SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)
End of Buchanan Street
Albany, California 94706

Issued: March 3, 2025

Prepared for: **CITY OF ALBANY**
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This Soil Sampling and Analysis Plan was prepared by the staff of GSI Environmental Inc., under the supervision of the Engineer(s) and/or Geologist(s) whose signatures appear hereon.

The findings, recommendations, specifications, or professional opinions were prepared in accordance with generally accepted professional engineering and/or geologic practice. No warranty is expressed or implied.

Issued: March 3, 2025

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1.0 INTRODUCTION

GSI Environmental Inc. (GSI) prepared this Soil Sampling and Analysis Plan (SAP) on behalf of the City of Albany (City) for the former Albany Landfill, currently referred to as the Albany Bulb, located at the western end of Buchanan Street on the east shore of the San Francisco Bay in Albany, California (the Site). The Site location is shown on Figure 1. This SAP was prepared in response to a San Francisco Bay Regional Water Quality Control Board (Water Board) letter *Albany Landfill, Albany, Alameda County – Requirements for Technical Reports Pursuant to Water Code Section 13267* dated January 18, 2024 (Water Board, 2024a), requesting a work plan to conduct a one-time, representative sampling of soil and groundwater at the Site. The Order included a March 28, 1980 letter from Stauffer Chemical Company to the Department of Health Services which contained a reference to the Albany Landfill Co. and the possible delivery of waste material by Stauffer to the Landfill between 1960 and 1971. The Order required the City to investigate whether such material was in fact delivered to the Landfill.

GSI prepared a Site Investigation Work Plan (Work Plan) in response to the Water Board's Order dated April 1, 2024 (GSI, 2024a). GSI proposed a stepwise investigation approach with initial activities consisting of: (1) historical document and aerial photograph review for the subject Site to identify areas within the subject Site that might have been available to potentially receive Stauffer Richmond Plant (Stauffer; later known as Zeneca) waste streams (and thus potential alum mud) and (2) a gamma radiation walk-over survey (GWS) of the subject Site to identify potential near-surface radiation sources that may indicate the presence of alum mud. The Water Board issued a letter on May 14, 2024, concurring with the initial activities (Water Board, 2024b).

The findings of the historical document and aerial photograph review and GWS were presented in the November 6, 2024 *Historical Review and Gamma Radiation Survey Report* (GSI, 2024b). Based on the findings of the historical and aerial photograph review, it is GSI's opinion that it is unlikely that Stauffer waste was disposed of at the subject Site, and that any potential Stauffer waste disposal at the former Albany Landfill was more likely to have occurred on the privately owned, Santa Fe Land Improvement Company portion of the landfill, which is not owned by the City. The GWS, performed by Cabrera Services, Inc. (Cabrera), identified 10 locations that had statistically higher gamma count rate measurements, but noted that that the results of the GWS were generally consistent with what might be expected at a landfill that contains soils and construction debris from various sources. Of these ten locations identified, only three of the locations were considered potentially consistent with the disposal of alum mud. Cabrera recommended that these three locations be included as part of any future investigation at the subject Site.

In line with Cabrera's recommendation, GSI recommended conducting shallow trenching and soil sampling for radionuclides in these three locations to assess the possible presence of alum mud and collect additional data to evaluate the dose/exposure rate in these areas. Additional surface scanning at all ten locations that exhibited statistically higher gamma count rate measurements was also recommended to evaluate the dose/exposure rates. Given the results of the historical review and finding that it is unlikely that much alum mud, if any, was disposed of at the subject Site, GSI did not recommend any additional investigation activities beyond those described above at this time. The Water Board provided concurrence with the proposed approach in a letter dated November 25, 2024 (Water Board, 2024c).

GSI has prepared this SAP in conjunction with Cabrera to describe the field and analytical methodologies for the proposed additional investigation which will include:

- Collecting additional surface and subsurface radiological measurements and soil samples at the three locations identified during the GWS that were considered potentially consistent with the disposal of alum mud to assess the potential presence of alum mud and estimate potential exposure to radioactivity by members of the public utilizing the site for recreational purposes; and
- Collecting surface radiological measurements at all ten of the locations identified with statistically elevated gamma count rates to evaluate radiological conditions near the ground surface within these areas and estimate potential exposure to radioactivity by members of the public utilizing the site for recreational purposes.

An initial version of this SAP was submitted to the Water Board on December 30, 2024. Based on comments and subsequent discussion with the Water Board and additional information provided to them by the California Department of Toxic Substances Control (DTSC), the proposed additional investigation will also include:

- Collecting surface radiological measurements at an eleventh location (in Cell 4 of the former landfill).
- Advancement of a soil boring to observe the lithology and collect subsurface radiological measurements.

2.0 SITE DESCRIPTION AND BACKGROUND

The subject Site is approximately 40.8 acres and is a closed, unlined, Class III landfill. The subject Site is the City-owned portion of the former Albany Landfill, which included land to the east of the site, currently owned by East Bay Regional Parks District (EBRPD) and State of California. According to the Waste Discharge Requirements (WDR) Order 99-068, the subject Site received approximately 2,000,000 tons of waste from 1963[1] until December 1983. The landfill waste has an average depth of 40 feet. Landfill operations involved constructing waste cells by forming dikes composed of concrete rubble, soil and steel-mill slag and infilling these cells with waste. The subject Site contains four waste cells (Cells 1 through 4) that were constructed and filled. Reportedly a fifth waste cell (now the the tidal lagoon on the west side of the subject Site) was constructed, but never filled (Ninyo & Moore, 2020). The waste placed in these cells consisted primarily of construction and demolition wastes. Prior to 1975, some non-hazardous solid waste, such as wood and vegetable solid waste, was disposed of at the subject Site. The WDR focused on groundwater and surface water quality with respect to their potential impact to San Francisco Bay, should these media be impacted from landfill wastes. WDR Order 99-068 states that the landfill does not pose a water quality threat to San Francisco Bay. The landfill remains undeveloped and is used as public recreational area. The subject Site layout and approximate locations of the waste cells, as well as the adjacent portions of the former Albany Landfill consisting of the Albany Neck, Albany Sliver, and Albany Plateau, currently owned by the EBRPD, and Albany Beach, currently owned by the State of California, are shown in Figure 2.

In its January 18, 2024 Order, the Water Board states that it had recently discovered a letter that indicated industrial waste from Stauffer was potentially disposed of at the Albany Landfill from 1960 to 1971. The Water Board Order included a March 28, 1980, letter from Stauffer, identifying the Albany Landfill Co. site, owned by the Santa Fe Land & Improvement Co., as one recipient of

[1] The January 18, 2024 Water Board Order indicates the landfill operated intermittently beginning in the 1940s.

the Stauffer process waste (Stauffer, 1980). The Water Board Order states that the process waste may have included “alum mud,” a waste product generated from the processing of aluminum from bauxite ore. The primary constituents in alum mud include heavy and trace metals including iron, manganese, magnesium, zinc, cadmium, copper, trivalent chromium, and lead. Alum mud also typically contains certain radionuclides, referred to as “technologically enhanced naturally occurring radioactive material” (TENORM). Similar waste was disposed of at Blair Southern Pacific Landfill in Richmond, California. The Water Board Order indicated that radioisotopes associated with TENORM and pesticides that were produced at the Stauffer Richmond facility have been detected at the Blair Southern Pacific landfill. The March 1980 letter was the only evidence of potential Stauffer waste disposal provided or referenced in the Water Board Order.

It should be noted that the Water Board Order indicates the landfill is approximately 75 acres and operated intermittently beginning in the 1940s. This information is inconsistent with the description found in WDR Order 99-068, which states the City of Albany landfill occupies 40.8 acres and began filling operation in 1963. The Order appears to refer to the larger area that includes the former landfill currently owned by EBRPD and formerly referred to as the “Albany Dump” and “Santa Fe Pacific Landfill” that was historically owned by the Santa Fe Land Improvement Company.

2.1 Historical Review Summary

A review of historical ownership documentation for the Albany Bulb indicates that the subject Site was owned by the State of California until 1963, when the land was granted by the State Lands Division to the City of Albany. The ownership history shows that the subject Site has remained under public ownership since before its development as a landfill. A Waste Disposal Site Survey prepared in 1979 by the United States House of Representatives Subcommittee on Oversight and Investigations of the Interstate and Foreign Commercial Committee (U.S. House Subcommittee, 1979) includes the survey form provided in the Water Board Order and is the basis of the Water Board’s inquiry. The Waste Disposal Site Survey states that Stauffer waste was sent to a landfill owned by the “Santa Fe Land & Improvement Co.” and noted that the ownership at the time of disposal was “private but not company ownership.” The information provided in this survey form is inconsistent with the historical and current ownership of the subject Site, which has never been owned by a private entity or by Santa Fe Land & Development Company.

Additionally, the Waste Disposal Site Survey indicates that the period of potential Stauffer waste disposal at the former Albany Landfill occurred from 1960 to 1971; however, a review of historical aerial photographs shows that the subject Site did not exist until sometime between 1965 and 1968; thus, for nearly half of the time period that Stauffer waste disposal reportedly occurred, the subject Site was an unfilled portion of the San Francisco Bay. Additionally, the 1983 letter from Stauffer to the California DHS stated that alum mud from Stauffer was hauled to a Class II landfill, which is inconsistent with WDR Order No. 99-068 for the subject Site that states that the City-owned portion of the former Albany Landfill was a Class III landfill.

Based on the information gathered above, it appears unlikely that Stauffer waste was disposed of at the subject Site, and that any potential Stauffer waste disposal at the former Albany Landfill was more likely to have occurred on the privately owned, Santa Fe Land Improvement Company portion of the landfill.

2.2 Gamma Walkover Survey Results Summary

GSI contracted with Cabrera Services Inc. (Cabrera) to conduct a GWS between June 17, 2024, and June 21, 2024 to evaluate surface radiological conditions at the subject Site. The purpose of the GWS was to identify potential areas of elevated surface gamma radiation that may be indicative of alum mud disposal. The GWS was performed using a Ludlum Model 44-10 2-inch by 2-inch (2x2) sodium iodide (NaI) detector connected to a Ludlum Model 3000 digital survey reader to log the gamma count rate from each measurement. Cabrera technicians surveyed 100% of the accessible ground surface within the former Albany Landfill.

A total of 71,581 gamma count rate measurements were collected at the Site. Summary statistics were calculated that included the mean (5,919 counts per minute [cpm]) and standard deviation (1,346 cpm) for the data set. The Investigation Level (IL) was calculated as the mean plus three standard deviations (9,956 cpm). For a normal distribution, 99.7% of detection values are expected to fall within three standard deviations of the mean value. Therefore, the IL was designed to identify areas with statistically high gamma count rate measurements. The GWS revealed ten areas where at least one gamma count rate detection exceeded the IL. At eight of the ten locations static gamma count rate measurements were collected after completing the initial walk-over portion of the GWS. The static measurements were collected by placing the sodium iodide (NaI) detector on the ground at these locations to record the gamma count rate over a period of at least 1 minute. The ten areas with elevated gamma count rate measurements are shown in Figure 3.

Cabrera concluded that the results of the GWS and static measurements were consistent with levels of natural occurring radioactivity associated with soils and construction debris. The factor of 17.7 between the minimum and maximum GWS results is within the expected range of natural occurring radiation, given the potential range of terrestrial radionuclides in the materials present in the landfill. The presence of small areas of slightly elevated gamma radiation is expected as a result of deposition of varying materials at different locations within the landfill.

Cabrera reviewed the measurement data and analyzed the data with respect to three criteria to determine if the ten locations with elevated gamma count rates could be consistent with potential disposal of alum mud. These criteria included: 1) whether the locations were located within the footprint of a disposal cell; 2) whether locations had significantly higher static gamma count rate measurements as compared to the walk-over survey measurements, which would indicate a subsurface source of gamma radiation; and 3) whether the area was large enough to represent at least several cubic yards of material as would be expected with wastes historically transported by truck.

Based on these criteria, three of the ten locations identified were considered to be potentially consistent with the disposal of alum mud waste, including Location 2, Location 5, and Location 8 as shown on Exhibit 1.

