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Subject: MINIMUM RELEASE SURVEY REQUIREMENTS, RL MILESTONE RAD-94-034

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**Internal
Memo**

From: Health Physics Technology 33610-94-JRE-005
Phone: 376-5696 L8-20
Date: September 27, 1994
Subject: MINIMUM RELEASE SURVEY REQUIREMENTS, RL MILESTONE RAD-94-034

To: Distribution

cc: M. E. Hevland R3-12
S. R. Johnson T7-37
T. D. Merkling L8-16
R. M. Rogers L8-20
JRE File/LB

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

The minimum release survey requirements are documented in the attached supporting document, "Minimum Release Survey Requirements," WHC-SD-GN-TA-30004. An assessment was performed for each Westinghouse Hanford Company Radiological Control facility. The document assesses the methodology used by these facilities to release personnel and material/equipment from radiological controls.

This assessment is specific to each of the following facilities: B Plant, WESF, UO₃, 221 T, 2706 T, 313/333, 308, 377, 340, 3706, 309, 306-E, 3712, 3716, 303-A, 303-B, 303-E, 303-G, 303-K, FFTF, MASF, 222-S, PFP, PUREX, 100 K Area, CWC, Solid Waste Burial Grounds, 224-T, Tank Farm, 209-E, 242-A, 242-S, 242-T, 200 Area LEF, and ERHP Facilities.

Each of these facility Radiological Control organizations provided source term information that was used to determine the minimum release survey requirements. As additional facilities provide source terms, an assessment will be performed and survey requirements provided.

The assessment concluded that no facility is required to implement special procedures to perform material and/or personnel release surveys. The study assessed the requirement of dual surveys for each facility, and provides the justification for exemption of either the alpha or beta-gamma survey where applicable.

J. R. Ellis
Health Physicist

rls

Attachment

CORRESPONDENCE DISTRIBUTION COVERSHEET

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J. R. Ellis, 376-5696

Addressee

J. B. Hall, RL

Correspondence No.

9456370

Subject: COMPLETION OF MILESTONE ON MINIMUM RELEASE SURVEY REQUIREMENTS

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Westinghouse
Hanford Company

P.O. Box 1970 Richland, WA 99352

September 28, 1994

9456370

Mr. J. B. Hall, Acting Director
Quality, Safety, and Health Programs Division
U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352

Dear Mr. Hall:

COMPLETION OF MILESTONE ON MINIMUM RELEASE SURVEY REQUIREMENTS

Attached is the Westinghouse Hanford Company (WHC) Supporting Document, WHC-SD-GN-TA-30004, to complete U.S. Department of Energy, Richland Operations Office, Milestone RAD-94-034. The milestone, that required documentation of minimum survey requirements for release of materials and personnel from radiological controls, was completed on September 28, 1994. The methodology used by these facilities to release personnel and material/equipment from radiological control is contained in this document.

Each facility Radiological Control organization provided source term information. An assessment was performed to determine the minimum release survey requirements for each WHC Radiological Control facility.

The assessment concluded that no facility is required to implement a special procedure to perform material and/or personnel release surveys. The study assessed the requirement of dual surveys for each facility, and provides the justification for exemption of either the alpha or beta-gamma survey where applicable.

Very truly yours,

M. E. Hevland, Acting Manager
Radiological Control

rls

Attachment

RL - D. L. Clark
R. O. Puthoff (w/o attachment)

RADCON MILESTONE CLOSURE/ACTION PLAN STATUS REPORT

Section A - MILESTONE IDENTIFICATION: RAD-94-034

Control Log No: 106, Due Date: 09/30/94

Champion: J. R. Ellis, Milestone Class: DOE-RL X, WHC-KEY

Milestone Title: Document minimum release survey requirements.

Section B - ACTION PLAN STATUS:

On schedule: YES , NO (If no, include explanation)

Estimated completion date: / /

CHAMPION (Signature) _____ Date: ____/____/____

Section C - MILESTONE CLOSURE:

The above described milestone was completed on 09/28/94 (Date)

JUSTIFICATION FOR CLOSURE: (Attach copies of all documentation to substantiate closure)

The Minimum Release Survey Requirements was completed on September 28, 1994, and documented by Internal Memo 33610-94-JRE-005. The RL Milestone commitment was completed by transmitting the results of this requirement documentation to RL via External Letter number 9456370 attached.

SIGNATURES

CHAMPION: J. R. Ellis *JR Ellis* Date: 9/28/94

RESPONSIBLE MANAGER: R. M. Rogers R.M. Rogers Date: 9/28/94

PCI MANAGER: S. R. Johnson Date: 9/28/94

RADCON PROGRAM ELEMENT MANAGER: [Signature] Date: 8/28/92

SEP 30 1994

21

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT

607268

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Health Physics Technology	4. Related EDT No.:
5. Proj./Prog./Dept./Div.: W33610	6. Cog. Engr.: J. R. Ellis	7. Purchase Order No.: N/A
8. Originator Remarks: Issued for approval.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: September 9, 1994

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(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Impact Level	Reason for Trans- mittal	Orig- inator Dispo- sition	Receiv- er Dispo- sition
1	WHC-SD-GN-TA-30004	N/A	0	Minimum Release Survey Requirements	YES Q	1	1	1

16. KEY					
Impact Level (F)		Reason for Transmittal (G)		Disposition (H) & (I)	
1, 2, 3, or 4 (see MRP 5.43)		1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)										(G)	(H)
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1	1	Cog. Eng. J. R. Ellis	<i>J. R. Ellis</i>	9/13/94	14-03	E. J. Adams	<i>E. J. Adams</i>	9/13/94	14-03	1	1
1	1	Cog. Mgr. R. M. Rogers	<i>R. M. Rogers</i>	9/13/94	14-03	S. M. Albertin	<i>S. M. Albertin</i>	9/13/94	14-03	1	1
1	1	QA C. J. Stephan, II	<i>C. J. Stephan, II</i>	9/13/94	14-03	K. W. Gray	<i>K. W. Gray</i>	9/13/94	14-03	1	1
1	1	Safety G. R. Priddy	<i>G. R. Priddy</i>	9/13/94	14-03	M. M. Kavtani	<i>M. M. Kavtani</i>	9/13/94	14-03	1	1
1	1	Env. B. P. Gleckler	<i>B. P. Gleckler</i>	9/13/94	14-03	B. H. Lueck, Jr.	<i>B. H. Lueck, Jr.</i>	9/13/94	14-03	1	1
1	1	D. B. Ottley	<i>D. B. Ottley</i>	9/14/94	14-03	R. N. Smith	<i>R. N. Smith</i>	9/15/94	14-03	1	1
1	1	S. R. Johnson	<i>S. R. Johnson</i>	9/14/94	14-03	R. L. Watts	<i>R. L. Watts</i>	9/14/94	14-03	1	1
1	1	T. D. Merkle	<i>T. D. Merkle</i>	9/21/94	14-03	W. C. Mallory	<i>W. C. Mallory</i>	9/21/94	14-03	1	1

18. Signature of EDT Originator <i>J. R. Ellis</i> Date: 9/21/94	19. Authorized Representative Date for Receiving Organization <i>M. S. Balala</i> Date: 9/21/94	20. Cognizant/Project Engineer's Manager <i>R. M. Rogers</i> Date: 9/21/94	21. DOE APPROVAL (if required) Ltr. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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RELEASE AUTHORIZATION

Document Number: WHC-SD-GN-TA-30004, Rev.0

Document Title: Minimum Release Survey Requirements

Release Date: September 29, 1994

* * * * *

This document was reviewed following the
procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

* * * * *

WHC Information Release Administration Specialist:

Angela Laughery ^{For} M. Boston
(Signature)

9/29/94
(Date)

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

SUPPORTING DOCUMENT

1. Total Pages 36

2. Title Minimum Release Survey Requirements	3. Number WHC-SD-GN-TA-30004	4. Rev No. 0
5. Key Words Dual survey Hard-to-detect MDA Minimum release survey Release criteria Release survey <i>A. Laughery FOR C. Willingham 9-29-94</i> APPROVED FOR PUBLIC RELEASE	6. Author Name: Jackson R. Ellis <i>Jackson R. Ellis</i> Signature Organization/Charge Code W33610/3361	
7. Abstract This document documents the minimum release survey requirements for facilities at the Hanford site.		
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9. Impact Level 3ESQ		

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1.0 PURPOSE

The purpose of this technical work document is to document the minimum release survey requirements for the release of material/equipment and personnel from radiological control. This document assesses the methodology used by Westinghouse Hanford Company (WHC) Radiological Control (RC) facilities to release material/equipment and personnel from radiological control. This document provides a summary of the criteria applicable to the WHC radiological release program, and documents compliance with these requirements. The criteria for radiological release is provided in DOE Order 5400.5, "Radiation Protection of the Public and the Environment," for release to uncontrolled areas and in DOE/EH-0256T, "Radiological Control Manual," (DOE RadCon) and IOCFR835, "Occupational Radiation Protection; Final Rule," for controlled release.

