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RADIOLOGICAL CONTROL PROCEDURES

TITLE: Performing Radiation And Contamination Surveys

GENERAL REVISION

1.0 PURPOSE

This procedure establishes the methodology for performing radiation and contamination monitoring at the West Valley Demonstration Project (WVDP).

Workplace monitoring provides a basis for posting and labeling, development of RWPs and other work authorizations, implementation of ALARA measures, issuance of individual monitoring devices, and verification of the efficacy of design measures and engineering controls.

2.0 SCOPE

This procedure applies to Radiological Controls (RC) Department personnel performing radiation and contamination surveys at the WVDP. This procedure has been classified as “Reference Use”.

This procedure may be used in lieu of an RWP as described in WVDP-010 Article 321 for RCTs to perform monitoring in low contamination areas. Surveys in High Contamination Areas require the use of an RWP.

3.0 DEFINITIONS

3.1 Weekly – For routine surveys, weekly is seven day period (e.g., Friday through Thursday).

3.2 Monthly - For routine surveys, monthly is calendar month

4.0 RESPONSIBILITIES

4.1 Radiological Controls Manager - is responsible for ensuring RadCon personnel are available, qualified to perform actions in accordance with this procedure, and provide support in the area of radiation instrumentation availability and reliability.

4.2 Radiological Controls Supervisor - is responsible for ensuring that routine surveys are scheduled and completed, reviewing surveys and maps, and maintaining and distributing documentation in accordance with this procedure.

4.3 Radiological Control Technicians (RCT) - are responsible for performing surveys and recording the results in accordance with this procedure, ensuring that instruments are checked for operability and within the calibration date before use, and updating survey maps.

5.0 GENERAL

5.1 This procedure may be used in lieu of an RWP as described in WVDP-010 Article 321 for RCTs to perform routine tasks in low contamination areas. Surveys in High Contamination Areas require the use of an RWP.

5.1.1 Protective Clothing and Respiratory Protection Requirements

A. Guidelines from Attachment 1 should be used by RCTs when performing surveys in contaminated areas.

B. Respiratory protection equipment shall be worn as prescribed in WVDP-010 (Article 531) and applicable WVDP procedures.

5.1.2 Primary dosimetry is required; Electronic Dosimetry is required for surveys in Radiation Areas.

5.1.3 RCT personnel have a responsibility for limiting their own exposure ALARA.

5.2 Surveys for Conditional and Unconditional Release of materials and equipment are performed per RC-RPO-109.

5.3 A general plan for performing characterization measurements in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, NUREG-1575) is provided in Attachment 8.

5.4 A general plan for performing surveys for Unconditional Release of material for disposal at a landfill in New York State is provided in Attachment 10.

5.5 Use appropriate contamination control methods when transporting smears or swabs between radiological areas.

5.6 Instruments used to perform radiation and contamination monitoring should be performance-checked daily or, if not checked within the past 24 hours, prior to operation.

5.7 Monitoring for radiation and contamination should be performed as specified in technical work documents and radiological work permits.

5.7.1 Radiological areas that are established for a specific job shall be assessed daily when in use to ensure that radiological conditions have not significantly changed and that the radiological control boundaries are adequate.

5.7.2 Monitoring should be performed before, during, and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity.

5.8 Monitoring of radiological conditions should include a sufficient number of survey points to characterize the radiation present and to verify boundaries.

5.8.1 All areas routinely accessible shall be surveyed by RCTs according to the Routine Survey Master Schedule maintained by RC. The minimum number of survey points in each area is predetermined by the RC Supervisor, and indicated by the number of entries on the Routine Radiation / Contamination Survey, form WV-1196 or computer database printout.

5.9 Equipment and materials shall be adequately monitored and characterized when moved from higher radiological hazard areas to lower radiological hazard areas. Remote monitoring may be used where appropriate.

5.10 Contamination surveys should incorporate techniques to detect both removable and fixed contamination. Except in Fixed Contamination Areas or areas in which the background radiation levels do not permit a direct reading that is capable of detecting WVDP-010, Table 2-2 values, both types of survey measurements are required.

5.11 Large Area Wipes (LAW) should be used to supplement smears in areas generally assumed not to be contaminated, such as entrances to Radiological Buffer Areas. If the evaluation indicates that an area is contaminated, perform a detailed survey of the area and document the results on a Radiation and Contamination Survey Report, form WV-1156.

5.12 Maps with sufficient detail to permit identification of original survey and sampling locations should be maintained. Radiological monitoring results should be recorded on appropriate standard forms.

5.13 Radiation and contamination monitoring programs should be established to ensure that surveys are performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. The following survey frequencies should be modified as necessary to ensure area hazards are adequately characterized, based upon facility activities:

5.13.1 Daily, at change areas, or step-off pads when in use, or per shift in high use situations;

5.13.2 Daily, in office space located in radiological buffer areas and other areas surrounding radiological areas where the potential exists for external radiation exposure;

5.13.3 Daily, in lunch rooms or eating areas near radiological buffer areas;

5.13.4 Daily, in accessible areas where operations are under way that are likely to produce hot particles;

5.13.5 Weekly, in routinely occupied radiological buffer areas and radiation areas;

5.13.6 Weekly, or upon entry if entries are less frequent, in contamination areas and other areas where materials having removable contamination exceeding WVDP-010 Table 2-2 limits are handled or stored;

5.13.7 Weekly, or upon entry if entries are less frequent, where contamination area boundaries or postings are located;

5.13.8 Weekly, for operating HEPA-filtered ventilation units;

5.13.9 Weekly, for temporary radiation area boundaries to ensure that radiation areas do not extend beyond posted boundaries;

5.13.10 Quarterly, surveys of the outdoor fixed contamination areas and areas around them that are accessible and are accessed by personnel. Areas such as roof tops and walls above seven feet are controlled by Radiation Work Permits and are not accessed frequently enough to require more than an annual survey;

5.13.11 Monthly, or upon entry, if entries are less frequent than monthly, for radioactive material areas;

5.13.12 Monthly, for potentially contaminated ducts, piping, and hoses in use outside of radiological facilities.

5.13.13 Tool Survey

A. If any routine survey areas contain tools, survey a random number of tools and record the results on form WV-1196 or form WV-1156.

5.13.14 Government Vehicle Survey

A. Obtain a list of government vehicles from warehouse personnel annually and perform direct alpha, beta-gamma, and removable contamination surveys.

B. Record the survey results on form WV-1156.

C. Record the survey number on the vehicle inventory list. If the vehicle is not on the list, update the list with the vehicle, identification number, and survey number.

5.13.15 Vacuum Cleaners

A. Radiation and contamination surveys should be performed periodically for vacuum cleaners in use and the radioactive material tag on these units should be updated (form WV-1197). The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.

B. HEPA-filtered vacuum cleaners used in High Contamination Areas should be surveyed after each use. Record the survey results on a Radioactive Materials Tag, form WV-1157, and on form WV-1156.

5.13.16 Temporary Shielding

A. If temporary shielding is installed in the area encompassed by the routine survey, perform and document inspections for shielding effectiveness and integrity per RC-ADM-29, “Selection, Use, and Control of Shielding.”

5.13.17 HEPA Filtered Ventilation Units

A. Perform radiation exposure surveys on HEPA Filtered Ventilation Units weekly when in operation. This includes temporary, portable, and fixed-systems and units.

5.13.18 Radiation Survey Point Exposure Rate Levels

A. Measure radiation levels at the locations identified on the database printout using an Eberline E600 equipped with a bar code scanner.

NOTE *The E600 holds 500 data points in the internal memory. If more than 500 points are loaded, the first 500 are erased.*

B. Download data points from the E600 to the computerized database which will automatically print out the survey.

C. Verify all survey points are included in the computer generated report.

D. Review the trend report for any readings identified by the program as “out of range” and investigate readings that show an adverse trend (e.g., steadily increasing or sharp increase or decrease).

E. If the computerized system is unavailable, document the survey on form WV-1196 identifying the location of survey points.

6.0 PROCEDURE

6.1 Radiation Surveys

6.1.1 Radiation monitoring should the following as necessary to characterize the area;

A. The general area dose rates within occupied Radiation Areas, High Radiation Areas, and Radiological Buffer Areas established for exposure control.

B. Contact dose rates with potential sources of radiation where there is a potential for hands-on work or other direct contact.

C. Dose Rates at a distance of 30 centimeters (12 inches) from a source or surface of interest to evaluate potential whole body exposures,

D. Non-penetrating radiation readings (corrected beta) as necessary to characterize the hazard.

E. Boundaries of the radiological areas.

6.1.2 Radiation surveys for exposure control are performed using an ion chamber or a scintillation detector (e.g., RO-20, Bicron Micro Rem Meter) and record on form WV-1196 or form WV-1156.