Exhibit 1. Gamma Radiation Walkover Survey Investigation Level Exceedances and Static Measurement Results (Cabrera, 2024)

Survey Location	Maximum GWS Result (cpm)	Static Measurement (cpm)	Determination Criteria			Consistent with Alum Mud Disposal?
			Inside Former Disposal Cell?	Subsurface Potential?	Area of Elevated Readings (square feet)	
1	25,440	25,000	No	No	**5,000**	Unlikely
2	18,540	27,200	**Yes**	**Yes**	**1,900**	**Possible**
3	18,180	18,100	No	No	**2,400**	Unlikely
4	12,480	11,000	No	No	**3,000**	Unlikely
5	11,820	45,100	**Yes**	**Yes**	20	**Possible**
6	11,400	9,170	**Yes**	No	10	Unlikely
7	11,220	12,400	**Yes**	No	10	Unlikely
8	10,380	24,100	**Yes**	**Yes**	10	**Possible**
9	9,960	N/A	**Yes**	No	10	Unlikely
10	9,960	N/A	**Yes**	No	10	Unlikely

GWS investigation level (mean+3σ) = 9,956 cpm
GWS = gamma walkover survey
cpm = counts per minute

Based on the criteria described above, Location 2 appeared to be the most consistent with potential disposal of alum mud. This location is an approximately 1,900-square-feet area of elevated gamma radiation within the footprint of a waste disposal cell that had significantly higher static measurements as compared to the walk-over survey measurements. Location 5 and 8 were much smaller areas (20 and 10 square feet, respectively). They are located within the footprint of a waste disposal cell and had significantly higher static measurements as compared to the GWS measurements, which is consistent with potential alum mud disposal. However, based on the small area and the decrease in gamma radiation readings as the detector was moved farther from the source, the results could also indicate a small, buried radioactive object.

Cabrera concluded that the other seven locations with elevated gamma count readings appear to be unlikely to be associated with alum mud disposal because they are either outside the boundary of a waste disposal cell or have consistent static and GWS measurements, indicating that any potential radiological source would likely be located at or near the surface.

2.3 Cell 4 – Additional Historical Data Review

After their review of the initial SAP submittal, the Water Board provided verbal comments on the SAP during a January 15, 2025 conference call with the City of Albany and GSI. The Water Board reviewed the proposed scope of work in coordination with the DTSC, who noted that the 1974 aerial photograph of the Albany Bulb depicted several piles of light-colored stockpiles in Cell 4 that appear visually similar to piles of light-colored stockpiles observed in a 1971 aerial photograph from the Former Southern Pacific Blair Landfill (Blair Landfill). The Blair Landfill is a known Stauffer waste and Alum Mud disposal site located in Richmond, California. Although Cell 4 did not appear to have been infilled during the period from 1960 to 1971 (when Stauffer waste was reportedly disposed of at the Albany Landfill) and no measurements exceeded the IL during the gamma walkover survey, the Water Board requested that additional investigation be conducted in Cell 4 within the footprint of the light-colored stockpiles observed in the 1974 aerial photograph.

GSI reviewed test pit logs[2] from a previous investigation conducted at Albany Landfill in 1988 excavated within the footprint of the light-colored stockpiles to determine if any subsurface material was consistent with the description of Alum Mud originating from the Stauffer facility.[3] One test pit log (P-2) described a light gray clayey silt mixed with landfill debris, including plastic sheets, shredded rubber, and wood, from 12 to 15 feet below ground surface. "Light gray clayey silt" is similar to the description of alum mud material from the Stauffer facility. The location of P-2 is shown in Figure 4.

Based on our review of this additional information, GSI proposes drilling a soil boring in the vicinity of P-2 to a planned depth of 20 feet below ground surface in order to conduct a radiological survey of subsurface materials and visually identify Alum Mud, if present. The proposed work is described in more detail in Section 3.4.

3.0 PROPOSED SCOPE OF WORK

The purpose of the work proposed herein is to: (1) assess the potential presence of alum mud, (2) collect radiological data to assess the radionuclides present and dose/exposure rate of surface material to estimate potential exposure to radioactivity by members of the public utilizing the site for recreational purposes, and (3) collect radiological data to evaluate the radionuclide concentrations and dose/exposure rate of the subsurface material.

GSI proposes the following activities:

- Conduct surface radiological measurements at all ten locations that exceeded the IL during the GWS, including those where the presence of alum mud was determined to be unlikely, and one location in Cell 4 where material resembling the description of alum mud was observed during a previous investigation (Section 2.3). Data to be collected includes:
    - Field measurements to identify the radionuclides present near the ground surface; and
    - Dose/exposure rate field measurements to assess potential exposure to radioactivity near the ground surface.
- Excavate shallow test pits in the three areas identified during the GWS as potentially consistent with the disposal of alum mud waste to evaluate if alum mud is present. Data to be collected includes:
    - Lithologic observations for evidence of alum mud;
    - Field measurements to identify the potential presence of elevated radioactivity in subsurface material;
    - Dose/exposure rate field measurements to assess potential exposure to radioactivity near ground surface and/or in subsurface material;
    - Field measurements to identify the specific radionuclides present in subsurface material to assess potential presence of alum mud material (only if elevated radioactivity is observed);

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[2] Test pit logs were provided in Appendix A of the Landfill Characterization Report prepared by EMCON Associates for the City of Albany (EMCON, 1988).

[3] Alum mud originating from Stauffer Richmond Plant observed at the Blair Southern Pacific Landfill site located in Richmond, California, has been described as having a silty to clayey texture and white to very light grey color (Terraphase, 2024).

  - Laboratory analysis of soil samples for radionuclides of concern to confirm their presence and concentrations in subsurface material;
- Advance one soil boring in Cell 4 in the vicinity of previous subsurface soil observations resembling alum mud material. Data to be collected includes:
  - Lithologic observations for evidence of alum mud
  - Field measurements to identify the potential presence of elevated radioactivity in subsurface material;
  - Dose/exposure rate field measurements to assess potential exposure to radioactivity near ground surface and/or in subsurface material;
  - Field measurements to identify the specific radionuclides present in subsurface material to assess potential presence of alum mud material (only if elevated radioactivity is observed);
  - Possible laboratory analysis of soil samples for radionuclides to confirm their presence and concentrations in subsurface material (depending on lithologic observations and field measurements).

Given the results of the historical review and finding that it is unlikely that alum mud was disposed of at the subject Site, additional investigation activities beyond those described in this SAP do not appear warranted at this time.

3.1 Pre-Field Activities

Prior to any subsurface field activities, GSI will perform the following tasks:

- Obtain an encroachment permit from the City of Albany Community Development Department;
- Obtain a drilling permit from the Alameda County Public Works Agency;
- Notify Alameda County (Local Enforcement Agency);
- Mark proposed trenching locations and notify Underground Service Alert (USA) a minimum of two full working days head of proposed subsurface work;
- Prepare a site-specific health and safety plan;

Additionally, Cabrera will notify California Department of Public Health (CDPH) that California Agreement State Radioactive Material License (CARML) 7958-34 will be implemented to control any radioactive material encountered during the field investigation. The Radiation Safety Program (RSP) for CARML 7958-34 and a copy of the Radioactive Materials License (RML) are provided in **Appendix A**.

GSI will also conduct a site walk with the trenching contractor and driller to confirm proposed sampling locations are accessible for the necessary excavation equipment.

3.2 Surface Radiological Screening

A Global Positioning System (GPS) will be used to identify each of the ten locations exceeding the GWS investigation level and the approximate location of historical test pit P-2 in Cell 4. Four locations are significantly larger (between 2,000 and 5,000 square feet [ft^2]) than the other locations. The boundaries of these four locations (Location 1 through 4) will be marked and each area will be divided into approximately 1,000 ft^2 sections. These locations are shown on Figure 4.

Each location, and each section of a larger location, will be scanned using a SPIR-Ace radioisotope identification device (or equivalent instrument) with a lanthanum bromide ($LaBr_3$)

detector installed. The $LaBr_3$ detector has a higher resolution than the sodium iodide (NaI) detectors previously used for the GWS, improving identification of individual energy peaks in the gamma ray spectrum and improving the confidence in the identification of isotopes. The results of this scan will be used to identify the location within each scan area with the highest count rate. The SPIR-Ace will then be used to perform a biased static measurement at the location with the highest count rate in each area. If the count rate reported by the SPIR-Ace is consistent throughout a location, the static measurement will be performed in the approximate center of that location. The SPIRAce static measurements are not intended to reproduce the GWS results from the previous investigation and are only used to provide sufficient counts for nuclide identification purposes.

To perform the static measurements, a radiological control technician (RCT) will utilize and position the SPIR-Ace so that the detector points downwards towards the ground surface, the axis of the detector is perpendicular to the ground, the front face of the detector is parallel to the ground, and the front face of the detector is approximately 12 inches (30 cm) above the ground. The RCT will record a gamma spectrum for 5 minutes (300 seconds) to analyze the spectrum to identify specific radionuclides. The RCT may increase the count time in 5-minute increments until acceptable results are obtained. The SPIR-Ace is programmed to report gamma count rate as well as gamma dose rate. The collected gamma spectrum can be analyzed to provide an estimate of concentrations for each radioisotope identified.

At least one background measurement will be performed using the SPIR-Ace. The background location will be at least 50 feet away from any of the ten locations previously surveyed during the GWS survey.

Operation of the SPIR-Ace and details on efficiency calibrations, energy calibrations, and instructions for performing different types of measurements are provided in *OP-3416, Field Operations of the SPIR-Ace Portable Spectrometer* (Appendix B).

3.3 Test Pits and Soil Sampling

GSI will retain a California-licensed contractor to excavate test pits at Locations 2, 5, and 8 (Figure 4), which were identified as potentially consistent with alum mud disposal based on the GWS results. Test pits will be excavated at the location within each scan area with the highest gamma count rate (as feasible given access for equipment and surface cover considerations). Test pits will be excavated with a tracked excavator or backhoe equipped with a 2- or 3-foot-wide excavator bucket. Test pits will be excavated to a total depth of approximately 5 feet below ground surface (bgs). The anticipated lateral dimensions of each test pit will be approximately one to two bucket widths and approximately 5 to 10 feet in length, depending on soil stability or other subsurface conditions encountered (e.g., large concrete slabs). Excavated material will be observed by GSI and Cabrera field staff to record lithology and/or waste composition, identify visual evidence of potential alum mud[4], conduct a radiological screening of subsurface materials, and collect radiological soil samples.

Prior to commencing trenching activities, a subsurface geophysical survey will be conducted via ground penetrating radar and electromagnetic induction methods at the three proposed trench locations to assess the presence of subsurface obstructions such as reinforced concrete and other large demolition debris. During trenching activities, excavated soil and/or landfill material will be placed on polyethylene sheeting to allow for visual observation, radiological soil screening,

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[4] Alum mud originating from Stauffer Richmond Plant observed at the Blair Southern Pacific Landfill site located in Richmond, California, has been described as having a silty to clayey texture and white to very light grey color (Terraphase, 2024).

and discrete-depth soil sampling. Excavated material will be removed in 1-foot lifts and spread evenly on the polyethylene sheeting. Trenches will be logged for lithologic information in accordance with the American Society of Testing Materials Standard Practice for the Description and Identification of Soils, Visual Manual Procedure (ASTM D2488) by GSI field staff under the direction of a California Professional Geologist and/or Civil Engineer.

Radiological surveys will be performed to identify photon-emitting radiation sources located in the excavated soil. Each 1-foot lift of excavated soil will be screened for radioactivity by an RCT using a 3-inch by 3-inch (3x3) NaI detector, or equivalent. All identified discrete radiation sources will be removed, secured, and disposed of appropriately per the attached RSP. Radiological surveys may also be performed using the SPIR-Ace to identify specific radionuclides, if elevated radioactivity is observed.

It is anticipated that three soil samples will be collected from each test pit for radioisotope analysis. A grab sample will be collected from areas of comparatively high gamma count rate identified by the RCT or if visual evidence of alum mud materials is identified by the GSI professional geologist and/or professional civil engineer. If no indicators of alum mud are identified, a four-point composite sample will be collected from each depth interval of approximately 1, 3 and 5 feet bgs. The sample depth(s) may be adjusted per recommendation of the RCT, GSI professional geologist and/or professional civil engineer, based on professional judgment. Test pitting and associated sampling will be conducted under the RML 7958-34 and associated RSP (Appendix A) and will be overseen by a Cabrera Authorized User.

Soil sample collection for radionuclide analysis is described in detail in *ESFS-FO-PR-3110, Surface Soil Sampling* (Appendix C). Samples will consist of approximately 500 grams of excavated material placed inside a plastic resealable bag or other suitable container. The container will be labelled with the location and sample identification, the sample date and time, and the initials of the technician collecting the sample. The labelled sample container will then be placed inside a resealable plastic bag. No sample preservation is required for radiological analyses.

Following the completion of sample collection, the trenches will be backfilled with the excavated material in a “last out, first in” manner and compacted in approximately 1-foot lifts with a wheel roller (or other equivalent compaction method). The backhoe and supporting equipment that come in contact with excavated material will be decontaminated as described in Section 7.3.1 of ESFS-FO-PR-3801, *Field Equipment Decontamination* (Appendix D) between each trench location. Dry decontamination techniques will involve manual labor of cleaning any equipment that comes into contact with subsurface materials and performing radiological screening surveys to confirm residual radioactivity is not present. At the end of each day, the backhoe and supporting equipment will undergo final decontamination and be screened for total and removable residual radioactivity to ensure no potential radiological or chemical contaminants are being tracked off Site.