2.0 SCOPE

This document applies to all material/equipment and personnel being released at WHC out of Contamination, High Contamination, or Airborne Radioactivity Areas to Controlled Areas, and to potentially contaminated material being released from Controlled Areas and Radioactive Material Areas (RMA) to uncontrolled areas. This document does not apply to materials that have been contaminated in depth or volume.

The facility source terms in this document were provided by the facility Radiological Control organizations and are considered to represent the areas of contamination of the facility. Changes to these source terms should be reported to Radiological Engineering and ALARA for incorporation into this document as revised.

3.0 CRITERIA

The requirements for material release surveys are separated into two groups, release to controlled areas and release to uncontrolled areas. Releases to controlled areas include those to Controlled Areas or RMAs. Uncontrolled releases include releases to areas that are not radiologically controlled.

A review of the criteria for these cases revealed that the release methodology for WHC RC did not meet the minimum release requirements because it did not require the identification of individual radionuclides present at a facility nor the required instrumentation and procedure to detect those radionuclides. Release criteria applicable to the scope of this document are described below.

3.1 APPLICABLE REQUIREMENTS FOR RELEASE TO CONTROLLED AREAS

The DOE RadCon manual, Article 421.1 states, "Radioactive Material in Contamination, High Contamination or Airborne Radioactivity Areas shall be

surveyed prior to release." The survey must demonstrate that the material being released does not contain surface contamination levels greater than the specified limits of Table 2-2 in the DOE RadCon manual.

3.2 APPLICABLE REQUIREMENTS FOR RELEASE TO UNCONTROLLED AREAS

The DOE RadCon manual, Article 422.1 states, "Material in Controlled Areas or Radioactive Material Areas, documented to have been released from Contamination, High Contamination, or Airborne Radioactivity Areas, shall be surveyed prior to release to uncontrolled areas. For specific criteria on releasing radioactive material to uncontrolled areas, the DOE RadCon manual refers to DOE Order 5400.5. The differences in release criteria for these are summarized in Section 4.0.

3.3 APPLICABLE REQUIREMENTS FOR PERSONNEL RELEASE

The DOE RadCon manual, Article 221.2 states, "Monitoring for contamination should be performed using frisking equipment that under laboratory conditions can detect total contamination of at least the values specified in Table 2-2."

4.0 TECHNICAL BASIS FOR RELEASE OF PERSONNEL AND RADIOACTIVE MATERIAL

Material must be demonstrated to contain less fixed and removable contamination than the specified limits, provided by the DOE RadCon manual for controlled releases, and by DOE Order 5400.5 for radiological releases to uncontrolled areas. Personnel release requires the limits for total contamination be met. The minimum detectable activity MDA study (Johnson 1993) performed by PNL demonstrated that the material release procedure in WHC-IP-0718 (WHC 1994) adequately meets the detection limits, with certain special provisions that are addressed in Section 5.0 of this document. The conclusions of this study are not limited to any type of release survey material release, and the data are considered valid for material release surveys and personnel release surveys (scanning data only).

4.1 BASIS FOR RELEASE TO RADIOLOGICALLY CONTROLLED AREAS

The DOE RadCon manual requires that material being released from a Contamination, High Contamination, or Airborne Radioactivity Area to a Controlled Area be demonstrated to contain radioactive contamination levels less than those listed in Table 2-2. These surface contamination release limits are summarized below:

- Less than 20 dpm/100 cm² alpha removable contamination
- Less than 500 dpm/100 cm² alpha total contamination
- Less than 1000 dpm/100 cm² beta-gamma removable contamination
- Less than 5000 dpm/100 cm² beta-gamma total contamination

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For a complete list with specific isotopes, refer to Table 2-2 of the DOE RadCon manual.

Procedure 3.1.1 of the WHC-IP-0178 manual provides guidance for performing and documenting surface contamination release surveys of material and equipment. This procedure assumes that detection to the levels above is attainable using a portable/semi-portable count rate meter (CRM) with a G-M pancake probe in a background of less than 150 cpm for beta-gamma contamination, and a PAM, PAC-6, or a Poppy in a background less than 3 cpm for alpha contamination.

The MDA study by PNL demonstrates that these instruments meet the required detection limits in the major isotope groups of Table 2-2, using the methods described in procedure 3.1.1 of WHC-IP-0718.

4.2 BASIS FOR RELEASE TO UNCONTROLLED AREAS

The guidance document for unrestricted radiological release of materials at Department of Energy (DOE) operated facilities is DOE Order 5400.5, "Radiation Protection of the Public and the Environment." DOE Order 5400.5, Section II.5.c.3 states that "Surfaces of potentially contaminated property shall be surveyed using instruments and techniques appropriate for detecting the limits stated in Figure IV-1."

These surface contamination release limits are summarized below:

- RESERVED for alpha removable contamination
- RESERVED for alpha total contamination
- Less than 1000 dpm/100 cm² beta-gamma removable contamination
- Less than 5000 dpm/100 cm² beta-gamma total contamination

For a complete list with specific isotopes, refer to Figure IV-1, of DOE Order 5400.5.

This table has reserved the limits for transuranic (TRU) contamination. Due to the lack of guidance for TRU contamination in DOE Order 5400.5, the criteria for unrestricted radioactive material must be obtained from another guidance source. WHC is using the radiological release limits provided in the DOE RadCon manual, Table 2-2 for release of TRU to uncontrolled areas (Bump 1994). It is noted above that the results of the MDA study show that detection to those levels is attainable using the methodology described in WHC-IP-0178, Procedure 3.1.1.

5.0 RELEASE METHODOLOGY

The constituents of a release methodology include criteria, a procedure, instruments for release and their capabilities, facility specific source terms, and problems and solutions, where applicable. The release criteria are

defined in the references introduced in Section 3.0. The procedure for release of materials at WHC is WHC-IP-0718 Section 3.1.1, "Material Release Surveys," (WHC 1994). The instruments and their capabilities are defined in the MDA document produced by PNL, (Johnson 1993). The source term is developed and maintained by each facility RC program. This document addresses the problem areas and provides solutions where necessary.

5.1 PROCEDURE

WHC-IP-0718, Section 3.1.1, "Material Release Surveys" provides the Health Physics Technician (HPT) with guidance and criteria for performing and documenting radiological release surveys of material and equipment. The technical basis for the statistical methodology for release of material and equipment is provided in PNL-9789, "Contamination Surveys for Release of Material," (Durham 1994). The MDA study (Johnson 1993) provides the data used to determine the scan speed for surveying material/equipment and personnel.

5.2 INSTRUMENT CAPABILITIES

The PNL MDA study (Johnson 1993) provides the calculated and empirical minimum detectable activity for Hanford site portable instruments used for release surveys. The study included static and scanning surveys. The static survey was performed using 5 second static counts in contact with the surface. The scanning survey was performed at speeds of 1 in./s (3 cm/s) and 2 in./s (5 cm/s) at a distance of 1/4 inch (6 mm) from the surface. The study included point sources and distributed sources. Background was varied (with no notable change in MDA) from 100 to 200 cpm for beta-gamma probes. Background was assumed to be zero for alpha probes. The following table summarizes the information reported in the PNL study. The 67% statistical data was presented in a follow-up study.

