SECTION 7.0

SCANNING AND MEASUREMENT TECHNIQUES

SECTION 7.1

SURFACE SCANNING

1.0 Purpose

To provide a method for identifying areas of elevated surface radiation.

2.0 Responsibilities

- The site coordinator is responsible for assuring that this procedure is implemented.
- Survey team personnel are responsible for following this procedure.

3.0 Procedure

Surfaces are scanned to determine the level of gross activity present. Action levels are determined based on guidelines established for each site (see Sections 7.3-7.5) and serve as indicators that further investigation is necessary. Scans are conducted for all radionuclides potentially present based on the site history. Monitoring for the unexpected is also recommended. Headphones are recommended for all scanning activities.

3.1 Gamma Scanning

3.1.1 Equipment

✔ Sodium iodide gamma scintillator: Model 489-55, Victoreen Instrument Co.; Model SPA-3, Eberline Instrument Corporation; or equivalent (Thin crystal, Model PG-2, Eberline Instrument Corporation, Model G5 "FIDLER", Bicron Corporation, or equivalent may be used when low energy photons are the radiation of concern).

✔ Portable ratemeter or ratemeter-scaler: Model PRM-6; Eberline Instrument Corporation; Model 2221, Ludlum Instrument Corporation; or equivalent, equipped with audible speaker.

✔ Cable: As appropriate (see Section 5).

✔ Record forms.

✔ Check source.

3.1.2 Operational Check-Out

Assemble equipment, check battery, and adjust high voltage, if necessary. Check background and gamma check source count rates. Follow procedures described in Section 5.

3.1.3 Scanning

3.1.3.1 Set the instrument for 'FAST' response.

3.1.3.2 Pass the detector slowly over the surface. The detector is maintained at a distance as close to the surface as conditions allow, nominally one to four centimeters. The speed of detector movement will vary depending upon the radionuclide of concern, the experience of the surveyor, and the required observation interval, but is typically 0.5 to 1.0 m per second. Gamma scanning is usually performed by swinging the detector in front of the body in a pendulum manner while progressing at the speed of a slow walk.

3.1.3.3 Note increases in count rate as indicated by the audible output. Compare count rates to the established site action level as discussed below.

If the scan sensitivity, which is based on available data and the site coordinator's professional experience, is greater than the guideline, then any locations of direct radiation distinguishable from background will require the surveyor to pause, investigate the area, and mark positive findings.

If the scan sensitivity is less than the guideline, establish action levels as either a multiplier of the ambient background or a specific count rate.

NUREG-1507[1] provides acceptable gamma scanning minium detectable concentrations for the more commonly encountered gamma-emitting radionuclides.

3.1.3.4 Mark areas that meet or exceed action levels using survey flags for open land areas and paint, grease pencil or other appropriate method for other surfaces. Further investigation is necessary at these locations.

[1] U.S. Nuclear Regulatory Commission. NUREG-1507, Minimum detectable concentrations with typical radiation survey instruments for various contaminants and field conditions. Washington, DC; June 1998.

3.1.3.5 For systematic scans, continue traversing the area at intervals of generally 0.5 to 10 meters, depending upon the site's radiological history, contamination potential, survey plan specifications for the minimum percent scan coverage, and findings as the survey progresses. Judgmental scans may be performed in addition to or in place of systematic scanning.

3.1.3.6 After a specific area (usually a grid block or survey unit), has been scanned, map the dimensions of any areas of concern; record locations and levels of ambient gamma radiation and elevated gamma radiation on the appropriate survey form (Figures B-9, B-10, or equivalent).

3.2 Beta-Gamma Scanning (also see step 3.5 for floor monitor scanning)

3.2.1 Equipment

- ✔ Beta detector: Model 489 (GM "Pancake"), Victoreen Instrument Co., Model HP-260 (GM "Pancake"), Model 43-68 (proportional), Ludlum Instrument Corporation; or equivalent.
- ✔ Portable ratemeter-scaler: Model PRM-6 or PRS-1, Eberline Instrument Corporation; Model 2221, Ludlum Instrument Corporation; or equivalent, equipped with audible speaker.
- ✔ Cable: As appropriate (see Section 5).
- ✔ Record forms.
- ✔ Check source.