6.1.3 Radiation surveys for information may be taken using a Geiger-Mueller (GM) detector (e.g. remote surveys)

6.1.4 Obtaining Radioactive Waste Container Dose Rates for Characterization and/or Shipping refer to Attachment 2

6.1.5 Surveying Radioactive Waste Containers refer to Attachment 3

6.1.6 Notify RC Supervisor if levels necessitate adjusting boundaries or postings.

6.1.7 Notify RC Supervision if any unexpected radiological conditions are found.

6.2 Contamination Surveys

6.2.1 Removable Contamination Levels

A. Take smears of 100 cm^2 and count using the appropriate instrument.

B. Record removable contamination in units of net dpm/100 cm^2. Record results of small items, <100 cm^2, in units of net dpm per area smeared.

1. Count swabs, on both sides, add the results together and record results of swabs (i.e. internal pipe surveys with cotton tipped applicator) in units of net dpm per area smeared.

2. Swabs should be used to determine contamination levels in areas where there is difficulty performing smear surveys (e.g., tell-taling, instrument tubing),

C. Identify smear locations on the survey map by using a circled number (e.g., ①,②, etc.). Indicate any detail that may be used to identify the location (e.g. floor, vertical surfaces, valve #, etc.)

D. Convert the quantitative measurement (cpm) into dpm/100 cm², if required,

1. The nominal efficiency for a GM pancake probe is 16%. A conservative value of 10% may be used for ease of calculation.

2. IF results are less than the MDA of the instrument used, THEN record the results as less than the value of the MDA (e.g. < 20 dpm/100cm^2, <200 dpm/100cm^2)

a. For an alpha scaler, the desired MDA is < 20 dpm/100cm^2

b. For a beta scaler, the desired MDA is < 200 dpm/100cm^2

c. For a hand held alpha meter (e.g.), the desired MDA is < 50 dpm/100cm^2 for a smear and <100 dpm/100cm^2 for a direct check.

d. For a hand held GM (e.g.), the desired MDA is < 1000 dpm/100cm^2 for a smear and <5000 dpm/100cm^2 for a direct check.

E. If the net removable activity is greater than WVDP-010, Table 2-2 limits in a normally uncontaminated area, circle the data, perform a detailed survey of the area, document on form WV-1156 and post the area as required.

6.2.2 Large Area Wipes (LAW)

A. LAW of one square meter or greater should be taken and counted for alpha and beta-gamma activity with appropriate portable instrumentation.

B. Identify LAW locations on the survey map with a number and the letter “L” (e.g., L1, L2, etc.).

C. Survey the LAWs per section 6.2.3 for Beta-Gamma and Section 6.2.4 for Alpha.

D. IF LAWs have detectable levels of contamination, THEN resurvey the area using 100cm^2 smears.

E. If the net removable activity is greater than WVDP-010, Table 2-2 limits in a normally uncontaminated area, circle the data, perform a detailed survey of the area, document on form WV-1156 and post the area as required.

6.2.3 Direct Beta-Gamma Scanning Measurements

A. Determine the background count rate for the GM detector. If the background count rate is 200 cpm, determine the scanning speed from the following table.

AREA BACKGROUND (cpm)	SCANNING SPEED (inch/sec)
<50	2
50 <100	1
100 <200	0.5

B. If the background count rate is greater than 200 cpm, shield the detector, or area in which the survey is to be performed, or move to a lower background area.

C. Place the GM detector at 0.5 inch from, but not on contact with the surface.

D. Scan the surface at the rate designated in the above table.

E. If surface activity above background is detected, hold the GM detector stationary over the area for approximately three or more seconds for a quantitative measurement.

F. Convert the quantitative measurement (cpm) into dpm/100 cm², if required.

1. The nominal efficiency for the GM pancake probe is 16% and a 15.5 cm² area for the GM detector. For ease of calculation, the cpm can be multiplied by 40 to convert to dpm/100cm^2.

$$dpm/100cm^2 = \frac{cpm}{probe} \times \frac{100\%}{16\%} \times \frac{100cm^2}{15.5cm^2} = \frac{cpm}{probe} \times 40$$

G. See attachment 7 for additional survey techniques associated with elevated Sr-90 areas.

6.2.4 Direct Alpha Scan

A. Place the detector probe at ≤0.25 inch from, but not on contact with the surface.

B. Scan the surface at a speed of ≤0.5 inch/second.

C. If surface activity is detected, hold the probe stationary for approximately ten seconds or more for a quantitative measurement.

D. Convert the quantitative measurement (cpm) into dpm/100 cm², if required, using an active detector area of 50 cm² and a detector efficiency of 10 percent, unless a special use efficiency is specified (e.g., high level alpha probes for TRU waste sorting).

$$dpm/100cm^2 = \frac{cpm}{probe} \times \frac{100\%}{10\%} \times \frac{100cm^2}{50cm^2} = \frac{cpm}{probe} \times 20$$

6.3 Special Surveys

6.3.1 Stack Monitor chart inspections for all building stacks (e.g., Main Plant, 01-14, PVS, CSPF, etc.). refer to Attachment 4

6.3.2 Direct Surveys for Sr-90 Greater Than 90 Percent of Total Fission Product Activity refer to Attachment 7

6.3.3 Radiological Survey Plan for Large Structures and/or Materials refer to Attachment 8

6.3.4 Surveying Respiratory Protection Equipment refer to Attachment 9

6.3.5 Radiological Survey Plan for Disposal of Material at a Landfill in New York State refer to Attachment 10

6.4 Recording Survey Results

6.4.1 Records shall contain sufficient detail to be meaningful even after the originator is no longer available. Radiological surveys should be recorded on appropriate standard forms and include the following common elements:

A. Date, time, and purpose of the survey;

B. General and specific location of the survey;

C. Name and signature of the surveyor (RCT), and reviewer;

D. Pertinent information needed to interpret the survey results;

E. Reference to a specific RWP if the survey is performed to support the permit;

F. Instrument/counting equipment model and serial number(s);

G. Results of the measurements of area exposure rates;

H. Locations of hot spots and other radiological hazards;

I. Contamination levels and appropriate supporting parameters including counting efficiency, counting time, correction factors, type of radiation, and if the contamination was fixed or removable;

J. Location of areas found to contain hot particles or high concentrations of localized contamination;

K. Follow-up survey results for decontamination processes cross-referenced to the original survey;

L. Facility conditions existing during the survey that may have affected radiological conditions;

M. Legible entries in black or blue ink;

N. Corrections identified by a single line-out, initialed and dated;

O. Supervisor signature to ensure review and proper completion of forms.

6.4.2 A RC Supervisor shall review survey data, assign corrective actions when necessary, and ensure the following actions are taken if a survey detects abnormal conditions:

A. Area is posted appropriately;

B. Notify the facility/area supervisor with the results and copies of survey maps.

6.4.3 Completed surveys shall be distributed by the RC Supervisor, or designee:

A. Surveys with no action, file originals in the routine survey file.

B. Surveys which require action, file originals in the routine file and route copies to the responsible supervisor.

C. Copies of surveys should be routed to the responsible manager if an area is not returned to normal condition within five days.

6.4.4 Current copies of the results of routine surveys or survey maps should be conspicuously posted to inform personnel of radiological conditions.

6.4.5 For areas where routine work is covered by standard operating procedures (SOP), or equivalent, survey results or maps should be posted and updated weekly after review by the RC Supervisor.

7.0 RECORDS

7.1 The following forms, data sheets, logs, reports, or any other form of documentation are considered records and when created are to be prepared, maintained, and transferred to Records in accordance with WVDP-262 and WVDP-529. Refer to the CHBWV Master File Plan for further information.