TABLE 1

Isotope	Isotope (Instrument)	DOE RadCon Limits dpm/100 cm ²	67% Statistical Survey	67% Scanning Survey 2"/s
U(Nat), ²³⁵ U, ²³⁸ U, and decay products	²³⁰ Th (PAM)	5,000	Detectable	Detectable
²³⁰ Th, ²³¹ Pa	²³⁰ Th (PAM)	500	Detectable	Non-detectable
²³⁹ Pu, ²²⁸ Th, ²²⁶ Ra, ²²⁷ Ac	²³⁹ Pu (PAM)	500	Detectable	Detectable
¹²⁵ I	5.5" dia. NaI (Fidler; eff. = 4%)*	1000	Non-detectable	Non-detectable
¹²⁹ I	100 cm ² gas proportional At 1 in./s*	500	Non-detectable	Non-detectable
²³⁰ Th(Nat)	²³⁰ Th (PAM)	1,000	Detectable	Detectable
²³² Th	²³⁰ Th (PAM)	1,000	Detectable	Detectable
⁹⁰ Sr	⁹⁰ Sr(Y); ⁹⁰ Sr(Y); gas proportional*	1,000	Non-detectable Detectable	Non-detectable Detectable
²²³ Ra, ²²⁴ Ra, ²³² U	²³⁹ Pu (PAM)	1,000	Detectable	Detectable
¹²⁶ I, ¹³¹ I, ¹³³ I	Short T _{1/2}	1,000	Not Studied	Not Studied
Mixed fission products	¹³⁷ Cs, ⁹⁰ Sr(Y), ⁹⁹ Tc	5,000	Detectable	Detectable
Tritium	Nondetectable with portable instruments	10,000	Not Studied	Not Studied

*
Not normally used

The study demonstrated that the portable instruments are sensitive enough to comply with the DOE RadCon for most radionuclides. The list below includes the hard-to-detect (HTD) nuclides as identified from the PNL study. The HTD is a nuclide that could not be detected at or below the contamination limit for a 67% confident survey. Based on their energies relative to the nuclides in the MDA study, other nuclides listed below were identified in an ORIGEN2 computer run (mixed fission products [MFP]) and the N Reactor source term (activation products). The nuclide ^{99}Tc has a maximum beta energy of 294 keV and MDA of 4400 dpm/100 cm². Therefore, any nuclide with an energy <300 keV was included in the HTD list. The ORIGEN2 data is a computer generated list of radionuclides in spent N Reactor fuel. The top 99% of nuclides listed in the ORIGEN2 data were evaluated, and the hard-to-detect nuclides are included here.

^{125}I The half-life ($T_{1/2}$) for ^{125}I is 60.1 days. Iodine-125 is an isotope generally used in the medical field and was not identified in the typical Hanford source term.

^{129}I Iodine-129 has a very long half-life (~16 million years). The low energy of ^{129}I (maximum β energy ~152 keV) makes it very difficult to detect with portable instrumentation. The detection of ^{129}I contamination must be performed using gamma spectroscopy. However, it can be shown that ^{129}I cannot add enough undetectable activity to the typical mixed fission product (MFP) source term to surpass its contamination limit of 500 dpm/100 cm² without an easier-to-detect nuclide such as ^{137}Cs being detected. This topic is discussed in Section 6.0 of this document. If a facility has ^{129}I in higher concentrations than are allowed per this document, Radiological Engineering and ALARA should be contacted for support in developing a procedure to survey for this nuclide.

^{90}Sr The total contamination limit for ^{90}Sr , when separated from the other fission products, is 1000 dpm/100 cm² as compared to the MFP limit of 5000 dpm/100 cm². A 100 cm² gas proportional detector, surveying at 2 in./s (5 cm/s) with the probe 1/4 inch (6 mm) from the surface, can detect ^{90}Sr below 1000 dpm/100 cm². These detectors are available through the portable instrument pool. If a facility has separated or enriched ^{90}Sr in the MFP source term, the facility should communicate this to Radiological Engineering and ALARA for the development of a procedure to detect this nuclide.

Other Other radionuclides that were not included in the MDA study are present in the typical MFP source term. ^{125}Sb has an effective maximum beta energy of 286 keV. The nuclides ^{155}Eu , and ^{151}Sm appear in the typical MFP source term, and with low maximum beta energies (167 keV and 76 keV, respectively), they cannot be detected to the 5,000 dpm/100 cm² contamination limit. These nuclides have low concentrations in the typical source term, and

like the nuclides listed above, will not add enough undetectable activity to surpass the contamination limit without an easier-to-detect nuclide such as ^{137}Cs surpassing its MDA. The nuclide ^{147}Pm (maximum beta energy, 225 keV) does contribute a significant amount of activity to the typical source term, and ^{137}Cs alone will not exempt this nuclide from detection. This will be discussed later in Section 6.0. The nuclide ^{241}Pu is a very low energy, beta-emitting transuranic radionuclide (maximum beta energy, 21 keV) that cannot be measured using any of Hanford's portable instruments. As per draft ANSI N13.12 (ANSI 1987), ^{241}Pu is included in the beta-gamma-emitting group for surface contamination limits, instead of the predominantly alpha-emitting TRU group. ANSI 317 (ANSI 1980) also provides exemption for the monitoring of this nuclide as compared to the other TRU plutonium isotopes. For the purpose of radiological release surveys, the surface contamination release limits for this nuclide are 1000 dpm/100 cm² removable, and 5000 dpm/100 cm² total. The means of detection for low beta-energy nuclides as described in the PNL MDA paper is liquid scintillation. This is only useful for removable contamination. New technology for the detection of fixed low energy beta contamination, the windowless gas proportional monitor, is being considered for evaluation by the Hanford Instruments Evaluation Committee (HIEC).

Activation products are the nuclides of concern in the coolant components of the fission reactors. Characterizations at N Reactor and the Fast Flux Test Facility (FFTF) has shown that the HTD nuclides, ^{54}Mn , ^{63}Ni , and ^{22}Na are present. Calculations show that the nuclides mentioned here are not abundant enough to cause the total activity to exceed the contamination limit without the easily detected nuclides being detected.

^3H

The maximum beta energy of Tritium is ~19 keV. It cannot be detected with a portable GM probe. The best form of tritium detection is liquid scintillation. This type of analysis is costly and time-consuming, and it is desirable to exempt the survey for tritium. Using the same argument as for ^{129}I , tritium cannot add enough undetectable activity to the typical MFP source term to surpass its contamination limit of 10,000 dpm/100 cm² without ^{137}Cs being detected. Facilities that have concentrations of tritium in their source terms higher than will allow exemption, should have a liquid scintillation program to detect this nuclide.

^{230}Th

The MDA study reported that ^{230}Th is non-detectable by 12% at a speed of 2 in./s (5 cm/s). This nuclide is the only barrier from setting the scan speed at 2 in./s (5 cm/s). However, as with the nuclides above, ^{230}Th is not a very abundant nuclide in the typical site source term and will not be present above the contamination limit without detecting ^{137}Cs , or ^{239}Pu . Therefore, the survey speed has been established at 2 in./s (5 cm/s).

The source term from each facility should be compared to this list in order to ensure that all required release surveys are being performed. The recommendations for alternate detection methods for the nuclides listed above are necessary only if the hard-to-detect nuclide(s) are present in the facility source term above the levels discussed in Section 6.0. If a facility has HTDs in higher concentrations than are allowed, Radiological Engineering and ALARA should be contacted to aid in the development of a procedure to detect the nuclide(s).

6.0 EXEMPTION FROM SURVEY FOR HARD-TO-DETECT RADIONUCLIDES

The MDA study performed by PNL (Johnson 1993) identified some hard-to-detect radionuclides that, if present in a facility's source term, would require an alternate procedure for release surveys. However, the relative abundance of these nuclides in a typical source term (see Table 2) is so low that it is not possible for the HTDs to be present above the contamination limits when no activity is detected.

To illustrate this for nuclides in the beta-gamma category, ^{125}Sb , an HTD nuclide, will be compared to the easily detected ^{137}Cs . Antimony-125 has an effective maximum beta energy of 286 keV. The maximum beta energy of ^{137}Cs is 512 Kev. Therefore, ^{137}Cs is more readily detected than ^{125}Sb .

