to neutron exposure. The Hanford Combination Neutron Dosimeter (HCND) shall be used for personnel who are expected to receive neutron exposure on a regular basis. The contractors may use the Hanford Standard Dosimeter (HSD) for limited monitoring of neutrons where the anticipated neutron dose as read (prior to correction) is less than 100 mrem. When the HSD is to be used for limited monitoring of neutron dose, the contractor shall document the anticipated neutron energy, the likelihood of neutron energy variance and any correction factors used to adjust neutron dose in a technical assessment/basis [HSD F.6]***

3. ***Personnel shall return dosimeters for processing as scheduled or upon request. [HSD F.1, 1st bullet]*** Line management should restrict personnel from continued radiological work until dosimeters are returned.

4. ***Personnel shall wear their primary dosimeters on the chest area, on or between the waist and the neck, or in the manner prescribed by radiological control procedures or work authorizations. [HSD F.1]***

5. ***Personnel shall not wear dosimeters issued by their Project/Activity while doing work and being monitored by a dosimeter at a non-Hanford facility unless authorized by the person's Project/Activity Radiological Control Manager. Personnel shall not expose their dosimeters to security x-ray devices, excessive heat, or medical sources of radiation. [HSD F.2]***
   a. Personnel should notify line management and the Project/Activity Radiological Control Organization of pending offsite work involving expected occupational exposures to radiation or radioactive materials.

   b. For work at offsite facilities that will involve occupational exposure to radiation or radioactive materials, the CHPRC Radiation Protection Program Manager may specify the use of a special Hanford dosimeter during the work.

   c. ***If off-site work is authorized, records of off-site dose shall be submitted for inclusion into the individual's radiation exposure monitoring records within 30 days upon receipt. [HSD F.7]***

6. A person whose dosimeter is lost, damaged, or contaminated should place work in a safe condition, immediately exit the area and report the occurrence to the Project/Activity Radiological Control Organization. Management should approve reentry of the person into areas requiring dosimetry.

7. ***A dose assessment shall be performed for each instance of a lost, damaged or contaminated personnel dosimeter that has been issued to an individual. This dose assessment shall become part of the individual's radiation exposure monitoring records. [HSD F.4]*** In the situation of a lost, damaged, or contaminated dosimeter, the responsible line management should coordinate performance of a dose assessment with the Project/Activity Radiological Control Organization and the CHPRC External Dosimetry Company Technical Authority.

512 Technical Requirements for External Dosimetry

1. ***External dose monitoring programs implemented to demonstrate compliance with Article 511.1 shall [835.402(b)] be adequate to demonstrate compliance with the dose limits in Chapter 2. [RPP # 81] The external dose monitoring program shall [835.402(b)(1)] be accredited in accordance with the DOE Laboratory Accreditation Program for Personnel Dosimetry. [RPP # 82]***

   a. ***A technical basis document shall be developed and maintained for the external dosimetry program. The CHPRC External Dosimetry Company Technical Authority shall review and concur with any revision or change to the external dosimetry technical basis document. [HSD F.3]***

   b. Personnel external dosimeters include but are not limited to TLDs, track etches dosimeters and neutron sensitive film.

   c. For the context of this Manual, reference to the external dosimetry technical basis document pertains to information to be contained in the *Hanford External Dosimetry Technical Basis Manual* (MSA-MA-842 or HNF-55634) or to the Radiation and Health Technology Quality Assurance Program Plan (no number assigned).

d. ***CHPRC shall utilize only external dosimetry programs that have been DOELAP accredited through RL and in accordance with the sitewide external dosimetry technical basis document e. [HSD F.8]***

2. ***Personnel exposures to the skin, lens of the eye, and extremities shall [835.702(c)(3)] be reported separately when monitored. [RPP #149-151]***

3. Multiple whole body dosimetry should be worn to assess the Effective Dose (ED) from external radiation when either of the following two criteria are met:

   a. The calculated ED is expected to exceed the deep plus neutron equivalent dose measured by the reference dosimeter by more than 30%, and is expected to exceed 100 mrem; or

   b. The calculated ED is expected to exceed the deep plus neutron equivalent dose measured by the reference dosimeter by more than 100 mrem.

4. ED should be calculated using the method and compartment weighting factors described in the *Hanford External Dosimetry Technical Basis Manual* (MSA-MA-842 or HNF-55634). The above criteria do not preclude the use of multiple dosimetry if deemed appropriate (e.g. because of uncertainties in worker movement or radiation field strength.)

513 Pocket and Electronic Dosimeters

Pocket and electronic dosimeters are supplemental dosimeters that provide real-time indication of exposure to radiation and assist in maintaining personnel doses less than Administrative Control Levels.

1. ***Personnel shall don supplemental dosimeters prior to entry into a High Radiation or Very High Radiation Area as directed by Article 334. [HSD F.1]***

   a. Supplemental dosimeters should be issued when a person could exceed 10 percent of an Administrative Control Level from external radiation in one workday; or when required by a Radiological Work Permit.

   b. Pocket dosimeters should be selected with the lowest range applicable (typically 0-200 mrem) for anticipated personnel exposures.

2. Supplemental dosimeters should be worn simultaneously with the primary dosimeter and located in accordance with Article 511.4.

3. Supplemental dosimeters should be read periodically while in use in High Radiation or Very High Radiation Areas and should not be allowed to exceed 75 percent of full scale.

4. The energy dependence of supplemental dosimeters, particularly to low-energy beta radiation, should be considered in determining their applicability.

5. Use of electronic dosimeters is encouraged for entry into High Radiation Areas or when planned doses greater than 100 mrem in one workday are expected. An electronic dosimeter provides an early

warning of elevated exposure through the use of alarm set points at specified dose rates or integrated doses.

6. Supplemental pocket or electronic dosimeters used for exposure control should be worn outside the personal protective clothing, in a manner accessible to the worker. Workers should protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches. In other situations the supplemental or electronic dosimeter should be worn inside the personal protective clothing unless directed otherwise by Project/Activity Radiological Control.

514 Area Monitoring Dosimeters

Establishment and maintenance of a comprehensive area monitoring program minimize the number of areas requiring the issuance of personnel dosimeters and demonstrate that doses outside Radiological Buffer Areas are negligible. Minimizing the number of personnel dosimeters issued saves in the costs of operating the dosimetry program and reduces costs associated with maintaining personnel with enhanced training and qualifications.

1. Area monitoring dosimeters should be used to record and document radiation levels in routinely occupied areas adjacent to areas where radiation or operations with radiation exist. 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 dosimeter results may be used to support dosimetry investigations where personnel express concerns about their work environments and exposure to ionizing radiation.

3. Area monitoring dosimeters may be used in Controlled Areas to supplement existing monitoring programs and to provide data in the event of an emergency.

515 Nuclear Accident Dosimeters

1. ***Installations possessing sufficient quantities of fissile material to potentially constitute a critical mass, such that the excessive exposure of individuals to radiation from a nuclear accident is possible, shall [835.1304(a)] provide nuclear accident dosimetry for those individuals. [RPP #243]***

2. ***Nuclear accident dosimetry shall [835.1304(b)] include the following:***

   a. A method to conduct initial screening of individuals involved in a nuclear accident to determine whether significant exposures to radiation occurred; [RPP #244]
   b. Methods and equipment for analysis of biological materials; [RPP #245]
   c. A system of fixed nuclear accident dosimeter units; [RPP #246] capable of measuring the estimated neutron dose and approximate neutron spectrum, ***and***
   d. Personal nuclear accident dosimeters. [RPP #247]

3. The fixed dosimeters discussed above should be:

   a. Capable of determining the neutron dose from 10 rads to approximately 10,000 rads with an accuracy of ±25%.

b. Capable of measuring fission gamma radiation from 10 rads to approximately 10,000 rads in the presence of neutron radiation with an accuracy of approximately ±25%.

4. Personnel nuclear accident dosimeters should be capable of measuring an absorbed dose in or on a phantom from 10 rads to approximately 1,000 rads with an accuracy of ±25%.

5. Personnel nuclear accident dosimeters should be worn by individuals entering an area where a criticality accident alarm system is required.

6. An analysis of the fixed dosimetry system needs should be documented and should consider such factors as the nature of operations, structural design of the facility, area accessibility, number of dosimeters and their location, and the effect of intervening shielding. The analysis should be reevaluated as necessary to ensure facility modifications do not impair the capabilities of the fixed dosimetry system. Reanalysis of fixed nuclear accident dosimetry is not required where the potential for criticality is removed.

7. Placement criteria for Hanford Nuclear Accident Dosimeter are provided in the *Hanford External Dosimetry Program Technical Basis Document* (MSA-MA-842 or HNF-55634).

PART 2 - Internal Dosimetry

521 Requirements

1. ***For the purpose of monitoring individual exposures to internal radiation, internal dosimetry programs (including routine bioassay programs) shall [835.402(c)] be conducted for:***

   a. Radiological workers who, under typical conditions, are likely to receive a committed effective dose of 0.1 rem (0.001 Sv) or more from all occupational radionuclide intakes in a year; [RPP #84]

   b. Declared pregnant workers likely to receive an intake or intakes resulting in an equivalent dose to the embryo/fetus in excess of 10 percent of the limit stated at Table 2-1; [RPP #85]

   c. Occupationally exposed minors who are likely to receive a dose in excess of 50 percent of the applicable limit stated at Table 2-1 from all radionuclide intakes in a year; [RPP #86] or

   d. Members of the public entering a controlled area likely to receive a dose in excess of 50 percent of the limit stated at Article 214 from all radionuclide intakes in a year. [RPP #87]

   e. The following are example activities that have the potential to result in a committed effective dose of 0.1 rem or more in a year:

      - Work involves the use of a respiratory protection device and involves actually working with, or contact with the radioactive material. It is not intended to include occasional observation, unrelated work in the same room, or other activities involving much less risk of contamination.

- Work occurring in a High Contamination Area that involves contact with or disturbance of the contamination.

- 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, it is unlikely that a worker would exceed a 100 mrem unless workplace monitoring indicates that a loss of control of the material occurred. (See criteria for follow-up bioassay, Article 522.7.)

- Work with contaminated soil at or exceeding values listed in Table 5-2.

- Exposure to low-level airborne activity, below posting requirements, such that the total exposure for a year would exceed 40 DAC-hours.

Criteria for Considering Bioassay Monitoring [a]
Table 5-1

Type of Material[b]	Activity (uCi)[c, d]								
	General Contamination/Liquids			Powders			Spotty		
	Bench Top	Fume Hood	Glovebox	Bench Top	Fume Hood	Glovebox	Bench Top	Fume Hood	Glovebox
Pu, Am-241, Pu mixtures with Am	0.96	96	9600	0.096	9.6	960	9.6	960	9.60E04
U, very soluble, Types F	96	9.60E03	9.60E05	9.6	960	9.60E04	960	9.60E04	9.60E06
U, moderate to insoluble, Types M & S	13.4	1.34E03	1.1.34E05	1.34	134	1.34E04	134	1.34E04	1.34E06
Th-232, Types M & S	0.56	56	5.6E03	.056	5.6	560	5.6	560	5.6E04
Sr-90, soluble, Type F	2320	2.32E05	2.32E06	232	2.32E04	2.32E06	2.32E04	2.32E06	2.32E08
Cs-137, Type F	1.60E04	1.60E06	1.60E8	1.60E03	1.60E05	1.60E07	1.60E05	1.60E07	1.60E09
Radiolodines, half-life >1 day <1 yr	3840	3.84E05	3.84E07	384	3.84E04	3.84E06	3.84E04	3.84E06	3.84E08
Iodine-129	960	9.6E04	9.6E06	96	9600	9.6E05	9600	9.6E05	9.6E07
Tritium (HTO) (nucleotide precursors)	6.00E06	6.00E08	6.00E10	6.00E05	6.00E07	6.00E09	6.00E07	6.00E09	6.00E11
C-14 (all conditions)	1.84E05	1.84E07	1.84E09	NA	NA	NA	NA	NA	NA
Tc-99	3.36E04	3.36E06	3.36E08	3.36E03	3.36E05	3.36E07	3.36E05	3.36E07	3.36E09

Notes:
(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 Dosimetrist for guidance.
(c) Divide a value above by 10 if cutting, grinding, heating, or chemical reactions (exothermic) are occurring (anything energy adding).
(d) Calculations based on most restrictive ALI and daily occupancy. Numbers may be adjusted based on actual occupancy by multiplying applicable value by 25 (Monthly exposure), 5 (Weekly exposure) or 250 (One exposure).

Criteria for Considering Bioassay Monitoring for Work Involving Exposure to Contaminated Soil[a]
Table 5-2

(Technical information from Hanford Internal Dosimetry Project Manual (MSA-MA-552 or HNF-55719)

Nuclide, Form[b]	Soil Concentration (pCi/g)[c]	
	Acute[d]	Chronic[e]
Uranium – Total[f]		
Type M	40,000	1,000
Type S	10,000	400
Plutonium-α		
Type M	2,000	70
Type S	9,000	300
Thorium-232 Type M	500	15
Thorium-228 Type M	2,700	80
Strontium-90 Type F	2,000,000	70,000
Cesium-137 Type F	11,000,000	300,000
Cobalt-60 Type S	4,000,000	100,000
Tritium in groundwater[g]	6,000 µCi/L	24 µCi/L

Notes:
(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 5-µm AMAD soil dust in a single exposure.
(e) Assumes a 48-mg/day inhalation intake rate of 5-µm AMAD soil dust particles for 250 working days/year (12g/yr). Exposure is comparable to OSHA 5-mg/m^3 respirable particle fugitive dust standard on a 8-h time-weighted average basis.
(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 (0.25L) or chronic consumption of one cup (0.25 L) per day of groundwater at the indicated contamination.

2. ***The estimation of internal dose shall [835.209(b)] be based on bioassay data rather than air concentration values unless bioassay data are:***

   a. unavailable;
   b. inadequate; or
   c. internal dose estimates based on air concentration values are demonstrated to be as or more accurate. [RPP #63]

3. Personnel should participate in follow-up bioassay monitoring when their routine bioassay results indicate an intake in the current year with a committed effective dose of 100 mrem or more.

4. Personnel whose routine duties may involve exposure to surface or airborne contamination or to radionuclides readily absorbed through the skin, such as tritium, should be considered for participation in the bioassay program.