7.1.1 Routine Radiation/Contamination Survey, form WV-1196

7.1.2 Radiation and Contamination Survey Report, form WV-1156

8.0 AUTHORITY

8.1 Title 10, Code of Federal Regulations, Part 835, "Occupational Radiation Protection."

8.2 U.S. Department of Energy Standard, DOE-STD-1098-2008, “Radiological Control.”

9.0 REFERENCES

9.1 WVDP-010, “WVDP Radiological Controls Manual.”

9.2 WVDP-262, “WVDP Records Management Plan.”

9.3 WVDP-529, “WVDP Records Disposition Plan.”

9.4 RC-ADM-29, “Selection, Use, and Control of Shielding.”

10.0 ATTACHMENTS

10.1 Attachment 1 - Guidelines for Selecting Protective Clothing

10.2 Attachment 2 - Obtaining Radioactive Waste Container Dose Rates for Characterization and/or Shipping

10.3 Attachment 3 - Surveying Radioactive Waste Containers

10.4 Attachment 4 - Stack Monitor chart inspections for all building stacks (e.g., Main Plant, 01-14, PVS, CSPF, etc.).

10.5 Attachment 5 - Sample calculations for DL and MDA

10.6 Attachment 6 - Sample Calculations for Surface Activity Scanning

10.7 Attachment 7 - Direct Surveys for Elevated Sr-90 Levels

10.8 Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

10.9 Attachment 9 - Surveying Respiratory Protection Equipment

10.10 Attachment 10 - Radiological Survey Plan for Disposal of Material at a Landfill in New York State

Attachment 1 - Guidelines for Selecting Protective Clothing (PC)

REMOVABLE CONTAMINATION LEVELS			
WORK ACTIVITY	**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 PCs	Full set of PCs	See RWP
Heavy work	Full set of PCs, work gloves	Double set of PCs, work gloves	See RWP
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PCs	Double set of PCs (outer set non-permeable), rubber boots	See RWP

Reference: WVDP-010, Table 3-2

Use the following guidelines for performing radiological surveys, instrument checks, and inspections:

1. Low removable contamination - paper suit (per RC Supervisor discretion), shoe covers, and gloves.

2. Moderate removable contamination - paper or cloth PCs, shoe covers, and gloves.

3. High removable contamination – See RWP for PPE Requirements

Attachment 2 - Obtaining Radioactive Waste Container Dose Rates for Characterization and/or Shipping

WARNING
Consider radioactive waste containers as potential sources of high radiation or contamination prior to performing surveys, in order to prevent inadvertent exposure or contamination events. Waste containers should be approached with a dose rate meter before performing smear or wipe surveys.

WARNING
Do not place any body part under a suspended load when surveying.

NOTE *A radiation survey is performed for characterization of radioactive waste packaged for shipment in "Waste Boxes" or "Waste Drums."*

1.0 Radioactive Waste Container Radiation Survey for Characterization and/or Shipping

1.1 Use a survey meter with an appropriate range (i.e.., Ludlum 2241 with 133-2 probe).

1.2 Take background dose rate readings prior to the waste container arrival at the survey location.

1.3 Obtain dose rate readings on all six sides of the container including the top and bottom (side 1 [front] is the side opposite the side with the CPC label unless otherwise designated), normally starting with side one and continuing in a clockwise rotation.

NOTE *Waste Drum dose rate readings are to be taken on top, bottom and all Sides (quadrants) of the drum. Side 1 (lid ring bolt side), 2, 3, and 4 readings should be taken around the circumference, approximately 90^{o} apart. (Document the highest dose rate found in the quadrant).*

1.4 Survey the entire surface of the container on contact and record the highest contact dose rate reading obtained on each of the six sides.

1.5 If any contact dose rate is greater than 100 mR/hr, obtain dose rate readings on all sides of the container at distances of 1 foot and 1 (one) meter. Use a measuring device to ensure readings are taken at one meter. This reading must be taken at a point perpendicular to the location of the highest contact dose rate measured on each side of the container. The probe is held parallel to the side of the waste container.

NOTE *Radiation readings for appendix D of SOP 300-07 may be calculated based on inner container readings if the container is not in the final packaging.*

1.6 Document survey results on Appendix D "Radioactive Waste Package Data Sheet" found in SOP 300-07.

1.7 Complete bottom portion of the "Radioactive Waste Packaging Tag" and remove the white copy for RC Supervisor review.

Attachment 3 - Surveying Radioactive Waste Containers

WARNING

Consider radioactive waste containers as potential sources of high radiation or contamination prior to performing surveys, in order to prevent inadvertent exposure or contamination events. Waste containers should be approached with a dose rate meter before performing smear or wipe surveys.

WARNING

Do not place any body part under a suspended load when surveying.

1.0 Radiation Surveys

1.1 Radioactive waste drums and boxes must be approached with a dose rate meter to determine radiation levels, notify RC Supervisor if any container exceeds 100 mR/hr at contact.

1.2 Waste containers need contact dose rate readings performed on each of the six sides (top, bottom, front back, and ends) "six sided dose rate survey" when initially packaged, normally starting with side one (side 1 [front] is the side opposite the side with the CPC label unless otherwise designated) and continuing in a clockwise rotation.

1.3 Waste containers need dose rate readings performed at one foot from all accessible surfaces before and after movement, this does not need to be performed for movement between LSA-3 and LSA-4, or as exempted by SOP 300-07. In general, there is no need to a perform one foot survey the bottom of the container unless it is to be placed on a platform to enable personnel access underneath for inspection.

1.4 A Radioactive Material Tag identifying the highest contact dose rate and which side it is located on, shall be affixed to the container, and any additional information on back of the tag (e.g. dose rate on each side, 1 ft reading if any contact reading is ≥ 100 mR/hr).

1.5 If any waste container has radiation levels > 200 mR/hr at contact, it should be handled according to requirements described in WVDP-010, Article 441, for non-contact handleable waste.

1.5.1 If these conditions are found, notify the RC Supervisor and Waste Processing Supervisor.

1.5.2 Post the area in accordance with WVDP-010.

2.0 Removable Contamination Surveys

2.1 Smears of rad waste containers are to be of a 100 cm^2 area. Enough smears must be taken to be representative of the entire surface area of the item(s). Large Area Wipes should be used to supplement the smears

2.2 The number of smears per waste container shall meet the following criteria:

Attachment 3 - Surveying Radioactive Waste Containers

Waste Container	Minimum Number of Smears on Each **			
	Top	Bottom	Side	End
Clear Rad Waste Bags			2	
Drums	1	1	2	
Drum Liners	1	1	2	
B-25 / S-70 Boxes	2	2	2	1
HICs	4	4	4	
Intermodals	4	4	4	2
Sea-Lands	4	4	4	2
SP Boxes	4	4	4	2
Lift Liners	2	4	4	

** Or as directed by RC Supervisor.

3.0 Contamination Surveys of Containers for Reuse.

3.1 A minimum of seven smears are needed to survey an empty drum, or drum liner for reuse. Obtain one smear on the top, two smears on the side, and one smear on the bottom of the outside of the drum (or drum liner). Obtain one smear on the inside of the drum lid (or drum liner lid), and two smears on the inside of the drum (or drum liner).

3.2 A minimum of twenty smears are needed to survey an empty waste box for reuse. Ten smears on the outside of the box - two smears on the top, two on each side, one on each end, and two on the bottom. Ten smears on the inside of the box - two on the inside of the lid, two on each side, one on each end, and two on the bottom.

4.0 Clear Waste Bag Surveys

4.1 Clear rad waste bags may be approached with either a dose rate meter or a count rate meter with Geiger-Mueller (GM) detector to determine radiation levels.

NOTE *4,000 net cpm beta-gamma is approximately equal to 1 mR/hr.*

4.1.1 Record the radiation level results as < 1 mR/hr on a Radioactive Waste Packaging Tag, if a GM detector and count rate meter was sufficient to survey a clear radioactive waste bag.

4.1.2 If the rad waste bag has radiation level is > 4,000 net cpm beta-gamma, perform survey with a dose rate meter.

4.1.3 If the rad waste bag has radiation levels > 2 mR/hr, then package in a waste container. Notify a RC Supervisor of the radiation levels.

4.1.4 The work group that generated the waste is responsible for packaging the bag(s).

Attachment 3 - Surveying Radioactive Waste Containers

5.0 Documentation/Survey Results

5.1 Waste container surveys performed shall be documented on form WV-1156 including surveys performed for movement to and from processing areas.

5.2 Radioactive Material Tag with current survey data shall be affixed to each waste container.

5.3 Complete the appropriate paperwork as requested by Waste Management (i.e., SOP 300-7 Appendix D etc.), and label the radioactive waste containers as appropriate.

NOTE *When documenting waste container smear results, if all smears are less than WVDP-010, Table 2-2 limits, a single line entry per container may be recorded on form WV-1156.*

5.4 All radioactive waste container smear results must be less than contamination limits before the container can be moved from the area.

5.5 Any radioactive waste container surveyed for reuse requires, at a minimum, a radioactive materials tag. The tag shall be marked "Potential Internal Contamination" if internal smearable contamination is below contamination limits. The tag shall be marked "Internal Contamination," with the highest smearable level written on the tag, if internal smearable contamination greater than contamination limits is found. Drums that have internal poly liners shall have a radioactive materials tag attached to the poly liner lid and the drum lid, indicating the internal and external contamination levels. If a poly liner is to be transferred to a different drum, a minimum of four smears will be taken on the exterior of the poly liner and a minimum of two smears on the inside of the original drum. Radioactive material tags on the drum and liner must reflect the new survey results.

Attachment 4 - Stack Monitor Chart Inspections for All Building Stacks (e.g., Main Plant, 01-14, PVS, CSPF, etc.)