The surface contamination limit for mixed fission products from the DOE RadCon manual is 5,000 dpm/100 cm^2 . When ^{137}Cs is initially detected at 2,900 dpm/100 cm^2 (MDA), the activity added to the source term from ^{125}Sb will not be enough for the total activity to exceed the contamination limit. This can be seen by comparing the abundance of ^{125}Sb and ^{137}Cs in the typical source term. This information is taken from ORIGEN2 data. The data from ORIGEN2 is the fractional curie inventory of products of the burn-up of 12% Pu enriched N Reactor fuel, predominantly mixed fission products. The fuel is decayed 10 years to account for the approximate period since N Reactor's last operation. ^{85}Kr has been deleted from the ORIGEN2 data because it is a gas and will dissipate. ^{137}Ba has been deleted from the ORIGEN2 data because the gamma from this nuclide is considered a delayed gamma from ^{137}Cs .

The fraction of a unit curie of activity from ^{125}Sb is 4.92E-3. The fraction of a unit curie of activity from ^{137}Cs is 2.78E-1. Therefore, the activity from Cs-137 is $(2.78\text{E}-1 / 4.92\text{E}-3)$ 57 times the activity of ^{125}Sb . Therefore, for unaltered source terms, if ^{125}Sb were present at the contamination limit of 5,000 dpm/100 cm^2 , the activity of ^{137}Cs would be 2.83E5 dpm/100 cm^2 . Conversely, if ^{137}Cs is present at 2,900 dpm/100 cm^2 (its MDA), then the activity of the ^{125}Sb present would be approximately 51 dpm/100 cm^2 . Therefore, when the ^{137}Cs is first detected with the GM detector at 2,900 dpm/100 cm^2 , ^{125}Sb will add 51 disintegrations per minute. Therefore, the total activity (2,957 dpm/100 cm^2) is well below the 5,000 dpm/100 cm^2 contamination limit in the DOE RadCon manual.

This calculation is repeated for a different nuclide. The nuclide tritium (^3H) is not detectable with a GM probe, and the contamination limit for ^3H is 10,000 dpm/100 cm^2 . The fraction of a unit curie of activity from ^3H is $1.06\text{E}-3$. The activity of ^{137}Cs is $(2.78\text{E}-1 / 1.06\text{E}-3)$ 262 times the activity of ^3H . Therefore, for unaltered source terms, if ^3H were present at the contamination limit of 10,000 dpm/100 cm^2 , the activity of Cs-137 would be $2.62\text{E}6$ dpm/100 cm^2 . Conversely, if ^{137}Cs is present at 2,900 dpm/100 cm^2 (its MDA), then the activity of the ^3H present would be approximately 11 dpm/100 cm^2 . As with ^{125}Sb , the total activity of ^{137}Cs plus ^3H will not exceed the contamination limit when the activity is first detected.

In addition to ^{137}Cs , the other easily detected nuclides in the typical source term as defined by the ORIGEN2 data, are ^{90}Sr and ^{90}Y . The argument above is made stronger by including the activity from these two additional nuclides in the calculations. The PNL MDA study reports that the MDA for ^{137}Cs is 2,900 dpm/100 cm^2 , while the weighted MDA for $^{90}\text{Sr}(\text{Y})$ is 2,000 dpm/100 cm^2 . The ORIGEN2 data shows that ^{137}Cs , ^{90}Sr , and ^{90}Y account for approximately 72% of the typical source term for beta-gamma emitters. The weighted MDA for these three nuclides is 2,350 dpm/100 cm^2 . To be conservative, the lower MDA of ^{137}Cs , 2900 dpm/100 cm^2 will be used. Table 3 presents the "hard-to-detect" nuclides and their activities when the sum of the activity from ^{137}Cs , ^{90}Sr , and ^{90}Y is present at MDA (2,900 dpm/100 cm^2). In instances where the source term is altered significantly from the N Reactor spent fuel source term, the total weighted MDA of the hard-to-detect nuclides and the easily detected nuclides must remain below the contamination limit.

The contamination limit for beta-gamma emitting MFPs is 5,000 dpm/100 cm^2 . Therefore, when activity is detected at the MDA of 2,900 dpm/100 cm^2 , 2,100 dpm/100 cm^2 (5,000 - 2,900) of additional undetectable activity may be present before the contamination limit is reached. Consequently, the ratio of the hard-to-detect nuclides to the easily detected nuclides must be less than 72% (2,100/2,900). In the typical source term defined by the ORIGEN2 data, the HTD nuclides account for approximately 26% of the total activity, approximately 36% of the easily detected nuclides. For source terms that are significantly altered from the typical source term and do not meet this criteria, the alternate detection methods mentioned earlier must be implemented.

Iodine-129 has a contamination limit of 500 dpm/100 cm^2 . Therefore, this nuclide should be compared to the easier to detect MFPs separately from the other HTDs. The ratio for exemption of survey for ^{129}I is 7%, determined by the sum-of-the-fractions of the release limits of this nuclide and the easily detected nuclides.

The only alpha emitters that were determined to be hard-to-detect in the MDA study were ^{230}Th and ^{231}Pa . As seen in Table 3, these nuclides provide an extremely low amount of activity to the unit curie of activity in the typical source term. These nuclides add less than one disintegration per minute when ^{239}Pu is present at the contamination limit of 500 dpm/100 cm^2 . For ^{230}Th or ^{231}Pa to add one disintegration per minute to the activity of Pu-239 at the

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contamination limit, the nuclide must be present at 0.2% of the activity of ^{239}Pu ($1/500 = 0.2\%$). Therefore, a source term with enriched quantities of ^{230}Th or ^{231}Pa must contain these nuclides at a ratio of less than 0.2% to ^{239}Pu to exempt their detection.

Table 2
Typical Source Term

Nuclide	% of Unit Curie
¹³⁷ Cs	27.7
⁹⁰ Y	21.9
⁹⁰ Sr	21.9
²⁴¹ Pu	16.9
¹⁴⁷ Pm	7.4
¹²⁵ Sb	0.49
¹³⁴ Cs	0.48
²³⁹ Pu	0.42
²⁴¹ Am	0.35
¹⁵¹ Sm	0.34
¹⁵⁴ Eu	0.33
²⁴⁰ Pu	0.22
¹⁵⁵ Eu	0.13
³ H	0.11
⁶³ Ni	8.16E-3
⁹⁹ Tc	4.80E-3
⁵⁹ Ni	6.9E-5
¹²⁹ I	1.03E-5
²³⁰ Th	1.54E-7
²³¹ Pa	1.50E-8
Total	99

TABLE 3
Typical Source Term Hard-to-Detect Activity

NUCLIDE	% OF UNIT CURIE	ACTIVITY OF NUCLIDE WITH EASY-TO-DETECT NUCLIDES AT MDA (2900 DPM/100 CM ²)
³ H	1.06E-1	4.3 ^a
¹⁴⁷ Pm	7.44	300 ^b
¹⁵⁵ Eu	1.32E-1	5.3 ^b
¹⁵¹ Sm	3.41E-1	14 ^b
²⁴¹ Pu	16.9	681 ^b
¹²⁹ I	1.03E-5	0.0004 ^c
¹²⁵ Sb	4.92E-1	20
²³⁰ Th	1.54E-7	6.2E-6 ^c
²³¹ Pa	1.50E-8	6.0E-7 ^c
Total	25.6	1025

- a. Contamination limit = 10,000 dpm/100 cm²
b. Contamination limit = 5,000 dpm/100 cm²
c. Contamination limit = 500 dpm/100 cm²

Note: The activation products, Ni-63 and Mn-54 are not listed in the table above since they do not appear in the ORIGEN2 fuel source term.

7.0 EXEMPTION FROM DUAL CONTAMINATION RELEASE SURVEYS

In the Internal Memo from Radiological Control manager, R. E. Heineman to area RC managers (Heineman 1992), it was directed that all radiological releases to uncontrolled areas require both alpha and beta-gamma surveys, unless an approved characterization has been developed as a basis for not requiring a dual survey.

The purpose of this section is to provide the technical basis for the elimination of one of the surveys. For the elimination of the alpha survey, the approach is to ratio the DOE specified contamination limit for alpha (500 dpm/100 cm²) to that for beta-gamma (5000 dpm/100 cm²). That ratio (500/5000) is 0.1, or 10%. For conservatism, the recommended limit is 5%. If the alpha activity is less than 5% of the beta-gamma activity, then the alpha survey may be eliminated. With a comfortable margin for error, the alpha activity will not exceed the contamination limit without the beta-gamma activity being detected well in advance. The elimination of the beta-gamma survey, in a single survey situation in which only the alpha survey is desired, requires that the beta-gamma activity be no more than five (5) [(5000/500)/2] times the alpha activity. In this situation, the beta-gamma activity cannot exceed 5000 dpm/100 cm² without the alpha being detected well in advance.