3.2.2 Operational Check-Out

Assemble equipment, check battery, and adjust high voltage and threshold, if necessary. Check background and check source count rates. Follow procedures described in Section 5.

3.2.3 Scanning

3.2.3.1 Pass the detector slowly over the surface. The detector is maintained at a distance as close to the surface as conditions allow, nominally no more than one centimeter. The speed of detector movement will vary depending upon the radionuclide of concern,

the experience of the surveyor, and the required observation interval, but is typically one-half to one detector width per second.

3.2.3.2 Note increases in count rate as indicated by the audible output. Compare count rates to the established site action level as discussed below.

If the scan sensitivity, which is based on available data and the site coordinators professional experience, is greater than the guideline, then any locations of direct radiation distinguishable from background will require the surveyor to pause, investigate the area, and mark positive findings.

If the scan sensitivity is less than the guideline, establish action levels as either a multiplier of the ambient background or a specific count rate. See Section 7.4 for determination of action levels.

ESSAP protocols and NUREGs 1507 and 1575[2] provide additional information for calculating specific scan MDC's.

3.2.3.3 Mark areas that meet or exceed action levels using flags, stakes, paint, chalk, markers etc., as necessary. Further investigation is necessary at these locations.

3.2.3.4 Continue traversing the area at close intervals. Due to the short range of the beta radiation and the directional dependence of the detector, scanning intervals may overlap.

3.2.3.5 After a specific area (usually a grid block or survey unit) has been scanned, map the dimensions of any areas of concern; record all scan data, including the locations and activity levels of elevated radiation on the appropriate survey forms (Figures B-9, B-10, or equivalent).

3.3 Alpha Scanning (also see Step 3.5 for floor monitor scanning)

3.3.1 Equipment

✔ Alpha detector: Model AC3-7, AC3-8 or HP-100A, Eberline Instrument Corporation; Model 43-68 Ludlum Instrument Corporation; or equivalent.

[2] U.S. Nuclear Regulatory Commission. NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual. Washington, DC; December 1997.

- ✔ Portable ratemeter-scaler: Model PRS-1, Eberline Instrument Corporation; Model 2221 or 2223, Ludlum Instrument Corporation; or equivalent, equipped with audible speaker.

- ✔ Cable: As appropriate (see Section 5).

- ✔ Record forms.

- ✔ Check source.

3.3.2 Operational Check-Out

Assemble equipment, check battery, and adjust high voltage and threshold if necessary. Check background and alpha source count rates. Follow procedures described in Section 5.

3.3.3 Scanning

3.3.3.1 Pass the detector slowly over the surface. The detector is maintained at a distance as close to the surface as conditions allow, nominally less than one centimeter. The speed of detector movement will vary depending upon the experience of the surveyor and the action level/guideline but is typically 2 to 5 centimeters per second.

3.3.3.2 The alpha background count rates for most detectors are very close to zero. This, combined with typically low activity guidelines for alpha-emitters requires that the surveyor pause liberally when counts are detected, investigate the area, and mark positive findings. Compare count rates to the established site action level. See Section 7.3 for determination of action levels.

ESSAP protocols and NUREG-1575 provide additional information on calculating alpha scan MDC's.

3.3.3.3 Mark areas that meet or exceed site action levels using paint, chalk or grease pencil. Further investigation is necessary at these locations.

3.3.3.4 Continue traversing the area at close intervals. Due to the short range of the alpha radiation and the directional dependence of the detector scanning, intervals may overlap.

3.3.3.5 After a specific area (usually a grid block or survey unit) has been scanned, map the dimensions of any areas of concern; record scan data,

including the operational mode (i.e. alpha only), if applicable, and the locations and activity levels of elevated radiation on the appropriate survey forms (Figures B-9, B-10, or equivalent).

3.4 Alpha plus Beta Scanning

3.4.1 Equipment

✔ Alpha-beta detector: Model 43-68 or 43-89 Ludlum Instrument Corporation; or equivalent.

NOTE: These detectors may be used to scan for either alpha or alpha-beta activity by varying the high voltage on the ratemeter-scaler or simultaneous alpha and beta counting using the 43-89 coupled to the 2223.