Air monitoring will be performed during excavation activities. Air samples will be collected at upwind and downwind locations for each excavation to monitor potential exposures to workers and members of the general public. Collected air filters will be analyzed on Site for total alpha and total beta radiological activity. If any air filter results exceed the most restrictive derived air concentration (DAC) for the radionuclides listed in Section 4.0 of this SAP, the filter will be sent to the laboratory for isotope-specific analysis. Air sampling procedures can be seen in *ESFS-FO-PR-3304, Air Sampling Pumps* (Appendix E).

3.4 Drilling

GSI will retain a C-57 licensed well driller to advance one soil boring within Cell 4 in the vicinity of test pit P-2 (Figure 4). The soil boring will be advanced with a sonic drilling rig to a planned depth of 20 feet bgs. The drilling rig will be equipped with a 6-inch outer-diameter core barrel. Soil retrieved from the core barrel will be placed into plastic liners to collect a continuous core from the ground surface to the total boring depth. The soil core will be observed by GSI and Cabrera field staff to record lithology and/or waste composition, identify visual evidence of potential Alum Mud, and conduct a radiological survey of subsurface materials. If visual observations or the radiological survey indicate the presence of alum mud material at 20 feet bgs, the boring may be advanced deeper to assess the vertical distribution of the alum mud material. The soil boring will be logged for lithologic information in accordance with the American Society of Testing Materials Standard Practice for the Description and Identification of Soils, Visual Manual Procedure (ASTM D2488) by GSI field staff under the direction of a California Professional Geologist and/or Civil Engineer.

During drilling, a radiological survey will be performed to identify photon-emitting radiation sources in the soil core retrieved from the boring. The soil core will be screened for radioactivity by an RCT in 1-foot intervals with the same instrumentation and techniques described in Section 3.3. If encountered, all identified discrete radiation sources will be removed, secured, and disposed of appropriately per the attached RSP. Radiological surveys may also be performed using the SPIR-Ace to identify specific radionuclides, if elevated radioactivity is observed.

If soil with a comparatively high gamma count rate is identified by the RCT or if visual evidence of potential alum mud materials is identified by the GSI professional geologist, one or more grab soil samples will be collected from the location(s) in the soil core with the highest gamma count rate measurement and/or visual evidence of potential alum mud material. All drilling and soil sample activities will be conducted under the RML 7958-34 and associated RSP (Appendix A) and will be overseen by a Cabrera Authorized User.

Soil sample collection for radionuclide analysis is described in detail in *ESFS-FO-PR-3110, Surface Soil Sampling* (Appendix C). Any soil samples collected from the boring will be collected, labelled, and stored in a manner consistent with the soil sampling procedures described in Section 3.3.

Following the completion of drilling activities, the boring will be backfilled with neat cement grout from the bottom of the borehole to the ground surface emplaced via a tremie pipe and completed to match the existing ground surface. The drilling rig and supporting equipment that comes into contact with subsurface material will be decontaminated at the end of each day as described in Section 7.3.1 of *Field Equipment Decontamination* (Appendix D). The drilling rig and downhole equipment decontamination and screening techniques will be consistent with those described for the equipment in Section 3.3.

Air monitoring will be performed during all drilling activities consistent with the methodology described in Section 3.3 Air sampling procedures can be seen in *ESFS-FO-PR-3304, Air Sampling Pumps* (Appendix E).

3.5 Equipment Staging and Access Control

All large equipment, vehicles, and trailers will be stored on Site or at a nearby location specified by the City, as needed. Due to the public and open nature of the site, temporary fencing will be used to secure the staging area and work areas, and after-hours security will be retained for the duration of the trenching activities.

3.6 Investigation-Derived Waste

GSI anticipates generating IDW consisting of one drum of soil cuttings and one drum of decontamination water from drilling activities. No IDW is anticipated to be generated from test pitting activities. IDW will be stored on-Site in labeled, DOT-approved drums pending characterization for disposal. Drums will be appropriately labeled and stored in a secure on-Site location specified by the City, prior to transport and disposal activities. Any required radiological postings will be managed by Cabrera and in accordance with the RSP (Appendix A).

An appropriate waste transportation and disposal specialist will be utilized for transportation and off-site disposal of IDW. Prior to any IDW leaving the Site, IDW will be surveyed and cleared for unrestricted release as described in the RSP (Appendix A) and *OP-3802, Unconditional Release of Materials and Equipment from Radiological Controls* (Appendix F). All unrestricted release surveys will be conducted under the oversight of the Cabrera Authorized User.

Other solid IDW may consist of disposable personal protective equipment (PPE) and polyethylene sheeting, and will be surveyed for unrestricted release as regular municipal waste. If a small quantity of radioactive material (such as a small, buried object) is encountered, the material or object will be properly contained and disposed of off Site at an appropriate facility per the RSP.

4.0 SAMPLE ANALYSIS

Composite soil samples collected for radioisotope analysis will be analyzed by a California Environmental Laboratory Accreditation Program (California ELAP), Department of Energy (DOE), and National Environmental Laboratory Accreditation Program (NELAP) certified laboratory. Soil samples will be analyzed for naturally occurring photon-emitting radioisotopes following a 21-day ingrowth period for radon decay products via gamma spectroscopy (DOE Method GA-01-R). The full list of radioisotopes that will be reported include:

- Thorium-232 (and decay products radium-228, actinium-228, lead-212, bismuth-212, and thallium-208);
- Uranium-238 (and decay products thorium-234, radium-226, lead-214, bismuth-214, and lead-210);
- Uranium-235;
- Potassium-40;
- Cesium-137;
- Cobalt-60; and
- Europium-152, 154 and 155.

The laboratory will provide standard quality control analyses including, at a minimum, one laboratory method blank, laboratory control sample and one laboratory control sample duplicate for each batch of samples. All of the soil samples are expected to be included in one single batch of samples.

5.0 DATA EVALUATION

The gamma dose rate recorded at the surface for each location will be compared with the background gamma dose rate measurement results collected on Site. If any surface gamma dose rate exceeds the background gamma dose rate by more than 20%, a more detailed dose analysis will be performed for that location. The detailed dose evaluation will include estimating individual radionuclide concentrations based on the SPIR-Ace gamma spectra and estimating total area and volume of radioactive soil based on the GWS results. The radionuclide concentrations and soil volumes will be further evaluated using the RESRAD-ONSITE version 7.2 exposure pathway model to calculate dose to a member of the public based on a recreational site use scenario. RESRAD-ONSITE is a computer code designed at Argonne National Laboratory for estimating radiation doses and cancer risks to an individual located on top of radioactively contaminated soils.

The laboratory soil sample results for radionuclides will be compared with expected concentrations and relative ratios of radionuclides associated with alum mud to determine if its presence is likely or unlikely. Historical soil sample radiological results for alum mud collected from the Former Southern Pacific Blair Landfill (Terraphase, 2024) will be used to define the radionuclides of concern and radiological characteristics of alum mud for comparison with laboratory soil sample results. The results will be evaluated to identify similarities to alum mud and differences from alum mud. Based on the analysis of similarities and differences, a recommendation concerning the potential presence of alum mud at the site will be provided.

6.0 SITE INVESTIGATION COMPLETION REPORT

Following implementation of the SAP, GSI will prepare a Site Investigation Completion Report (Completion Report) for submittal to the Water Board. The components of the Completion Report will include:

- a description of soil sampling activities, sampling methodologies, radiological screening methodologies and laboratory analytical methods;
- an evaluation of surface and subsurface radiological screening measurements;
- an evaluation of the soil laboratory analytical data;
- tables summarizing laboratory analytical results;
- Site maps showing surface scan results, sample locations and depths;
- test pit and boring logs;
- photograph documentation of the boring soil obtained with its corresponding depth; and
- a data validation summary.

7.0 PROJECT SCHEDULE

GSI proposes the following project schedule to implement the scope of work described in this SAP:

- Implementation of the field components of this SAP within 45 days following Water Board review and approval, dependent on subcontractor availability and weather conditions.
- Receipt of laboratory analytical results within approximately 30 days following the completion of field work and submittal of soil samples to the analytical laboratory.
- Preparation and submittal of the Completion Report to the Water Board within 90 days following receipt of the final laboratory analytical report.

8.0 REFERENCES

Cabrera Services Inc. 2024. Gamma Walkover Survey Report, Final, Former Albany Landfill (Albany Bulb), End of Buchanan Street, Albany, California 94706. October 24.

California Regional Water Quality Control Board, San Francisco Bay Region (Water Board). 1999. Order 99-068, Updated Waste Discharge Requirements and Recission of Order No. 84-089 for, City of Albany, Albany Landfill Albany, Alameda County, California. September 15.

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GSI Environmental Inc. (GSI). 2024a. Site Investigation Work Plan, Former Albany Landfill (Albany Bulb), End of Buchanan Street, Albany, California 94706. April 1.

GSI Environmental Inc. (GSI). 2024b. Historical Review and Gamma Radiation Survey Report, Former Albany Landfill (Albany Bulb), End of Buchanan Street, Albany, California 94706. November 6.

Ninyo & Moore. 2020. Limited Historical Study, Albany Landfill, Western Area of Buchanan Street, Albany, California, SWIS No. 01-AA-011. 7 April.

Terraphase Engineering (Terraphase), 2024. Work Plan for Determining Background Concentrations of Radionuclides. January.

SOIL SAMPLING AND ANALYSIS PLAN
Former Albany Landfill (Albany Bulb)
End of Buchanan Street
Albany, California

FIGURES

GSI ENVIRONMENTAL	GSI Job No. 10008	Drawn by: AJC		SITE LOCATION MAP
	Issued: 29-Mar-2024	Chk'd by: KCA		
	Revised:	Aprv'd by: JPD		
	Map ID: Bulb_SiteLoc	FIGURE 1		Former Albany Landfill Albany, California

N

LEGEND

- Landfill Area
- Subject Site
- Waste Containment Cell

Note

Imagery provided by Esri ArcGIS Online, September 2021.

Feet
0 200 400

Projected Coordinate System
Datum: NAD 83
State Plane California Zone III
Units: Feet

GSI ENVIRONMENTAL

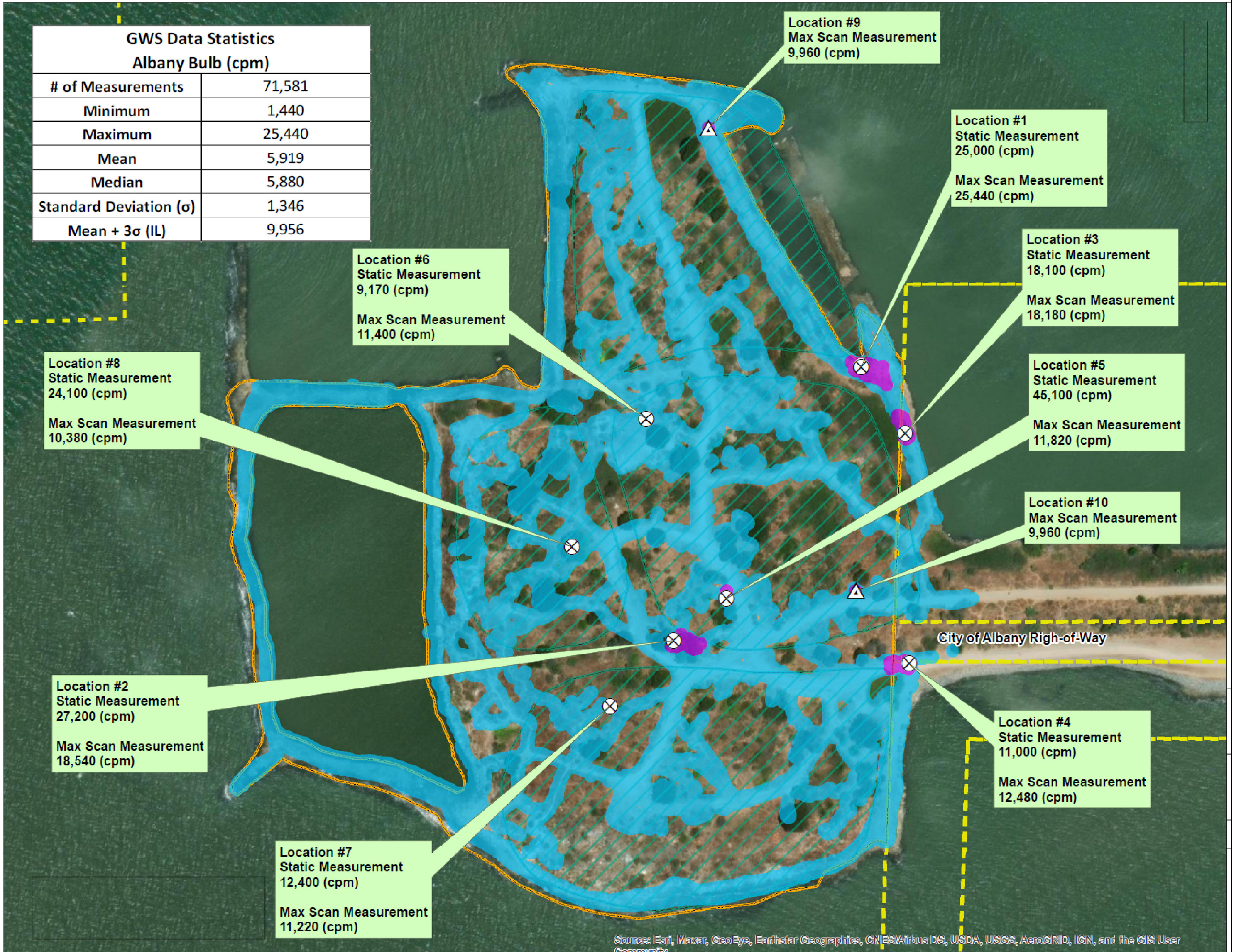
**FORMER ALBANY LANDFILL
LAYOUT AND NOMENCLATURE**