The ratios described above must be documented in a source term characterization that has met the criteria of this document. The data for this characterization should be developed from a comprehensive collection of samples of radioactive material that is commonly present at the facility, and/or with several smears of contamination areas (CA) at the facility. The total activity from the alpha and beta-gamma radionuclides of each of the sample locations in this comprehensive analysis should be compared, and those comparisons evaluated against the criteria described above. The characterization should address each individual source stream as an independent source term.

The elimination of one of the contamination surveys requires the characterization to be reviewed periodically, and updated if applicable. This insures that the ratio does not become non-compliant with the criteria for dual survey exemption in this document. This review, required only if the elimination of a survey is elected, must be performed annually, or more frequently as introductions of radioactive material potentially alter the source term. Radiological Engineering and ALARA should be notified of each review, and its approval is required for revisions. Contamination control measures should also be implemented to control the introduction of radioactive materials that may alter the source term.

This practice is a cautionary one, as the lack of an alpha (or beta-gamma) survey may allow the alpha (or beta-gamma) activity to go unnoticed after a break down in contamination control. The RC manager at each facility must put great emphasis on the contamination control program if elimination of one of the surveys is elected. Table 4 lists the dual survey status of each

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facility. Facilities not listed below require dual survey for radiological releases of material/equipment and personnel.

Table 4

<u>Dual Survey Required</u>	<u>Beta-gamma Survey Only</u>	<u>Alpha Survey Only</u>
U03	B Plant	PFP
221 T, 2706 T	WESF	224-T
313/333, 308, 377	FFTF/MASF	
340, 3706, 309	100 K Areas	
306-E, 3712, 3716		
303-A, 303-B, 303-E		
303-G, 303-K		
222-S (Single Survey allowed based on case- by-case evaluation)		
PUREX		
CWC, Solid Waste Burial Grounds		
Tank Farms		
242-A, 209-E		
242-S/242-T		
200 Area LEF		
ERHP Facilities (Depending on case- by-case analysis)		

8.0 EVALUATION OF MINIMUM RELEASE SURVEY REQUIREMENTS

Based on an evaluation of the source term against the criteria given in this document, the following facilities have no additional or special release survey requirements. Nuclides that were more than three orders of magnitude below the abundance of the easier to detect nuclides were not considered.

B Plant The source term for B Plant was determined by taking several smear samples from the canyon deck, to satisfy the criteria for Hanford solid waste acceptance criteria (Serkowski 1990). The results of the analysis are:

^{137}Cs	30%
$^{137\text{m}}\text{Ba}$	30%
^{90}Sr	20%
^{90}Y	20%

The source term is dominated by ^{137}Cs and ^{90}Sr and their daughters.

None of the HTDs appeared in the analyses of the smears. No alpha-emitting nuclides were detected in the analysis. No alpha survey is required.

WESF The source term for WESF was produced by taking 20 smear samples from the canyon and 15 smear samples from the support areas, such as the service gallery and manipulator repair shops (Koerner 1993). The samples were analyzed for total beta, total alpha, and gamma energy analysis (GEA). The results of the analysis are:

^{137}Cs	40%
$^{137\text{m}}\text{Ba}$	40%
^{90}Sr	10%
^{90}Y	10%

The source term is dominated by ^{137}Cs and ^{90}Sr and their daughters. None of the HTDs appeared in the analyses of the smears. The report indicates that alpha-emitting radionuclides could not be detected in several of the samples, and that those that did contain alpha-emitters, contained quantities very near the analytical detection limits. No alpha survey is required.

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UO₃

The source term for the UO₃ plant was developed to satisfy Hanford solid waste acceptance criteria (Ellis 1992). The table below contains the radionuclide distribution data for UO₃ that was provided, with the daughters of the uranium nuclides added.

Source Term Activity for UO₃.

Nuclide	Type of Decay	Curies* in 1992	Curies in 1994
²³⁴ U	γ, α	21.33	21.33
²³⁵ U	γ, α	.75	.75
²³⁶ U	γ, α	1.74	1.74
²³⁸ U	γ, α	12.61	12.61
⁹⁹ Tc	γ, β,	63.64	63.64
²³⁴ Pa	γ, β	0.00	12.61
²³¹ Th	γ, β	0.00	.75
²³⁴ Th	γ, β	0.00	12.61

* Original data in %, so this is activity per 100 Ci sample.

One HTD, ²³⁴Th is identified in this source term. Thorium-234 is a daughter of ²³⁸U, and the parent of ^{234m}Pa. A weighted MDA can be calculated using the method described in Section 6.0 using ⁹⁹Tc and ^{234m}Pa. The weighted MDA of these two nuclides is approximately 4000 dpm/100 cm². Therefore, the HTD, ²³⁴Th, may be present at 25% [(5000-4000)/4000] without the total activity exceeding the contamination limit. ²³⁴Th is present at approximately 16%. The release of material and personnel from the UO₃ plant will not require a procedure to detect ²³⁴Th.

Further analysis of the source term indicates that the ratio of alpha emitting nuclides to beta-gamma emitting nuclides is 1/2.5, or 40%. This is larger than the required 5% that allows the exemption of the alpha survey. Therefore, release of material and personnel from the UO₃ plant requires an alpha and a beta-gamma survey.

T-Plant The source term for T-Plant was produced by analyzing the contents of Tank 15-1 at T-Plant (Morford 1992).

Nuclide	Source Strength ($\mu\text{Ci}/\text{cm}^2$)	
	Normal	Sludge
^{90}Sr	1.01E-2	9.28E-1
^{90}Y	1.01E-2	9.28E-1
^{137}Cs	4.35E-3	6.27E-3
$^{137\text{m}}\text{Ba}$	4.09E-3	5.89E-3
^{60}Co	4.38E-5	3.50E-4
^{241}Am	4.55E-6	1.33E-3

The 15-1 tank at T-Plant is a temporary storage tank for waste leaving the facility. The tank is emptied and re-filled as different decontamination projects are undertaken. The contents of 15-1 are not in a homogeneous liquid form; sludge collects at the bottom of the tank. An analysis of the tank contents will generate a list of the nuclides expected to be found inside the facility from former decontamination projects, however, relative concentrations of contamination expected inside the facility can not be generated using sampling from this tank. T-Plant RC is developing a sampling plan to accurately characterize the surfaces of the facility. This characterization will be incorporated into this document once it is available. The 15-1 tank data will be used as a baseline for the type of contaminants expected in the facility until the analysis above is completed.

The HTDs in this source term are several orders of magnitude below the easier to detect nuclides, and so are not included in the table above. Therefore, no special requirements are needed to release material and personnel. An evaluation of the source term demonstrates that the ratio of the alpha-emitting nuclides to the predominant beta-emitting nuclides is less than 1/1300. This indicates that an alpha survey is not required to release material and personnel from T-Plant. However, a collection of smears from throughout the plant (Frisbee 1992) identified abundant alpha contamination in the 221 T canyon and minor alpha contamination in the 221 T stack. Material and personnel exiting these areas will undergo an alpha and a beta-gamma release survey. Alpha contamination was also determined to be present in the low-level decontamination facility, 2706 T. Dual survey is required for material and personnel exiting this area.

300 Area Listed below are the source terms for the 300 Area Facilities for which WHC presently has radiological safety responsibility as described by 300/400 area RC (Ames 1994). Included is the basis, or background information, used to determine the source term.

313/333 Buildings

The source term for these facilities is associated with fabrication of fuel assemblies for the N Reactor, primarily slightly enriched ^{238}U .

308 Facility

The source term for this facility is associated with fabrication and inspection of fuel for the Fast Flux Test Facility (FFTF). Isotopes associated with that process were: ^{238}Pu , ^{239}Pu , ^{240}Pu , and ^{242}Pu in addition to Uranium (natural, depleted, and enriched). This facility was shutdown near the end of March 1994. All processes, including glove boxes, ventilation, hoods, etc., were cleaned out, stabilized and sealed as part of that shutdown. The facility will remain shutdown until Decontamination and Deactivation activities are begun.