5. Personnel should submit bioassay samples, such as urine or fecal samples, and participate in bioassay monitoring, such as whole body or lung counting, at the frequency required by the bioassay program.

6. Personnel should be notified of positive bioassay results and the results of dose assessments and subsequent refinements in accordance with the requirements of Article 781. Dose assessment results should be provided in terms of rem or mrem.

7. ***Bioassay monitoring to satisfy the requirements may be routine, confirmatory, 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. [HSD G.2]***

8. In general, the 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 CHPRC Internal Dosimetry Company Technical Authority should be contacted for specific guidance.

9. Broad scope bioassay programs should 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.

10. The Project/Activity Radiological Control Manager should be notified when planned or installed engineered controls that prevent worker exposure to airborne radioactivity, such as barriers, gloveboxes and glovebags, are compromised.

    a. An evaluation should be made with participation of project or activity radiological personnel of the need for continuing operations with compromised engineered controls.

    b. The use of respiratory protection to continue activities under these conditions is discouraged.

    c. Implementation of short-term engineered modifications that provide a commensurate level of worker protection is the preferred alternative.

522 Technical Requirements for Internal Dosimetry

1. ***Internal dose monitoring programs implemented to demonstrate compliance with Article 521.1 a, b, c, and d shall [835.402(d))] be adequate to demonstrate compliance with the dose limits established in Table 2-1 and Article 214.1. [RPP # 88] [HSD G.3] The internal dose monitoring programs shall [835.402(d)(1)] be accredited in accordance with DOE Laboratory Accreditation Program for Radiobioassay. [RPP #89)]***

2. ***CHPRC shall utilize only direct and indirect radiobioassay programs which have been DOELAP accredited through RL. [HSD G.7]***

3. ***A technical basis document shall be developed for the internal dosimetry program. [HSD G.4]***

   a. The CHPRC Internal Dosimetry Company Technical Authority shall review and concur with any revision or change to the internal dosimetry technical basis document. [HSD G.3]
   b. The CHPRC internal dosimetry program shall be performed in accordance with the Hanford sitewide internal dosimetry technical basis document. [HSD G.2]
   c. For the context of this Manual, reference to the internal dosimetry technical basis document pertains to information contained in the current version of:

      - *Hanford Internal Dosimetry Project Manual*, (MSA-MA-552 or HNF-55719)
      - *Methods and Models of the Hanford Internal Dosimetry Program*, (MSA-MA-860 or HNF-55720)

4. ***Management shall ensure that appropriate bioassay monitoring methods, analytical procedures, and frequencies for the collection of bioassay samples, such as urine or fecal samples, and appropriate participation in bioassay monitoring, such as whole body or lung counting are established for personnel who are likely to receive intakes in a calendar year resulting in a committed effective dose greater than 100 mrem [HSD G.3]***

5. ***Routine bioassay monitoring methods and frequencies shall be established for personnel who are likely to receive intakes resulting in a committed effective dose greater than 100 mrem. [HSD G.1]*** CHPRC will document the technical basis for the methods and frequency of bioassay monitoring.

6. ***Management shall require termination bioassay monitoring when a person who participated in the routine bioassay program terminates employment or concludes work involving the potential for internal exposure. [HSD G.1]***

   a. End of assignment bioassay should be performed when future potential exposure is not anticipated.

   b. Bioassay is not required when it is documented in the worker's exposure file that the worker was not potentially exposed to unencapsulated material in the workplace.

7. ***Bioassay analyses shall [835.402(c)(1)] also be performed when any of the following occurs:***

   a. Facial or nasal contamination is detected that indicates a potential for internal contamination;

   b. Airborne monitoring indicates the potential for intakes exceeding 100 mrem committed effective dose; or

   c. When directed by the Radiological Control Organization. [RPP #84]

8. Levels of intakes that warrant the consideration of medical intervention should be established for site-specific radionuclides. The effectiveness of medical intervention, such as blocking or chelating agents, should be documented using bioassay results.

9. A preliminary assessment of any intakes detected should be conducted prior to permitting an employee to return to radiological work.

10. Internal dosimetry program personnel should use radionuclide standards from or traceable to the National Institute of Standards and Technology (NIST).

523 Technical Requirements for Dose Assessment

1. ***Interpretation of bioassay results and subsequent dose assessments shall [HSD G.4] include the following:***

   a. Characteristics of the radionuclide(s), such as chemical and physical form [HSD G.4.a]
   b. Bioassay results and the individual's previous exposure history pertinent to the dose assessment. [HSD G.4.b]
   c. Exposure information, such as route of intake and time and duration of exposure. [HSD G.4.c]
   d. Biological models used for dosimetry of radionuclides. [HSD G.4.d]
   e. Models to estimate intake or deposition and to assess dose. [HSD G.4.e]

2. There should be coordination of the Project/Activity Radiological Control Organization and the medical Organization for doses that may require medical intervention. The Hanford Internal Dosimetry Project should be included in coordination for evaluation of doses that require medical intervention.

3. ***The contractor shall use air monitoring data to assess and assign internal dose when:***

   a. The accumulated exposures to airborne radioactivity exceed 40 DAC-hrs in a calendar year, and,
   b. The minimum detectable dose for the applicable bioassay technology available at Hanford exceeds the anticipated dose (committed effective dose) from these exposures. [HSD G.5]

4. ***The contractor shall develop and maintain a technical basis document for the collection, analysis, and assessment of air monitoring data used to assess and assign internal dose. [HSD G.6]***

PART 3 - Respiratory Protection Program

531 Requirements

1. Containment of radioactivity at the source to limit respiratory protection use should be utilized through the implementation of engineered controls and work practices.

2. Respirators, used for radiological controls, should be issued only to personnel who are trained, fitted and medically qualified to wear the specific type of respirator.

    a. Half-face respirators should not be used 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.

PART 4 - Handling Radiologically Contaminated Personnel

541 Skin Contamination

1. Radiological monitoring should be performed to determine the extent of skin contamination.

2. When personnel detect skin contamination, they should notify the Project/Activity Radiological Control Organization.

3. The extent of the skin contamination location should be determined prior to initiating decontamination procedures.

4. Skin decontamination methods should be established for site-specific radionuclides. Skin abrasion should be avoided during the decontamination process. Intrusive decontamination methods, such as tissue removal, require medical assistance.

5. Levels of skin contamination that trigger the need for dose assessments should be established for site-specific radionuclides. These trigger levels should not exceed 100 mrem.

6. Personnel with skin contamination that triggers the need for dose assessment should be informed of the initial dose estimate to 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 will be conducted in accordance with Appendix 2C and, promptly after completion, the results should be explained to the persons affected.

542 Contaminated Wounds

1. Emergency medical care should be administered immediately for injuries involving radioactive materials. Medical treatment of injuries takes precedence over radiological considerations.

2. The treatment of contaminated injuries should include the following:

   a. Treatment of contaminated wounds by medically qualified personnel;
   b. Monitoring of wounds and associated bandages for contamination, including alpha emitters, if applicable;
   c. Identification of the radionuclides involved;
   d. Medical determination of the need for therapeutic intervention such as blocking or chelating agents;
   e. Initiation of appropriate bioassay monitoring; and
   f. Determination of need for work restrictions.

3. An injured person should be counseled promptly on the medical and radiological implications resulting from contaminated wounds that result in internal doses greater than 2 percent of the Table 2-1 limits. Radiological control and medical professionals should perform the counseling.

543 Exposures to Airborne Radioactivity

Potential intakes of radioactive material are indicated when personnel without respiratory protection are exposed to airborne radioactivity or when respiratory protection has been compromised. If intakes of radioactive material are indicated which could result in an individual receiving a committed effective dose greater than 100 mrem, the following actions should be taken:

1. Identify personnel potentially exposed to airborne radioactivity;

2. Obtain nasal smears for qualitative indication of intakes, where appropriate;

3. Analyze air samples to determine airborne concentrations, where appropriate;

4. Determine duration of potential exposure to airborne radioactivity;

5. Perform bioassay appropriate for the type and quantity of radionuclides involved; and

6. Evaluate dose prior to permitting the worker to return to radiological work.

PART 5 - Radiological Monitoring and Surveys

551 Requirements

1. ***Monitoring of individuals and areas shall [835.401(a)] be performed to:***

    a. Demonstrate compliance with the requirements of this Manual [RPP #64];
    b. Document radiological conditions; [RPP #65]
    c. Detect changes in radiological conditions; [RPP #66]
    d. Detect the gradual buildup of radioactive material; [RPP #67]
    e. Verify the effectiveness of engineered and administrative controls in containing radioactive material and reducing radiation exposure; [RPP #68] and
    f. Identify and control potential sources of individual exposure to radiation and/or radioactive material. [RPP #69]

2. Monitoring performed to evaluate radiological conditions or evaluate items or materials for clearance will be performed by RCTs qualified in accordance with Article 642.

3. Radiological monitoring for radiation, contamination, and airborne radioactive materials should be performed as specified in Technical Work Documents and Radiological Work Permits.

4. The Project/Activity should perform and document a review of the adequacy of radiological sampling and monitoring systems as part of any facility modification or operational changes. In absence of such changes, a review should be conducted and documented annually.

5. ***Instruments and equipment used for monitoring shall [835.401(b)] be:***

    a. Periodically maintained and calibrated on an established frequency; [RPP #70]
    b. Appropriate for the type(s), levels and energies of the radiation(s) encountered; [RPP #71]
    c. Appropriate for the existing environmental conditions; [RPP #72] and
    d. Routinely tested for operability. [RPP #73]

6. Performance testing requirements for portable radiological survey instruments are identified in ANSI N323-1978 and ANSI N323A-1997. The ANSI standards include requirements for a daily, or prior to intermittent use, response check with a ± 20% variation. Compensatory actions should be established to ensure proper instrument performance when performance tests are not feasible, such as with instruments used to measure neutrons or tritium.

7. Reserved

8. Assessment of radiological conditions should include a sufficient number of survey points to characterize the radiation present and to verify boundaries.

9. Surveys should be performed before, during and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity.

10. ***Survey frequencies shall [835.401(a) and 835.1102(a)] be established based on potential radiological conditions, probability of change in conditions and area occupancy factors. [RPP #64-69 & 219]***

11. Monitoring results should be reviewed by the cognizant radiological supervisor. The review should ensure that all required surveys have been performed and that the documentation is accurate and complete.

12. Results of current surveys or survey maps should be conspicuously posted to inform personnel of the radiological conditions. As an alternative, the work document may require use of the pre-job brief to inform personnel of current radiological conditions.

13. Monitoring results should be made available to line management and used in support of pre- and post-job evaluations, ALARA preplanning, contamination control and management of radiological control operations.

14. Monitoring data in each building or area should be compiled and reviewed at least quarterly or upon entry (or if entries are performed less frequently than quarterly then compare to previous data). Negative changes or trends should be documented and corrective action initiated, as appropriate.

552 Radiation Exposure Surveys

1. In addition to the requirements of Article 551, unless the survey frequency has been reduced and specifically identified in an approved Radiation Protection Technical Equivalency Determination (see Article 113.3), routine radiation surveys should be performed in accordance with the following minimum frequencies:

    a. Weekly, in routinely occupied Radiological Buffer Areas and Radiation Areas;
    b. Upon initial entry, weekly during continuing operations, and when levels are expected to change in High Radiation Areas;
    c. Weekly, for temporary Radiation Area boundaries to ensure that Radiation Areas do not extend beyond posted boundaries;
    d. Monthly, or upon entry, if entries are less frequent than monthly for Radioactive Material Areas; and
    e. Monthly, for potentially contaminated ducts, piping and hoses in use outside radiological facilities.

2. Unless the survey method is specifically identified in an approved Radiation Protection Technical Equivalency Determination (see Article 113.3) performance of radiation surveys should include dose rate measurements of the general area, dose rates at a distance of 30 centimeters from a source or surface of interest to evaluate potential whole body exposures, and dose rates on contact with sources of radiation where there is a potential for hands-on work.

3. 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.

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 with the potential for unexpected 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 a workplace.

3. In addition to the requirements of Article 561, area radiation monitors 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.

4. If 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.

5. ***Where an area radiation monitor is incorporated into a safety interlock system the circuitry shall be such that a failure of the monitor should either prevent entry into the area or prevent operation of the radiation-producing device. [HSD H.3]***

554 Contamination Surveys

1. In addition to the requirements of Article 551, unless the survey frequency has been reduced and specifically identified in an approved Radiation Protection Technical Equivalency Determination (see Article 113.3), routine contamination surveys should be conducted in Radiological Buffer Areas established for the control of contamination and other areas with the potential for spread of contamination in accordance with the following minimum frequencies:

    a. Daily, at contamination area control points, PPE removal areas, or step-off pads when in use, or per shift in high use situations;

    b. Weekly, in lunch rooms or eating areas near Radiological Buffer Areas;

    c. Weekly, in routinely occupied Radiological Buffer Areas;

    d. Weekly, or upon entry if entries are less frequent, in areas where packaged radioactive materials are handled or stored except for the following approved conditions:

        1. Monthly or upon entry in radioactive materials established solely to store radioactive material packaged in compliance with DOT regulations; or
        2. Semi-annually for locations containing only sealed radioactive sources;

e. Weekly, or upon entry if entries are less frequent, where contamination boundaries or postings are located;

f. At a minimum, an annual inspection and radiological survey to verify control and labeling of Fixed Contamination Areas should be performed.

2. Surveys for the release of materials should be conducted in accordance with Articles 421 and 422.

3. Items with inaccessible surfaces which were located in known or suspected contamination areas and had the potential to become contaminated at levels likely to exceed Table 4-1 values should be treated as potentially contaminated and subject to administrative controls unless the items are dismantled and monitored or special survey techniques are used to survey all surfaces.

4. Swipe surveys for removable contamination should be recorded in units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). For swipe surveys of small items covering less than 100 cm^2, the results should be recorded in units of dpm per area swiped. If contamination levels exceed the range of the available count rate meters, the swipes should be analyzed by holding an appropriate exposure rate meter within one half inch and the results should be recorded in units of millirad or rad per hour.

5. Large area wipes are encouraged. LAW should be used to supplement standard swipe techniques in areas generally assumed to be non-contaminated, such as entrances to Radiological Buffer Areas. If an evaluation indicates that an area wiped is contaminated, a thorough contamination swipe survey should be performed.