Former Albany Landfill
Albany, California

GSI Job No.	10008	Drawn By:	AJC
Issued:	8-Oct-2024	Chk'd By:	KCA
Map ID:	**Bulb_Areas**	Appv'd By:	JPD

FIGURE 2

GWS Data Statistics Albany Bulb (cpm)	
# of Measurements	71,581
Minimum	1,440
Maximum	25,440
Mean	5,919
Median	5,880
Standard Deviation (σ)	1,346
Mean + 3σ (IL)	9,956



N

LEGEND

IL Exceedances

- Static Measurement
- Max Scan Measurement
- Survey Boundary
- Containment Cells
- Property Boundary

GWS Results

(Z-Score)

- -3.3 - 2.9
- 3.0 - 14.5

Notes: Survey performed with Ludlum 44-10 (2x2 NaI)/ 2221

GWS = Gamma Walkover Survey
IL = Investigation Level
cpm = counts per minute

Note

1) Imagery provided by Esri ArcGIS Online, September 2021.
2) Source: Cabrera Services Inc., 2024, Gamma Walkover Survey Report, Final, Former Albany Landfill (Albany Bulb), End of Buchanan Street, Albany, California 94706.

Feet
0 225 450

Projected Coordinate System
Datum: NAD 83
State Plane California Zone III
Units: Feet

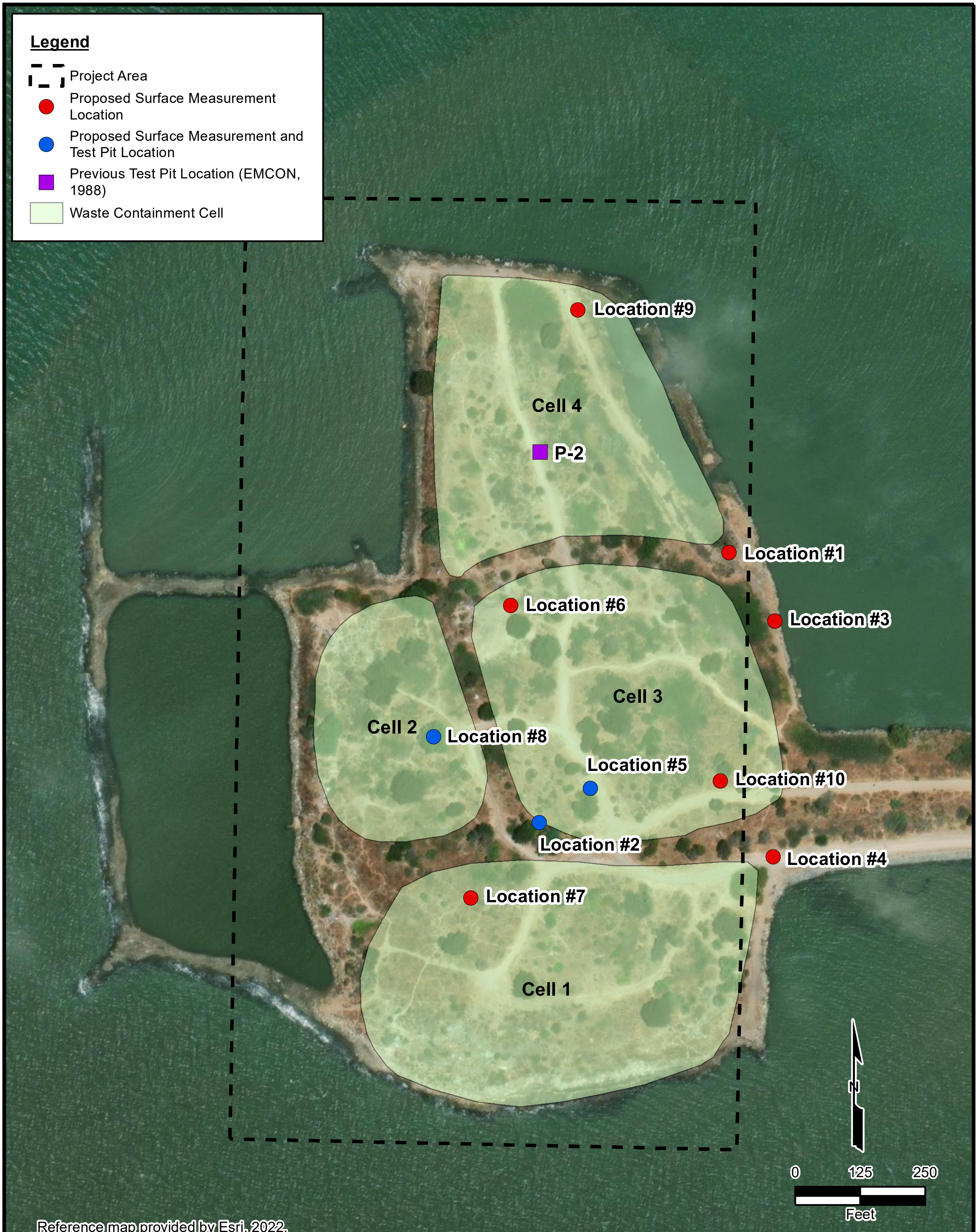
GSI ENVIRONMENTAL

GAMMA WALKOVER SURVEY INVESTIGATION LEVEL EXCEEDANCE LOCATIONS

Former Albany Landfill
Albany, California

GSI Job No. 10008	Drawn By: AJC
Issued: 8-Oct-2024	Chk'd By: KCA
Map ID: **Bulb_F4**	Appv'd By: JPD

FIGURE 3



GSI ENVIRONMENTAL	GSI Job No. 10008	Drawn by: AJC	PROPOSED INVESTIGTION AREAS
	Issued: 13-Feb-2025	Chk'd by: KCA	
	Revised:	Aprv'd by: JPD	
	Map ID: Bulb_PropInvest	FIGURE 4	Former Albany Landfill Albany, California

SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)

End of Buchanan Street
Albany, California

APPENDICES

SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)
End of Buchanan Street
Albany, California

APPENDIX A

Cabrera Services Radioactive Materials License 7958-34 and Radiation Safety Program

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Radiation Safety Program
State of California
June 2014

1.0 PURPOSE

Cabrera Services, Inc. (Cabrera) is engaged in radiological activities that require the documentation and implementation of a Radiation Safety Program (RSP) compliant with radiation protection regulations. The elements of the Cabrera Radiation Protection Program are set forth by this RSP and the appropriate guidelines to which Cabrera implements the scope of activities requested. This RSP defines the Cabrera approach to health physics and includes the applicable provisions of California Code of Regulations Title 17, Division 1, Chapter 5, Subchapter 4, and Title 10 Code of Federal Regulations, (10 CFR) Parts 19 and 20. The RSP is presented in a program level document from which specific project health physics procedures are to be developed and implemented.

The purpose of this document is to define program requirements and radiation protection standards in support of Cabrera operations. In addition, this document serves to fulfill the requirement of a documented Program for temporary jobsites or projects where Cabrera is required to implement such a Program. An example could include work under a Cabrera State of California, Radioactive Material License at a customer's facility where Cabrera would be required to implement this Program rather than participate in the existing site Program. Through monitoring and ALARA practices, Cabrera intends to use this Program to ensure the health and safety of employees and workers, their protection from ionizing radiation, and the prevention of release of radioactive contaminants that could adversely affect the environment.

Portions of the Program will be implemented during Cabrera's performance of site surveys, remediation activities, decontamination activities, waste characterization, waste packaging and shipment. Use, possession, and "possession incident to performing commercial services" on unsealed radioactive materials will occur incident to performing these activities. This Radiation Safety Program manual will be supported by Cabrera operating procedures, work instructions, and technical bases; each subject to the review and approval of the Radiation Safety Officer (RSO).

2.0 ALARA

It is the policy of Cabrera to maintain exposures to workers, members of the public and environment As Low As is Reasonably Achievable (ALARA), taking into account the state of technology and the economics of improvements in relation to benefits. Cabrera has established a comprehensive ALARA program designed which will comply with applicable regulations, including 10 CFR 20.1101 and 10 CFR 20.2102 per 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 1, Section 30253. Cabrera's ALARA procedure sets the minimum standards for performance of formal ALARA reviews and briefings, including the performance of pre- and post-job ALARA Reviews and Briefings, Formal ALARA Job Review and Briefing Requirements, and Review and Briefing Recordkeeping. The overall goal of the ALARA program is to maintain the annual internal and external radiation dose to each individual and the annual collective dose to personnel ALARA.

Responsibilities – The RSO of the company is responsible for ensuring that a meaningful ALARA program is developed and implemented. To meet this responsibility, the RSO assigns responsibility for assuring that ALARA is given proper consideration in project planning and in operations to the Director of Applied Sciences.

The Director of Applied Sciences is responsible for ensuring that ALARA considerations are included in the design of project plans.

Project Managers are responsible to ensure that radiological operations and activities are pre-planned and conducted to allow for the effective implementation of dose reduction, contamination reduction and control measures to achieve specific ALARA goals and objective for the facility/site.

Employees of Cabrera involved in radiological work are responsible for maintaining their exposure ALARA, keeping track of their radiation exposure status and obeying posted, written and oral radiological control instructions and procedures.

Cabrera Health Physicists are responsible for assisting Project Managers, the RSO, and the Director of Applied Sciences in the development and implementation of the Cabrera Radiation Safety Program, which shall include the operational ALARA program. The Health Physicists are also responsible for assisting with ALARA input to system and facility/site designs, which involve potential exposure of personnel to radiation or radioactive materials.

The key to the success of an ALARA program depends upon the understanding and cooperation of each individual performing radiation- related activities. Each individual is responsible for maintaining his/her own exposure as low as is reasonably achievable and to assure that his/her actions do not adversely affect the exposures of other individuals.

Supervisors are responsible for planning and coordinating work to ensure that their personnel comply with all established procedures, instructions, and policies for health physics to minimize radiation exposures.

The ALARA program shall be incorporated into the Radiation Safety Program so that ALARA becomes an integral part of all aspects of the day- to-day operations involving radiation exposure and radioactive materials. The overall goal of the ALARA program is to maintain the annual internal and external radiation dose to each individual and the annual collective dose to personnel ALARA.

3.0 RESPIRATORY PROTECTION POLICY

It is Cabrera’s policy to maintain personnel exposure to known or suspected airborne radioactive and/or hazardous material ALARA with regulatory guidance.

The respiratory protection program is an integral part of the Health and Safety program. The primary objective of the respiratory protection program is to limit, to the extent practicable, the inhalation of airborne radioactive materials and/or hazardous material. Under normal circumstances, this objective shall be achieved by the application of practicable engineering controls such as process, containment, and ventilation equipment. When such controls cannot be applied or are not feasible, respirators may be used.

The management of Cabrera does not consider protection of workers from airborne radioactive materials through the use of respirators to be routine. For this reason their use, except for emergencies, shall only be authorized pursuant to an approved radiation work permit. The use of respirators as a backup system for practicable engineering controls is an acceptable practice for routine operations provided an approved radiation work permit covers their use.

Any individual who may be required to use respiratory protection must have medical clearance for such use and have received required training in the proper use, maintenance, and care of respirators.