377 Facility

This facility was previously operated by PNL for experiments on a steam generator removed from a pressurized water reactor. Former activities also include sampling and repackaging of low level waste. The contamination from these activities has been stabilized or removed.

340 Complex

The 340 Complex is a radioactive/mixed waste facility servicing PNL facilities utilizing a large variety of radionuclides. Samples of PNL waste are evaluated in this facility. While the source term for this facility is not uniform and constant, the generators of the waste are consistent. The quarterly liquid waste analysis for the last year were examined to evaluate the radionuclidic distribution for the 340 Complex. These samples were collected on the following dates: 3/17/93, 6/16/93, 9/27/93, 12/1/93, and 3/29/94. The radionuclides identified in these analyses were consistent within an order of magnitude. The ratio of HTD to easily detectable radionuclides ranged from 3.2% to 16.7%; all well below the criteria of Section 6.0.

3706 Building

Although this building is posted for radiological concerns there are no loose surface contamination concerns for normal operations in the facility. Past operations produced contamination of some of the lab spaces and some of the ventilation ducting. However, as part of the cleanup of those activities, the loose contamination was removed from the work area and the ventilation

was abandoned in place in the attic. Any remaining activity was fixed in place. A routine survey program continues to assure no loose surface activity is present in the building. Removal of standard office materials or equipment and materials, as well as personnel exiting, does not require survey at this facility. The attic remains posted for radiological concerns and additional precautions are required to enter. The nuclides of primary concern during the past operations were Uranium and Plutonium.

309 Building

The 309 facility housed the now deactivated Plutonium Recycle Test Reactor (PRTR) reactor. Significant portions of the facility were decontaminated and turned into clean room shop areas to support sodium system development. Only two areas have CA postings; the lower level and the Rupture Loop. Characterization data is not currently available for these isolated areas. Neither of these areas is routinely accessed. Special RWPs are required for entry/work in those areas, and dual survey is required for future entries until a nuclidic characterization can be performed. Routine surveys continue to verify no loose surface activity in other areas of this facility. No personnel surveys or material release surveys are required upon exit or removal from the normally occupied work areas.

306-E

All areas of 306 building are clean work areas except for rooms 158 and 159. Both of these rooms were used to support the 308 facility fuels program for the FFTF, therefore, the source term for 308 will apply for 306-E. Both rooms are isolated and only entered on a sporadic basis, i.e., only a few times a year and then only with a special RWP and HPT coverage. The routine survey program continues to confirm no loose surface contamination in the rest of the facility.

3712, 3716, and 303-A, 303-B, 303-E, 303-G, and 303-K

These buildings are all storage facilities. They have no operational ventilation system and no work activities are carried out in the buildings. They store packaged Special Nuclear Materials in the form of uranium billets, clad fuel assemblies, clad fuel elements and unfinished fuel elements. The isotope of concern is slightly enriched Uranium. Building 303-K has Uranium and Zircaloy-2 chips and fines stored in sealed drums.

Each of these facilities requires an alpha and a beta-gamma survey to release material and personnel unless otherwise noted above. Facilities performing work under temporary RWPs only should determine the source term of the project before the work begins, and the RWP should refer to this document for minimum release survey requirements.

FFTF

The source term for the Fast Flux Test Facility (FFTF) is given by sample analysis of the collection tanks (T1 and T2) at the Maintenance and Storage Facility (MASF) facility. The MASF facility, has sodium removal capabilities and is used to decontaminate equipment used in the FFTF. The FFTF reactor is no longer operating, therefore no fission/activation products are currently being produced. The activation products ^{60}Co , ^{54}Mn , and ^{22}Na , have relatively short half-lives, and are diminishing in abundance at a rapid rate. For this reason, the table below shows the source term for the MASF facility for the last year only.

DATE	^{137}Cs	^{134}Cs	^{54}Mn	^{60}Co	^{22}Na	^{182}Ta	α/β
5/93	3.87E-4	2.03E-4	5.86E-5	-	2.25E-5	3.38E-5	< 0.2%
5/93	4.5E-4	2.9E-5	5.4E-5	1.1E-5	1.6E-5	1.35E-3	< 0.04%
7/93	8.2E-4	5.8E-5	-	2.1E-5	9.1E-6	-	< 0.05%
9/93	4.28E-4	2.16E-5	1.49E-5	5.41E-6	1.44E-5	9.91E-5	< 0.07%
12/93	7.5E-4	4.7E-5	6.3E-6	2.0E-5	$^{154}\text{Eu} = 2.3\text{e-}5$		0.5% .

* Activity is expressed in mCi/ml

An evaluation of the data in the table above demonstrates that the HTDs are not in an abundance that will require the facility to perform special release surveys. The HTDs in this source term are fairly short-lived and are decaying at much higher rates than the ^{137}Cs . Therefore, this facility should not develop a problem with the HTDs during its decommissioning.

The data for the alpha to beta-gamma ratios shown in the last column is from total alpha and total beta activity. All ratios are less than the required 5% criteria as discussed in Section 7.0. Total gamma activity was not available; however, the added activity would make the ratios above smaller. The necessity of dual survey was evaluated by FFTF RC personnel in 1992 (Nelsen 1992), following the issuance of the memo mentioned in Section 7.0 (Heineman 1992). In the memo, FFTF RC determined that an alpha survey was not required based on an analysis of approximately 10 years of samples from the IEM Cell, FFTF's fuel destructive examination complex, and a review of all survey reports from 1991 that noted no alpha contamination using portable alpha instrumentation. A review of an ORIGEN2 run for radionuclide content, also referenced in the memo concluded that contamination by breach of fuel would have beta-gamma contamination at a ratio of 65 to alpha contamination. FFTF RC currently verify the absence of alpha contamination via quarterly routine radiological surveys of the IEM Cell.

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The FFTF has a tritium sampling plan to detect the tritium that is present in the facility. Routine samples are taken in several locations and when tritium is found (due to a spill, etc.) the items released from that area are surveyed for tritium until the tritium contamination is removed.

222-S

The source term for the 222-S laboratories was derived from sample analysis from calendar year 1993 for the radioactive liquid waste from 219-S (Hall 1994). The table below displays the beta-gamma emitting radionuclides from that source terms that are within three orders of magnitude of the ^{137}Cs level.

Nuclide	^{137}Cs	^{90}Sr	^{90}Y	^{99}Tc	^{147}Pm	^3H
$\mu\text{Ci/l}$	45.7	29.7	29.7	0.03	3.59	0.37

An evaluation of the source term shows that the ratio of HTD to the easier to detect radionuclides is 3.8%, below the required maximum ratio. The total alpha from the 222-S source term is $0.41 \mu\text{Ci/l}$. The alpha to easily detectable beta-gamma ratio is 0.4%. This suggests that the 222-S facility should not have concerns with alpha contamination. However, because the source term is a compilation of wastes from different areas of the lab, administrative controls must be in place to recognize the areas of alpha concern and require both beta-gamma and alpha surveys in those areas with alpha to beta-gamma concentrations greater than 5%. This can be controlled with Radiation Work Permits (RWP); the alpha and beta-gamma contamination levels are already being determined on a case by case basis, and can easily be compared for exemption from dual survey.

PFP

The source term for the Plutonium Finishing Plant (PFP), shown in the table below, was derived from 67 samples of material from PFP in 1989 and is decayed to the current year (Hamilton 1990).

Nuclide	Activity 1989 (Ci/g)	Activity 1994 (Ci/g)
^{241}Am	$4.11\text{E}-2$	$4.37\text{E}-1$
^{238}Pu	$5.16\text{E}-1$	$4.96\text{E}-1$
^{239}Pu	$5.71\text{E}+0$	$5.71\text{E}+0$
^{240}Pu	$1.31\text{E}+0$	$1.31\text{E}+0$
^{241}Pu	$5.59\text{E}+1$	$4.39\text{E}+1$

The source term is basically 12% ^{240}Pu enriched fuel. The major radiological contributor to this source term is the beta-emitter ^{241}Pu . The beta activity from this nuclide is 5.5 times the alpha activity. This is 10% over the criteria of Section 7.0, but the conservative factor of two that established the ratio at 5% is not

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meant to be ultimately restrictive. The source term for PFP is dominated by alpha contamination and is acceptable to allow the exemption from the beta-gamma survey. Therefore, PFP will not require liquid scintillation to detect the ^{241}Pu .