6. Areas identified as either contaminated with, or having the potential for being contaminated with, highly radioactive particles ("hot particles") should be surveyed weekly. These areas should be surveyed at least daily during periods of work that may result in the generation of hot particles. Special swipe techniques to collect hot particles, such as tape and large area wipes, should be used.

555 Airborne Radioactivity Monitoring

1. In addition to the requirements of Article 551, air monitoring equipment should be used in situations where airborne radioactivity levels can fluctuate and early detection of air-borne radioactivity could prevent or minimize inhalation of radioactivity 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. ***Monitoring of airborne radioactivity shall [835.403(a)] be performed:***

   a. Where an individual is likely to receive an exposure of 40 or more DAC-hours in a year, [RPP #91] or
   b. As necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed. [RPP #92]

3. ***Real-time air monitoring shall [835.403(b)] be performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material. [RPP #93]***

a. Real-time air monitoring equipment should be installed where unexpected increases in airborne radioactivity levels, should they occur, are likely to result in an exposure exceeding 40 DAC-hours in one week. Such exposures could result from a breakdown of engineered controls or improper establishment of boundaries during work that creates airborne radioactivity.

4. Air sampling equipment should be positioned to measure air concentrations to which persons are exposed. If this cannot be achieved, a program of personal breathing-zone air sampling should be initiated.

5. Air monitoring equipment should be routinely calibrated and maintained on an established frequency.

   a. Continuous air monitors should be capable of measuring 1 DAC when averaged over 8 hours (8 DAC-hours) under laboratory conditions.
   b. Air flow meters, differential pressure indicators, and other devices used to determine volumetric flow rates of air samplers and monitors should be calibrated to within ±10% of the full scale.
   c. Calibrations should be performed annually at the atmospheric pressure and temperature conditions that are expected during sampling conditions, or the appropriate correction factor should be applied during the calculation of the flow rate.

6. Continuous air monitoring equipment required by Article 555.3 should have alarm capability and sufficient sensitivity to alert personnel that immediate action is necessary in order to minimize or terminate inhalation exposures.

7. ***The proper operation of continuous air monitoring equipment shall [835.401(b)(4)] be routinely tested by performing an operational check. [RPP #73]*** Operational checks should include positive airflow indication, non-zero response to background activity, and internal check sources, or 60 Hz electronic checks when available. Continuous air monitoring equipment should be verified weekly by checking for instrument response with a check source or with ambient levels of radon and thoron daughters.

8. Preliminary field assessments of special air samples meeting criteria of 555.9 should be performed promptly upon removal. In situations where background levels of radon and thoron daughters interfere with evaluation of alpha air samples, prompt field assessments may not be possible. Prompt field assessments are not required for fixed-location, portable, or personal air samples used to routinely sample the individual's breathing environment unless upset conditions are identified or suspected.

9. Air sample results should be evaluated as quickly as practicable to determine the need for respiratory protection, area evacuation (if necessary), worker intake and worker relief from respirator use.

PART 6 - Instrumentation and Calibration

561 Inspection, Calibration and Performance Tests

1. ***Radiological instruments and equipment shall [835.401(b)(1)] be periodically maintained and calibrated on an established frequency. [RPP #70]***

   a. Radiological instruments and equipment shall [835.401(b)(2)] be used only to measure the radiation for which their calibrations are valid. [RPP #71]

   b. ***ANSI N323-1978 or*** ANSI N323A-1997 ***shall be used for calibration of radiological measurement instruments used to support the occupational radiation protection program. [HSD H.2]***

   c. Calibrations shall use National Institute of Standards and Technology (NIST) or equivalent traceable sources. [HSD H.1]

2. Calibration procedures should be developed for each radiological instrument type and should include frequency of calibration, precalibration requirements, primary calibration requirements, periodic performance test requirements, calibration record requirements and maintenance requirements.

3. ***All radiological monitoring instruments, including pocket and electronic dosimeters and area radiation monitoring, shall [835.401(b)(1)] be maintained and calibrated on an established frequency. [RPP #70]***

4. ***The effects of environmental conditions, including interfering radiation, on an instrument shall [835.401(b)(3)] be known prior to use. [RPP #72]***

5. Functional tests should be used to assess instrumentation designs that include alarms or that involve a process control. A functional test should be developed to periodically test all components involved in an alarm or trip function.

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 shall be performed for use of instrumentation outside manufacturer's specifications. The instrument shall be adjusted, calibrated and labeled to identify the special conditions and used only under the special conditions for which it was calibrated. [RPP #71 & 72]***

7. Instruments should bear a label or tag with the date of calibration and date calibration expires.

8. ***The Project/Activity shall evaluate the potential radiological consequences and document any corrections to the original monitoring results upon determination of the use of an out-of-calibration or failed radiation measurement instrument. [HSD H.4]***

   a. If the evaluation determines an impact on survey results, the Project/Activity Radiological Control Organization should review surveys performed with the instrument while it was out of calibration.

562 Maintenance

1. A program for preventive and corrective maintenance of radiological instrumentation should be established and documented.

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.

3. ***Radiological instruments shall [835.401(b)(1)] undergo calibration prior to use following any preventive or corrective maintenance or any adjustment that voids the previous calibration. A battery change is not normally considered maintenance. [RPP #70]***

563 Calibration Facilities

1. ***Calibration facilities shall [835.703(d)] take the following actions: Generate records of calibration, functional tests, and maintenance in accordance with the referenced standards. [RPP #168]***

2. Self-performed work documents, work orders and contracts should obtain services that are compliant with Article 561 through 563.

3. Calibrations of available ranges that are not intended for use do not need to be conducted, providing the specific limitations on instrument use are clearly marked on the instrument.

CHAPTER 6
TRAINING AND QUALIFICATION

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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 As-Low-As-Reasonably-Achievable (ALARA). Training requirements in this chapter apply to personnel entering CHPRC sites, facilities, or activities. Each CHPRC Activity/Facility is responsible for facility specific radiological training necessary for ensuring compliance.

Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this Manual shall [835.103] have the appropriate education, training, and skills to discharge these responsibilities. [RPP #30] [HSD I.1]

This Chapter reflects the Hanford Site consistency criteria approved by the Hanford Radiological Control Forum and directed by the CHPRC Radiation Protection Program Manager. [HSD I.4 & I.6]

612 Standardization

1. ***Radiological training courses and training material shall utilize DOE standardized core-training material to the maximum extent practical. Activity/Facility-specific information shall supplement the training materials [HSD I.2]***

2. RESERVED

3. ***Documentation of previous training shall [835.704(a)] include the individual's name, date of training, topics covered, and the name of the certifying official. [RPP #169]***

4. Activity/Facility-specific aspects of the radiological training, OJTs, and Oral Boards should be completed. Activity/Facility-specific training for General Employee Radiological Training and Radiological Worker I and II training may be included with other training.

5. The training may be Activity/Facility-specific if personnel access is limited to those facilities for which training has been completed.

6. The Activity/Facility Radiological Control Manager for each organization or a designee should concur in radiological training material specifically generated for that organization.

7. ***Course content, examinations, performance demonstrations, and requalification, for GERT, Radiological Worker I, Radiological Worker II, will be sufficiently consistent to maintain reciprocity of this training between contractors for core training materials and Hanford site-specific training. [HSD I.4]***

613 Requirements

1. ***Radiation safety training shall [835.901(c)] include the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards [RPP # 190]:***

   a. ***Risks of exposure to radiation and radioactive materials, including prenatal radiation exposure; [RPP #191]***

   b. ***Basic radiological fundamentals and radiation protection concepts; [RPP #192]***

   c. ***Physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented at the facility to manage doses and maintain doses ALARA, including both routine and emergency actions; [RPP #193]***

   d. ***Individual rights and responsibilities as related to implementation of the facility radiation protection program; [RPP #194]***

   e. ***Individual responsibilities for implementing ALARA measures; [RPP #195] and***

   f. ***Individual exposure reports that may be requested in accordance with Article 781.1-781.6. [RPP #196]***

2. Training should address both normal and abnormal situations in radiological control.

3. The need for activity specific training should be identified through the use of a systematic approach to training task analysis or job hazard analysis.

4. General Employee Radiological Training

   Each individual shall [835.901(a)] complete radiation safety training on the topics established at Article 613.1 commensurate with the hazards in the area and the required controls: [RPP # 184]

   a. Before being permitted unescorted access to controlled areas; and [RPP # 185]

   b. Before receiving occupational dose during access to controlled areas at a DOE site or facility. [RPP # 186]

   NOTE: General Employee Radiological Training (GERT) is used to satisfy this 10 CFR 835 requirement.

5. ***GERT satisfies the orientation required by the Health and Safety Document. [HSD I.7 and Table 2]***

a. HGET, which includes GERT, is performed as required by the Hanford Site Access Training Program Description.

b. The time interval to conduct these activities may be extended by a period not to exceed 30 days to accommodate scheduling needs (See Article 113.1). See Part 2 of this Chapter for additional requirements for implementing GERT.

6. Radiological Worker Training

Each individual shall [835.901(b)] demonstrate knowledge of the radiation safety training topics established in Article 613.1, commensurate with the hazards in the area and required controls, by successful completion of an examination and performance demonstrations: [RPP #187]

a. Before being permitted unescorted access to radiological areas; and [RPP #188]

b. Before performing unescorted assignments as a radiological worker. [RPP #189]

7. Radiological Worker I and Radiological Worker II, augmented by Activity/Facility specific training, are used to satisfy the 10 CFR 835 requirements for unescorted access to radiological areas as specified in Table 6-1.

a. On-the-Job Training (OJT) and specialized training courses, such as for containment installation, inspection and use, are provided as appropriate to fully meet the requirements of 10 CFR 835 for performing unescorted assignments as a radiological worker.

b. The job hazard analysis and work planning process may identify the need for additional job specific training.

8. ***Radiation safety training shall [835.901(e)] be provided to individuals when there is a significant change to radiation protection policies and procedures that may affect the individual and at intervals not to exceed 24 months. [RPP #199] Such training provided for individuals subject to the requirements of Articles 613.6.a and 613.6.b shall [835.901(e)] include successful completion of an examination. [RPP #200]***

9. The time interval to conduct these activities may be extended by a period not to exceed 30 days to accommodate scheduling needs (See Article 113.1). See Part 3 of this Chapter, Radiological Worker Training, for additional requirements.

10. ***Examinations for Radiological Worker I and II training and Radiological Control Technician qualification shall [835.901] be used to demonstrate satisfactory completion of theoretical and classroom material. [RPP #187]*** Examinations should be written; however, the CHPRC Radiation Protection Director may approve alternatives to accommodate special needs. Alternative examinations should be equivalent in content to written examinations. The examination process should require:

a. That a minimum passing score be established;

b. That true/false questions not be included;

c. Use of questions randomly selected from the question bank;

d. Acknowledgment by signature that the student participated in a post-examination review;

e. That competence in required skills is measured using performance-based examinations;

f. Remedial actions for failure to meet the minimum score; and

g. That the question bank contains questions that test what the student is expected to remember months after the training rather than to test short-term memory of theoretical material.

11. ***Examination and performance demonstrations, appropriate to the level of training, for initial and biennial qualification (not to exceed 24 months) shall be conducted for Radiological Worker I, Radiological Worker II, and Radiological Control Technician qualification. [HSD I.3]***

12. Site-specific training and refresher training should include changes in requirements and updates of radiological lessons learned from operations and maintenance experience and occurrence reporting, for the site and across the DOE complex.

13. Training programs developed for radiological control should meet the requirements for performance-based training.

14. Reading and comprehension skills in the English language are generally necessary for General Employee Radiological Training.

    a. The CHPRC Radiation Protection Director is authorized to approve alternative temporary training methods for those lacking reading and comprehension skills in the English language until adequate English language skills can be achieved.

    b. Training in an alternate language should be equivalent to training in English.

    c. The use of trained escorts provides an alternative to training with the concurrence of the CHPRC Radiation Protection Director.

614 Instructor Training and Qualifications

1. All instructors should be qualified in accordance with the CHPRC Instructor Qualification Program or possess equivalent qualifications.

2. A minimum of a high school diploma is required.

3. Radiological instructors should have two years of related experience and at least 3 months of DOE related radiological experience.

4. Instructors should have the technical knowledge, experience and instructional skills required to fulfill their assigned duties.

5. Instructors-in-training should be monitored by a qualified instructor.

6. Subject matter experts without instructor qualification may provide training in their area of expertise. However, these subject matter experts should be trained as instructors when this occurs routinely.

615 Key Radiological Control Positions

NOTE: The below criteria are consistent or equivalent with the guidelines provided in DOE-STD-1107-97, Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities.

1. ***Key Radiological Control positions for CHPRC radiological activities are based on DOE STD 1107-97, Appendix A and identified in Table 6-0. [HSD B.1, B.3] Training and Qualification requirements for these positions are defined in the Training Program Descriptions. [HSD B.2]*** Table 6-0 lists these key positions.

CHPRC Radiological Control Key Positions
Table 6-0

Example CHPRC Key Position Title	Training Requirement Location - Article	DOE STD 1107-97 Equivalent Title
o Radiation Protection Director	651.1	o Rad Con Manager
o Rad Con First Line Manager o Rad Con Supervisor	641, 646 & 651.4	o Radiological Technician Supervisor
o Radiation Protection Program Manager o Project Rad Con Manager o Activity/Facility Rad Con Manager o 10 CFR 835 Interpretive Authority o Rad Con Engineer o Health Physicist o Dosimetrist o Technical Specialist o Subject Matter Expert o Technical Support Staff	652	o Radiological Control Senior, Technical and Support Staff
o Senior Radiological Control Technician – Lead Assignment	Part 4; Articles 641- 645 and 647	o Senior Radiological Control Technician
o Radiological Assessor	654	o Radiological Assessor
o Radiological Trainer o Radiological Instructor	614	o Radiological Control Instructor

2. Training Equivalencies, Waivers, and Extensions should be issued in situations where the most effective individual for the position does not satisfy the above qualifications. Education and experience requirements should be based on DOE STD 1107-97, where applicable.

3. Temporary assignment of personnel who do not fully satisfy the requirements of this Manual may occur with approval of the CHPRC Radiation Protection Director. The following factors should be considered.

   a. The individual is supported by the collective experience and knowledge of other personnel within the Activity/Facility.

   b. Temporary upgrades should, at a minimum, meet the requirements of the next lower functional position.

   c. Temporary assignments should be justified and a time period for the assignment specified.

   d. The individual should meet any special requirements specified for the temporary assignment.