✔ Portable ratemeter-scaler: Model PRS-1, Eberline Instrument Corporation; Model 2221 or 2223, Ludlum Instrument Corporation; or equivalent with audible speaker.

✔ Cable: As appropriate (see Section 5).

✔ Record forms.

✔ Check source.

3.4.2 Operational Check-Out

Assemble equipment, check batteries, and adjust high voltage and threshold, if necessary. Check background and source count rates. Follow procedures described in Section 5.

3.4.3 Scanning

3.4.3.1 Pass the detector slowly over the surface. The detector is maintained at a distance as close to the surface as conditions allow, nominally no more than one centimeter. The speed of the detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor, but is typically one detector width per second. The detector should be kept as close to the surface as conditions allow.

3.4.3.2 Note increases in count rate as indicated by the audible output. Compare count rates to the established site action level.
If the scan sensitivity, which is based on available data and the site

coordinators professional experience, is greater than the guideline, then any locations of direct radiation distinguishable from background will require the surveyor to pause, investigate the area, and mark positive findings.

If the scan sensitivity is less than the guideline, establish action levels as either a multiplier of the ambient background or a specific count rate. See Section 7.3 and 7.4 for determination of action levels.
ESSAP protocols and NUREGs 1507 and 1575 provide additional information on calculating specific scan MDCs.

3.4.3.3 Mark areas that meet or exceed site action levels using paint, chalk or grease pencil. Further investigation is necessary at these locations.

3.4.3.4 Continue traversing the area at close intervals. Due to the relatively short range of the alpha and beta radiation and the directional dependence of the detector, scanning intervals may overlap.

3.4.3.5 After a specific area (usually a grid block or survey unit) has been scanned, map the dimensions of any areas of concern; record all scan data, including the operational mode (i.e. alpha-beta) and the locations and activity levels of elevated radiation on the appropriate survey forms (Figures B-9, B-10, or equivalent).

NOTE: It may be necessary to perform a scan for alpha only in conjunction with the alpha plus beta scan since significant levels of alpha activity may be masked by the background levels obtained when operating in the alpha plus beta plateau region.

3.5 Floor Monitor Scanning

3.5.1 Equipment

- ✔ Proportional floor monitor, Model 239-1, Ludlum Instrument Company.
- ✔ Portable ratemeter-scaler: Model 2220 or 2221, Ludlum Instrument Corp.; or equivalent, equipped with audible speaker.
- ✔ Cable: As appropriate (see Section 5).
- ✔ P-10 counting gas.
- ✔ Record forms.

✔ Check source.

3.5.2 Operational Check-Out

Assemble equipment, check battery, and adjust high voltage and threshold if necessary. Purge detector with P-10 gas. Check background and alpha-beta source count rates. Follow procedures described in Section 5.

NOTE: This unit may be used to scan for either alpha or alpha-beta activity by varying the high voltage on the ratemeter-scaler.

3.5.3 Scanning

3.5.3.1 Pass the detector slowly over the floor. The detector is maintained at a distance as close to the surface as conditions allow, nominally one centimeter. The speed of detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor, but is typically about one detector width per second.

3.5.3.2 Note increases in count rate as indicated by the audible output.

If the scan sensitivity, which is based on available data and the site coordinators professional experience, is greater than the guideline, then any locations of direct radiation distinguishable from background will require the surveyor to pause, investigate the area, and mark positive findings.

If the scan sensitivity is less than the guideline, establish action levels as a multiplier of the ambient background.

NOTE: Because the floor monitor is not calibrated, it serves as a qualitative scanning method. Specific count rate action levels are therefore not determined. General MDCs are available in ESSAP protocols.

3.5.3.3 Circle areas of increased count rate using paint, chalk, or grease pencil. Further investigation is necessary at these locations.

3.5.3.4 Continue traversing the area at close intervals. Due to the relatively short range of the alpha and beta radiation and the directional dependence of the detector, scanning intervals may overlap.

3.5.3.5 After a specific area (usually a grid block or survey unit) has been scanned, map the dimensions of any areas of concern; record the operational mode (i.e., alpha or alpha plus beta) and all scan data, including the locations and activity levels of elevated radiation on the appropriate survey forms (Figures B-9, B-10, or equivalent).