PUREX

The source term for PUREX was derived by taking smear samples at the facility (Ellis 1994) and comparing the results of those smear surveys to the predictions of the ORIGEN2 computer code for N reactor fuel. The table below shows the PUREX source term with the predominant radionuclides listed.

Nuclide	Activity (Ci/g)		
	Sample Gallery	Hot Shop East & West CMP's	203-A
^3H	5.62E-13	5.75E-10	-
^{90}Sr	1.23E-10	1.26E-07	-
^{90}Y	1.23E-10	1.26E-07	-
^{137}Cs	1.43E-10	1.46E-07	-
^{147}Pm	8.90E-11	9.11E-08	-
^{241}Pu	2.86E-11	2.93E-08	-
^{99}Tc	-	-	5.64E-10
^{235}U	-	-	6.62E-12
^{238}U	-	-	1.12E-1

An evaluation of the ratios of HTDs to the easier detected radionuclides in these source terms shows that no special release survey requirements are necessary at PUREX. The ratios for the sample gallery and the hot shops are both 30%. The 203-A facility contains only the ^{99}Tc beta-emitter, and the beta-emitting progeny, ^{231}Pa of ^{238}U , both of which are detectable. The PUREX facility will continue to perform both alpha and beta-gamma surveys in all areas due to the possibility of alpha contamination throughout the facility.

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K Basins The source term for K Basins was taken from a study consisting of acquiring smears of several locations and analyzing those smears for alpha, beta, and gamma emitting radionuclides (Devanney 1990). The tables below show the activity reported in the study of 1989, and with five years of decay.

Source Term Activity for East K Basin

Nuclide	$\mu\text{Ci/smear}$ in 1989					Activity $\mu\text{Ci/smear}$ in 1994
	K Basin A	K Basin B	K Basin C	K Basin D	Average	
^{241}Am	-	-	2.8E+00	1.0E+01	3.2E+00	3.5E+00
^{137}Ba	-	-	-	-	-	2.5E+01
^{57}Co	-	-	1.3E+00	-	3.3E-01	-
^{51}Cr	-	-	-	1.2E+00	3.0E-01	-
^{137}Cs	-	1.3E+01	9.2E+01	1.3E+01	3.0E+01	2.7E+01
$^{239}\text{Pu}/^{240}\text{Pu}$	-	1.4E+00	4.1E+00	-	1.4E+00	1.4E+00
^{241}Pu	3.4E+00	4.7E+01	1.0E+02	1.5E+01	4.1E+01	3.2E+01
^{89}Sr	-	7.2E+00	9.6E+00	3.4E+00	5.1E+00	-
^{90}Sr	-	3.0E+01	3.4E+01	2.5E+01	2.2E+01	1.9E+01
^{90}Y	-	-	-	-	-	1.9E+01

Environs of East K Basin Source Term.

Nuclide	Activity 1989 ($\mu\text{Ci/smeat}$)	Activity 1994 ($\mu\text{Ci/smeat}$)
^{241}Am	1.7E-02	1.9E-02
$^{137\text{m}}\text{Ba}$	-	1.8E-01
^{144}Ce	1.9E-03	-
^{60}Co	1.3E-02	6.6E-03
^{51}Cr	1.5E-03	-
^{137}Cs	2.1E-01	1.9E-01
^{154}Eu	7.4E-03	5.0E-03
^{155}Eu	6.2E-03	3.1E-03
^{54}Mn	3.7E-03	-
^{59}Ni	1.4E-03	1.4E-03
^{238}Pu	2.8E-03	2.7E-03
^{239}Pu	1.7E-02	1.6E-02
^{241}Pu	2.6E-01	2.0E-01
^{106}Ru	1.0E-03	-
^{125}Sb	1.7E-03	-
^{89}Sr	8.4E-02	-
^{90}Sr	1.3E-01	1.2E-01
^{90}Y	-	1.2E-01

Environs of West K Basin Source Term.

Nuclide	Activity 1989 ($\mu\text{Ci/smear}$)	Activity 1994 ($\mu\text{Ci/smear}$)
$^{137\text{m}}\text{Ba}$	-	2.0E-02
^{10}Be	1.4E-04	1.4E-04
^{144}Ce	6.3E-04	-
^{60}Co	2.12E-03	1.1E-03
^{51}Cr	2.9E-04	-
^{134}Cs	5.9E-04	1.1E-04
^{137}Cs	2.37E-02	2.1E-02
^3H	3.4E-04	2.6E-04
^{131}I	1.1E-04	-
^{54}Mn	4.4E-04	-
^{59}Ni	9.3E-04	9.29E-04
^{63}Ni	6.7E-04	-
^{239}Pu	1.11E-04	1.1E-04
^{241}Pu	1.1E-03	8.6E-04
^{106}Ru	3.0E-04	-
^{125}Sb	3.4E-04	-
^{79}Se	1.6E-04	1.6E-04
^{89}Sr	7.23E-03	-
^{90}Sr	1.19E-02	1.1E-02
^{90}Y	-	1.1E-02

An analysis of the source terms above shows that the abundance HTDs are below 72% of the easily detected nuclides. Therefore, no special procedure is required for release surveys from the 100 K areas.

The ratio of alpha contamination to beta-gamma contamination was determined to be over the required 5% for the K Basin East situations, but were below 10% (the actual alpha to beta-gamma contamination limit ratio). K Basin RC then reviewed several weekly K Basin smears survey reports (Lewis 1994) to document the

alpha to beta-gamma ratios. These surveys showed that the average alpha to beta-gamma ratio is 0.7%. The discrepancy in the two ratios (one order of magnitude) is partly due to the smear survey reports perform gross beta, while the ratio for the source term from the tables above compares the alpha to only the easily detectable beta-gamma emitters. The HTD beta-gamma emitters included in the gross count can not be present at ten times the easily detected beta-gamma emitters. The HTDs are usually less than half of any Hanford source term. Therefore, the gross alpha to beta-gamma ratios are acceptable for exemption of the facility from alpha survey.

CWC

The Central Waste Complex (CWC) accepts solid waste from most facilities at the Hanford Site. There are no contamination areas to characterize for the purpose of this document. The release surveys performed at this facility are from the radioactive material areas (RMA) where the waste is handled in closed containers. CWC requires that all waste shipped to the facility be accompanied by a characterization of the contents. CWC has a mechanism for the HPT to be notified if ^3H is being shipped to the facility. This process of notification should be expanded to also signal the HPT if any HTDs are present in the waste characterizations in concentrations that would require special survey procedures. With the abundance and variance of radioactive material entering the facility, dual survey will be required at release stations.

The solid waste burial grounds in the 200 west also accepts waste from various facilities at the Hanford site. The same process described for CWC will apply to the burial grounds. The burial grounds do, however, contain a few contamination areas. These CAs contain waste from unknown tank farm origin and are not characterized. Since no surface contamination is expected, these CAs are in the process of being reposted as underground contamination areas. The source term for these CAs will be represented by the ORIGEN2 data described earlier in this document. No special survey requirements are needed for release surveys, and dual survey will be required.

The accessible portion of the 224-T facility contains TRU waste that awaits shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico. This facility receives closed waste from PFP for assay, and uses data from PFP for documentation of its source term (Fishburn 1994b). The source term was derived from 67 samples of material from PFP in 1989 (Hamilton 1990) and is decayed to the current year. The table below presents the source term from PFP for use at 224-T.

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Nuclide	Activity 1989 (Ci/g)	Activity 1994 (Ci/g)
²⁴¹ Am	4.11E-2	4.37E-1
²³⁸ Pu	5.16E-1	4.96E-1
²³⁹ Pu	5.71E+0	5.71E+0
²⁴⁰ Pu	1.31E+0	1.31E+0
²⁴¹ Pu	5.59E+1	4.39E+1

The source term in this table is identical to the source term for PFP. 224-T requires no special HTD survey procedures, and beta-gamma survey is not required.

Tank Farms The source terms for the tanks at the tank farms and for several other facilities involved in tank farm work, 209-E, 242-A, and 242-S and 242-T were produced by the Tank Farm RC organization (Olsen 1994). The source terms for the double shell tanks and the single shell tanks were compiled from data taken to produce the inventories of the tanks. Tank farms RC used the worst case data for tanks with the same location identifying letters. This shorter list was then analyzed for the predominant radionuclide content.