PART 2 General Employee Radiological Training

621 General Employees

1. ***Individuals shall [835.901(a)] complete General Employee Radiological Training in accordance with the requirements of Article 613.4. [RPP #184]*** Proof of completion of a DOE Site or activity Radiation Worker qualification satisfies the requirements for GERT.

2. ***Individuals who maintain qualification as a Radiological Worker I, Radiological Worker II, or Radiological Control Technician, satisfy the requirements for GERT [835.901(a)]. [RPP #184]***

3. Proof of completion of a DOE Site or activity Radiation Worker qualification satisfies the requirements for GERT.

622 Radiological Training for Members of the Public

1. ***Members of the public shall [835.901(a)] receive radiation safety training prior to being permitted unescorted access to Controlled Areas.***

   a. ***This training shall [835.901(c)] address the radiation safety training topics in Article 613.1 to the extent appropriate for the degree of exposure to radiological hazards that may be encountered. [RPP #184]***

   b. Members of the public should receive the same level of training as general employees in accordance with the requirements of Articles 613.3, 613.4, 613.5 or 635, as applicable.

2. Information may be communicated by videotape or handout to personnel entering a site. An examination is not required.

3. Records of the training should be maintained as directed by Article 724.3. Visitor sign-in logs may be used as training records.

4. The training for continuously escorted individuals or groups should be commensurate with the areas to be visited. Records of training for such individuals or groups should be retained as directed by Article 724.

PART 3 Radiological Worker Training

631 Requirements

1. Table 6-1 defines the minimum Radiological Worker I and II training requirements for unescorted entry into the listed areas.

2. Additional radiological training may be identified through the hazard analysis process or be required based on special job functions in accordance with Article 634.

   a. The training should include tasks specific to an individual's job assignment.

   b. The level of training is to be commensurate with each worker's assignment.

   c. Additional training may be required based on the potential radiological hazards, potential for change in radiological condition, or worker skill and proficiency.

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 should be completed. The proficiency evaluation portion cannot be challenged.

4. Radiological Worker I training is not a prerequisite for Radiological Worker II training.

5. Radiological Worker I and Radiological Worker II training are 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 higher levels of radiation and radioactive contamination.

632 Radiological Worker I

1. Workers whose job assignments require access to Radiological Buffer Areas, Radiation Areas and Radioactive Material Areas should complete Radiological Worker I training and applicable Activity/Facility-specific Radiological Worker I training before being permitted to enter these areas without a qualified escort.

2. Radiological Worker I training, including High/Very High Radiation Area training (Article 632.3), should encompass at a minimum the following practical factors:

a. Entering and exiting simulated Radiological Buffer Areas and Radiation Areas (and High/Very High Radiation Areas when such training is included)

b. Performance of frisking for personnel contamination, as applicable

c. Verification of instrument response and source check

d. Anticipated response to alarm situations.

Training Requirements for Unescorted Entry
Table 6-1

AREAS	RADIOLOGICAL WORKER I	RADIOLOGICAL WORKER II
Entry into Radiological Buffer Areas	YES	YES
Entry into Radiation Areas	YES	YES
Entry into High or Very High Radiation Areas*	NO**	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***
Entry into Radioactive Material Areas ****	YES	YES

*Entry requirements further restricted by Article 334.
**Entry prohibited unless trained in accordance with Article 632.3
***Requires respiratory protection qualification (Article 531)
****Entry requirements further restricted by Article 333.

3. Unescorted worker access to High or Very High Radiation Areas is permitted upon successful completion of Radiological Worker I training and High/Very High Radiation Area training. Completion of this training does not authorize access to Contamination, High Contamination, Soil Contamination, or Airborne Radioactivity Areas.

633 Radiological Worker II

1. Workers whose job assignments involve entry to High and Very High Radiation Areas, Contamination Areas, Soil Contamination Areas (if soil is disturbed), Underground Radioactive Material Areas (if soil is disturbed), High Contamination Areas and Airborne Radioactivity Areas should complete Radiological Worker II training. Radiological Worker II training is not required for access limited to High or Very High Radiation Areas for workers trained in accordance with Article 632.3. Further, workers who have potential contact with hot particles or use of gloveboxes with high contamination levels should complete Radiological Worker II training.

2. Radiological Worker II training should encompass at a minimum the following practical factors:

   a. Donning of protective clothing;

   b. Entering a simulated Radiological Buffer Area, Contamination Area and High Radiation Area to perform a task;

   c. Anticipated response to simulated abnormal situations;

   d. Anticipated response to simulated alarms or faulty radiological control equipment;

   e. Removing protective clothing and equipment and subsequently exiting the simulated area;

   f. Performance of frisking for personnel contamination; and

   g. Verification of instrument response and source check.

634 Specialized Radiological Worker Training

1. Specialized Radiological Worker training should be completed for non-routine operations, new activities (including decommissioning), or performance of beyond skill based work in areas with changing radiological conditions. The need for additional training is based on a completed training needs analysis or job hazard analysis.

   a. This training is in addition to Radiological Worker II training and is required for personnel planning, preparing and performing jobs that have the potential for high radiological consequences.

   b. Such jobs may involve special containment devices, the use of mockups and ALARA considerations.

635 Training Requirements for Escorted Individuals

1. ***When an escort is used in lieu of training in accordance with Article 613.4 and 613.6, the escort shall [835.901(d)]:***

   a. Have completed radiation safety training, examinations, and performance demonstrations required for entry to the area and performance of the work; and [RPP #197]

   b. Ensure that all escorted individuals comply with the documented radiation protection program. [RPP #198]

2. When entry will be into only the Radiologically Controlled Area, no radiation training is required for the escorted individual.

3. When entry will be into a Radioactive Material Area, Radiological Buffer Area, Contamination Area, or Radiation Area, the escorted individual should be GERT trained.

PART 4 Radiological Control Technician Qualification

641 Requirements

1. Training and qualification of Radiological Control Technicians and their immediate supervisors should address routine operations and also focus on recognizing and handling situations in both normal and changing radiological conditions. Newly qualified technicians and those still in training should be given the opportunity to work with qualified, experienced technicians to foster development.

642 Radiological Control Technician

1. Radiological Control Technician initial qualification should consist of the course academics training material, on-the-job training, and passing both a final comprehensive written examination and final Oral Examination Board.

2. Radiological Control Technician candidates who have prerequisite knowledge, such as college credit, operational experience or related qualifications, may satisfy individual sections of the academic course training requirements by passing comprehensive challenge examinations.

3. Entry-level prerequisites should be established to ensure that Radiological Control Technicians meet standards for physical condition and education. At a minimum, these should include the following:

   a. High school education or equivalency;

   b. Fundamentals of mathematics, physics, chemistry and science;

   c. Systems and fundamentals of process, operations and maintenance;

   d. Reading and comprehension level sufficient to follow procedures, write permits, prepare survey maps, write reports and prepare shipping and transfer permits;

   e. Ability to work in a support role, including communicating verbal instructions to others; and

   f. Physical requirements to handle Personal Protective Equipment, other equipment and assist others in work locations, commensurate with assignment.

4. Radiological Control Technicians are encouraged to pursue registration by the National Registry of Radiation Protection Technologists (NRRPT).

5. CHPRC will give credit toward completion of standardized core training requirements for NRRPT registration.

643 Qualification Standards for Radiological Control Technicians

1. The CHPRC Radiological Control Technician core course content should be supplemented by Activity/Facility-specific elements.

2. Prior to performing a job function without direct supervision, a trainee with partially completed qualifications should have completed the qualifications for that task.

3. When performing a job function for which the trainee has not been qualified, the trainee should be under direct control of qualified personnel.

4. Individuals should meet physical requirements to handle and wear personal protective equipment (PPE) and other equipment and should assist others in work locations, commensurate with their assignment.

644 RCT Initial Qualification Oral Examination Boards

1. An Oral Examination Board should determine the initial qualification of candidates for Radiological Control Technician and Supervisor positions.

2. The Activity/Facility Radiological Control Manager should 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 to include a Rad Con Supervisor, Rad Con Senior, Technical and Support staff, and line management operations department supervisors and staff personnel, as applicable. Radiological Control 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 types that are not normally covered in a written examination.

5. The Board constituted to evaluate Rad Con Supervisor qualification should not include peers or subordinates as voting members.

645 RCT Continuing Training

1. Following initial qualification, the Radiological Control Technician should begin a 2-year cycle of continuing training required for requalification. Every requalification requires completion of practical training and a comprehensive written examination. RCT requalification should require a performance demonstration as described in Radiation Protection Training Program Descriptions.

2. Continuing Training should provide continued improvement in the knowledge and skills of the Radiological Control Technician.

3. Continuing training should include site-specific and DOE-wide changes in radiological requirements and should include updates of lessons learned from operating experience and industry events.

4. Continuing training should include written examinations as applicable, and demonstrations of proficiency to prepare for the comprehensive biennial requalification.

5. Infrequently performed tasks, such as those for emergency response, may require annual training. Other tasks may require retraining prior to initiation of a task.

6. Personnel who maintain qualifications as Radiological Control Technicians satisfy the requirements of Radiological Worker II training.

646 Rad Con Supervisor

1. Rad Con Supervisors/Rad Con First Line Managers are individuals who directly supervise Radiological Control Technicians and are authorized to sign documents as the Rad Con Supervisors/Rad Con First Line Managers.

2. Rad Con Supervisors should initially qualify as Radiological Control Technicians and should participate in continuing radiological training programs.

3. Rad Con Supervisors should have supervisory and leadership capabilities to direct the work of technicians; effectively interact with crafts, line supervisors, professional staff and other managers; and be able to respond and direct others in emergency and abnormal situations.

4. Initial qualification oral examination boards should focus on the ability to analyze situations and supervise subordinates. The Rad Con Supervisor's depth of knowledge should exceed that expected of a Radiological Control Technician.

647 Subcontracted Radiological Control Technicians

1. Subcontracted Radiological Control Technicians should have the same knowledge and qualifications required of facility technicians performing the same duties. At a minimum, the training and qualification program should include the following:

    a. Review of resumes to identify technicians with experience in jobs similar to those for which they will be employed;

    b. Written examination and oral evaluation to verify appropriate knowledge level;

    c. Identification of the duties technicians will be authorized to perform;

    d. Training in facility procedures and equipment associated with the authorized duties;

    e. Training on recent operating experience; and

    f. Observation of on-the-job performances by the Rad Con 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. Radiation Protection Director:

    a. Minimum education and training requirements:

        1. Baccalaureate in Science, Health Physics, or Engineering including formal training in Radiation Protection.

        2. Experience requirements:

            - Four years related experience that includes three years DOE Radiological Control experience of which at least 3 months should be in a management or supervisory role and
            - at least 6 months on-site experience.

        3. Certification by the American Board of Health Physics (ABHP) provides equivalency to the related experience and education requirements.

        4. Advanced academic degrees can count as related experience where course work related to Radiological Control is involved.

    b. The individual should be capable of providing the management direction described in Article 142.1.

    c. Selection as Radiation Protection Director should include a preference for certification by the ABHP or a commitment to attain certification through a structured program. Completion of certification should not be sole criteria for exclusion from assignment as Radiation Protection Director.

2. Radiation Protection Program Manager, Project and Facility/Activity Radiological Control Managers and the 10 CFR 835 Interpretative Authority should satisfy the training, qualification and experience requirements of Article 652.

3. The Rad Con First Line Manager must be able to obtain and maintain qualification as Rad Con Supervisor.

    a. The individual should be capable of providing the management direction described in Article 142.1.

4. Rad Con Supervisor:

NOTE: Some facilities use the title Rad Con First Line Manager which is equivalent.

    a. Rad Con Supervisors should have supervisory and leadership capabilities to direct the work of technicians; effectively interact with crafts, line supervisors, professional staff and other managers; and be able to respond to and direct others in emergency and abnormal situations.

b. Minimum education and training requirements:

1. High school diploma

2. At least 3 years of job related experience, including participation in radiological control activities for six months, 2 years DOE experience and 3 months of on-site experience.

3. Registration under the National Registry of Radiation Protection Technologists (NRRPT) provides equivalency to related experience and education requirements.

4. A Rad Con Supervisor must be able to obtain and maintain qualification as Radiological Control Technician.

5. Line Managers and Field Work Supervisors (including subcontractor personnel) who manage, supervise, or provide oversight of radiological activities performed within the scope of the CHPRC should be trained in the requirements of 10 CFR 835 and this Manual. Course 020704, Radiological Control Manual Training for Managers meets this requirement.

a. Field Work Supervisors (FWS) who manage radiological work should complete initial and continuing training as identified in the Field Work Supervisor Training Program Description.

b. Line Managers and Radiological Personnel should be trained to deal with the perception of personnel concerning radiation risks. Managers and first-line supervisors should be sensitive to the fact that workers have to understand the fundamentals of radiation, its risks, and their role in minimizing exposure. Such training should be completed by new personnel prior to formally assuming line supervision and management responsibilities. If desired, questions should be referred to the Activity/Facility Rad Con organization.

652 Senior, Technical and Support Staff

1. Radiological control senior and technical staff functions as managers and supervisors and provide technical expertise. Radiological support personnel perform health physics and radiological engineering, dosimetry, independent oversight, instrumentation, and program support. Senior, Technical and Support staff are Radiological Control organization exempt employees classified as Health Physicists, Scientist, or Project or Activity/Facility Rad Con Managers.

a. Minimum education and training requirements:

1. Baccalaureate in Science, Health Physics, or Engineering including formal training in Radiation Protection.

2. Additional requisites are; 4 years related experience, 3 years DOE Radiological Control experience of which at least 6 months should be in a radiological control organization. Experience should include at least 6 months on-site experience.

3. Certification by the ABHP provides equivalency to the related experience and education requirements.

4. Advanced academic degrees can count as related experience, up to a maximum of 1 year, where course work related to radiological controls is involved.

5. Completion of the training identified in the Key Radiological Control Positions Training Program Description for individuals assigned as Radiological Control Senior/Technical and Support Staff.

6. Certification and involvement with professional industry organizations such as ABHP and NRRPT is encouraged.

7. Training equivalencies, waivers, and/or extensions should be issued in situations where the most effective individual for the position does not satisfy the above qualifications.

653 Radiological Work Planner

1. Radiological Control Senior, Technical and Support Staff who prepare, review or approve the radiological work planning documents should be qualified as a Radiological Work Planner. Additionally, all Rad Con Supervisors are required to be trained as a Radiological Work Planner to satisfy Rad Con Supervisor qualification requirements.

