



CABRERA SERVICES

RADIOLOGICAL • ENVIRONMENTAL • REMEDIATION

Radiation Safety Procedure

For

Radiological Surveys

OP-001

Revision 2

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1.0 PURPOSE

The purpose of this procedure is to establish the framework and to define the requirements for Cabrera Services, Inc., (CABRERA) personnel performing radiological surveys. Adherence to this procedure will provide reasonable assurance that the radiological surveys performed maintain reproducible results. In addition, adherence to this procedure will provide adequate control of radiation exposures As Low As Reasonably Achievable (ALARA).

2.0 APPLICABILITY

This procedure provides the requirements for identifying, scheduling, and performing routine, radiation, contamination, and airborne surveys by radiation safety personnel. Remediation and facility areas that are radiologically controlled (restricted areas) due to the potential for fixed or transferable contamination are considered for routine survey performance. This procedure does not include survey requirements for radiation generating devices and survey requirements specified in radiation work permits (RWP's).

The following types of surveys may be performed using this procedure.

- Surveys for shipping radioactive materials (DOT regulations may require additional consideration).
- Surveys performed to characterize facilities, sites, and/or release items potentially contaminated with radioactive materials from restricted areas.
- Surveys performed to provide information used to guide or direct decontamination and decommissioning of facilities and sites.

3.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

3.1 Precautions

- 3.1.1 Instruments used to perform routine surveys should be operated in accordance with the respective operating procedures or manufacturer's recommendations.
- 3.1.2 Large area smears may be used to augment (but not replace) the 100 cm² smear survey. Large area smears may be counted with a Ludlum Model-3 and 43-89 probe or equivalent. Large area smears are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing smears on an item easily identified as contaminated.

- 3.1.3 Personnel performing routine surveys shall be logged in on a Radiation Work Permit in accordance with AP-012 (if applicable).
- 3.1.4 Audible response instruments should be used during direct scan surveys.
- 3.1.5 The instruments used for routine surveys shall be within current calibration and shall have had a performance test check performed daily or before use in accordance with the instrument's operating procedure.

3.2 Limitations

- 3.2.1 The maximum probe speed during direct scan surveys of surfaces shall be 3 cm/sec.
- 3.2.2 The probe face shall be held within $\frac{1}{4}$ inch of the surface being surveyed for alpha radiation, and within $\frac{1}{2}$ inch of the surface being surveyed for beta-gamma radiation.
- 3.2.3 If an instrument used to perform routine surveys fails operational checks, it shall be removed from service. Data collected during the period of instrument failure must be evaluated by the RSO or duly authorized representative.
- 3.2.4 Posting of radiological control areas shall be performed in accordance with OP-019.

3.3 Requirements

- 3.3.1 Individuals performing surveys should obtain and review any previous surveys performed in the area or on the object to determine radiation conditions which may be encountered.
- 3.3.2 Qualified individuals shall perform surveys. Qualification will be determined on a case basis by the Project Manager, RSO or duly authorized representative field. Qualification considers prior training, experience, and certifications such as, Health Physics Technician (HPT), NRRPT, etc.
- 3.3.3 To ensure achieving the required sensitivity of measurements, survey samples will be analyzed in a low-background area whenever practical.
- 3.3.4 Dose rate surveys, at a minimum, should be performed in locations where workers are exposed to radiation levels that might result in radiation doses in excess of 10% of the occupational dose limits or

where an individual is working in a dose rate area of 2.5 mrem/hr or more.

- 3.3.5 If contamination is found in unrestricted areas, prevent access to the area and immediately notify the RSO or duly authorized representative.

4.0 REFERENCES

- 10 CFR 20, Subpart E Radiological Criteria for License Termination
- 10 CFR 20, Subpart F Surveys and Monitoring
- 10 CFR 20.2103 Records of Surveys
- RSP Radiation Safety Program
- AP-001 Record Retention
- AP-010 Personnel Protective Equipment
- OP-020 Operation of Contamination Survey Meters
- OP-021 Alpha-Beta Counting Instrumentation
- OP-022 Operation of Micro-R Meters
- OP-023 Operation of Ionization Chambers

5.0 DEFINITIONS AND ABBREVIATIONS

- 5.1 Radiological Control / Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.
- 5.2 Contamination Survey – A survey technique to determine fixed and removable radioactive contamination on components and facilities.
- 5.3 Radiation Survey – is defined as an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.
- 5.4 ALARA – (acronym for “as low as is reasonably achievable”) An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as technical, economical and practical considerations permit.