Tank Farm	⁹⁰ Sr	⁹⁹ Tc	¹²⁹ I	¹³⁷ Cs	U-nat	²³⁹ Pu/40	²⁴¹ Pu	²⁴¹ Am
AN	7.78e+06	1.51e+06	3.5e+02	4.80e+08	8.40e+00	7.5e+03	2.98e+04	3.70e+05
AP	1.45e+04	4.83e-02	3.2e-02	8.28e+03	7.72e-03	3.81e+02	-	3.10e+03
AW	1.27e+06	5.14e+03	1.05e+01	3.06e+07	1.34e+00	3.42e+04	-	4.89e+03
AY	6.95e+07	5.8e+02	2.70e+00	3.90e+06	4.76e+01	8.42e+03	-	4.03e+04
AZ	1.10e+08	1.52e+04	2.67e01	7.51e+07	8.24e+01	1.95e+04	7.23e+04	5.22e+05
SY	9.11e+05	2.79e+03	3.00e+00	9.99e+07	8.40e-01	2.09e+03	1.53e+04	1.20e+04
A	1.70e+09	4.76e+04	7.07e+01	7.07e+07	6.97e+02	2.45e+05	3.48e+05	7.07e+05

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AX	1.74e+06	8.71e+02	1.74e+00	8.30e+09	1.31e+01	1.13e+06	1.30e+04	2.84e+03
B	2.96e+07	1.22e+05	2.11e+02	5.92e+07	1.07e+03	4.15e+04	9.83e+04	1.85e+05
BX	7.36e+07	6.05e+04	5.06e+02	5.86e+07	79.9e+01	2.85e+04	1.74e+03	9.83e+04
BY	8.86e+06	1.02e+04	1.49e+01	1.29e+07	3.88e+02	2.66e+03	1.73e+03	3.63e+03
C	8.98e+07	6.70e+05	7.56e+00	2.21e+07	1.95e+03	5.45e+05	3.29e+04	1.34e+05
S	3.03e+07	3.73e+04	7.56e+01	9.58e+07	5.27e+00	1.11e+04	3.55e+02	1.87e+04
SX	8.08e+08	3.75e+03	7.51e+01	6.6e+09	3.14e+02	2.19e+05	6.67e+04	4.37e+04
T	2.64e+07	2.54e+03	3.61e+00	1.30e+08	7.23e+00	1.88e+04	1.16e+03	3.15e+02
TX	1.09e+06	2.26e+04	2.5e+01	1.80e+08	1.61e+04	5.84e+03	2.54e+03	3.30e+03
TY	1.37e+07	1.23e+04	6.36e+03	1.23e+06	2.17e+02	8.60e+03	7.65e-01	2.32e+03
U	1.56e+07	3.62e+04	6.22e+01	1.20e+08	1.56e+03	2.26e+03	1.56e+04	5.24e+03

* Units of bq/cm3

The HTDs listed above are ^{241}Pu and ^{129}I . Iodine-129 was not very abundant in the tank farms. The highest ratio of ^{129}I to the nuclide ^{137}Cs is $5.17\text{E}-3$, or 0.5%, in the TY tank farms. The highest ratio for ^{241}Pu to ^{137}Cs is $4.92\text{E}-3$, or 0.5% in the A tank farms. Therefore, no special survey procedure is needed to detect ^{241}Pu or ^{129}I in the tank farms.

Currently, all of tank farms is performing dual survey. To exempt some tank farms from alpha survey, smear surveys of all the tanks are being taken. These samples will be analyzed, and ratios of alpha to beta-gamma will be calculated. This will determine the tank farms that require alpha surveys.

When performing tank intrusive work, tank specific source term information is used to determine release requirements. This data is provided in separate documents that contain the inventories of the double shell (WHC 1993a) and single shell (WHC 1993b) tanks.

242-A Evaporator

The 242-A evaporator processes inventory from all of tank farms. None of the HTDs were found to be in abundance above the criteria of this document, therefore, no special requirements for the detection of HTDs is required. Since several tanks contain alpha constituents, dual survey is required at 242-A. A complete smear analysis of this facility along with samples of current subsequent campaigns as they change are required to modify the status of release survey requirements in this facility.

209-E

The source term for the critical assembly room and the mixer room of this facility was determined to contain the following radionuclidic distribution.

$^{239}\text{Pu}/^{240}\text{Pu}$	-	$4.44\text{E-}3 \mu\text{Ci}/100 \text{ cm}^2$
^{241}Pu	-	$2.02\text{E-}5 \mu\text{Ci}/100 \text{ cm}^2$
^{241}Am	-	$9.36\text{E-}3 \mu\text{Ci}/100 \text{ cm}^2$

The ^{241}Pu to alpha ratio is 0.15%, less than the ratio to exempt this facility from HTD survey. The critical assembly room and the mixer room of this facility have participated in activities that warrant release surveys for detection of alpha and beta-gamma contamination. Dual Survey is required.

Other areas of this facility are used to repackage waste for all of tank farms. Because the content of the waste is not known during repackaging, beta-gamma and alpha surveys need to be performed in these areas.

242-S

The source term for this facility is an average of nine surveys taken in the condenser room of this facility. This facility has had a thorough shutdown. It was determined to contain the following radionuclidic distribution.

$^{239}\text{Pu}/^{240}\text{Pu}$	-	$1.43\text{E-}4 \mu\text{Ci}/100 \text{ cm}^2$
^{137}Cs	-	$3.16\text{E-}3 \mu\text{Ci}/100 \text{ cm}^2$
^{90}Sr	-	$3.16\text{E-}3 \mu\text{Ci}/100 \text{ cm}^2$

No HTDs were identified in the source term. The evaporator has a history of processing tank farm waste, and requires dual survey since several tank farms contain alpha constituents.

242-T

The 242-T evaporator processed tank farms waste during its operational phase. This facility, although it is in

shutdown, may have changing conditions that result in a different radionuclidic content. This facility is required to perform dual survey for release.

200 Area LEF

The 200 Area Liquid Effluent Facility (LEF) will begin receiving waste in the spring of 1995. It is scheduled to first treat the waste from the Liquid Effluent Retention Facility (LERF) for approximately two weeks. At the completion of this first run, the LEF will treat condensate from the 242-A evaporator. The source term for the first run is the source term for the LERF (Fishburn 1994a). The table below is a summary of this data.

LIQUID EFFLUENT RETENTION FACILITY SOURCE TERM	
RADIONUCLIDE	pCi/L
Total Alpha	0.0633
Total Beta	1430
⁹⁰ Sr	46.3
¹⁰⁶ Ru	35.9
¹³⁷ Cs	1480
³ H	4520000
²³⁹ Pu	0.104
¹⁵⁵ Eu	5.58

An analysis of this source term show that the HTDs, ¹⁰⁶Ru and ¹⁵⁵Eu, are approximately 2.7% of the easily detectable ¹³⁷Cs and ⁹⁰Sr. Therefore, no special surveys for HTDs are necessary. The ³H levels in this facility have the potential to be high, therefore a program to monitor the presence of ³H will be necessary while the LEF is processing this source stream.

The only alpha emitter present is ²³⁹Pu. The ratio of this nuclide to the easily detectable beta-gamma emitters is extremely low. No alpha survey will be required in the LEF while this source stream is being processed.

Once the LEF begins processing the 242-A evaporator condensate, the facility will be required to survey to the same extent as the evaporator. Dual survey will be required in this facility for each new campaign until a radiological analysis of the feed is performed and smears within the

facility are evaluated against the criteria of this document.

ERHP

The Environmental Restoration Health Physics (ERHP) organization is in transition to the contractor, Bechtel. The health physics technicians are still under contract to WHC management. Until the transition of the HPTs is fully complete to Bechtel, the facilities using those HPTs of the ERHP group will remain included in this document. The listing of facilities within the Inactive Facilities program that ERHP is responsible for is contained in the document, "Hanford Surplus Facilities Listings and Descriptions," WHC-SP-0331, dated January 1994 (Kiser 1994).

The ERHP organization performs characterizations or research to determine nuclides of concern for each facility before any work is performed. This characterization will be reviewed for the presence of HTDs, and the proper radiological release surveys will be determined based on that review.

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