2. A qualified Radiological Work Planner should meet the following requirements.

   a. Be a qualified Radiological Control Senior, Technical and Support Staff as described in Article 652, or be a qualified Rad Con Supervisor as described in Article 646.

   b. Complete the training and knowledge examination requirements of the Radiological Work Planner course.

   c. Complete the Rad Work Planner on-the-job evaluation.

3. Following initial qualification, a Radiological Work Planner should attend refresher training every two years to maintain qualification.

4. The Project or Activity/Facility Radiological Controls Manager should consider the need for additional radiological work planner training. If additional training is determined necessary, the Radiological Work Planner should complete the activity/facility training before being considered qualified.

654 Radiological Control Assessor

1. The Radiological Assessor is the individual responsible for evaluating the effectiveness of implementation of the CHPRC Radiological Control Program.

2. Minimum education and training requirements:

   a. Baccalaureate in Science, Health Physics, or Engineering including formal training in Radiation Protection.

b. Additional requisites are; 4 years related experience, 3 years DOE Radiological Control experience and at least 1 year supervisory or management experience.

c. One year experience performing quality verification activities in radiological controls.

d. Advanced academic degrees can count as related experience where course work related to Radiological Control is involved.

e. Completion of training identified in the Senior, Technical and Support Staff Training Program Description.

3. Training equivalencies, waivers, and/or extensions should be issued in situations where the most effective individual for the position does not satisfy the above qualifications.

655 Radiographers and Radiation Generating Device Operators

1. Radiation Generating Device Operators should have radiological worker training as described in Article 632, Radiological Worker I, or Article 633, Radiological Worker II, as applicable and appropriate training on the type of equipment used and the source of radiation involved.

2. Radiographers should have training commensurate with the level described in 10 CFR 34.43(g) when using sealed radioactive sources, meeting the glossary term of a Radiation Generating Device, to perform radiography operations.

3. Well logging equipment operators should have training commensurate with the level described in 10 CFR 39.61 when using sealed radioactive sources, meeting the glossary term of a Radiation Generating Device, to perform well logging operations.

656 Emergency Response Personnel

1. Provisions should be in place to accommodate rapid site radiological area access by on-site and off-site emergency workers such as firefighters, medical personnel, and security personnel.

2. Emergency response personnel, from both on-site and off-site, may be required to work in radiological areas.

3. Emergency response personnel should receive special radiological worker training commensurate with the situations they are likely to encounter.

4. Training should make it clear that lifesaving has priority over radiological controls.

5. Records of this training should be maintained.

657 International Atomic Energy Agency (IAEA) Personnel

1. International Atomic Energy Agency (IAEA) Inspectors are governed by the International Nuclear Non-Proliferation Treaty and trained in accordance with "The Agency's Radiation Protection Rules and Procedures."

    a. The treaty requires continuous escort within a facility; and prohibits inspectors from performing any "hands-on" work.

    b. Access to all CHPRC Radiological Areas is granted so long as the requirements of the treaty are followed and a facility orientation is provided to the inspector(s).

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CHAPTER 7
RADIOLOGICAL RECORDS

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PART 1 Requirements

711 Purpose

1. This chapter contains the prescribed practices for preparing and managing radiologically related records. ***Radiological control records shall [835.701(a) and 835.702(c)(1)] be maintained to document compliance with the requirements of 10 CFR 835 and with radiation protection programs required by 10 CFR 835.101. [RPP #142 & 146]***

2. ***Records of radiological programs may be required to support worker health studies and future disputes or claims. [HSD J.1] Therefore, these records shall be high quality, readily retrievable and managed for the prescribed retention period. [HSD J.2]***

3. Records maintained on individuals (including dose) are considered sensitive and should be protected from disclosure with the requirements established in *The Privacy Act of 1974*.

712 Records Management Program

1. CHPRC radiological records are maintained in accordance with the PRC and the CHPRC Record Management Program.

2. ***The records management program shall include the following:***

   a. Radiological Control Procedures; [HSD J.1]

   b. Individual Radiological Doses; [HSD J.1]

   c. Internal and External Dosimetry Policies and Procedures (including Facility/Project Technical Bases Documents); [HSD J.1]

   d. Personnel Training (course records and individual records); [HSD J.1]

   e. Radiological Instrumentation Test, Repair and Calibration Records; [HSD J.1]

   f. Radiological Surveys; [HSD J.1]

   g. Area Monitoring Dosimetry Results; [HSD J.1]

   h. Radiological Work Permits; [HSD J.1]

   i. Radiological Incident and Occurrence Reports (and Critique Reports, if applicable) [HSD J.1]

   j. Sealed radioactive source accountability and control. [HSD J.1]

   k. Release of material to uncontrolled areas. [HSD J.1]

l. Reports of loss of radioactive material (required to be controlled and labeled in accordance with 10 CFR 835). [HSD J.1]

m. Minor Consent Forms. [HSD J.1]

3. The records management program should also include the following:
   a. ALARA Records; [also refer to Art. 742]
   b. Radiological Assessments

4. ***Where radiological services (for example, dosimetry and laboratory analyses) are purchased, there shall [835.701(a)] be a clear agreement regarding records responsibility during performance of the service. Records of results should reside in the custody of the originating contract organization. [RPP #142]***

5. ***Changes in equipment, techniques and procedures used for monitoring shall [835.704(e)] be documented. [RPP #173]***

713 Recordkeeping Standards

1. ***Radiological control records shall be accurate, legible and maintained according to the CHPRC Quality Assurance Program. [HSD J.2]***

   a. Projects/Activities shall ensure that completed records contain sufficient detail to be understandable to those that may utilize the record in the future (i.e., intelligible to a person with training and experience equivalent to that of a person with a B.S. in health physics; for the life of the record). [HSD J.3]

2. The records should include the following:

   a. As appropriate, identification of the facility, purpose, specific location, results, function and process;

   b. Signature or other identifying code of the preparer and date;

   c. Identification of contractor performing the radiological monitoring;

   d. Corrections identified by a single line-out, initialed and dated; and

   e. Supervisory signature to ensure review and proper completion of monitoring and workplace records.

   f. Initials may be used in radiological documents provided that a log is maintained.

3. ***Unless otherwise specified, the quantities used in the records required by this Manual shall [835.4] be clearly indicated in special units of curie, rad, roentgen, or rem, including multiples and subdivisions of these units, or other conventional units, such as, dpm, dpm/100 cm^2 or mass units. The SI units, becquerel (Bq), gray (Gy), and sievert (Sv), may be provided parenthetically in 10 CFR 835 for reference with scientific standards. [RPP #13]***

PART 2 Employee Records

721 Employment History

Records detailing an employee's pre-employment and employment history and the associated radiation dose should be maintained using the Hanford Radiological Record Project procedures. The following information should be maintained:

1. ***For radiological workers whose occupational dose is monitored in accordance with Articles 511 and 521, reasonable efforts shall [835.702(e)] be made to obtain complete records of prior years occupational internal and external doses. [RPP #161]***

2. Nuclear Regulatory Commission Form 4 or equivalent that documents previous occupational radiation doses. The DOE and DOE contractors should use the *Personnel Radiation Exposure History* Form BC-3000-710 (03/98) to document previous occupational radiation exposure.

722 Individual Monitoring Records

1. ***Except as described by Article 722.11, records shall [835.702(a)] be maintained to document doses received by all individuals for whom monitoring was conducted and to document doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of Articles 511 and 521, and authorized emergency exposures. [RPP #144; HSD J.4.a]***

   a. The results of individual external and internal dose monitoring that is performed, but not required by Articles 511 and 521, shall [835.702(b)] be recorded. [RPP #145]

   b. Multiple required data may be contained in a single data record to allow for management of data, records, and reports.

   c. Documentation of all occupational doses received during the current year, except for doses resulting from planned special exposures conducted in compliance with Article 213.3 and emergency exposures authorized in accordance with Article 213.4, shall [835.702(d)] be obtained to demonstrate compliance with dose limits in Table 2-1 for general employees. [RPP #159] If complete records documenting previous occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted to demonstrate compliance [835.702(d)]. [RPP #160]

2. ***Individual monitoring records required by Article 722 shall [835.702(c)]:***

   a. Be sufficient to evaluate compliance with Articles 213, 214, and 215,; [RPP #146] and

   b. Be sufficient to provide dose information necessary to complete reports required by Article 781. [RPP #147]

   c. Radiation dose records shall [835.702(f)] contain information sufficient to identify each person, including social security, employee number, or other unique identification number. [RPP #162]

3. ***Routine and special records related to radiation doses shall [835.702(a-b)] be retained for each person monitored. [RPP #144 & 145] Procedures, data, and supporting information necessary for future verification or reassessment of the recorded doses shall [835.702(g)] be recorded. [RPP #163]***

4. ***External dose records shall include the following:***

   a. Results of monitoring used to determine individual occupational dose from external sources shall [835.703(b)] be documented and maintained and include applicable extremity, skin, eye and whole body dose results measured with personnel dosimeters, including all multiple dosimeter badging results and area monitoring records; [RPP # 166]

   b. Quantities for external dose received during the year [835.702(c)(3)]:

   - ***The effective dose from external sources of radiation (equivalent dose to the whole body may be used as effective dose for external exposure); [RPP #148]***
   - ***The equivalent dose to the lens of the eye; [RPP #149]***
   - ***The equivalent dose to the skin; and [RPP #150]***
   - ***The equivalent dose to the extremities. [RPP #151]***

   c. ***Evaluations resulting from anomalous dose results such as unexpected high or low doses; [RPP #148 & 166]***

   d. ***Dose reconstructions from lost or damaged dosimeters, or for unbadged workers***; and ***[RPP #148 & 166]***

   e. ***Evaluations of non-uniform radiation doses. [RPP #148 & 166]***

5. ***Internal dose records shall [835.702(c)(4)] include the following:***

   a. Results of monitoring used to determine individual occupational dose from internal sources shall [835.703(b)] be documented and maintained; [RPP # 166]

   b. Information for internal dose resulting from intakes received during the year:

- ***Committed effective dose, [RPP #152]***
- ***Committed equivalent dose to any organ or tissue of concern, [RPP #153] and***
- ***Identity of radionuclides [RPP #154];***

c. Applicable whole body and lung counting results (including chest wall thickness measurements where applicable);

d. Applicable urine, fecal and specimen analysis results, including estimated intake and identity of radionuclides; and

e. Dose assessment, as required.

6. Records of the summation of external dose and committed equivalent dose to any organ receiving a reportable dose should be maintained for the individual receiving such dose (see article 722.7.b).

7. ***Include the following quantities for the summation of the external and internal dose:***

   a. Total effective dose in a year; [RPP # 155]

   b. For any organ or tissue assigned an internal dose during the year, the sum of the equivalent dose to the whole body from external exposures and the committed equivalent dose to that organ or tissue; [RPP # 156] and

   c. Cumulative total effective dose. [RPP # 157]

8. ***The equivalent dose to the embryo/fetus of a declared pregnant worker shall [835.702(c)(6)] be maintained with the occupational exposure records for that worker. [RPP #158]***

9. ***Records of lifetime occupational dose, including cumulative total effective dose since January 1, 1989, shall [835.702(c)(2) and 835.702(c)(5)] be maintained with the individual's occupational exposure records. [RPP #147 & 157]***

10. ***Authorized emergency exposures and planned special exposures shall [835.702(a), 835.702(c)(2), and 835.1301(b)] be accounted for separately, but maintained with the individual's occupational exposure records. [RPP #, 52, 144, 147 & 236]***

11. ***Recording of the non-uniform equivalent dose to the skin is not required if the dose is less than 2 percent of the limit specified for the skin at Table 2-1[835.702(b)]. [RPP #145]***

12. ***Recording of internal dose (committed effective dose or committed equivalent dose) is not required for any monitoring result estimated to correspond to an individual receiving less than 0.01 rem (0.1 mSv) committed effective dose. The bioassay or air monitoring result used to make the estimate shall be maintained in accordance with § 835.703(b) and the unrecorded internal dose estimated for any individual in a year shall not exceed the applicable monitoring threshold at § 835.402(c). [RPP #145]***

723 Other Personnel Radiological Records

1. ***The complete records of radiological incidents and occurrences involving personnel dose shall [835.702(a), 835.702(c)(2), and 835.1301(b)] be retained. [RPP #144, 147 & 236]***

   a. ***Records of radiological incidents and occurrences resulting in changes to, or conformation of, recorded exposures within personnel radiation exposure monitoring records shall [HSD J.4.a] be retained.***
   b. ***When practicable, these records shall [HSD J.4.b] be retained or cross-referenced to applicable personnel radiation exposure monitoring records.***

2. ***Written declarations of pregnancy, including the estimated date of conception, and revocations of declarations of pregnancy shall [835.704(d)] be maintained. [RPP #172]***

3. ***Area monitoring dosimetry results used for dose reconstruction shall [835.703(b)] be maintained. [RPP #166]***

4. ***Records of employee radiological safety concerns that have been formally investigated and documented shall be retained. [HSD J.4.c]***

5. Counseling of persons about radiological concerns should be documented and this documentation retained. It is desirable that the counseled person signs the documentation to acknowledge participation.