6.0 EQUIPMENT

Instruments used to perform routine surveys shall be used in accordance with the applicable CABRERA administrative and operational procedures. Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments. Equipment counting efficiencies may be determined by qualified Cabrera personnel.

Radiation and Contamination survey meters will be selected based on job specific requirements and be identified in the Site Work Plans.

7.0 RESPONSIBILITIES

- 7.1 Project Manager (PM) – the PM is responsible for ensuring that personnel assigned the task of performing routine surveys are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.
- 7.2 Radiation Safety Officer (RSO) – The RSO is responsible for monitoring compliance with this procedure and training personnel in performing radiation and contamination surveys. The RSO can also assist in the interpretation of the results obtained during surveys.
- 7.3 Radiological Field Supervisor (RFS) – During field assignments, the RFS is responsible for ensuring that this procedure is implemented. When the RSO is not on site, the RFS will act as the RSO's duly authorized representative for radiological issues.
- 7.4 Health Physics Technicians (HPT) – The HPT performing radiation and contamination surveys are responsible for knowing and complying with this procedure.

8.0 INSTRUCTIONS

8.1 Safety Considerations

The safety requirements specified in the job specific Health and Safety Plans and Work Plans, the Radiation Safety Program, and other safety documentation must be adhered to when performing surveys.

8.2 Initial Preparations

Obtain and review any previous surveys performed in the area to determine radiation conditions, which may be encountered.

- 8.2.1 Obtain appropriate survey instruments and assure daily QC checks have been performed prior to instrument use.
- 8.2.2 Obtain necessary forms, smears, and protective clothing, which will be used during the survey.
- 8.2.3 Plan any strategy for performing the survey before entering the area to reduce exposure time within the area.

- 8.2.4 If smearable contamination is expected to be above allowable limits, set up an entry/exit area which will prevent the spread of contamination.

8.3 Radiation Surveys

- 8.3.1 If radiation levels are unknown or previous surveys remain in question, first measure general area radiation levels using a Micro-R Meter or equivalent dose rate meter to determine if elevated radiation levels exist in the survey area.

- 8.3.2 Small Areas/Items/Containers – This survey technique is used to establish exposure rates from small areas, items, or containers, which contain radioactive materials.

8.3.2.1 Scan the entire surface area of the area, item, or container with a Micro-R or equivalent meter and record locations and readings on OP-001-02 or equivalent form.

8.3.2.2 Measure the exposure rate at 30 centimeters from all surfaces or sides of the area, item, or container and record the location and readings on OP-001-02 or equivalent form.

8.3.2.3 Large waste containers used for shipment of bulk quantities of soil debris etc., may have a single dose rate measurement per accessible side of the container for ALARA purposes. DOT regulations may require additional dose rate measurements prior to shipping not covered by this procedure. Note readings on OP-001-02 or equivalent form.

- 8.3.3 Facility Surveys – This survey technique may be used to release facilities (buildings etc.) to “unrestricted” status or determine status of facilities requiring decontamination and decommissioning. Final release of a facility will be established using MARSSIM guidance.

8.3.3.1 Establish a 1 meter by 1 meter grid system of the facility surfaces using a marking system that assigns a unique number/letter system to the center of each grid. Graphically illustrate the location of the grid system on OP-001-02 or equivalent form.

8.3.3.2 Using a Micro-R Meter, obtain radiation levels at 1 meter from the grid center point and at contact with the grid center point. Record reading on OP-001-02 or equivalent Form. If elevated readings are noted, scan the surface of the grid

and note location of any elevated readings with a marker and on OP-001-02 or equivalent Form.