Non-routine operations are those that occur infrequently at irregular intervals and for this reason the application of engineering controls may be impracticable. The protection of workers from airborne radioactive material and/or hazardous materials by the use of respirators during non-routine operations is acceptable to the management of Cabrera provided that such use is authorized pursuant to an approved radiation work permit.

Emergency conditions are unplanned events characterized by the need for rapid and aggressive actions to prevent or mitigate the effects of rapidly deteriorating conditions. The use of respirators during such is often a reasonable substitute for engineering controls that must be assumed to be nonfunctional or ineffective. The use of respirators in emergency conditions is acceptable.

The use of a respirator subjects the wearer to added stress and some discomfort. For this reason, no specific limits have been placed on time duration that a respirator may be worn. It is the policy of Cabrera that a person wearing a respirator may leave the area at any time to seek relief. This may be for reasons of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that might require such relief.

4.0 RESPONSIBILITY FOR RADIATION SAFETY PROGRAM

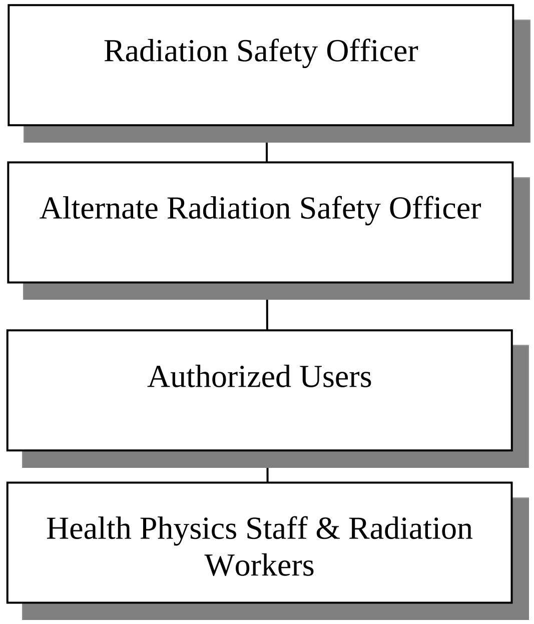


Figure 1. Cabrera Services, Inc. Radiation Safety Program Organizational Chart

Cabrera has a hierarchy of individuals responsible for the implementation and management of the radiation safety program. The California Department of Public Health – Radiologic Health Branch (CDPH) retains overall authority to approve designation of named individuals to a license position (i.e., RSO, ARSO or AU) and; to approve proposed changes to this RSP Manual. The functional responsibilities for license activities are as follows:

- The RSO is approved by the CDPH and is responsible for overall radiation protection decision-making and license compliance. The RSO is fully empowered to make all decisions necessary to ensure radiological work is conducted safely and in according with license requirements.
- The ARSO is designated by the RSO and approved by the CDPH and; is the primary back-up when the RSO is unavailable for direction/consultation on license matters. The RSO may designate specific license support duties to the ARSO. The ARSO is empowered by the RSO with Stop-Work authority to use when a break-down in RSP effectiveness is suspected or identified.
- AUs are designated by the RSO and approved by the CDPH and; are the primary overseers of radioactive material uses in Cabrera offices or at temporary field locations. AUs implement RSP elements, as directed by the RSO/ARSO. AUs are empowered by the RSO with Stop-Work authority to use when a break-down in RSP effectiveness is suspected or identified.

- Health Physics Staff and Radiation Workers are assigned by the RSO, ARSO, or AUs to perform specific duties necessary to support effective RSP implementation. These activities are performed under the indirect/direct supervision of the RSO, ARSO, or an AU.

4.1 Qualifications

4.1.1 Radiation Safety Officer

The RSO must have a B.S. or higher degree in Health Physics or a related field and at least five (5) years of practical health physics experience, of which at least two (2) years must be in a similar position and/or equivalent training, unless certified by the American Board of Health Physics. The RSO shall be approved by the CDPH prior to officially being placed in that position.

In the absence of the RSO, the ARSO, an Authorized User (AU) or Certified Health Physicist (CHP) serves in that capacity. These personnel may assume the duties of the RSO but the responsibility for decisions of the RSO remain with license designated RSO until a named replacement is approved by the CDPH

4.1.2 Authorized Users

AUs implement/oversee the implementation of the RSP at Cabrera offices and project sites within CA. These individuals may serve as the RSO in the absence of Mr. Winters and will be delegated responsibilities, as needed, to support the RSO. The RSO maintains the right to vet each authorized user’s experience and practical knowledge to ensure they are capable of serving as RSO. Authorized users will demonstrate having received the training, or obtained work experience comparable to that described in Appendix H in NUREG-1556, Vol. 18, 'Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Service Provider Licenses,' dated November 2000 (herein referred to NUREG-1556).

4.2 Responsibility

The RSO, ARSO, AUs or, any Ancillary Personnel have authority to stop any operation could reasonably pose a hazard to the health and safety of the employees or general public. Only the RSO or designee has the authority to re-start the work.

4.2.1 Radiation Safety Officer

The RSO is qualified in the field of health physics and heads the RSP. The RSO performs or supervises others to ensure that the duties specified are performed in a timely manner. The RSO shall conduct a minimum of one visit to the main Cabrera office in Sacramento or to an active license-use site within the State of California once per calendar quarter. Individual personnel may be assigned and made available to the RSO for technical support and auditing purposes. The RSO is assisted by AUs and the Health Physics staff to administer the RSP as set forth in this program. The RSO, or designee, performs audits of all areas of use and individuals who are authorized to use radioactive material to ensure work is done in accordance with the license, regulations, and user permit conditions. Specific duties and responsibilities of the RSO include:

- Responsible for oversight of the day-to-day health physics program.
- Monitoring and surveys of all areas in which radioactive material is used.
- Packaging, labeling, surveys, etc., of all radioactive shipments.

- Determine, review, and approve appropriate radiation detection instrumentation to utilize in the field based upon knowledge of the processes and radionuclides and/or field characterization of the radionuclides involved and the radiations and the abundances emitted by these radionuclides
- Personnel monitoring program including determining the need for and evaluating bioassays, monitoring personnel exposure records, and developing corrective actions for those exposures approaching maximum permissible limits.
- Training program
- Waste disposal program
- Inventory and leak tests of sealed sources
- Decontamination
- Investigating any incidents and responding to any emergencies
- Maintaining all required records regarding program implementation and compliance status.
- Serve as the primary Cabrera liaison to the CDPH on license inspection matters.

4.2.2 Authorized Users

Authorized Users and the overall Cabrera Health Physics Group are responsible for implementing sound radiological principles on projects as directed by the RSO, or designee. Projects will be managed following license, federal, and state requirements. AUs and the supporting Health Physics Group staff have the following duties and responsibilities:

- Implement and maintain an effective RSP that complies with the most recent provisions and conditions of this program, operating procedures, the radioactive materials license and applicable federal and state regulations.
- Provide necessary information on all aspects of health physics to personnel at all levels of responsibility pursuant to 17 CCR, 10 CFR 19.12 and 10 CFR 20.
- Maintain surveillance of overall activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used or stored.
- Maintain a current ionizing radiation source inventory under Cabrera control and a record of their location to ensure that sources are secure against loss or unauthorized use.
- Performance or arrangement of leak test evaluations on all sealed sources and calibration of radiation detection survey instruments.
- Develop, coordinate, and participate in orientation and training programs for potential occupationally exposed individuals at periodic intervals (refresher training), and other personnel as required by changes in procedures, equipment regulations etc.
- Maintain current, all applicable required license amendments, and apply for amendments and renewals in a timely manner.
- Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor records.

- For trends and unexpected exposures, notify individuals and their supervisors of radiation exposures approaching maximum permissible amounts, and recommend appropriate remedial action as necessary.
- Formulate, revise, and maintain procedures for and in support of, the RSP.
- Stop any job or activity that in their opinion could pose a hazard to the health and safety of employees or the general public.

4.2.3 Ancillary Personnel

Individuals assigned to work activities involving radioactive material have the following responsibilities, in accordance with 17 CCR and this Program.

- Obey posted, verbal and written health physics procedures.
- Wear dosimetry devices as instructed by procedure and when required by other specific instruction of this program, project health physics, etc.
- Promptly report to their supervisor or RSO any incident, personnel injury, suspected overexposure, contamination, internal deposition, and any suspicious or questionable occurrence involving radioactive material.
- Avoid any unnecessary exposure by use of the concept of time, distance and shielding when working in the presence of radiation sources to maintain their exposure As Low As is Reasonably Achievable (ALARA).

5.0 TRAINING

5.1 General

Before beginning work with or in the vicinity of licensed material, all general employees, and radiation workers assigned to the project who are likely to receive an occupational dose in excess of 100 mrem in a year shall receive radiation safety training. Successful completion of the Cabrera Radiation Worker Training in support of the NRC license is adequate to meet the training requirements for support of the California Radioactive Material License (CARML). The training will be commensurate with their assigned duties and specific to the licensee's RSP. The purpose of the training is to ensure personnel that receive occupational exposure are adequately trained in radiation safety to perform assigned work and to maintain exposure ALARA. Each individual shall also receive periodic refresher training. Retraining shall be performed whenever there is a change in duties or the work environment and at a frequency sufficient to ensure that all staff is adequately trained.

5.2 Radworker Training

The Cabrera training program provides a commitment to initial training, retraining, and continuing education. The type and amount of instruction will be based on regulatory requirements (10 CFR 19.12 per 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 1, Section 30253), past documented experience, and will be commensurate with potential radiological health protection problems in the areas in which the employees are expected to work. Performance based training modules and continuing education is considered important aspects of this training program. The training may take any form which may include utilizing video tapes or interactive on line or off line computer programs.

In accordance with 10 CFR 19.12, all radiation workers will receive general and site-specific instruction prior to beginning work with licensed materials. The elements of this training will include but are not limited to:

- Applicable portions of regulations and license conditions.
- Area locations where radioactive material is used and/or stored.
- Potential hazards associated with radioactive material.
- Appropriate health physics procedures.
- Individual‘s obligation to report unsafe conditions to the RSO or applicable authorities.
- Appropriate response to emergencies and unsafe conditions.
- Locations of pertinent procedures, regulations, licenses and other material required by regulations.
- Radiation Work Permit

In addition to basic classroom instruction, performance-based (on-the-job) training specific to the individual's duties may be conducted. This helps to ensure safe handling of radioactive materials in accordance with ALARA principles.

Since different radiation hazards will be encountered on different types of projects, site specific programs and/or job specific programs will be developed to instruct each different group with appropriate information in accordance with 17 CCR. This information may be incorporated into other training programs or may be presented separately. Specialized training, such as, emergency procedures OSHA, etc. are examples of training programs that would be presented as a separate training subject.

Prior to beginning radiological work, each worker shall successfully complete radiation safety training. The student attaining a minimum score of 80% on a written exam demonstrates successful completion of this training that includes as a minimum, the following topics. Training is good for a period of one year.

- Types and sources of ionizing radiation contributing to personnel exposure,
- Biological effects and risks associated with exposure to ionizing radiation,
- Radiation exposure limits and control levels,
- Specifics for using time, distance and shielding to maintain individual exposures ALARA,
- Specific personnel dosimetry requirements,
- Operating, maintenance, handling and accountability procedures for radioactive sources,
- Facility or site survey requirements and procedures,
- Responsibilities of individuals,
- Emergency procedures and,
- Demonstrate specific hands-on survey instrument requirements for frisking.

5.2.1 Testing

Initial training will be a minimum of four hours and conducted by the RSO or a designated representative. Completion of the training course includes successfully completing a minimum 20 question exam with a passing grade of 80%. An alternative to attending the four hour class is passing a 50-question challenge exam with a minimum grade of 80%. This alternative is designed for an individual with prior experience, similar qualification at another facility, or formal training in radiological controls or health physics.

5.2.2 Requalification

Once an individual has successfully completed the course, they are classified as a Radiological Worker for a period of one (1) year. This re- qualification period will be tracked through the personnel and training matrix documentation that will be maintained by either or both the radiation safety office and the Corporate Safety office. The worker will be retrained or may take a challenge exam not later than 14 days from the expiration of their certificate.

5.2.3 Refresher

Radiation Worker refresher training will be provided sooner than annually, if deemed necessary by the Health Physics staff.

5.2.4 Instructor

The instructor should have a college level degree and two (2) years of experience in training, or five (5) years of experience in radiological controls. The instructor must be familiar with Cabrera RSP and procedures, applicable Federal and State regulations and Cabrera's license requirements.