1.0 The RCT shall record the counts per minute readout values, RCT initials, time, and date on the monitor chart and in the Stack Monitor log.

2.0 The RCT shall check the Stack Monitors to ensure that there is an adequate amount of chart paper to last until the next inspection.

3.0 The RCT shall look for any abnormal events on the Stack Monitor curve plot. Any abnormal conditions should be reported to the RC Supervisor, Shift Supervisor, and the Environmental Laboratory group.

4.0 The RCT shall promptly notify the PSOSS of any Stack Monitor CAM malfunction or mechanical problem.

Attachment 5 - Sample Calculations for Decision Level (DL) and Minimum Detectable Activity (MDA)

1.0 Calculating Removable Contamination Measurement Results

1.1 The results from assaying smears shall be used to determine the removable contamination level using the following formula (WVDP-234):

$$A = \frac{R_s - R_b}{E} \qquad \text{Eq. 5-1}$$

where:

A = Removable contamination activity level for alpha or beta radionuclides (net dpm/smear);

R_S = Gross count rate for alpha or beta sample smear results (cpm);

R_B = Background count rate for alpha or beta (cpm);

E = Instrument efficiency in decimal form for alpha or beta activity (cpm/dpm);

1.2 Decision Level (DL) and MDA for removable contamination measurements.

1.2.1 The DL may be used to indicate if a net count rate result represents the presence of activity on the wipe (95 percent probability) above background. The DL is calculated as follows (WVDP-234):

$$DL(R_n) = 1.645\sqrt{R_b(1/T_b + 1/T_s)} \qquad \text{Eq. 5-2}$$

where

$DL(R_n)$ = Decision Level, net count rate in cpm

R_b = Background count rate in cpm

T_b = Background count time in minutes

T_s = Sample count time in minutes

1.645 = Constant representing the 95% Confidence Level.

A. Sample Calculation:

If the background count rate is 0.8 cpm alpha, the background count time is 10 minutes, and the sample count time is 1.25 minute, the DL is calculated as follows:

$$DL(R_n) = 1.645\sqrt{0.8cpm(1/10\,\text{min} + 1/1.25\,\text{min})}$$

= 1.4 cpm alpha

Attachment 5 - Sample Calculations for Decision Level (DL) and Minimum Detectable Activity (MDA)

Using this counting scenario, any net count rate above 1.4 cpm would be judged to be "significant" or "positive," with only a 5 percent chance of being a "negative" result. In other words, there is a 95% chance of saying activity is present, when it is actually present; and only a 5% chance of saying activity is present, when it is not present.

B. Sample Calculation:

If the background count rate is 10 cpm beta-gamma, the background count time is 10 minutes, and the sample count time is 1.25 minute, the DL is calculated as follows:

$$DL(R_{n)} = 1.645\sqrt{10cpm(1/10\,\text{min} + 1/1.25\,\text{min})}$$

= 4.9 cpm beta-gamma

Using this counting scenario, any net count rate above 4.9 cpm would be judged to be "significant" or "positive," with only a 5 percent chance of being a "negative" result. In other words, there is a 95% chance of saying activity is present, when it is actually present; and only a 5% chance of saying activity is present, when it is not present.

1.2.2 The MDA may be used to indicate a value of activity that will yield a level greater than the DL 95 percent of the time. The MDA is calculated as follows (WVDP-234):

$$MDA = \frac{2.71 + 3.29\sqrt{R_b T_s (1 + T_s / T_b)}}{(E)(T_s)} \qquad \text{Eq. 5-3}$$

A. Sample Calculation:

If the background count rate on a Tennelec is 0.8 cpm alpha, the background count time is 10 minutes, and the sample count time is 1.25 minute, an alpha efficiency of 0.25 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(0.8cpm)(1.25\,\text{min})(1 + 1.25\,\text{min}/10\,\text{min})}}{(0.25\,cpm/dpm)(1.25\,\text{min})}$$

= 19.8 dpm

This means that a removable contamination level of 19.8 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

**Attachment 5 - Sample Calculations for
Decision Level (DL) and Minimum Detectable Activity (MDA)**

B. Sample Calculation:

If the background count rate on a Tennelec is 10 cpm alpha, the background count time is 10 minutes, and the sample count time is 1.25 minute, an alpha efficiency of 0.35 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(10cpm)(1.25\,\text{min})(1 + 1.25\,\text{min}/10\,\text{min})}}{(0.35\,cpm/dpm)(1.25\,\text{min})}$$

=34.4 dpm

This means that a removable contamination level of 34.4 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

C. Sample Calculation:

If the background count rate on a portable scaler is 0.6 cpm alpha, the background count time is 10 minutes, and the sample count time is 1 minute, an alpha efficiency of 0.27 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(0.6cpm)(1\,\text{min})(1 + 1\,\text{min}/10\,\text{min})}}{(0.27\,cpm/dpm)(1\,\text{min})}$$

= 19.9 dpm

This means that a removable contamination level of 19.9 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

D. Sample Calculation:

If the background count rate on a portable scaler is 200 cpm beta, the background count time is 10 minutes, and the sample count time is 1 minute, a beta efficiency of 0.27 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(200cpm)(1\,\text{min})(1 + 1\,\text{min}/10\,\text{min})}}{(0.27\,cpm/dpm)(1\,\text{min})}$$

=190 dpm

This means that a removable contamination level of 190 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

**Attachment 5 - Sample Calculations for
Decision Level (DL) and Minimum Detectable Activity (MDA)**

E. Sample Calculation:

If the background count rate on a hand held alpha is 2 cpm alpha, the background count time is 1 minutes, and the sample count time is 1 minute, an alpha efficiency of 0.1 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(2cpm)(1\min)(1 + 1\min/1\min)}}{(0.1cpm/dpm)(1\min)}$$

= 93 dpm

This means that a removable contamination level of 93 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

F. Sample Calculation:

If the background count rate on a GM Panckae probe is 200 cpm beta, the background count time is 1 minutes, and the sample count time is 10 seconds, a beta efficiency of 0.16 cpm/dpm, the MDA is calculated as follows:

$$MDA = \frac{2.71 + 3.29\sqrt{(200cpm)(0.166\min)(1 + 0.166\min/1\min)}}{(0.16cpm/dpm)(0.166\min)}$$

= 871 dpm

This means that a removable contamination level of 871 dpm is the lowest activity level that can be verified to a 95% confidence that radioactivity is present based on the counting parameters.

1.3 Surface Activity - Static Measurements

For an integrated measurement over a preset time, the MDA for a surface activity measurement is calculated by (WVDP-234):

$$MDA = \frac{2.71 + 4.65\sqrt{(B)(t)}}{(t)(E)(A/100)} \qquad \text{Eq. 5-4}$$

Attachment 5 - Sample Calculations for Decision Level (DL) and Minimum Detectable Activity (MDA)

where:

MDA = activity level in disintegrations/minute/100 cm²
B = background in counts/minute
t = counting time in minutes
E = detector efficiency in counts/disintegration
A = active probe area in cm²

1.3.1 Sample Calculation:

B = 2 counts/minute alpha
t = 1 minute
E = 0.20 counts/disintegration
A = 50 cm²

$$MDA = \frac{2.71 + 4.65\sqrt{(2cpm)(1\min)}}{(1\min)(0.2\,cpm/dpm)(50cm^2/100cm^2)}$$

= 93 disintegrations/minute/100 cm² alpha

The goal for the desired minimum sensitivity is 100 net dpm/100 cm² for alpha.

1.3.2 Sample Calculation:

B = 200 counts/minute beta-gamma
t = 1 minute
E = 0.1 counts/disintegration
A = 15.5 cm²

$$MDA = \frac{2.71 + 4.65\sqrt{(200cpm)(1\min)}}{(1\min)(0.1cpm/dpm)(15.5cm^2/100cm^2)}$$

= 4420 disintegrations/minute/100 cm² beta-gamma

The goal for the desired minimum sensitivity is 5000 net dpm/100 cm² for beta-gamma.