6. Records of Administrative Control Levels changes should be retained.

724 Radiological Training and Qualification Records

1. ***Records of training and qualification in radiological control shall [835.704(a)] be maintained to demonstrate that a person received appropriate information to perform the work assignment in a safe manner. Qualification standard records shall [835.704(a)] be retained for on-the-job and practical factor training as well as for formal classroom training. [RPP #169]***

2. ***Personnel training records shall [835.704(a)] be controlled and retained. At a minimum, these records shall include the following:***

   a. ***Course title;***

   b. ***Attendance sheets with instructor's name;***

   c. ***Employee's name, identification number and signature;***

   d. ***Date of training;***

   e. ***Identification of the examination or evaluation form, including sufficient data to identify which test each person completed;***

   f. ***Verification document or record confirming satisfaction of the training requirement;***

g. Documentation related to exceptions for training requirements and extensions of qualification;

h. Quizzes, tests, responses and acknowledgements of training, with the date and signature of the person trained; and

i. Special instructions to individuals concerning prenatal radiation dose, acknowledged by the individual's signature. [RPP #169]

3. ***Records shall [835.704(a)] be retained for the following types of radiation safety training:***

- ***General employee radiological training***
- ***Radiological worker training***
- ***Periodic retraining***
- ***Training of radiological control technicians***
- ***Members of the public training***
- ***Instructor training for those providing radiation safety training***
- ***Training of other radiological control personnel***
- ***Training of RGD operators [RPP #169]***

4. Records shall be retained for the following types of radiation safety training:

- Respiratory protection training
- Qualifications for special tests or operations
- Training of emergency response personnel
- Onsite training of radiographers

5. ***The following instructional materials shall [835.704(a)] be maintained:***

a. Course name, with revision and approval date.

b. Instructor's manuals, course content, or lesson plans containing topical outlines.

c. Video and audio instructional materials, including the dates and lessons for which they were used.

d. Handouts or other materials retained with the master copy of the course.

e. ***Job-specific training documents, such as instrument use, radiological procedures, Radiological Work Permit special training requirements, pre-job briefings and mock-up training. [RPP #169]***

6. ***Documentation of training and qualification received at another DOE location need not be duplicated. [RPP #169]***

PART 3 Member of the Public

731 Record Requirements

1. ***Records of doses, including zero dose, received by all members of the public for whom monitoring was performed shall [835.702(a)] be maintained. [RPP #144, 147] These records shall [835.702(c)(2)] be sufficient to evaluate compliance with all applicable dose limits and monitoring and reporting requirements. [RPP #147]***

PART 4 Radiological Control Procedures

741 Radiological Work Documents

Records of the Radiological Control Program should consist of policy statements, procedures, Radiological Work Permits and supporting documents and data. The records should be maintained in a chronological sequence that will allow correlation with the corresponding support information. Completed Radiological Work Permits should be maintained.

742 ALARA Records

Actions taken to maintain occupational exposures as low as reasonably achievable, including actions required for this purpose in the radiation protection program (RPP), as well as facility design and control actions required by Articles 125 and 311, shall [835.704(b)] be documented. [RPP #170] These records should include the minutes of ALARA committees and other committees where radiological safety issues are formally discussed.

743 Quality Assurance Records

Records shall [835.704 (c)] be maintained to document the results of internal audits and other reviews of radiation protection program content and implementation [RPP #171] to ensure that records are specified, prepared, reviewed, approved and maintained to accurately reflect completed work. The CHPRC Quality Assurance Program provides additional information regarding quality assurance records.

PART 5 Radiological Surveys

751 Requirements

1. ***Results of monitoring for radiation and radioactive material as required by Articles 421 and 423, and Chapter 5, Part 5, shall [835.703(a)] be documented and maintained. [RPP #165]***

a. Radiation, airborne radioactivity and contamination surveys are performed to determine existing radiological conditions and identify changes in radiological conditions in a given location.

b. Maps with sufficient detail to permit identification of original survey and sampling locations should be maintained.

c. Records should contain sufficient detail to be meaningful even after the originator is no longer available.

d. Records should reference the applicable RWP.

2. ***Radiological surveys shall be recorded on appropriate standard forms and shall include the following common elements:***

   a. Date, time and purpose of the survey; [HSD J.5]

   b. General and specific location of the survey; [HSD J.5]

   c. Name and signature of the surveyor and reviewer; [HSD J.5]

   d. Pertinent information needed to interpret the monitoring results; [HSD J.5] and

   e. Contractor Name (CHPRC) [HSD J.5]

3. Manage employee exposure measurements as sensitive information that requires limiting access to personnel exposure and contamination records to those with a need to know. Reference to the record containing the privacy act information should be included in the survey form to aid in data retrieval.

752 Radiation Surveys

1. ***In addition to the elements provided in Article 751, records of radiation surveys shall [835.703(a)] include, at a minimum, the following information:***

   a. Instrument model and serial number, and [RPP #165]

   b. Results of the measurements of area dose rates [RPP #165]

753 Airborne Radioactivity

1. ***In addition to the elements provided in Article 751, records of airborne radioactivity shall [835.703(a)] include, at a minimum, the following information:***

   a. Model and serial numbers of the sampler and laboratory counting instrument when available or unique identifier of each sampler and instrument;

b. Location of fixed air samplers;

c. Location of portable air samplers used for a survey; [RPP #165]

d. Air concentrations in general airborne areas and breathing zones; and [RPP #165]

e. Supporting parameters, including collection efficiency, flow rate, duration of sampling, correction factors and filter medium. [RPP #165]

754 Contamination and Release Surveys

1. ***In addition to the elements required by Article 751, records of contamination surveys shall [835.703(a)] include, at a minimum, the following information:***

   a. Model and serial number of counting equipment;

   b. Contamination levels (using appropriate units) and appropriate supporting parameters including counting efficiency, counting time, correction factors, type of radiation and whether the contamination was fixed or removable;

   c. Location of areas found to contain hot particles or high concentrations of localized contamination; and

   d. Follow-up survey results for decontamination processes cross-referenced to the original survey. [RPP #165]

2. Information should be documented and maintained regarding the results of monitoring for the release and control of material and equipment as required by Article 421.

755 Sealed Radioactive Source Leak Tests and Inventories

1. ***Records shall [835.704(f)] be maintained as necessary to demonstrate compliance with the requirements of Article 431 for sealed radioactive source control, inventory, and source leak tests. [RPP #174]***

2. ***In addition to the elements provided in Article 751, records of sealed radioactive source leak tests shall [835.704(e); 835.1202] include, at a minimum, the following information:***

   a. Model and serial number of counting equipment;

   b. Contamination levels (using appropriate units) and appropriate supporting parameters including counting efficiency, counting time, correction factors, and type of radiation; and

   c. Corrective actions for leaking sources. [RPP #174]

3. ***Records of sealed radioactive source inventories shall [835.704(f); 835.1202] include, at a minimum, the following information:***

   a. ***The physical location of each accountable sealed radioactive source;***

   b. ***Verification of the presence and adequacy of associated postings and labels; and***

   c. ***Verification of the adequacy of storage locations, containers, and devices. [RPP #174]***

PART 6 Instrumentation and Calibration Records

761 Calibration and Operational Checks

1. ***Results of calibrations performed on instruments and equipment used for monitoring individuals, materials, and areas as required by this Manual shall [835.703(d)] be documented and maintained [RPP # 168] and shall include frequencies, method, dates, personnel, training and traceability of calibration sources to National Institute of Science and Technology or other acceptable standards. [HSD J.6]***

2. ***Calibration records shall be maintained for the following equipment:***

   a. ***Portable survey instruments,***

   b. ***Bioassay measurement equipment,***

   c. ***Laboratory, counting room and fixed radiation measuring equipment,***

   d. ***Process and effluent monitors and sampling equipment,***

   e. ***Radiation area monitors,***

   f. ***Portal monitors and other personnel contamination monitors,***

   g. ***Pocket and electronic dosimeters,***

   h. ***Air sampling equipment,***

   i. ***Tool and waste monitoring equipment,***

   j. ***Protective clothing and equipment monitors,***

   k. ***Dosimetry Processing Instrumentation, and***

   l. ***Other devices used in radiation detection or measurement, as applicable. [HSD J.4.d]***

NOTE: ***Calibration records are only maintained for §835.703(d) compliance when instruments are used for occupational radiation protection per 10 CFR 835. [RPP #168]***

3. ***Documentation of instrument operational checks shall [835.703(d)] be maintained for a period not less than the calibration period of the instrument or equipment. [RPP #168]***

4. ***Maintenance histories, including the nature of any defects and corrective actions taken, and calibration results for each instrument or equipment shall [835.703(d)] be created and retained. [RPP #168]***

762 Special Calibration Records

Records of additional tests and checks of instrumentation or equipment used in conjunction with a suspected overexposure, questionable indication or unusual occurrence shall be retained. In addition, records of special instrument calibrations and modifications made in accordance with Article 561.6 shall [835.703(d)] be retained. [RPP #168]

PART 7 Records Management

771 Retention

1. ***Unless otherwise specified in this Manual, records shall [835.701(b)] be retained until final disposition is authorized by DOE. [RPP #143] All individual monitoring records required by Articles 721, 722, and 731.1 shall [835.702(h)] be transferred to DOE upon cessation of activities that could cause exposure to individuals. [RPP #164]***

   a. Record inventory results and assignment of appropriate record schedules are documented on each organization's Record Inventory and Disposition Schedules (RIDS).

2. Once a document has been created, reviewed, and signed by appropriate supervision, the document is considered a completed record. Subsequent errors identified in a completed record that has not been retired to the Records Holding Area may be corrected by a single line out, initialed, and dated. A corrected record requires supervisory signature to ensure proper completion of record document.

PART 8 Radiological Reporting

781 Reports to Individuals

1. ***Radiation exposure data for individuals monitored in accordance with Articles 511 and 521 shall [835.801(a)] be reported as specified in this Manual. [RPP #175] The information shall [835.801(a)] include the data required under Article 722.2, 722.4.e, 722.5.e, 722.7 and 722.8. [RPP #176] Each notification and report shall [835.801(a)] be in writing and include: the DOE site or facility name, the name of the individual, and the individual's social security number, employee number, or other unique identification number. [RPP #177]***

2. ***Upon the request from an individual terminating employment, records of exposure shall [835.801(b)] be provided to that individual as soon as the data are available, but not later than 90 days after termination. [RPP #178]*** The provisions for termination dose reports and written estimates only apply if the individual requests this information on or before the individual's last day of employment. If the request is made after the termination date, then the request should be handled in accordance with Article 781.5. When a termination dose report is provided to an individual, then an annual report to that individual, under Article 781.7, is not necessary.

    a. A termination dose report will be provided only upon request of the individual terminating employment.

3. ***A written estimate of the radiation dose received by that employee based on available information shall [10 CFR 835.801(b)] be provided at the time of termination, if requested. [RPP #179]***

4. ***Each DOE- or DOE-contractor-operated site or facility shall [835.801(c)], on an annual basis, provide a radiation dose report to each individual monitored during the year at that site or facility in accordance with Articles 511 and 521. [RPP #180]***

5. ***The records specified in Articles 721 and 722 that are identified with a specific individual shall [835.702(f)] be readily available to that individual. [RPP #162] Detailed information concerning any individual's exposure shall [835.801(d)] be made available to the individual upon request of that individual, consistent with the provisions of the Privacy Act (5 U.S.C. 552a). [RPP #181]***

6. ***When a DOE contractor is required to report to the Department, pursuant to Department requirements for occurrence reporting and processing, any exposure of an individual to radiation and/or radioactive material, or planned special exposure in accordance with Article 213.3, the contractor shall [835.801(e)] also provide that individual with a report on his or her exposure data included therein. [RPP #182] Such report shall [835.801(e)] be transmitted at a time not later than the transmittal to the Department. [RPP #183]***

7. Reports identifying a specific individual exposure data may be required by DOE. These reports include occurrences reported under DOE O 232.1(series), *Environmental, Safety and Health Reporting*, of exposure of an individual to radiation and/or radioactive material, or planned special exposures.

    a. Each individual specifically identified in such reports shall be provided a report on his or her exposure data included in the report to DOE at a time not later than the transmittal to DOE (See Article 781.6).

    b. A separate report should be provided to each affected individual discussing the nature and content of the report to DOE and his or her exposure data contained in the DOE report. Alternatively, a copy of the report sent to DOE may be sent to each affected individual to satisfy this requirement.

    c. Privacy Act restrictions should be considered since the DOE report may contain personal information concerning other affected individuals. In accordance with DOE Order 231.1A, thirty days is interpreted to mean thirty days after the visit or within thirty days after the exposure has been determined, whichever is later.

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GLOSSARY

Terms defined in the Atomic Energy Act of 1954 or in 10 CFR part 820 and not defined in this Glossary are used consistent with their meanings given in the Atomic Energy Act of 1954 or in 10 CFR part 820. [RPP #6]

abnormal situation: Unplanned event or condition that adversely affects, potentially affects or indicates degradation in the safety, security, environmental or health protection performance or operation of a facility.

accountable sealed radioactive source: Accountable sealed radioactive source means a sealed radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than the corresponding value provided in 10 CFR 835 Appendix E. [RPP #5] (see Appendix 4A of this manual)

activation: Process of producing a radioactive material by bombardment with neutrons, protons or other nuclear particles.

Activity Median Aerodynamic Diameter (AMAD): means a particle size in an aerosol where fifty percent of the activity in the aerosol is associated with particles of aerodynamic diameter greater than the AMAD. ***[RPP #5]***

administrative control level: A numerical dose constraint established at a level below the regulatory limits to administratively control and help reduce individual and collective dose.

airborne radioactive material or airborne radioactivity: means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases. [RPP # 5]

airborne radioactivity area: Any area, accessible to individuals, where:
1) The concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in appendix A or appendix C of 10 CFR 835; or
2) An individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week. [RPP # 5]

annual limit on intake (ALI): means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man (ICRP Publication 23) that would result in a committed effective dose of 5 rems (0.05 Sv) (1 rem = 0.01 Sv) or a committed equivalent dose of 50 rems (0.5 Sv) to any individual organ or tissue. ALI values for intake by ingestion and inhalation of selected radionuclides are based on International Commission on Radiological Protection Publication 68, Dose Coefficients for Intakes of Radionuclides by Workers, published July, 1994 (ISBN 0 08 042651 4). This document is available from Elsevier Science Inc., Tarrytown, NY.
[RPP # 5]

As Low As Reasonably Achievable (ALARA): the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this 10 CFR 835, ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits of this part as is reasonably achievable. [RPP # 5]

ALARA Committee: Multidisciplined management team that reviews and advises management on improving progress toward minimizing radiation exposure and radiological releases. (also be referred to as the multi-disciplinary management review group.)

assessment: Evaluation or appraisal of a process, program, or activity to estimate its acceptability.