8.3.3.3 Obtain Micro-R readings from locations surrounding the facility or within the facility, which do not contain activity. This establishes a background level for comparison to the reading taken in step 8.3.3.2 above.

8.3.4 Area Surveys – This survey technique may be used to release land masses to “unrestricted” status or determine status of areas requiring decontamination before release. Final release of a site area will be established using MARSSIM guidance

8.3.4.1 Establish a 10 meter by 10 meter grid system of the area to be surveyed using surveyor stakes or equivalent, which are numbered with a unique number/letter system to identify the center of each grid. List the locations of the “gridded” system on OP-001-02 or equivalent form.

8.3.4.2 Using a Micro-R meter or equivalent, obtain radiation levels at 1 meter above the ground surface in the center of the grid. Record all readings on OP-001-02 or equivalent Form.

8.3.4.3 Survey the remainder of the grid at the surface using an “S” pattern for the instrument. If elevated readings are noted above or below the grid center point reading, subdivide the grid into additional subgrids and obtain readings at 1 meter above the ground surface. Record all readings on OP-001-02 or equivalent.

8.4 Contamination Surveys

8.4.1 If removable contamination is suspected or previous surveys are in question, first scan likely contaminated areas with an α and/or β probe to determine if elevated areas of contamination exists. Obtain smear samples from any elevated areas and count smears in sample counter. If smearable contamination above limits set for the job are found, use appropriate protective clothing and entry control techniques to prevent the spread of contamination.

8.4.2 Small Areas/Items/Containers – This survey technique is used to establish total and transferable contamination levels on small areas, items, or containers, which contain radioactive materials.

- 8.4.2.1 If the area, item, or container contains alpha activity, scan the area with an alpha probe at $\frac{1}{4}$ inch above the surface. Note total (fixed plus transferable contamination) readings on OP-001-02 or equivalent form.
- 8.4.2.2 If the area, item, or container contains beta activity, scan the area with a beta probe at approximately $\frac{1}{2}$ inch above the surface to be surveyed and obtain reading following meter stabilization. Record meter reading on OP-001-02 or equivalent form. The surface of a container can only be directly surveyed for beta activity if the radiation level from the container does not significantly elevate the beta probe background. Note total fixed plus transferable contamination readings on OP-001-02 or equivalent survey form.
- 8.4.2.3 Provide transferable smear contamination survey on the area, item or container by performing 100 cm² smears at routine intervals on the subject area, item, or container.
- 8.4.2.4 Large waste containers used for shipment of bulk quantities of material will have one or more contact readings taken at routine intervals on the accessible sides of the container. Note total (fixed plus transferable) contamination readings on OP-001-02 or equivalent form. DOT regulations may require additional survey points.
- 8.4.2.5 For large waste containers used for shipment of bulk quantities of material for disposal (or other large items such as soil moving equipment), determine the transferable surface contamination by taking Large Area Smears (LAS). Use Masslin cloth or equivalent material to obtain a large area smear representative of the potentially contaminated area. Count the LAS in a low background area using alpha and beta detection equipment. If no transferable contamination above limits is found on the LAS, take several confirmatory 100 cm² smears at routine intervals on the object and count smears for alpha and beta activity. Record results on OP-001-02 or equivalent form. DOT regulations may require additional survey points.

NOTE: The presence of activity above transferable limits on an LAS signifies potential contamination. Determine actions to be taken with the RSO or RFS.

- 8.4.3 Facility Surveys – This survey technique is used to aid in the release of facilities (buildings etc.) to “unrestricted” status or determine status

of facilities requiring decontamination and decommissioning. Final release of a facility will be established using MARSSIM guidance.

8.4.3.1 The grid system established in section 8.3.3.1 will also be utilized for contamination surveys.

8.4.3.2 Hold the beta probe at approximately $\frac{1}{2}$ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on OP-001-02 or equivalent form.

8.4.3.3 If the readings are at background levels, randomly scan the remainder of the grid, concentrating on cracks, floor/wall joints, top of horizontal surfaces, ventilation ducts and grills, and other areas that might collect radioactive materials. Mark any locations above the release criteria on OP-001-02 or equivalent form.