Attachment 6 – Sample Calculations for Surface Activity Scanning

1.0 Surface Activity - Scanning

NOTE *Scanning surveys rely on the response to the audio output of the instrument as well.*

1.1 Alpha Scanning

For alpha survey instrumentation with backgrounds ranging from <1 to 3 cpm, a single count will give sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination are calculated by use of Poison summation statistics. Given a known scan rate and a contamination guideline value, the probability of detecting a single count while passing over the contaminated area is:

$$P(n \geq 1) = 1 - e^{-(GED/60v)} \qquad \text{Eq. 6-1}$$

where:

P(n ≥ 1)	=	Probability of getting a single count
G	=	Contamination activity (dpm)
E	=	Detector efficiency (4π)
d	=	Width of detector in direction of scan (cm)
v	=	Scan speed (cm/s)

1.1.1 Sample Calculation:

G = 300 dpm
E = 0.10 cpm/dpm
D = 5 cm
v = 1.27 cm/s

$$P(n \geq 1) = 1 - e^{-((300dpm)(0.1cpm/dpm)(5cm)/(60\sec/\min)(1.27cm/\sec))}$$

= 1 - 0.14 = 0.86

Once a count has been detected, stop and wait a sufficient period of time such that if the guideline level of contamination is present, the probability of getting another count is greater than 70 percent. This time interval can be calculated by:

$$t = \frac{13800}{CAE} \qquad \text{Eq. 6-2}$$

where:

t	=	Time period for static count (seconds)
C	=	Contamination guideline (dpm/100 cm²)
A	=	Detector area (cm²)
E	=	Detector efficiency (4π)

Attachment 6 – Sample Calculations for Surface Activity Scanning

1.1.2 Sample Calculation:

C = 300 dpm/100 cm²
E = 0.10 cpm/dpm
A = 50 cm²

$$t = \frac{13800}{(300\,dpm/100cm^2)(50cm^2)(0.1\,cpm/dpm)}$$

= 9.2 seconds

1.2 Beta Scanning

When scanning is conducted for beta with instrumentation that provides an audible signal, the scanning velocity must be taken into account for the calculation. The value used for the counting time will be the time a point source is directly under the probe. A rough estimate of the scanning detection limit for beta radiation may be estimated by (WVDP-234):

$$Detection\_Limit = \frac{2.32\sqrt{Bt}}{tE(A/100)}$$ Eq. 6-3

where:

Detection -Limit = activity level in disintegrations/minute/100 cm²
B = background in counts/minute
t = time source is under probe (minutes)
E = detector efficiency in counts/disintegration
A = active probe area in cm²
B•t = ≥1

1.2.1 Sample Calculation:

Scan velocity = 5.1 cm/s (2 inch/sec)
Probe dimension in direction of scan = 5 cm

$$t(counting\_time) = \frac{5cm}{5.1\,cm/\sec} = 0.98\sec onds$$

B = 50 cpm
t = 0.016 minutes (0.98 seconds)
E = 0.16 counts/disintegration
A = 15.5 cm²

$$Detection\_Limit = \frac{2.32\sqrt{(50cpm)(0.016\min)}}{(0.016\min)(0.16\,cpm/dpm)\,(15.5cm^2/100cm^2)}$$

= 5230 dpm/100 cm²

Attachment 6 – Sample Calculations for Surface Activity Scanning

1.2.2 Sample Calculation:

Scan velocity = 2.54 cm/s (1.0 inch/sec)
Probe dimension in direction of scan = 5 cm

$$t(counting\_time) = \frac{5cm}{2.54\,cm/\sec} = 2.0\sec onds$$

B = 100 cpm
t = 0.033 minutes (2.0 seconds)
E = 0.16 counts/disintegration
A = 15.5 cm²

$$Detection\_Limit = \frac{2.32\sqrt{(100cpm)(0.033\min)}}{(0.033\min)(0.16\,cpm/dpm)\,(15.5cm^2/100cm^2)}$$

= 5150 dpm/100 cm²

1.2.3 Sample Calculation:

Scan velocity = 1.3 cm/s (0.5 inch/sec)
Probe dimension in direction of scan = 5 cm

$$t(counting\_time) = \frac{5cm}{1.3\,cm/\sec} = 3.8\sec onds$$

B = 200 cpm
t = 0.064 minutes (3.8 seconds)
E = 0.16 counts/disintegration
A = 15.5 cm²

$$Detection\_Limit = \frac{2.32\sqrt{(200cpm)(0.064\min)}}{(0.064\min)(0.16\,cpm/dpm)\,(15.5cm^2/100cm^2)}$$

= 5230 dpm/100 cm²

Attachment 7 - Direct Surveys for Elevated Sr-90 Levels

NOTE *Perform survey of item using the 1000 dpm/100 cm² total surface contamination limit for Sr-90 and beta-gamma emitters.*

1.0 Categorize item(s) into survey units, based on contamination potential (i.e., how was the item potentially contaminated, e.g., submersed in liquid or exposed to airborne radioactivity) and material type (i.e., steel, plastic, concrete, etc.).

1.1 Group similar materials together, e.g., plastic bottles and buckets; metal tools, equipment, and containers; concrete and asphalt areas, etc.

1.2 Segregate items that have different potential contamination histories, e.g., metal valve and equipment from liquid handling system from tools used during maintenance work that were potentially exposed to surface contamination.

1.3 Perform scan of item for areas greater than 3000 dpm/100 cm² and document results on Radiation and Contamination Survey Report, form WV-1156. Using 70 net counts per minute with the GM probe, use the following scan rates:

Background (cpm)	Scan rate (inch per second)
<50	≤1.0
50 - <100	≤0.5
100 - <200	≤0.25

1.4 Ensure direct background measurements have been taken on reference materials in the area where survey is being conducted. If no background measurements have been taken in the area where survey is being performed, obtain reference materials and perform 25 fixed-point measurements and document results on form WV-1156.

1.4.1 Use background reference materials and obtain measurements where item(s) is to be surveyed, so that background readings are the same. These background readings are good for that location (i.e., no time limit) as long as the background levels in the area have not changed or have been affected.

1.4.2 Change or enter or have Radiological Engineering (RE) change or enter background reference material readings into the Excel spreadsheet being used for the Wilcoxon-Rank Sum (WRS) calculation.

1.5 Measure 25 survey points using systematic grid on survey unit (i.e., item or group of like items as mentioned in step 1.1). For an object like a bucket, take half of the readings on the inside and the other half on the outside, covering the sides and bottom. For small objects, this statistical survey does not apply when 100 percent of the object can be covered with less than 25 fixed-point measurements.

1.6 Obtain gross direct measurement at each survey point using 1 minute counts and document on form WV-1156.

Attachment 7 - Direct Surveys for Elevated Sr-90 Levels

1.7 Enter or have RE enter the 25 survey point measurements into the Excel spreadsheet being used for the WRS statistical calculation.

1.8 When data is being entered, the Excel spreadsheet is calculating the results. If the ranking result number is greater than the stated critical value (for 25 background and 25 sample measurements, the critical value is 722), the survey unit is releasable.

1.9 Print out the spreadsheet and attach to form WV-1156.

1.10 Direct Surveys for Sr-90 Greater Than 50 Percent But Less Than 90 percent of Total Fission Product Activity

NOTE *Perform scan of item using the 3000 dpm/100 cm² total surface contamination limit for Sr-90 and beta-gamma emitters.*

1.11 Using 70 net counts per minute with the GM probe as the field contamination limit, apply the following scan rates:

Background (cpm)	Scan rate (inch per second)
<50	≤1.0
50 - <100	≤0.5
100 - <200	≤0.25

1.12 Apply the same criteria and techniques as in steps 6.1.1 through 6.1.8 of this procedure.

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

1.0 Purpose and Scope

The purpose of this radiological survey plan is to demonstrate what portions of a large structure or material (e.g., building) may be safely released for unrestricted use or disposed of as low-level radioactive waste. This plan provides the minimum requirements for the performance and documentation of the radiological survey.

This survey plan addresses the specific measurement and sampling tasks that will be performed and how these tasks will be documented.

2.0 Survey Types and Objectives

2.1 Surface Contamination Surveys

2.1.1 Surface contamination surveys incorporate techniques to assess both total and removable surface contamination levels. Surface scans identify areas of elevated direct radiation levels that may be indicative of surface contamination. Direct measurements of surface activity are performed to quantify surface contamination levels at systematic and biased locations, e.g., at locations of elevated direct radiation levels as identified by surface scans. Smear surveys are performed to provide a semi-quantitative assessment of removable contamination, and typically cover an area of 100 square centimeters (100 cm^2). Large area smears may be performed to qualitatively assess the level of removable contamination on building surfaces and equipment.

2.2 Equipment and Material Release Surveys

2.2.1 Equipment and material release (unrestricted) surveys are performed for materials, items, and equipment being released from radiologically posted areas to uncontrolled areas and intended for unconditional release (see WVDP-010, Article 422). Equipment and material release surveys include surface scanning, surface activity measurements, and miscellaneous sample collection, and may require disassembly of equipment and items if inaccessible surface contamination is suspected.

3.0 Radiological Survey Practices

3.1 Total Surface Contamination Assessment

Scanning surfaces to identify the presence of elevated direct radiation levels which might indicate residual gross activity is performed before conducting any fixed measurements of surface activity. When contamination is identified, the area is traversed with the detector to define the boundaries of the contamination.

The average background count rate for each type of surface material measured is determined from a number of measurements as determined by the DQO Process. Surface activity measurements are performed at systematically and randomly biased selected locations and at locations of elevated direct radiation levels, identified by surface scans.