Authorized Limit: Means a limit on the concentration of residual radioactive material on the surfaces or within the property that has been derived consistent with DOE directives including the as low as is reasonably achievable (ALARA) process requirements, given the anticipated use of the property and has been authorized by DOE to permit the release of the property from DOE radiological control. [RPP # 5]

background: means radiation from:

- ***(1) Naturally occurring radioactive materials which have not been technologically enhanced;***
- ***(2) Cosmic sources;***
- ***(3) Global fallout as it exists in the environment (such as from the testing of nuclear explosive devices);***
- ***(4) Radon and its progeny in concentrations or levels existing in buildings or the environment which have not been elevated as a result of current or prior activities; and***
- ***(5) Consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation. [RPP # 5]***

becquerel (Bq): The International System (SI) unit for activity of radioactive material. One becquerel is that quantity of radioactive material in which one atom is transformed per second or undergoes one disintegration per second.

bioassay: means the determination of the kinds, quantities, or concentrations, and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis and evaluation of radioactive materials excreted or removed from the human body. [RPP # 5]

calibration: means to adjust and/or determine either:

(1) The response or reading of an instrument relative to a standard (e.g., primary, secondary, or tertiary) or to a series of conventionally true values; or

(2) The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value. [RPP # 5]

clearance: The process used to remove material from DOE radiological control after confirming that the residual radioactive material meets the guidelines in DOE O458.1.

company-issued clothing: Clothing provided by the company, such as work coveralls and shoes. For radiological control purposes, company-issued clothing should be considered the same as personal clothing.

containment device: Barrier for inhibiting or controlling the spread of radioactive material from a specific location. Examples of containments are drapes, glovebags, gloveboxes, tents and portable ventilation systems.

contamination: The presence of residual or unwanted radioactive material resulting from a DOE activity in or on a material or property.[HSD, L]

contamination area: means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in Appendix D of 10 CFR 835, but do not exceed 100 times those values. [RPP # 5] (See Table 2-2, of this Manual)

continuing training: Training scheduled over a specified time such as over a two-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: means any entity under contract with the Department of Energy with the responsibility to perform activities at a DOE site or facility.

contractor senior site executive: The person at a DOE contractor-operated facility or site who has final on-site corporate authority and is often called President, General Manager, Site Manager or Director.

controlled area: means any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material. [RPP # 5] For the Hanford Site, a controlled area by this definition is called a radiologically controlled area to more precisely identify the reason for which control is established.

conventionally true value of a quantity: The commonly accepted, best estimate of the true value of a quantity. The conventionally true value and the associated uncertainty will normally be determined by comparison with a national or transfer standard, using a reference instrument that has been calibrated against a national or transfer standard.

counseling: Advice, information exchange and guidance provided to employees on radiologically related topics, such as dose perspectives; potential health effects from radiation exposure; skin contamination; contaminated wounds; internally deposited radioactivity; pregnancy; and radiation exposure. Knowledgeable, senior professionals normally provide this advice and guidance 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 listing of the facts.

declared pregnant worker: means a woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to the occupational dose limits to the embryo/fetus as provided in Article 215. This declaration may be revoked, in writing, at any time by the declared pregnant worker. [RPP # 5]

decontamination: Process of removing radioactive contamination and materials from personnel, equipment or areas.

deposition, new confirmed: A deposition of radioactive material in the body or any organ or tissue of an individual identified during the current reporting period, confirmed through bioassay results to be greater than the site-determined reportable level.

Derived air concentration (DAC): means, for the radionuclides listed in 10 CFR 835, Appendix A, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2,000 hours (assuming a breathing volume of 2,400 m^3). For the radionuclides listed in 10 CFR 835, Appendix C, the air immersion DACs were calculated for a continuous, non-shielded exposure via immersion in a semi-infinite cloud of radioactive material. Except as noted in the footnotes to 10 CFR 835, Appendix A, the values are based on dose coefficients from International Commission on Radiological Protection Publication 68, Dose Coefficients for Intakes of Radionuclides by Workers, published July, 1994 (ISBN 0 08 042651 4) and the associated ICRP computer program, The ICRP Database of Dose Coefficients: Workers and Members of the Public, (ISBN 0 08 043 8768). These materials are available from Elsevier Science Inc., Tarrytown, NY. [RPP # 5]

derived air concentration-hour (DAC-hour): means the product of the concentration of radioactive material in air (expressed as a fraction or multiple of the DAC for each radionuclide) and the time of exposure to that radionuclide, in hours. [RPP # 5]

Deterministic effects: means effects due to radiation exposure for which the severity varies with the dose and for which a threshold normally exists (e.g., radiation induced opacities within the lens of the eye). [RPP # 5]

direct contamination reading: The apparent surface contamination level, expressed in disintegrations per minute per a given area, resulting when an appropriate contamination probe or detector is placed in close proximity (e.g., ~1/4 inch) to the soil surface, e.g., soil, in question. Appropriate efficiency and geometry correction factors should be applied to such a reading. [HSD, L]

disintegration per minute (dpm): The rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

DOE: means the United States Department of Energy. [RPP # 5]

DOE activity: means an activity taken for or by the DOE in a DOE operation or facility that has the potential to result in the occupational exposure of an individual to radiation or radioactive material. The activity may be, but is not limited to, design, construction, operation, or decommissioning. To the extent appropriate, the activity may involve a single DOE facility or operation or a combination of facilities and operations, possibly including an entire site or multiple DOE sites. [RPP # 5]

DOELAP: Department of Energy Laboratory Accreditation Program for personnel dosimetry under DOE 5480.15.

dose: is a general term for absorbed dose, equivalent dose, effective dose, committed equivalent dose, committed effective dose, or total effective dose as defined in 10 CFR 835. [RPP # 6]

absorbed dose (D): means the average energy imparted by ionizing radiation to the matter in a volume element per unit mass of irradiated material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray). [RPP # 6]

collective dose: the sum of the total effective dose values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert).

Committed effective dose (E_{50}) means the sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate tissue weighting factor (w_T)--that is, $E_{50} = \Sigma w_T H_{T,50} + w_{Remainder} H_{Remainder,50}$. Where $w_{Remainder}$ is the tissue weighting factor assigned to the remainder organs and tissues and $H_{Remainder,50}$ is the committed equivalent dose to the remainder organs and tissues. Committed effective dose is expressed in units of rem (or Sv). [RPP # 6]

Committed equivalent dose ($H_{T,50}$) means the equivalent dose calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed equivalent dose is expressed in units of rem (or Sv). [RPP # 6]

cumulative total effective dose: means the sum of all total effective dose values recorded for an individual plus, for occupational exposures received before the implementation date of this amendment, the cumulative total effective dose equivalent (as defined in the November 4, 1998 amendment to this rule) values recorded for an individual, where available, for each year occupational dose was received, beginning January 1, 1989. [RPP # 6]

Effective dose (E): means the summation of the products of the equivalent dose received by specified tissues or organs of the body (H_T) and the appropriate tissue weighting factor (w_T)--that is, $E = \Sigma w_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with this part, equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of rem (or Sv). [RPP # 6]

Equivalent dose (H_T): means the product of average absorbed dose ($D_{T,R}$) in rad (or gray) in a tissue or organ (T) and a radiation (R) weighting factor (w_R). For external dose, the equivalent dose to the whole body is assessed at a depth of 1 cm in tissue; the equivalent dose to the lens of the eye is assessed at a depth of 0.3 cm in tissue, and the equivalent dose to the extremity and skin is assessed at a depth of 0.007 cm in tissue. Equivalent dose is expressed in units of rem (or Sv). [RPP # 6]

external dose or exposure: means that portion of the equivalent dose received from radiation sources outside the body (i.e., "external sources"). [RPP # 6]

extremity: means hands and arms below the elbow or feet and legs below the knee. [RPP # 6]

internal dose or exposure: means that portion of the equivalent dose received from radioactive material taken into the body (i.e., "internal sources"). [RPP # 6]

Radiation weighting factor (w_R): means the modifying factor used to calculate the equivalent dose from the average tissue or organ absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate radiation weighting factor. The radiation weighting factors to be used for determining equivalent dose in rem are as follows:

RADIATION WEIGHTING FACTORS, w_R

Type and energy range	w_R
Photons, electrons and muons, all energies ……	1
Neutrons, energy < 10 keV[2, 3] ……	5
Neutrons, energy 10 keV to 100 keV[2, 3] ……..	10
Neutrons, energy > 100 keV to 2 MeV[2, 3] ……..	20
Neutrons, energy > 2 MeV to 20 MeV[2, 3] ……..	10
Neutrons, energy > 20 MeV[2, 3] ……	5
Protons, other than recoil protons, energy > 2 MeV ……...	5
Alpha particles, fission fragments, heavy nuclei ……..	20

[1] ***All values relate to the radiation incident on the body or, for internal sources, emitted from the source.***

[2] ***When spectral data are insufficient to identify the energy of the neutrons, a radiation weighting factor of 20 shall be used.***

[3] ***When spectral data are sufficient to identify the energy of the neutrons, the following equation may be used to determine a neutron radiation weighting factor value:***

$$w_R = 5 + 17 \exp[-(\ln(2E_n))^2 \div 6]$$

Where E_n is the neutron energy in MeV. [RPP # 6]

Tissue weighting factor (w_T): means the fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The equivalent dose to tissue, (H_T), is multiplied by the appropriate tissue weighting factor to obtain the effective dose (E) contribution from that tissue. The tissue weighting factors are as follows:

TISSUE WEIGHTING FACTORS FOR VARIOUS ORGANS AND TISSUES

Organs or tissues, T	Tissue weighting factor, w_T
Gonads …….	0.20
Red bone marrow ……	0.12
Colon …….	0.12
Lungs ……	0.12
Stomach ……	0.12

Bladder ……. 0.05
Breast …… 0.05
Liver …….. 0.05
Esophagus …… 0.05
Thyroid …….. 0.05
Skin …… 0.01
Bone surfaces …….. 0.01
Remainder[1] …… 0.05
Whole body[2] ……. 1.00

[1] ''Remainder'' means the following additional tissues and organs and their masses, in grams, following parenthetically: adrenals (14), brain (1400), extrathoracic airways (15), small intestine (640), kidneys (310), muscle (28,000), pancreas (100), spleen (180), thymus (20), and uterus (80). The equivalent dose to the remainder tissues ($H_{remainder}$), is normally calculated as the mass-weighted mean dose to the preceding ten organs and tissues. In those cases in which the most highly irradiated remainder tissue or organ receives the highest equivalent dose of all the organs, a weighting factor of 0.025 (half of remainder) is applied to that tissue or organ and 0.025 (half of remainder) to the mass-weighted equivalent dose in the rest of the remainder tissues and organs to give the remainder equivalent dose.

[2] For the case of uniform external irradiation of the whole body, a tissue weighting factor (w_T) equal to 1 may be used in determination of the effective dose. [RPP # 6]

Total effective dose (TED): means the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures). [RPP # 6]

whole body: means, for the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee. [RPP # 6]

dose assessment: Process of determining radiation dose and uncertainty included in the dose estimate, through the use of exposure scenarios, bioassay results, monitoring data, source term information, and pathway analysis. [HSD, L]

embryo/fetus: Developing human organism from conception until birth. Same as unborn child.

engineered controls: A special form of physical design feature in which components and systems, such as piping, containments, ventilation, filtration, or shielding, are used to reduce airborne radioactivity, radiation levels, and the spread of contamination..

entrance or access point: means any location through which an individual could gain access to areas controlled for the purposes of radiation protection. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use. [RPP # 5]

facility: For the purpose of this Manual, a facility includes systems, buildings, utilities, and related activities whose use is directed to a common purpose at a single location. Example include: accelerators, storage areas, test loops, nuclear reactors, radioactive waste disposal systems and burial grounds, testing laboratories, research laboratories, and accommodations for analytical examinations of components. Also

includes: pipelines, ponds, impoundments, landfills and the like, and motor vehicles, rolling stock, and aircraft.

filter integrity test: Test performed on High-Efficiency Particulate Air (HEPA) filters to identify any damage to the filter or leakage around the filter.

fixed contamination: Radioactive material that has been deposited onto a surface and cannot be readily removed by non-destructive means, such as casual contact, wiping, brushing, or laundering. Fixed contamination does not include radioactive material that is present in a matrix, such as soil or cement, or radioactive material that has been induced in a material through activation processes. [HSD, L]

flash X-ray unit: Any device that is capable of generating pulsed X-rays.

frisk or frisking: Process of monitoring personnel for contamination. Frisking can be performed with hand-held survey instruments, automated monitoring devices or by a Radiological Control Technician.

general employee: means an individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or an individual who performs work for or in conjunction with DOE or utilizes DOE facilities. [RPP # 5]

gestation period: The time from conception to birth, approximately 9 months.

gray (Gy): SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

high-efficiency particulate air (HEPA) filter: 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 percent for thermally generated monodisperse di-octyl phlalate smoke particles with a diameter of 0.3 micrometer, and 3) a maximum pressure drop of 1.0 inch w.g. when clean and operated at its rated airflow capacity.

high contamination area: means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination values specified in Appendix D of 10 CFR 835. [RPP # 5] (See Table 2-2, of this Manual)

high radiation area: means any area, accessible to individuals, in which radiation levels could result in an individual receiving an equivalent dose to the whole body in excess of 0.1 rems (0.001 Sv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. [RPP # 5]

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. At the Hanford Site, hot particles are defined as small (typically with dimensions of less than or about 1 mm), generally insoluble particles with an activity in excess of 10 μCi.

hot spot: 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 (deep dose rate) on contact.

individual: means any human being. [RPP # 5]

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.

intrusive activity: Any activity that disturbs a surface or barrier that is intended to protect the worker or workplace from the underlying or contained radioactive materials.

irradiator: Sealed radioactive material used to irradiate other materials that have the potential to create a radiation level exceeding 500 rad (5 grays) in 1 hour at 1 meter. Although not addressed in this Manual, acceptable radiological controls for irradiator use are specified in Title 10, Code of Federal Regulations, Part 20.1603.

key radiation protection position: A person specifically designated within the radiological health and safety organization to exercise discretionary authority and/or make independent judgments and decisions beyond those covered by established procedures concerning radiation protection issues associated with the design, construction, operation and maintenance, or decommissioning of facilities and/or activities. [HSD, L]

lifetime dose: Total occupational exposure over a worker's lifetime, including external and committed internal dose.

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 provided the concentration of transuranic activity is less than 100 nCi/g.

member of the public: means an individual who is not a general employee. An individual is not a "member of the public" during any period in which the individual receives an occupational dose. [RPP # 5]

minor: means an individual less than 18 years of age. [RPP # 5]

mixed waste: Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively.