5.2.5 Annual Program Assessment

To ensure the training program is successful in ensuring workers understand the concerns of working with or around radioactive material, the RSO or independent consultant will conduct an annual assessment of the program. This may be part of the 10CFR20.1101(c) Annual Review

5.2.6 Records

Records of training will be maintained for a minimum of three (3) years. Training records will include, but are not limited to:

- A list of topics presented.
- Names of instructors and students, including a manner of positive identification.
- Date(s) of training.
- A written assessment or test for each student that documents satisfactory completion of training.

5.3 Training and Experience for Authorized Users

Authorized users for the CARML will have training and experience commensurate with the following as described in Appendix H in NUREG-1556, Vol. 18:

- Classroom Training: Classroom training may be in the form of lecture, videotape, or self-study that emphasize practical subject matter important to the safe handling of licensed materials. Duration and technical level of training should be commensurate with the expected hazards encountered during routine and emergency conditions.

- Frequency of Training: Before assuming duties with, or in the vicinity of, radioactive materials;
  Whenever there is a significant change in duties, regulations, or the terms and conditions of the license;
  Annually for refresher training.
- Radiation Safety Topics:
- Fundamentals of Radiation Safety:

  Characteristics of radiation;
  Units of radiation dose and quantity of radioactivity;
  Hazards of exposure to radiation;
  Levels of radiation from licensed material;
  Methods of controlling radiation dose (time, distance, and shielding);
  ALARA concept.

- Radiation Detection Instruments:

  Operation;
  Calibration;
  Limitations of radiation survey instruments;
  Radiation survey techniques for measuring radiation field;
  Radiation survey techniques for measuring removable/fixed contamination;
  Handling and proper use of personnel monitoring equipment.

- Radiation Protection Equipment and Use:

  Proper use of protective equipment;
  Decontamination of contaminated protection equipment.

- NRC regulations (10 CFR 19 and 20).
  NRC regulations (10 CFR 31, 32, 34, 35, 36, 39, 40, 70, and 71) as applicable.
  Licensee’s operating and emergency procedures.
  Case histories relevant to operations.

- Course Examination (Didactic):

  - Successful completion of closed-book written/oral examination depending on the complexity and hazards of authorized activities;
    Review of incorrect answers with student.

- On-the Job Training and Examination (Practical):

  - On-the-job training done under the supervision of a qualified individual (AU, RSO, or manufacturer’s representative authorized by NRC or an Agreement State) that includes supervised hands-on experience performing the task authorized on the license that are commensurate with the expected hazards during routine and emergency conditions;
    Practical examination consisting of an assessment by the RSO to ensure that each proposed AU is qualified to work independently and that each individual is

knowledgeable of the radiation safety aspects of licensed activities. This may be demonstrated by observing the proposed AU perform licensed activities.

Discussion and/or drill on emergency procedures.
Retraining on areas found to be deficient in both the practical and didactic areas.

6.0 MATERIAL RECEIPT AND ACCOUNTABILITY

The RSO shall approve or place all orders for radioactive material, shall ensure that the requested material, quantities, manufacturer, and model are authorized by the license and that the possession limits are not exceeded. Ordering licensed material and package receipt and opening will follow the model procedures in Appendix K to NUREG-1556, Vol. 18. Packages containing radioactive materials will be visually inspected for any visible signs of damage, opened with care, surveyed for radioactive contamination in accordance with 10 CFR 20.1906 and 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Articles 3 and 3.1, Sections 30275, 30293, and 30295.

7.0 OCCUPATIONAL DOSE

The potential occupational doses to workers will be estimated during project planning phases of every project. The potential for exposure is low on most Cabrera projects. Dosimetry will be utilized on projects where the dose is expected to reach 10% of occupational exposure limits per 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 1, Section 30253.

7.1 Personnel Monitoring

Personnel likely to receive in one year from radiation sources external to the body, a dose in excess of 10% of the applicable limits will be monitored by personnel dosimetry. The personnel, NVLAP-accredited dosimetry devices will indicate the amount of ionizing radiation to which the wearer was exposed. The personnel dosimeter will normally be worn on the upper front torso. NVLAP-accredited dosimetry (film badge, TLD, OSL, etc.) will be processed by a NVLAP-accredited entity. NVLAP-accredited dosimetry will be exchanged at the frequency specified in Section 8.10.4 of NUREG-1556, Vol. 18. Personnel are responsible to wear dosimetry as directed by the RSO. If a personnel dosimeter is lost, misplaced, or indicates an off-scale reading, the employee is required to notify their supervisor, health physics and/or the RSO immediately.

7.2 Embryo/Fetus

Cabrera will then institute radiation control measures that will limit radiation exposure to the unborn fetus to less than 500 mrem for the term of the pregnancy and below 50 mrem per month in any month after declaration.

7.3 Minors

No individual under the age of 18 years will be assigned radiation worker duties.

8.0 SAFE USE OF RADIONUCLIDES

Radioactive sources used for portable radiation detectors must be handled carefully to ensure that sources are not be lost or misplaced, that personnel remain free of contamination, and, contamination does not be spread beyond any designated contaminated areas. Control of radioactive material is maintained through completion of regular source inventories (at intervals not exceeding six months), accountability and direct control of sources at all times when unlocked and in use, completion of leak testing of radioactive sources in compliance with requirements of 10 CFR 20.2103(a)(4), 10 CFR 30.53, care, surveyed for radioactive contamination in accordance with 10 CFR 20.1906 and 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30275, and NUREG-1556, Vol. 18.

As described below, Cabrera shall comply with posting and labeling in accordance with CCR Title 17, Division 1, Chapter 5, Subchapter 4, Group 3, Article 1, Section 30253.

8.1 Emergency Plans

Emergency plans are not required because Cabrera does possess quantities equal to the activities specified in Schedule C of 10 CFR 30.72.

8.2 Licensed Material

Cabrera's work with licensed materials will be performed within the requirements specified in a Radioactive Materials License issued by the CDPH.

8.3 Exempt Materials

Cabrera may and does possess exempt quantities of radioactive materials in the form of check sources that are used to check instrument operation. Radioactive sources (that are exempt from licensing) are kept in a shielded source storage locker located at the Sacramento, California office. When these sources are used for field assignments, they are transferred by the RSO or authorized representative out of the storage locker to the individual user who is then responsible for their positive control. Upon completion of the field assignment, the sources are then returned to the storage locker and logged in by the RSO or duly authorized representative. These sources may be inventoried in their field locations, as required.

8.4 Calibration Sources and Reference Samples/Standards

Sources shall be handled in accordance with Section 8.0.

8.4.1 Gamma Spectroscopy Instruments

A combination of reference source standards/samples are used to perform energy & efficiency calibrations for high/low resolution gamma spectroscopy systems. These systems are most commonly used to perform in-situ and ex-situ photon field & lab measurements to determine gross radioactivity levels and; where practicable, identify the isotope(s)-of-interest and establish activity concentrations. Systems may be cooled by natural ventilation, electronically, or through use of liquid nitrogen depending on the manufacturer and detector configuration. Source standard/sample geometries/activity levels are appropriate for measurements of environmental radioactivity (e.g., point sources, Marinelli-type beakers, “tuna” cans, etc. Calibrations and ongoing operational verifications shall be conducted according to vendor manuals or established Cabrera instrument quality system document(s).

8.4.2 Other Radiological Instruments

Annual calibrations are performed by third-party vendors with calibration programs conforming to ANSI N323.

Cabrera may perform additional field calibrations of surface contamination monitors to support specific client applications. As a specific example: Cabrera uses a series of alpha/beta planar surface emission sources across the common beta energy spectrum to determine efficiency values in accordance with ISO-7503, as follows:

$$\varepsilon_i = \frac{N_S - N_B}{2\pi}$$

Where:
ε_i = instrument efficiency
N_S = measured gross count rate per minute
N_B = measured background count rate per minute
2π = source surface emission rate per minute

The Instrument Efficiency (***ε_i***), when determined in this manner, is then multiplied by a dimensionless Source Efficiency (***ε_s***) value, obtained from ISO-7503 for given emission types and energies, to determine the Total Efficiency (***ε_T***) used for field measurements, as follows:

$$\varepsilon_T = \varepsilon_i * \varepsilon_S$$

8.5 Receiving and Opening Packages

In accordance with 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30275, packages containing radioactive materials will be surveyed for radioactive contamination and radiation levels. The survey will be performed within three (3) hours after receiving the transported package during normal working hours, or not longer than three (3) working hours from the beginning of the next scheduled working day after receipt, if delivered after work hours.

8.6 Contaminated Areas and Materials

All licensed materials at customer facilities shall be stored in secured areas when not in use or under surveillance by personnel to prevent unauthorized removal or access. Contaminated Areas that exceed the contamination limits in Table I shall be secured to prevent unauthorized or inadvertent entry or removal of contamination (refer to Table I).

Table I Contamination Limits

RADIONUCLIDE	ALLOWABLE SURFACE CONTAMINATION (DPM/100 CM^2) REMOVABLE	Total FIXED + REMOVABLE
Transuranic, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	100
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1000
U-Natural, U-235, U-238, and associated Decay products	1000 α	5000 α
Beta-Gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above)	1000 β–γ	5000 β–γ
Based on NRC Reg- Guide 1.86		

8.7 Posting of Radiation Areas

Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates shall be posted. Sufficient indicators (such as barrier rope or ribbon) shall be used to identify the boundary of the radiation area. At a minimum, the posting shall have a sign with the following:

CAUTION RADIATION AREA

An exemption to this requirement is permitted in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met.

- The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent exposure to radiation or radioactive materials in excess of the limits specified above and stated in 17 CCR.
- The area or room is subject to the licensee’s control. For example, the area around a truck loading radioactive waste does not require posting if the above conditions are met.

8.8 High Radiation Areas

Any radiation area accessible to personnel in which there exists ionizing radiation at such levels that an individual may receive in excess of 100 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates shall be locked or continuously guarded and posted. At a minimum, the posting shall have a sign with the following:

CAUTION, HIGH RADIATION AREA

or

DANGER, HIGH RADIATION AREA

8.9 Very High Radiation Areas

Any area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 500 Rad in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates shall be locked or continuously guarded when open and posted. At a minimum, the posting shall have a sign with the following:

GRAVE DANGER

VERY HIGH RADIATION AREA

8.10 Airborne Radioactivity Area

Any room, enclosure, or area in which airborne radioactive material exist in concentrations in excess of the derived air concentrations (DAC's) specified in Table I, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations, or concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 present of the annual limit on intake (ALI), i.e., 12 DAC-hours, shall be posted. At a minimum, the posting shall have a sign with the following:

CAUTION, AIRBORNE RADIOACTIVITY AREA

or

DANGER, AIRBORNE RADIOACTIVITY AREA

8.11 Radioactive Materials Area

Any room, or area in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C, Title 10 Part 20 of the Code of Federal Regulations shall be posted. At a minimum, the posting shall have a sign with the following:

CAUTION, RADIOACTIVE MATERIALS AREA

or

DANGER, RADIOACTIVE MATERIALS AREA

8.12 Labeling Containers

A container that contains licensed material shall have a durable clearly visible label bearing the radiation symbol and the words “CAUTION, RADIOACTIVE MATERIAL” or “DANGER, RADIOACTIVE MATERIAL.” The label shall also contain the following information that will allow individuals working with or around the containers to implement precautions to avoid or minimize exposures:

- Radionuclide present.
- An estimate of the quantity of radioactivity and date of estimate.
- Radiation levels.
- Types of material and if appropriate, mass enrichment.

Containers are exempt from the above labeling requirements if the following conditions are met:

- Containers holding licensed material in quantities less than the quantities listed in Appendix C, Title 10 Part 20 of the Code of Federal Regulations.
- Containers holding licensed material in concentrations less than those specified in Table 3 of Appendix B to Title 10 Part 20 of the Code of Federal Regulations.
- Containers are attended by an individual who takes the necessary precautions to prevent the exposure of others in excess of 17 CCR limits.
- Containers when they are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation.
- Containers that are accessible only to individuals authorized to handle, use, or work in their vicinity provided the containers are in locations identified to individuals by a readily available written record (containers in storage vaults, hot cells, etc.)

9.0 SURVEYS

Survey is defined in NUREG-1556, Volume 11 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. Cabrera survey processes ensure compliance with 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30275 “Surveys and Tests” and NUREG-1556, Vol. 18. At a minimum, the procedures/processes shall address the requirements of this program in the area of contamination control, release of materials for facility which Cabrera is working at, radiation work permits, surveys, personnel access, frisking, posting, personnel protective equipment, and shipping radioactive materials.

Radiation staff members shall perform the following minimum frequencies for surveys performed at facilities were Cabrera is performing work under the Cabrera's California Radioactive Material license:

- Radiation surveys of areas not posted as radiation areas will be required monthly.
- Contamination surveys of areas not posted as contamination areas will be required monthly.