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

3.2 Removable Surface Contamination Assessment

3.2.1 Smear surveys are performed to assess removable contamination levels, and typically cover an area of 100 square centimeters. Smears should be taken in sufficient numbers and locations to ensure adequate assessment of radiological contamination in the area based on the DQOs for the particular survey. Large area smears may be used to supplement standard smear techniques in areas generally assumed not to be contaminated.

3.3 Miscellaneous Media Sampling

3.3.1 Sampling of various media, (e.g., concrete, floor tiles, paint, sludge, residue in drains, ventilation systems) may be performed depending on availability and practicality. Residual activity will often accumulate in cracks and joints in the floor. These should be sampled, the residue analyzed, and results evaluated for radioisotopic distribution

4.0 Radiological Survey Documentation

4.1 Once the radiological survey is documented it is maintained as a radiological record to document radiological conditions. Radiological survey records must be accurate and legible and contain sufficient detail to be meaningful even after the originator is no longer available. Radiological surveys will be recorded on appropriate standard forms. Data evaluation requires that the gross counts per minute (CPM) from the direct readings and gross CPM or disintegrations per minute (DPM) per smear of the Reference (background) area and Survey area be included with the survey results.

4.2 QA/QC Activities

4.2.1 Daily performance check determinations are made for all survey instrumentation used during the survey. Quality assurance for laboratory analyses must be integrated into the overall survey project. Acceptable measurement uncertainties must be assessed as part of the DQO process and regularly reviewed throughout the survey program. RC supervision will review survey data and provide oversight of daily activities.

4.3 Survey Data Quality Objectives

4.3.1 The DQO process is a series of planning steps that can be used to develop surveys designs for data collection that improve effectiveness, efficiency, and defensibility of survey decisions. Data quality objects are qualitative and quantitative statements that clarify the survey objective, define the most appropriate type of survey data to collect, determine the most appropriate facility/environmental conditions from which to collect the survey data, and specify acceptable limits on decision errors for the collection of survey data.

4.4 Structure and Material Descriptions

4.4.1 When planning radiological surveys, a description of the structure and or material(s) should be obtained. This will assist those individuals pre-planning the radiological survey on how to lay-out survey grids and where to perform systematic measurements.

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

4.5 Data Quality Objectives

4.5.1 The Problem

A. The structure and/or materials and/or structural components require surface radioactivity measurements to determine its radiological contamination status for disposition. The RC Department is designing and implementing a radiological survey approach that will be used to identify any residual radioactive material on the material/structural surfaces. After review of radiological survey data, the RC Supervisor will inform project management the appropriate disposition of the building, structure and/or materials.

B. The RC department will deploy qualified RCTs who will perform radiological surveys with ratemeters / scalers, hand-held friskers, paper swipes, survey maps, and other necessary equipment. Historical data from routine surveys and special surveys have indicated potential low levels of radiological contamination in isolated areas in the past. This contamination was found to be predominantly beta-gamma emitters. Buildings and structural materials and components may contain surface contamination from build-up and migration of removable contamination, as well as from rodent and insect droppings and nests. Safety and Quality Levels are "N" for the conduct of the radiological survey.

4.5.2 The Decision to be Made

A. The structural materials of the building structure and/or materials must be determined to be either releasable, based on the unrestricted release criteria of WVDP-010 (Table 2-2), or disposed as low-level radioactive waste. If portions of the building and/or structural materials are found to exceed the unrestricted release criteria, then they must be segregated from the clean materials for proper disposition. If the building and/or structural materials are found to be less than the unrestricted release criteria, then they may be disposed of as industrial waste (if no hazardous materials are present).

4.5.3 Inputs to the Decision

A. Radiological survey data results, including removable and total contamination levels, will provide for the determination whether the structural materials exceed the contamination limits or whether they may be released for unrestricted use. Results from area swipes that are analyzed for gross alpha and beta emitters will provide for the removable contamination levels. Results from direct measurements with friskers will provide for the total contamination levels.

B. Removable contamination levels and total contamination levels, including both scanning and fixed-point measurements, are performed in accordance with the techniques presented in this procedure. Smears taken from structural materials will be counted for gross alpha and beta on a scaler instrument with an MDA less than WVDP-010, Table 2-2 values.

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

4.5.4 Boundaries of the Study

A. The building and/or structural materials will be divided into segments and uniquely identified on radiological survey maps, for ease of identification. The radiological surveys will be performed as access to these materials is provided by project management and operation work groups.

B. Background measurements will be obtained from similar materials that are known to be free of radiological contamination to establish background radiation levels for scanning and fixed point measurements. Smaller building structural materials will be scanned approximately 100 percent with smears obtained from representative locations (100 cm^2) to determine their radiological status. Larger building structural materials will be scanned at biased locations where contamination may have been deposited for various reasons, followed by a series of fixed point measurements, and smears at both biased and fixed-point locations. Inaccessible locations will be made accessible to the extent practical, where professional judgment is made as to the potential for contamination to accumulate at the accessible location.

4.5.5 Decision Rule

A. The total (direct) and removable radioactivity measurement results will be compared to the contamination limits provided in WVDP-010, Table 2-2 for unrestricted release limits. Structural materials and items that exceed the contamination limits will be set aside for disposal as radioactive waste.

B. Smaller building structural materials will be scanned approximately 100 percent with smears obtained from representative locations (100 cm^2) to determine their disposition. These would include hand-held items to items that would be scanned within approximately 30 minutes (i.e., professional judgment used) to confirm radiological status.

C. Larger building structural materials will be scanned at biased locations where contamination may have been deposited for various reasons, followed by a series of fixed point measurements, and smears at both biased and fixed-point locations. Twenty-five fixed point measurements will be made on each side (i.e., interior and exterior) of larger building structural materials and analyzed by Radiological Engineering personnel per NUREG-1505 for determining the final status.

D. The contamination limits provided in WVDP-010, Table 2-2 will define the disposition for unrestricted release versus radioactive waste.

4.5.6 Systematic Sample Number Derivation

A. The survey design for surface contamination measurements will use a systematic sampling design approach, because of its relative ease to implement in the field. The number of measurements for each object or group of similar objects is (NUREG-1575, Section 5.5.2.2):

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3(P_r - 0.5)^2}$$

Where:

$Z_{1-\alpha}$ = standard statistical value, for 0.05 the value is 1.645
$Z_{1-\beta}$ = standard statistical value, for 0.05 the value is 1.645
P_r = the probability that a random measurement from the survey unit exceeds a random measurement from the background reference area by less than the $DCGL_W$ when the survey unit median is equal to the LBGR above background, when Δ/σ is 2.0, the value is 0.921319

$$N = \frac{(1.645 + 1.645)^2}{3(0.921319 - 0.5)^2} = 20.3$$

B. MARSSIM recommends that the number of data points should be increased by twenty percent, and rounded up, over the values calculated, to obtain sufficient data points to attain the desired power level with the statistical tests and allow for possible lost or unusable data. The value of 20 percent is selected to account for a reasonable amount of uncertainty in the parameters used to calculate "N" and still allow flexibility to account for some lost or unusable data. Therefore, the value of 20.3 is multiplied by "1.2", where the final number of data points is "25."

4.5.7 Critical Number Calculation

A. The gross results from the 25 measurements collected on the item or group or similar items being surveyed will be entered into the Excel spreadsheet containing the 25 reference (background) material results. The 25 reference material results will be "adjusted" by adding the appropriate surface contamination limit for each result value. The spreadsheet will perform the WRS Test per NUREG-1505 (see NUREG-1505, Tables 6.3 and 6.4 for example spreadsheets). The sum of the ranks for the WRS test is 1275 (that is, based on a total of 50 measurements per NUREG-1505, Table A-4). If the sum of the reference area results are greater than the value of 722, then the item or group of similar items may be considered for release as determined by the WRS test and pending the results of other radiological measurements.

$$CV = m(n+m+1)/2 + z(nm\{n+m+1\}/12)^{1/2}$$

where:
CV = Critical value
n = number of survey unit samples, (25)
m = number of background unit samples, (25)
z = the (1-α) percentile of a standard normal distribution, (1.645)

therefore:

$$CV = 25(25+25+1)/2 + 1.645(25*25\{25+25+1\}/12)^{1/2}$$

$$CV = 722$$

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

4.5.8 Quantile Test

A. The Quantile test was specifically developed to detect differences between the survey unit and the reference area that consist of a shift to higher values in only a fraction of the survey unit. The Quantile test is only evaluated if the survey unit passes the WRS test and there is evidence that a portion of the survey unit is elevated compared to the rest of the survey unit. In other words, the survey data is not uniformly distributed across the survey unit.