Monthly: For the purposes of occupational radiation protection instrument calibration, monthly occurs 12 times per year and at 30 days intervals, except when the calibration due date falls on a non-scheduled workday. Monthly intervals should not exceed 35 days, nor shall they be less than 25 days.

monitoring: means the measurement of radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses and the use of the results of these measurements to evaluate radiological hazards or potential and actual doses resulting from exposures to ionizing radiation. [RPP # 5]

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: means an individual's ionizing radiation dose (external and internal) as a result of that individual's work assignment. Occupational dose does not include doses received as a medical patient or doses resulting from background radiation or participation as a subject in medical research programs. [RPP # 5]

optimization: is a documented product that shows that the expense (in terms of money, person-hours, dose to install and maintain, etc.) of a project or feature of a project is justified in terms of the benefit received. This is in accordance with the idea of balancing ALARA considerations against technological, social, operational, and economic considerations.

person: means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency, any State or political subdivision of, or any political entity within a State, any foreign government or nation or other entity, and any legal successor, representative, agent or agency of the foregoing; provided that person does not include DOE or the United States Nuclear Regulatory Commission. [RPP # 5]

personnel dosimeters: Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers. [HSD, L]

personnel monitoring: Systematic and periodic estimate of radiation dose received by individuals during working hours. Also, the monitoring of individuals, their excretions, skin, or any part of their clothing to determine the amount of radioactive material present is personnel monitoring. [HSD, L]

personal protective equipment: Equipment such as respirators, face shields and safety glasses used to protect workers from excessive exposure to radioactive or hazardous materials.

planned special exposure: Preplanned, 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.

previously inaccessible: Any area that was not available to be surveyed prior to worker being exposed to the surfaces or material.

primary dosimeter: A dosimeter worn on the body used to obtain the formal record of whole body radiation dose.

protective clothing: Clothing provided to personnel to minimize the potential for skin, personal and company issued clothing contamination. Also referred to as "anti-contamination clothing," "anti-Cs" and "PCs."

Potential Radioactive Material: Material and equipment that may have been exposed to unconfined radioactive material above background as a consequence of past operations or activities.

public: Any individual or group of individuals who is not occupationally exposed to radiation or radioactive material. An individual is not a "member of the public" during any period in which the individual receives an occupational dose.

qualification standard: The explicit performance requirements for minimum proficiency in technical, academic, and site-specific knowledge and practical skills used in determining satisfactory completion of training programs. The qualification standard is used to qualify radiological control technicians (RCTs) at DOE facilities.

rad: Unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joules per kilogram (0.01 gray).

radiation: means ionizing radiation: alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in 10 CFR 835, does not include non-ionizing radiation, such as radio waves or microwaves, or visible, infrared, or ultraviolet light. [RPP # 5]

radiation area: means any area, accessible to individuals, in which radiation levels could result in an individual receiving an equivalent dose to the whole body in excess of 0.005 rem (0.05 mSv) in one hour at 30 centimeters from the source or from any surface that the radiation penetrates. [RPP # 5]

radiation generating device: A collective term for devices that produce ionizing radiation, including certain sealed sources that emit ionizing radiation, small particle accelerators used for single purpose applications which produce ionizing radiation (e.g., radiography), and electron-generating devices that produce x-rays incidentally. This term does not apply to video display terminals or other consumer products that only produce radiation considered to be background. Sealed radioactive sources that are capable of generating external radiation fields of 100 mrem/hr or greater at 30 cm from the accessible surface will be classified as an RGD. [HSD, L and modified by RL ltr. 02-AMSE-0057 of 8/5/02]

radioactive material: Any material that spontaneously emits ionizing radiation (e.g., X- or gamma rays, alpha or beta particles, neutrons). The term "radioactive material" also includes materials onto which radioactive material is deposited or into which it is incorporated. For purposes of practicality, 10 CFR 835 establishes certain threshold levels below which specified actions, such as posting, labeling, or individual monitoring, are not required. These threshold levels are usually expressed in terms of total activity or concentration, contamination levels, individual doses, or exposure rates. [HSD, L]

radioactive material area: means any area within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in Appendix 4A of CHPRC-00073. [RPP # 5]

radioactive material transportation: means the movement of radioactive material by aircraft, rail, vessel, or highway vehicle. Radioactive material transportation does not include preparation of material or packagings for transportation, storage of material awaiting transportation, or application of markings and labels required for transportation. [RPP # 5]

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 area: means any area within a Controlled Area defined in 10 CFR 835 as a "radiation area," "high radiation area," "very high radiation area," "contamination area," "high contamination area," or "airborne radioactivity area." [RPP # 5] NOTE: A Radiological Area does not include the controlled area.

radiological buffer area (RBA): A intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure. [HSD, L]

radiological conditions: Radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses from radiological hazards.

- changing radiological conditions: Radiological conditions, identified during the performance of radiological work, that result in or are expected to result in radiological hazards that were not considered during hazard analysis.

radiologically controlled area (RCA): Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material. (Defined as "controlled area" in 10 CFR 835.) [HSD, L]

Radiological Control First Line Manager: The first level of management within the Radiological Control Organization who supervise radiological control technicians (may also be referred to as Supervisor, Team Lead, etc.)

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.

radiological label: Label on an item that indicates the presence of radiation or radioactive materials.

radiological posting: Sign, marking, or label that indicates the presence or potential presence of radiation or radioactive materials.

Radiological Record: Information regardless of media (e.g., hardcopy, electronic, photos) created, developed, and received in connection with occupational radiation protection as required by CHPRC-00073, Chapter 7. Specific examples are listed in DOE G 441.1-1C, "Radiation Protection Programs Guide", Chapter 13, Occupational Radiation Protection Record-Keeping and Reporting. General examples include information related to:

* business or activities that document radiological administrative functions and policies,
* operational records involving radiological monitoring equipment or other radiological activities,
* maintenance records involving radiological monitoring equipment or other radiological activities, individual monitoring and dose records,
* ALARA decisions,
* radiological design and modification decisions,
* ALARA design review including results of optimization methods,
* radiological work planning documents including work authorizations (RWPs) and technical work documents,
* radiological safety training.

radiological work: Due to the nature and history of the Hanford site, all work is considered to be radiological work until all of the following conditions are verified by the work sponsor:

- Work **does not** involve radioactive material in quantities greater than or equal to 10% of CHPRC-00073, Appendix 4A and greater than or equal to 0.1 Curies;
- Work **will not** involve accessible removable contamination greater than CHPRC-00073, Table 2-2 values;
- Work **does not** include a Radiation Generating Device;
- Work **will not** require entry into a Radiological Area:
  - Contamination Area
  - High Contamination Area
  - Airborne Radioactivity Area
  - Radiation Area
  - High Radiation Area
  - Very High Radiation Area
- Work **will not** require entry into a Soil Contamination Area
- Work **will not** involve disturbing soil in an Underground Radioactive Material Area;
- Work **will not** disturb material fixing contamination in Fixed Contamination Areas;
- Work **will not** affect the radiological conditions of the facility (e.g., securing ventilation, relocating or modifying shielding material, interrupting power to radiological monitoring systems or components)

radiological work permit (RWP): The RWP is an administrative mechanism to support the planning process for radiological work activities and provide written authorization to control entry into and support performance of radiological work within radiological areas. The RWP also supports communication of existing and potential radiological hazards and related controls to the workers.

radiological work permit action level: A specific radiological condition or set of radiological conditions prescribed for the purpose of causing field work performance to shift to different radiological hazard controls. The purpose of Action Level(s) is to provide a break in work execution, to allow for verification of radiological conditions supporting success criteria established during work planning, such as area set

up, special tools and equipment, work instructions, hazard controls, adequate number and type of personnel, personnel protective equipment, or other matters with the potential to impede successful completion of the work as planned. Also, to facilitate implementation of alternate hazard controls if preplanned contingency conditions are encountered during work performance.

radiological work permit void limit: A specific radiological condition or set of radiological conditions, beyond the planned radiological conditions and basis for radiological hazard control, prescribed for the purpose of causing field work performance to be brought to a safe and orderly termination, due to encountering the specified radiological conditions. Reaching or exceeding a Void Limit(s) should cause a prompt and orderly curtailment of work and provide the opportunity for additional radiological hazard analysis. Use of a void limit is intended to be a mode of work performance prior to the initiation of Stop Radiological Work (Article 344), or other stop work processes.

radiological work planning team: A multi-disciplined team formed to plan the optimal method of accomplishing a given task.

radiological worker: means a general employee whose job assignment involves operation of radiation producing devices or working with radioactive materials, or who is likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year total effective dose. [RPP # 5]

Real property means land and anything permanently affixed to the land such as buildings, fences and those things attached to the buildings, such as light fixtures, plumbing and heating fixtures. [RPP # 5]

real-time air monitoring: means measurement of the concentrations or quantities of airborne radioactive materials on a continuous basis. [RPP # 5]

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: See Glossary term for clearance.

rem: Unit of dose equivalent. Dose equivalent in rem is numerically equal to the absorbed dose in rad multiplied by a quality factor, distribution factor and any other necessary modifying factor (1 rem = 0.01 Sv).

removable contamination: Radioactive material that can be removed from surfaces by non-destructive means, such as casual contact, wiping, brushing, or washing. [HSD, L]

representative sample: A sample that closely approximates both the concentration of activity and the physical and chemical properties of material (e.g., particle size and solubility in case of air sampling of the aerosol to which workers may be exposed).

respiratory protective device: means an apparatus, such as a respirator, worn by an individual for the purpose of reducing the individual's intake of airborne radioactive materials. [RPP # 5]

sealed radioactive source: means a radioactive source manufactured, obtained, or retained for the purpose of utilizing the emitted radiation. The sealed radioactive source consists of a known or estimated quantity of radioactive material contained within a sealed capsule, sealed between layer(s) of

non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means intended to prevent leakage or escape of the radioactive material. Sealed radioactive sources do not include reactor fuel elements, nuclear explosive devices, and radioisotope thermoelectric generators. [RPP # 5]

Secretarial Officer: Secretarial Officer means an individual who is appointed to a position in the Department of Energy by the President of the United States with the advice and consent of the Senate or the head of a departmental element who is primarily responsible for the conduct of an activity under the Act. With regard to activities and facilities covered under E.O. 12344, 42 U.S.C. 7158 note, pertaining to Naval nuclear propulsion, Secretarial Officer means the Deputy Administrator for Naval Reactors. [RPP # 5]

sievert (Sv): 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 rems).

site: An area managed by DOE where access can be limited for any reason. The site boundary encompasses Controlled Areas.

soil: The upper layer of earth that can be tilled and in which vegetation may grow, and including organic material such as vegetation or animal wastes that are deposited or mixed into the soil, and rubblized construction or deactivation and decommissioning debris. [HSD, L]

soil contamination area (SCA): An area in which radioactive material exists within the top 15 cm of soil such that:
1) A direct contamination reading of the soil surface exceeds the appropriate "total" contamination levels in Appendix D, 10 CFR 835, and
2) The transferable contamination from the area does not exceed the appropriate "removable" levels in Appendix D, 10 CFR 835. [RPP # 221, HSD, L]

soil intrusive activity: Any human activity that disturbs the surface and/or subsurface of the soil which has a reasonable possibility of increasing the amount of transferable contamination within a soil contamination area or an underground radioactive material area. [HSD, L]

source leak test: means a test to determine if a sealed radioactive source is leaking radioactive material. [RPP # 5]

Special tritium compound (STC) means any compound, except for H_2O, that contains tritium, either intentionally (e.g., by synthesis) or inadvertently (e.g., by contamination mechanisms). [RPP # 5]

stable radiological conditions: Radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses from radiological hazards resulting from exposures or potential exposures to ionizing radiation that are not expected to change during the performance of radiological work and do not require additional radiological hazard controls to be implemented before completion of the radiological work.

standard radiation symbols: Symbols designed and proportioned as illustrated in accordance with ANSI N2.1 for radiation symbols and ANSI N12.1 for fissile material.

step-off pad: Transition area between contaminated and non-contaminated areas that is used to allow exit of personnel and removal of equipment.

sticky pad: Step-off pad provided with a tacky surface to reduce the potential for inadvertently tracking contamination out of a contaminated area.

stochastic effects: means malignant and hereditary diseases for which the probability of an effect occurring, rather than its severity, is regarded as a function of dose without a threshold, for radiation protection purposes. [RPP # 5]

survey: An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present. [HSD, L]

technical equivalency determination (TED): a TED is a documented alternative solution, with supporting technical basis, analysis, and justification to demonstrate technical equivalency in lieu of a "should" provision. See Article 113.3 for additional criteria.

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.

temporary radiological contamination control barrier: A temporary radiological contamination control barrier is a barrier that is not a part of a facility engineering configuration control and is applied to a facility operating system, structure or component (SSC) for the purpose of providing a radiological contamination control barrier.

thermoluminescent dosimeter (TLD): Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

transferable contamination: The total contamination levels, expressed in terms of disintegrations per minute per a given area, on items such as shoes, shoe covers, vehicle tires, tools, or other equipment which has come into contact with contaminated soils. [HSD, L]

transuranics: As used in this Manual, means any radionuclide with an atomic number greater than 92, excluding ^{241}Pu. [RPP # 5]

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.

underground radioactive material area (URMA): An area that contains radioactive materials above DOE O 458.1 Section 4.k (CRD Section Section 2.k) release/clearance levels below the top 15 cm of soil, or below any layer of impervious soil cover material, e.g., asphalt, concrete. Radioactive materials

may include pipelines, radioactive cribs, covered ponds, covered ditched, catch tanks, inactive burial grounds, and sites of known, covered, unplanned releases (spills). [HSD, L]

very high radiation area: means any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates. [RPP # 5]

visitor: Person requesting access to Controlled Areas who has not been trained to the level required to permit unescorted access.

week: means a period of seven consecutive days. [RPP # 5]

weekly: once in a seven day period, approximately 52 times per year

whole body dose: The sum of the annual deep dose equivalent for external exposures and the committed effective dose for internal exposures (see definition of Total Effective Dose).

worker (Hanford): A "general employee" as defined in 10 CFR 835 who is either a DOE or DOE contractor employee assigned to the Hanford site; an employee of a subcontractor to a Hanford DOE contractor; or an individual who performs work for or in conjunction with DOE or utilizes DOE facilities on the Hanford site. [HSD, L]

worker (non-Hanford): A "general employee" as defined in 10 CFR 835 who is not a Hanford worker. [HSD, L]

year: means the period of time beginning on or near January 1 and ending on or near December 31 of that same year used to determine compliance with the provisions of 10 CFR 835. The starting and ending date of the year used to determine compliance may be changed provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years. [RPP # 5]