- Contamination survey of areas posted as contaminated will be performed weekly or daily when work is performed.
- Radiation surveys of areas posted as radiation areas will be performed weekly or daily when work is performed.
- Air samples shall be taken as required by the RWP.
- Additional surveys will be performed for work related activities and in support of RWPs as required by responsible radiation staff members, work plans, and/or operating procedures.

Radiation and Contamination survey meters will be selected based on job specific requirements and be identified in the site-specific work plans.

9.1 Radiation Surveys

Radiation surveys are performed to determine general radiation conditions in the work area and identify specific sources of gamma/beta/neutron radiation requiring further consideration. These type surveys are used to establish posted Radiation Areas and determine higher-hazard posting requirements. These measurements are evaluated along with stay-times to assess likely work doses from a planned work activity. Example instruments for this type survey include Eberline RO-2; Automess Teletector; Thermo MicroREM and; Ludlum Model 19.

Radiation levels are typically recorded on contact with a source of radiation; at 30 cm from a source (whole-body) and/or; at one meter from a source (general area). Gamma, Neutron, and Beta readings ([Open Window-Closed Window]* Beta Correction Factor) may be recorded in this manner.

Radiation measurements performed for DOT purposes shall be performed in accordance with 49 CFR 173.

9.2 Contamination Surveys

Contamination surveys are performed during characterization, operations, and final decommissioning to determine the residual radioactivity on the surfaces of structures, materials and, equipment. These measurements are compared to applicable criteria to determine radiological status and guide subsequent actions (e.g., decontamination and additional survey, packaging, management, & disposal as contaminated or, unrestricted release).

Contamination surveys for unrestricted release are limited to personnel, materials, and equipment and will use total & removable criteria based on NRC Reg. Guide 1.86 and the primary radionuclide(s) of concern.Agreements related to release criteria and survey methods to support final release determinations for real property interests (e.g., buildings, permanent structures and outdoor areas) impacted by licensed radioactive materials are negotiated on a case-by-case basis between the CDPH, the licensee, and the property owner representative(s).

“Total” surface contamination measurements are performed by suspending the active face of the detector over the surface being surveyed and observing the meter reading (analog or digital). The percentage of accessible surface subject to scanning is based on the professional judgment of the surveyor under the oversight of an AU, the ARSO, or the RSO. The detector face should be as close to the surface as practicable, without making direct contact (e.g., alpha radioactivity has a typical detection range of only around one centimeter [~1 cm]). Scan readings may be performed by moving the detector across the surface at a rate that should not exceed one probe width per second.

"Removable" or "Transferable" contamination is measured by use of a smear sample or by gross wipe method (e.g., Masslinn cloth). Smear/swipe samples should be collected with moderate pressure and cover an area of approximately 100 cm^2. The smear collection efficiency for DOT (49 CFR 173) survey purposes is assumed to be 10%. Samples are counted on suitable lab counter or field instrument with sensitivity (static MDC) results that are below the selected release criteria. Scan/Static-only surveys may be performed in lieu of removable measurements, if the results and associated detection limits are below the applicable removable criteria.

Reference background measurements may be subtracted from gross measurements to determine residual radioactivity above background. The net counts are then divided by the efficiency and other factors (i.e., probe area, sample collection efficiency) to determine the surface activity in units of dpm or $Bq/100cm^2$.

Example instruments for this type survey include Ludlum 43-93 and 44-9. Smears are typically counted on a portable lab instrument (e.g., Ludlum 2929/3030, Tennelec, Protean WPC-9550, etc.).

9.3 Air Sampling

Periodic air samples are taken as required verifying that air concentrations routinely remain below 10% of the Derived Air Concentration (DAC), to maintain the Committed Effective Dose Equivalent (CEDE) ALARA. Air samples are taken using personal lapel (or equivalent) air samplers or grab samplers that provide measurement of concentrations in the workers breathing zone. General Area samples to verify postings may be collected with fixed samples (e.g., LV-1, HVP-3800AFC, etc.). If the air concentration exceeds 10% of DAC values, the RSO should be notified so appropriate corrective actions can be taken and exposures received by workers evaluated and included in their personal exposure file.

9.4 Bioassay

In the event of an emergency where an individual may become contaminated and radioactive material was taken into the body through skin absorption or other means, or is suspected of having ingested or inhaled radioactive material; an estimate of the amount of material taken into the body may be required.

Bioassay may be used to assess inhaled, ingested, or absorbed radioactive materials in order to determine internal and/or total dose to workers. The detection level for bioassay samples shall be 10% of the Annual Limit of Intake (ALI) or lower, if practical.

9.5 Leak Test

Sealed sources used for instrument calibration and response checks shall be inventoried and stored in a secure location when not in use. Any single source with equal to greater than 10 microcuries for alpha and/or neutron-emitting radioactive material or, 100 microcuries for beta- and/or gamma-emitting radioactive material, shall be leak tested on an annual basis using the model procedures in NUREG-1556, Volume 18, and Appendix O.

10.0 WASTE MANAGEMENT

Cabrera will ensure that disposal of waste is performed in compliance with 10 CFR 20.1904; 10 CFR 20.2001; 10 CFR 20.2002; 10 CFR 20.2003; 10 CFR 20.2004; 10 CFR 20.2005; 10 CFR 20.2006; 10 CFR 20.2007; 10 CFR 20.2108;10 CFR 30.51 (associated sections within 17 CCR have been repealed). Cabrera will utilize safe management practices for handling of waste, safe and secure storage, waste characterization, waste minimization, and disposal of radioactive waste.

10.1 Releases into Air and Water

Cabrera shall halt operations where effluent concentrations in air or water are expected to exceed the applicable 10 CFR 20, Appendix B, Table 2, Columns 1 & 2 limits.

10.2 Disposal of Liquids in Sanitary Sewer

Cabrera shall not permit any disposal to sewers that exceeds 10% of the applicable 10 CFR 20, Appendix B, Table 3 limits.

10.3 Incineration of Waste

Cabrera employees shall not incinerate waste materials containing radioactive materials.

10.4 Solidification of Waste

Cabrera may utilize a process involving the application of a commercial agent used for solidification or sorption of waste. These processes are typically used to sorb free aqueous liquids in a waste stream and solidify the waste material, and do not constitute stabilization. These operations are to render the material into a less dispersible form and/or render the material into a form acceptable for disposal. Cabrera will conduct a thorough review of the specifications of the commercial agent to ensure compatibility of the agent with the waste material.

11.0 RECORDS, REPORTS AND NOTIFICATIONS

Records will be maintained as specified in 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3.1, Section. Unless otherwise specifically noted, all records generated as part of the Radiation Safety Program will be maintained on a calendar year basis or other required length of time.

11.1 Personnel Records

A personnel file is maintained for each employee assigned work duties involving radioactive materials. The content of these files include:

- A record of radiation exposure received by the individual during previous employment is maintained by requesting personal exposure information from previous employers where the individual worked with radioactive materials.
- A record of personnel dosimeter measurements is recorded in the personnel file to provide a permanent record of radiation exposure received during the course of Cabrera work assignments.
- If a personal dosimeter is lost or damaged, an exposure investigation will be performed and an exposure will be assigned for the monitoring period. A report detailing the exposure estimate will be included in the personnel record.

- If the air concentration in the work area exceeds 10% of DAC values, air samples and bioassay samples will be used to estimate internal exposures received by the worker and included into their personal exposure file.
- If a worker finds contamination on their person above the limits specified in Table I, a report of the incident will be placed in the personnel file to determine exposure from the incident.

The personnel records will be maintained indefinitely and personnel may review their file or request copies of information within their files. The licensee for which work is performed will be provided individual exposure information as required by their license or applicable regulations.

11.2 Records of Waste Disposal

Radiation Survey Records, contamination survey records, shipping manifests, and certifications generated for a licensee's shipment of radioactive materials to a licensed disposal site shall be stored in specific shipment files in the Sacramento office. Duplicate copies of the records are supplied to the licensee for whom the work was performed.

12.0 FACILITY CLOSURE

12.1 Records

The Authorized User shall maintain all documentation required by 17 CCR 30256 and 10 CFR 30.35(g) as long as licensed activities are performed at the site and notify the RSO of any newly designated RAM storage areas. This documentation is required in order to facilitate an efficient and timely closure of radiological activities at a site. Types of documents that shall be maintained in the decommissioning file are:

1. Records of radioactive material storage areas,
2. Records of the physical inventories of radioactive stock,
3. Records of any spills or breakage involving the release of radioactive material, and
4. Records of disposal of radioactive waste and disposition of radioactive sources.

12.2 Closeout Surveys

When licensed activities will be terminated at a site or when a storage area will no longer be used for radioactive storage, the RSO shall perform closeout surveys for unrestricted use. Closeout surveys that involve the relocation of the storage area to another building require timely notification of the RSO and approval by the CDPH before the storage location can be used for non-radioactive storage.

12.3 Decommissioning Surveys

Cabrera will develop a decommissioning survey protocol for the release of the Sacramento office Restricted Area(s). The protocol shall follow the guidance contained in the Multi-Agency Radiological Survey and Site Investigation Manual (MARSSIM), NUREG-1757, and 17 CCR, Division 1, Chapter 5, Subchapter 4, Group 3, Article 2, Section 30256.

State of California—Health and Human Services Agency
California Department of Public Health

TOMÁS J. ARAGÓN, M.D., Dr.P.H.
Director and State Public Health Officer

GAVIN NEWSOM
Governor

July 19, 2024

CABRERA SERVICES INC
MIKE WINTERS
RADIATION SAFETY OFFICER
299 SOUTH MAIN STREET STE 1700
SALT LAKE CITY UT 84111

NOTICE OF RECEIPT OF RENEWAL APPLICATION FOR REVIEW
Docket Number: 071924-7958
License Number: 7958-34
Application Date: 7/19/2024

The above referenced renewal application has been received by the Radiologic Health Branch. Since your application is deemed timely, the license will not expire until final action has been taken by the Department. This application will be processed in the order received. The license expiration date (*item 4* on the face of the license) will not change until the renewal is reviewed and approved by the Department.

Please retain this notice to demonstrate proof of an active license.

If your renewal application contains any radiation safety program changes, e.g. change of Radiation Safety Officer, change of storage/use location, change in possession limit, **please submit a separate amendment request,** and reference the license number.

Any additional correspondence regarding your renewal application **must be submitted in duplicate** and should reference the assigned docket number above.

Thank you,

Robert Custodio, Chief
Radioactive Materials Licensing Section
Radiologic Health Branch

RADIOACTIVE MATERIAL LICENSE

Pursuant to the California Code of Regulations, Division 1, Title 17, Chapter 5, Subchapter 4, Group 2, Licensing of Radioactive Material, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, use, possess, transfer, or dispose of radioactive material listed below; and to use such radioactive material for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders of the California Department of Public Health now or hereafter in effect and to any standard or specific condition specified in this license.

1. Licensee: CABRERA SERVICES INC	*3. License Number:* 7958-34 *Amendment Number:* 10
2. Address: 3355 MYRTLE AVENUE SUITE 210 NORTH HIGHLANDS CA 95660	*4. Expiration date:* August 21, 2024 (3)
Attention: MICHAEL S WINTERS CHP RADIATION SAFETY OFFICER	*5. Inspection agency:* Radiologic Health Branch North

In response to the email dated September 9, 2024, with attachments, from Michael S. Winters, CHP, RRPT, Radiation Safety Officer, License Number 7958-34 is hereby amended as follows:

6. Nuclide	7. Form	8. Possession limit
A. Any radionuclides with atomic numbers 1-83.	A. Any	A. Total not to exceed 3.7 GBq (100 mCi).
B. Any radionuclides with atomic numbers 84-103 except: 1. Radium-226 2. Source Material 3. Special Nuclear Material	B. Any	B. Total not to exceed 3.7 GBq (100 mCi).
C. Radium-226	C. Any	C. Total not to exceed 3.7 GBq (100 mCi).
D. Source Material	D. Any	D. Total not to exceed 3.7 GBq (100 mCi).
E. Special Nuclear Material	E. Any	E. Not to exceed 3.7 GBq (100 mCi of U-233), or 27.8 MBq (0.75 mCi) U-235, or 3.7 GBq (100 mCi) of Plutonium, or any combination of these provided that ratio does not exceed unity.
F. Any radionuclides with atomic numbers 1-103.	F. Sealed sources	F. Total not to exceed 3.7 GBq (100 mCi).

9. Authorized Use

A.–F. To be used incident to decontamination, decommissioning, remediation, and packaging for transport.