B. According to NUREG-1505, Table A.7c, when the values of "n" for the number of survey unit measurements and "m" for the number of reference unit measurements are 25 and 25, respectively, when the value of "α" is approximately 0.05, the values of "r" and "k" are 4 and 4, respectively. Therefore, if "k" or more of the "r" largest measurements in the combined ranked data set are from the survey unit, the survey unit fails the Quantile Test and the data are not uniformly distributed across the survey unit.

4.5.9 Acceptable Limits on Decision Errors (Practical Constraints on Data Collection)

A. The expected range of radiological contamination for buildings and/or structural materials considered for this type of radiological survey should not exceed 10-times the contamination limits, with a large portion of the measurements at or near background radiation levels. The building and/or structural materials that are scanned approximately 100 percent will have a near-zero risk of reporting false negative and false positive data. Structural materials that are subject to the fixed-point direct measurement regimen will theoretically have a 5 percent (i.e., 95% confidence level) of reporting false negative and false positive data per NUREG-1505, but will be reduced by the performance of biased measurements for areas with potential for build-up or accumulated contamination. Negative political and stakeholder consequences to more severe civil penalties under the Price-Anderson Amendment Act (PAAA) for noncompliance with nuclear safety rules are possible for the incorrect disposition of contaminated materials.

4.5.10 Optimize the Design

A. Small Structural Materials

1. Perform an approximate 100 percent scan on the item followed by biased location of smears to confirm total and removable contamination levels. Document radiological survey results. If the item takes longer than 30 minutes to scan, then use Large Structural Material methodology.

B. Large Structural Materials

1. Divide large items into segments for easy identification of measurements.

2. Perform scan, using ratemeter and frisker, at biased locations where contamination may have accumulated, followed by paper smears of representative biased locations. Perform large area wipes to supplement data, as necessary.

Attachment 8 - Radiological Survey Plan for Large Structures and/or Materials

3. Establish survey grid for 25 fixed-point measurement locations (for example, square items with a 5-by-5 point grid, rectangular items with a staggered-point (triangular) grid, etc.).

4. Perform 25 fixed-point measurements, using a scaler and frisker, to count 1-minute direct measurements.

5. Perform 25 removable measurements with paper swipes, and count on a scaler instrument with an MDA less than WVDP-010, Table 2-2 values.

6. Obtain 25 background fixed-point direct measurements or obtain data on known clean, similar material. Use scaler to count 1-minute direct fixed-point measurements.

7. Collect residue samples throughout structure (if possible) and send for analysis to Radiological Controls Laboratory.

8. Document radiological survey results and include direct readings and smear data results as needed for the radiological engineering data analysis.

9. Radiological Engineering performs data analysis on fixed-point measurement data per NUREG-1505 (Section 6.0).

10. RC Supervision review survey result package.

5.0 Lessons Learned and Feedback

5.1 RC Supervision and management will continuously reinforce communication feedback from RCTs to develop lessons learned and improve processes and procedure methodologies throughout conduct of radiological survey performance.

Attachment 9 - Surveying Respiratory Protection Equipment

NOTE *Respiratory Protection Equipment (RPE) is washed by an off-site vendor. Per SOP 15-79, "Incoming/Outgoing Laundry Operations," a percentage of respirators will be surveyed upon return from the vendor.*

1.0 Smear all accessible areas of each piece of respiratory equipment

1.1 Two smears are required for each respirator mask - one inside, one outside.

1.2 One smear is required for each breathing tube.

1.3 Supplied air valves should be surveyed with one smear, and one swab that is used to reach inside the valve.

2.0 Count the smears on an instrument with an MDA less than WVDP-010, Table 2-2 values. Smears and swabs used to survey the supplied air valves may be placed in the same planchet.

3.0 If the smear results are less than WVDP-010, Table 2-2 limits, the equipment shall be direct checked for fixed contamination.

4.0 If the smear results are greater than WVDP-010, Table 2-2 limits, notify the RC Supervisor.

4.1 Place contaminated RPE in a radioactive materials bag.

4.2 The bag should be sealed, and a radioactive materials tag, form WV-1157, should be attached to the exterior of the bag. The RCT may write on the bag, indicating the contamination levels detected, instead of using the tag.

5.0 Check for fixed contamination by performing direct surveys on the equipment that passed the removable.

6.0 All accessible areas of each piece of respiratory equipment should be direct checked for both alpha and beta-gamma contamination.

6.1 If direct readings are < 5 net cpm alpha and < 100 net cpm beta-gamma, then the equipment can be inspected to be returned to service.

6.2 If direct readings are > 5 net cpm alpha and/or > 100 net cpm beta-gamma, the equipment is contaminated. Notify the RC Supervisor and follow Steps 4.1 and 4.2 to properly handle the equipment.

7.0 The RC Supervisor or Radiological Engineering staff should provide instructions for surveying of other types of respiratory protection equipment.

8.0 Document survey results on form WV-1156, WVDP Radiation and Contamination Survey Report.

Attachment 10 - Radiological Survey Plan for Disposal of Material at a Landfill in New York State

1.0 Purpose and Scope

The purpose of this radiological survey plan is to demonstrate what portions of a large structure or material (e.g., building) may be safely released for disposal at a landfill in New York State. This plan is intended to be initiated prior to demolition. This plan provides the minimum requirements for the performance and documentation of the radiological survey to allow material to be safely released for disposal at a landfill in New York State. Additional survey techniques will be performed to meet the requirements of 10 CFR 835, Appendix D limits.

This survey plan addresses the specific measurement and sampling tasks that will be performed and how these tasks will be documented.

2.0 Survey Types and Objectives

2.1 Surface Contamination Surveys

2.1.1 Surface contamination surveys incorporate techniques to assess both total and removable surface contamination levels. Surface scans identify areas of elevated direct radiation levels that may be indicative of surface contamination. Direct measurements of surface activity are performed to quantify surface contamination levels at systematic and biased locations, e.g., at locations of elevated direct radiation levels as identified by surface scans. Smear surveys are performed to provide a semi-quantitative assessment of removable contamination, and typically cover an area of 100 square centimeters (100 cm^2). Large area smears may be performed to qualitatively assess the level of removable contamination on building surfaces and equipment.

2.2 Material Release Surveys for Landfill Disposal in New York State

2.2.1 Material release (unrestricted) surveys for disposal at a landfill in New York State are performed to demonstrate that the material being presented for disposal does not contain radioactivity outside of +2 sigma above background (95% confidence level). These surveys include surface scanning and surface activity static measurements.

3.0 Radiological Survey Practices

3.1 Total Surface Contamination Assessment

Scanning surfaces to identify the presence of elevated direct radiation levels which might indicate residual gross activity is performed before conducting any fixed measurements of surface activity. When contamination is identified, the area is traversed with the detector to define the boundaries of the contamination.

The average background count rate for each type of surface material measured is determined from a number of measurements as determined by the DQO Process. Surface activity measurements are performed at systematically and randomly biased selected locations and at locations of elevated direct radiation levels, identified by surface scans.

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4.0 Radiological Survey Documentation

4.1 Once the radiological survey is documented it is maintained as a radiological record to document radiological conditions. Radiological survey records must be accurate and legible and contain sufficient detail to be meaningful even after the originator is no longer available. Radiological surveys will be recorded on appropriate standard forms. Data evaluation requires that the gross counts per minute (CPM) from the direct readings of the Reference (background) area and Survey area be included with the survey results.

4.2 QA/QC Activities

4.2.1 Daily performance check determinations are made for all survey instrumentation used during the survey. Quality assurance for laboratory analyses must be integrated into the overall survey project. Acceptable measurement uncertainties must be assessed as part of the DQO process and regularly reviewed throughout the survey program. RC supervision will review survey data and provide oversight of daily activities.

4.3 Survey Data Quality Objectives

4.3.1 The DQO process is a series of planning steps that can be used to develop surveys designs for data collection that improve effectiveness, efficiency, and defensibility of survey decisions. Data quality objects are qualitative and quantitative statements that clarify the survey objective, define the most appropriate type of survey data to collect, determine the most appropriate facility/environmental conditions from which to collect the survey data, and specify acceptable limits on decision errors for the collection of survey data.

4.4 Material Description

4.4.1 When planning radiological surveys, a description of the material(s) should be obtained. This will assist those individuals pre-planning the radiological survey on how to lay-out survey grids and where to perform systematic measurements.

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4.5 Data Quality Objectives

4.5.1 The Problem

A. The material presented for New York state landfill disposal requires surface radioactivity measurements to be performed to determine its radiological contamination status for disposition. The Criteria for disposition of materials in New York State Industrial Landfills is “not distinguishable from background radiation”. “Not distinguishable from background radiation” as a measurement has been determined to be up to background plus 2 sigma. The RC Department is designing and implementing a radiological survey approach that will be used to identify any residual radioactive material in excess of +2 sigma above background on the material surfaces. After review of radiological survey data, the RC Supervisor will inform project management the appropriate disposition of the building, structure and/or materials.