8.4.3.4 If readings are at or near the release levels, scan grid surface and identify portion of the grid that is above the release criteria. Note these areas on the survey form and mark the area of the grid with spray marker (or equivalent) on OP-001-02 or equivalent form.

Repeat steps 8.4.3.2 through 8.4.3.4 with an alpha probe at $\frac{1}{4}$ inch above the grid center point. If sufficient documentation of previous history is known about the facility, the alpha survey may not be required if alpha contamination is known not to be present.

8.4.3.5 One smear sample from a 100 cm² area will be taken in each grid. If the above survey found no elevated readings in the grid, the smear sample will be taken in the center of the grid. If elevated levels readings are identified the smear sample will be taken from the area where the highest reading was obtained.

8.4.3.6 Each smear sample will be labeled with the grid location and counted for alpha and beta activity in the sample counter. The smear sample results will be recorded on OP-001-02 or equivalent Form.

8.4.4 Area Surveys – This survey technique is used to aid release of land masses to “unrestricted” status or determine status of area requiring decontamination before release. Final release of a facility will be established using MARSSIM guidance.

- 8.4.4.1 The grid system established in section 8.3.4, will be utilized for contamination surveys.
- 8.4.4.2 Hold the beta probe at ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on OP-001-02 or equivalent form.
- 8.4.4.3 If readings are at background levels, randomly scan the remainder of the grid. Mark any locations above release criteria on OP-001-02 or equivalent form.
- 8.4.4.4 If readings are at or near the release levels scan the grid surface and identify portion of the grid that is above release criteria. Note these areas on OP-001-02 or equivalent form.
- 8.4.4.5 Areas contaminated with radioactive materials may require soil sample analysis to determine the activity concentration. The quantity and location of samples will be determined on a case-by-case basis.

8.5 Frequency and Requirements for Routine Surveys

Appropriate routine radiological surveys shall be performed at the following frequencies as a minimum:

8.5.1 Radiation Surveys

- Upon initial entry after extended periods of closure
- Daily, at contamination control points, where the potential exists for personnel to be exposed to dose rates greater than 2 mrem/hr
- Daily, during continuous operation, and when levels are expected to change
- Weekly, in routinely occupied areas adjacent to radiological control areas with dose rates greater than 2 mrem/hr
- Weekly for operating HEPA-filtered ventilation units
- Weekly, for any temporary Radiation Area boundaries to ensure that the Radiation Areas do not extend beyond posted boundaries
- Monthly, or upon entry if entries are less than monthly, for Radioactive Material Storage Areas

8.5.2 Contamination Surveys

- Daily, at contamination control points from areas exhibiting contamination above surface contamination limits for the job site
- Daily, in office spaces located in the radiological control areas
- Weekly in lunchrooms or eating areas adjacent to radiological control areas
- Weekly, in routinely occupied locker rooms or the shower areas adjacent to radiological control areas associated with site radiological work
- Weekly, or upon entries, if entries are less frequent, in the areas where radioactive materials are handled or stored
- Weekly for all project offices on site

8.5.3 Airborne Surveys:

Airborne survey frequency, locations, and methods are determined by the radiation work permits (RWP's) and by the RSO.

8.6 Identifying and Scheduling Routine Radiological Surveys

8.6.1 To assist in assuring surveys are scheduled, the RSO or duly authorized representative shall identify and schedule routine surveys as required by the radiological conditions and work activities.

8.6.2 Routine Survey Schedules or equivalent should be developed using a standard system for designating surveys such as:

Frequency of Survey

- | | |
|-----------------|---|
| • Daily | D |
| • Weekly | W |
| • Monthly | M |
| • Quarterly | Q |
| • Semi-Annually | S |
| • Annually | A |
| • Upon Entry | U |

Type of Survey

- | | |
|-----------------|---|
| • Radiation | R |
| • Contamination | C |
| • Area TLD | T |

- Air Sample A

Example: DRC-1
Where:

D: is the survey frequency (Daily in this example)
R: is the type of survey (Radiation in this example)
C: is a type of survey (Contamination)
1 corresponds to the numerical sequence of the survey

8.6.3 Routine survey schedules should be submitted to and reviewed by the RSO or duly authorized representative.

8.6.4 Routine Survey Schedules should be indicated on form OP-001-01 or equivalent. Task Leaders may elect alternate methods of determining the information contained on OP-001-01.

8.7 Using As Low As is Reasonably Achievable (ALARA) Principles for Scheduling and Performing Surveys

8.7.1 Routine surveys should not be performed in High Radiation Areas unless other work necessitates entry. Boundary verification surveys would be appropriate if an entry is not required.

8.7.2 Routine surveys should be performed in conjunction with other work surveys as much as practicable.

8.8 Performance of Routine Surveys

8.8.1 HPT's and qualified individuals shall perform routine surveys in accordance with the applicable operational procedure.

8.8.2 Upon completion of a routine survey, the HPT shall initial and date the appropriate Survey Form.

8.9 Periodic Evaluation of Routine Surveys

8.9.1 Routine survey schedules should be reviewed and updated periodically to ensure that all areas within the project boundaries are receiving the appropriate routine survey coverage.

8.9.2 Changes of conditions within the project area will be reported to the RSO or duly authorized representative and may require a modification of the routine radiological survey schedule.

8.10 Management Notification

8.10.1 The RSO should be notified, by the project manager or duly authorized representative, of failure to complete a routine survey as scheduled. The missed survey will be completed within 24 hours (or next working day) of discovering the inconsistency.

9.0 QUALITY ASSURANCE/RECORDS

9.1 Quality Assurance

9.1.1 Instruments used to perform routine radiological surveys will be inspected for serviceability each day and checked against check sources to verify they are in proper working condition per the applicable Operational Procedure and standard work practices.

9.1.2 Radiation and Contamination surveys will be reviewed by the RSO or duly authorized representative for accuracy and completeness.

9.2 Records

9.2.1 At a minimum, each survey record should include the following:

- A diagram of the area surveyed, if applicable.
- A list of items and equipment surveyed.
- Specific locations on the survey diagram where wipe test were taken.
- Background radiation levels with appropriate units.
- Contamination levels with appropriate units.
- Make, model number, and serial number of instruments used.
- Name of the person making the evaluation and recording the results and date.

9.2.2 Radiological Survey Records, routine survey schedules, and tracking forms are generated during the performance of this procedure. Electronic equivalents of forms may be utilized.

9.2.3 Documented information shall be legibly written in ink.

9.2.4 Data shall not be obliterated by erasing, using white-out, or by any other means. Incorrect entries shall be corrected by striking a single line across the entry. The correction shall be entered, initialed, and dated.

- 9.2.5 Personnel performing the survey shall ensure that this procedure is the most current and approved revision.
- 9.2.6 Personnel performing the survey shall review forms and any other electronic equivalents for accuracy and completeness.
- 9.2.7 Entries on forms and any other pertinent forms must be dated and initialed by the individual performing the survey to be valid.
- 9.2.8 The RSO or duly authorized representative shall review any applicable completed forms. The review shall be for accuracy and completeness.

10.0 ATTACHMENTS

- OP-001-01 Routine Survey Schedule
- OP-001-02 Survey Form

OP-001-02 Radiological Survey Sheet

Location: Site:			RWP#			Survey #			Survey Type:			pg. 1 of __					
Smear (CPM/100 cm ²)						circle one											
Direct Count (CPM/Direct Frisk)																	
No.	α	β	No.	α	β												
1			26														
2			27														
3			28														
4			29														
5			30														
6			31														
7			32														
8			33														
9			34														
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23			48														
24			49														
25			50														
Comments			Surveyed By:	Date:	Instrument	Serial #	α Eff.	β Eff.	α Bkg.	β Bkg	γ Bkg	Cal. Due	Key				
													■	A/S Location			
													.	Boundary			
													○	Smear			
													□	Dose Rate _____ /hr			
			Reviewed By:	Date:									*	Direct Reading CPM/direct frisk			
													△	Grab Sample			