B. The RC department will deploy qualified RCTs who will perform radiological surveys with ratemeters / scalers, hand-held friskers, paper swipes, survey maps, and other necessary equipment. Historical data from routine surveys and special surveys have indicated potential low levels of radiological contamination in isolated areas in the past. This contamination was found to be predominantly beta-gamma emitters. Buildings and structural materials and components may contain surface contamination from build-up and migration of removable contamination, as well as from rodent and insect droppings and nests. Safety and Quality Levels are "N" for the conduct of the radiological survey.

4.5.2 The Decision to be Made

A. The structural materials of the building structure and/or materials must be determined to be either releasable to a landfill in New York State based on each individual measurement being within +2 sigma above background (95% confidence level) or disposed as low-level radioactive waste. If portions of the structural materials are found to exceed the +2 sigma above background criteria, then this material shall be segregated from the clean material for proper disposition. If structural materials are found to be less than the +2 sigma above background criteria, then they may be disposed of as industrial waste (if no hazardous materials are present).

4.5.3 Inputs to the Decision

A. Radiological survey data results for total contamination levels will provide for the determination whether the structural materials exceed the +2 sigma above background criteria or whether they may be released for disposal at a landfill in New York State. Results from direct and static measurements with friskers will provide for the total contamination levels.

B. Scanning and fixed-point measurements are performed in accordance with the techniques presented in this procedure.

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4.5.4 Boundaries of the Study

A. The structural materials will be divided into segments and uniquely identified on radiological survey maps, for ease of identification. The radiological surveys will be performed as access to these materials is provided by project management and operation work groups.

B. Background measurements will be obtained from similar materials that are known to be free of radiological contamination to establish background radiation levels for scanning and fixed point measurements. Scans of small building structural material shall be representative of the total surface area accessible. Larger building structural materials will be scanned at biased locations where contamination may have been deposited for various reasons, followed by a series of fixed point measurements at both biased and fixed-point locations. Inaccessible locations will be made accessible to the extent practical, where professional judgment is made as to the potential for contamination to accumulate at the accessible location.

4.5.5 Decision Rule

A. The total (direct) measurement results will be compared to the average background results+2 sigma limit for disposal at a landfill in New York State. Structural materials that exceed the average background +2 sigma limit will be set aside for reevaluation against this criteria prior to being released to a landfill within New York State.

B. Scans of small building structural material shall be representative of the total surface area accessible to determine their disposition. These would include hand-held items to items that would be scanned within approximately 30 minutes (i.e., professional judgment used) to confirm radiological status.

C. Larger building structural materials will be scanned at biased locations where contamination may have been deposited for various reasons, followed by a series of fixed point measurements, and smears at both biased and fixed-point locations. Twenty-five fixed point measurements will be made on each side (i.e., interior and exterior) of larger building structural materials and analyzed by Radiological Engineering personnel in accordance to 4.5.9 for determining the final status.

D. Material measurements within the average background +2 sigma limit will define the disposition for unrestricted release to a landfill in New York State versus radioactive waste.

4.5.6 Systematic Sample Number Derivation

A. The survey design for surface contamination measurements will use a systematic sampling design approach, because of its relative ease to implement in the field. The number of measurements for each object or group of similar objects is (NUREG-1575, Section 5.5.2.2):

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$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3(P_r - 0.5)^2}$$

Where:

$Z_{1-\alpha}$ = standard statistical value, for 0.05 the value is 1.645
$Z_{1-\beta}$ = standard statistical value, for 0.05 the value is 1.645
P_r = the probability that a random measurement from the survey unit exceeds a random measurement from the background reference area by less than the $DCGL_W$ when the survey unit median is equal to the LBGR above background, when Δ/σ is 2.0, the value is 0.921319

$$N = \frac{(1.645 + 1.645)^2}{3(0.921319 - 0.5)^2} = 20.3$$

B. MARSSIM recommends that the number of data points should be increased by twenty percent, and rounded up, over the values calculated, to obtain sufficient data points to attain the desired power level with the statistical tests and allow for possible lost or unusable data. The value of 20 percent is selected to account for a reasonable amount of uncertainty in the parameters used to calculate "N" and still allow flexibility to account for some lost or unusable data. Therefore, the value of 20.3 is multiplied by "1.2", where the final number of data points is "25."

4.5.7 Calculating Whether Material is Releasable to a Landfill in New York State

A. Twenty-five (25) reference background readings for total contamination will be taken and the results entered into an Excel Spreadsheet where the mean and + 2 sigma standard deviation will be calculated as follows:

Mean = $\overline{X} = \frac{1}{n}\sum X$

Where:

$\overline{X}$ = mean or average of the observed values
n= sample size
x= Observed value

+2 Sigma Standard Deviation = $\sigma = 1.96\sqrt{\frac{1}{n}\sum (x - \overline{x})^2}$

Where:

σ = standard deviation of the population
n= sample size
x= Observed value

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$\overline{X}$ = mean or average of the observed values

B. Twenty-five (25) gross results for total contamination will be taken on the subject material and the measurements will be entered into the Excel spreadsheet containing the 25 reference (background) material results. Each measurement from the subject material data set will be compared to the background mean +2 standard deviation limit. A material measurement above the mean background +2 standard deviations will be assumed to be statistically above background and that section of material shall be set aside and reevaluated against this criteria prior to being released to a landfill within New York State.

4.5.8 Acceptable Limits on Decision Errors (Practical Constraints on Data Collection)

The expected range of radiological contamination for buildings and/or structural materials considered for this type of radiological survey should be at or near background radiation levels. The building and/or structural materials that have a representative scan of their total surface area will have a near-zero risk of reporting false negative and false positive data. Structural materials that are subject to the fixed-point direct measurement regimen will theoretically have a 5 percent (i.e., 95% confidence level) of reporting false negative and false positive data per NUREG-1505, but will be reduced by the performance of biased measurements for areas with potential for build-up or accumulated contamination. Negative political and stakeholder consequences to more severe civil penalties under the Price-Anderson Amendment Act (PAAA) for noncompliance with nuclear safety rules are possible for the incorrect disposition of contaminated materials.

4.5.9 Optimize the Design

A. Small Structural Materials

1. Perform a scan representative of the total surface area accessible to confirm total contamination levels. Document radiological survey results. If the item takes longer than 30 minutes to scan, then use Large Structural Material methodology.

B. Large Structural Materials

1. Divide large items into segments for easy identification of measurements.

2. Perform scan, using ratemeter and frisker, at biased locations where contamination may have accumulated.

3. Establish survey grid for 25 fixed-point measurement locations (for example, square items with a 5-by-5 point grid, rectangular items with a staggered-point (triangular) grid, etc.).

4. Obtain 25 background fixed-point direct measurements or obtain data on known clean, similar material. Use scaler to count 1-minute direct fixed-point measurements.

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5. Perform 25 fixed-point measurements on the subject material using a scaler and frisker, to count 1-minute direct measurements.

6. Document radiological survey results for the radiological engineering data analysis.

7. Radiological Engineering performs data analysis on measurement data per Section 4.5.7.

8. RC Supervision review survey result package.

5.0 Lessons Learned and Feedback

5.1 RC Supervision and management will continuously reinforce communication feedback from RCTs to develop lessons learned and improve processes and procedure methodologies throughout conduct of radiological survey performance.

WVDP RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue Replaces RC-ADM-4 RPO is affected	All	06/30/03
1	General revision Incorporates computerization of the Routine Survey database. Closes J2-0530058-E / Surv RPO is affected.	All	06/20/05
2	General Revision Revised to reflect new company name, logo and department / position titles. RS is affected by this revision.	All	09/11/08
3	General Revision Revised to reflect new company name, logo and department / position titles. Incorporated applicable sections of RC-RPO-102 and RC-ADM-22 RC is affected by this revision.	All	11/03/11
4	Minor Revision Editorial changes Revised respiratory survey requirements RC is affected by this revision.	 All 33	02/01/12
5	General Revision Reformatted procedure Incorporated a Radiological Survey Plan for Disposal of Material at a Landfill in New York State (Attachment 10) Radiological Controls (RC) is affected by this revision.	All 2,7,9, and 34	04/02/12
6	General Revision Revised Attachment B- Radiological Survey Plan for Disposal of Material at a Landfill in New York State Radiological Controls (RC) is affected by this revision.	 34-40	04/16/12
7	Minor Revision Corrected sample calculations Attachment 5 - 1.2.2 E, F and 1.3.2 Radiological Controls (RC) is affected by this revision.	 19, 20	6/25/12