LICENSE CONDITIONS

10. Radioactive material shall be used only at the following approved locations:

(a) Temporary job sites of the licensee in areas not under exclusive federal jurisdiction throughout the State of California (see Condition 23).

RADIOACTIVE MATERIAL LICENSE

License Number: 7958-34

Amendment Number: 10

11. This license is subject to an annual fee for sources of radioactive material authorized to be possessed at any one time as specified in Items 6, 7, 8 and 9 of this license. The annual fee for this license is required by and computed in accordance with Title 17, California Code of Regulations, Sections 30230-30231 and is also subject to an annual cost-of-living adjustment pursuant to Section 100425 of the California Health and Safety Code.

12. Radioactive material shall be used by, or under the supervision of, the following individuals:

(a) Michael S. Winters, CHP	(c) Scott S. Hay	(e) **Eric M. McDonald**
(b) Bachir Badaoui	(d) Wade Fillingame	(f) **Chris Sanchez**

13. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 7, 8 and 9 of this license in accordance with the statements, representations, and procedures contained in the documents listed below. The Department's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

    (a) The application with attachments dated November 30, 2012, and letter dated December 19, 2012, both signed by James Reese, CHP. The letter with attachments dated July 5, 2013, signed by Craig-Alan C. Bias, Ph.D., CHP, Director of Health Physics, regarding the Decommissioning Funding Plan, and commitment to follow the Governor Davis' Executive Order dated 2002. The letter with attachments dated November 14, 2013, signed by Tony Mason, CHP, Principal Health Physicist, regarding facility map, Radiation Safety Procedures, and Operating Procedures. The revised letters with attachments dated May 8, 2014, and July 1, 2014, both signed by Michael S. Winters, CHP, Radiation Safety Officer, regarding the updated Radioactive Material License Application form RH 2050 dated May 8, 2014, the updated Delegation of Authority for the new Radiation Safety Officer, Mr. Michael S. Winters, updated emergency telephone contact list, and the revised Radiation Safety Program (July 2014).

    (b) The letter dated February 3, 2020, signed by Michael S. Winters, CHP, Radiation Safety Officer, with attached Decommissioning Funding Plan, July 2019, Rev A.

    (c) The email dated July 10, 2023, from Michael S. Winters, CHP, Radiation Safety Officer, with attached Decommissioning Funding Plan dated July 2023, Rev B., and the email dated September 21, 2023, from Rob Flowers, President.

    (d) The email dated February 16, 2024, with attachments, from Michael S. Winters, CHP, Radiation Safety Officer, regarding planned transfer of control of ownership.

    (e) The emails dated March 15, 2024, and June 6, 2024, with attachment, both from Michael S. Winters, CHP, Radiation Safety Officer, regarding change in ownership.

14. (a) The Radiation Safety Officer in this program shall be Michael S. Winters, CHP.

    (b) The Alternate Radiation Safety Officer in this program shall be Bachir Badaoui.

15. The licensee is authorized to perform tests for leakage and/or contamination of sealed sources. The following tests may be performed for sources possessed under this license:

    (a) Collection of wipe test samples from sealed sources and devices containing sealed sources.

    (b) Analysis of materials collected by the licensee as stated in (a) above for the amount of radioactivity. Reports to customers of analysis shall be in microcuries.

RADIOACTIVE MATERIAL LICENSE

License Number: 7958-34

Amendment Number: 10

16. Records of leak test results shall be kept in units of becquerels (microcuries) and maintained for inspection. Records may be disposed of following Department inspection. Any leak test revealing the presence of 185 Bq (0.005 µCi) or more of removable radioactive material shall be reported to the California Department of Public Health, Radiologic Health Branch MS 7610, P.O. Box 997414, Sacramento, CA 95899-7414, within five days of the test. This report shall include a description of the defective source or device, the results of the test, and the corrective action taken.

17. *Except for calibration sources, reference standards, and radioactively contaminated equipment owned by the licensee, possession of licensed material at each temporary job site shall be limited to material originating from each site. This material must either be transferred to an authorized recipient or remain at the site after licensee activities are completed.*

18. At least 14 days before initiating activities at a temporary job site, including military or former military sites where the temporary job site is not under exclusive federal jurisdiction, the licensee shall notify, in writing, the California Department of Public Health, Radiologic Health Branch. The notification shall include the following information:

    (a) Site-specific radiological procedures if they have not been previously approved by the California Department of Public Health.

    (b) Estimated type, quantity, and physical/chemical forms of radioactive material.

    (c) Specification of the site location.

    (d) Description of project activities that are planned for the site, including management and disposition of radioactive material.

    (e) Estimated project start date and duration of project.

    (f) Name, address, title, and phone number of a point of contact for the person managing radiological operations at the temporary job site.

    Within 30 days of completing activities at each job site, the licensee shall notify, in writing, the California Department of Public Health, Radiologic Health Branch, regarding the radiological status of the temporary job site and the disposition of any licensed radioactive material.

19. This license does not authorize the use of licensed material at temporary job sites for uses already specifically authorized by a customer's license. If a customer also holds a license issued by the NRC or an Agreement State, the licensee shall establish a written agreement between the licensee and the customer specifying which licensee activities shall be performed under the customer's license and supervision, and which licensee activities shall be performed under the licensee's supervision pursuant to this license. The agreement shall include a commitment by the licensee and the customer to ensure safety, and any commitments by the licensee to help the customer clean up the temporary job site if there is an accident. A copy of this agreement shall be included in the notification required by License Condition 18.

20. The licensee shall maintain records of information important to decommissioning each temporary job site at the applicable job site pursuant to Title 17, California Code of Regulations, Section 30256. The records shall be made available to the Department for inspection and to the customer upon request during decommissioning activities, and shall be transferred to the customer for retention at the completion of activities at a temporary job site.

21. The licensee shall comply with all requirements of Title 17, California Code of Regulations, Section 30373 when transporting or delivering radioactive materials to a carrier for shipment. These requirements include packaging, marking, labeling, loading, storage, placarding, monitoring, and accident reporting. Shipping papers shall be maintained for inspection pursuant to the U.S. Department of Transportation requirements (Title 49, Code of Federal Regulations, Part 172, Sections 172.200 through 172.204).

RADIOACTIVE MATERIAL LICENSE

License Number: 7958-34

Amendment Number: 10

22. The total mass of special nuclear material possessed under this license at any one time or at any one authorized location of use shall not exceed that stated in the following formula: The number of grams of Uranium 235 divided by 350, plus the number of grams of Uranium 233 divided by 200, plus the number of grams of Plutonium (all isotopes) divided by 200, shall not exceed one (i.e. unity).

23. Before radioactive materials may be used at a temporary job site at any federal facility, the jurisdictional status of the job site must be determined. If the jurisdictional status is unknown, the federal agency should be contacted to determine if the job site is under exclusive **F**ederal jurisdiction. A response shall be obtained in writing or a record made of the name and title of the person at the **F**ederal agency who provided the determination and the date that it was provided. Authorization for use of radioactive materials at the job sites under exclusive federal jurisdiction shall be obtained either by:

    (a) Filing an NRC Form-241 in accordance with the Title 10, Code of Federal Regulations, Part 150.20 (b), "Recognition of Agreement State Licenses", or

    (b) By applying for a specific NRC license.

    Before radioactive material can be used at a temporary job site in another State, authorization shall be obtained from the State if it is an Agreement State, or from the NRC for any non-Agreement State, either by filing for reciprocity or applying for a specific license.

24. In accordance with the Title 17, California Code of Regulations, Section 30195.1, the licensee shall maintain an acceptable financial instrument in the amount of $43,417.00 that satisfies the requirements outlined in the decommissioning funding plan attached to the email dated July 10, 2023.

25. *If approved by the Radiation Safety Officer specifically identified in this license, the licensee may take reasonable action in an emergency that departs from conditions in this license when action is immediately needed to protect public health and safety and no action consistent with all license conditions that can provide adequate or equivalent protection is immediately apparent. The licensee shall notify the CDPH-RHB before, if practicable, and in any case, immediately after taking such emergency action using reporting procedure specified in 10CFR30.50(c).*

26. In accordance with California Health and Safety Code Section 115000.1(h), the licensee shall annually report the radioactive waste inventory held in storage on December 31 of each year and all manifests of Low Level Radioactive Waste (LLRW) shipments to licensed LLRW disposal facilities made during the year to the Department via the online LLRW Tracking System at https://llrwts.cdph.ca.gov/.

27. At least 30 days prior to vacating any address of use listed in Condition 10 of this license, the licensee shall provide written notification of intent to vacate to the California Department of Public Health, in accordance with Title 17, California Code of Regulations (17 CCR), Section 30256 (b). Control of all licensed areas must be maintained until such areas are released by the Department for unrestricted use or the license is terminated, in accordance with 17 CCR**,** Section 30256 (j).

28. A copy of this license and a copy of all records and documents pertaining to this license shall be maintained available for inspection at 3355 Myrtle Ave., Suite 210, North Highlands, CA.

Issued for the State of California Department of Public Health

Date: October 14, 2024

By: Thomas Moore

Radiologic Health Branch
MS 7610, P.O. Box 997414
Sacramento, CA 95899-7414

GSI Job No: 10008

SOIL SAMPLING AND ANALYSIS PLAN
Former Albany Landfill (Albany Bulb)
End of Buchanan Street
Albany, California

APPENDIX B

OP-3416, Field Operations of the SPIR-Ace Portable Spectrometer

OPERATING PROCEDURE

FOR

FIELD OPERATIONS OF THE SPIR-ACE PORTABLE SPECTROMETER

OP-3416

Revision 0
October 2021

Level of Use:
Information Use

APPROVALS	
President	*R. Flowers, PMP, CHMM*
Quality Assurance	*S. Liddy, CSP*
Health Physics	*M. Winters, CHP*
Nuclear Measurements Program Lead	*B. Young, PhD*
This procedure is the property of Cabrera Services Inc. and is considered approved and effective for the duration it is posted electronically to the Controlled Copy Document Repository.	

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History of Revisions		
Revision	**Month-Year**	**Description**
0	October 2021	Original Issue. Subject matter expert is Brian Young, PhD

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1.0 PURPOSE

This operating procedure provides instruction and requirements for the operation of Cabrera Services Inc. (Cabrera) Spir-Ace Portable Spectrometer.

This procedure implements and serves an extension of the policies and guidelines specified in the Cabrera Non-Destructive Assay (NDA) Quality Systems Manual (OP-4201, *Operating Procedure for Non-Destructive Assay Measurements Program*).

2.0 SCOPE/APPLICABILITY

This procedure is applicable to personnel who set up, operate, and maintain Cabrera gamma spectroscopy equipment. Instructions, in this procedure, apply to:

- Equipment setup
- Routine instrument operation
- Spectrum file management

3.0 DEFINITIONS

3.1 Full Width at Half Maximum (FWHM) – The width of a single spectrum peak at one half of its centroid height.

3.2 Gamma Acquisition and Analysis (GAA) – The acquisition portion of the Genie 2000 software package that controls detector functions.

3.3 In-situ Object Counting System (ISOCS) – A system whose software and hardware components are utilized to detect and quantify radioactive gamma emitting nuclides.

3.4 Multi-Channel Analyzer (MCA) – An electronic instrument that segregates pulses received by the detector into various bins based on the pulse magnitude.

4.0 RESPONSIBILITIES

4.1 Nuclear Measurements Program Lead (NMPL)

Responsible for developing, revising, and implementing this procedure. Trains and qualifies subject-matter experts (SMEs) based the on minimum training and experience requirements of Cabrera's NDA Qualification Program. They ensure that analytical data are verified only by technically qualified personnel who are independent of performing those analyses The NMPL is the principal SME for Gamma Spectroscopy Operations.

4.2 Subject Matter Expert (SME)

SME qualification is synonymous with the Expert Analyst level, as defined by the US Department of Energy. This qualification can be either a Gamma Spectroscopy Subject Matter Expert or a Modeler/Analyst as defined in Attachment C of the Cabrera NDA Measurements Program Quality Systems Manual (OP-4201).

4.3 Gamma Spectrometry Analyst ("Analyst")

Responsible for the set-up, operation, routine maintenance, basic troubleshooting, and storage of gamma spectroscopy systems. Further details and training requirements for Analyst level personnel are specified in Attachment C of the Cabrera NDA Measurements Program Quality Systems Manual (OP-4201).

5.0 PRECAUTIONS, LIMITATIONS AND PREREQUISITES

5.1 Precautions

5.1.1 Mirion "Factory Mode"

The Spir-Ace has an undocumented "Factory Mode," which is used by Mirion factory and service personnel for diagnostics, firmware upgrades, etc. This mode is included here for completeness of information, but it is STRONGLY recommended that you not enable this mode.

To enable this mode, access the "Main Menu" on the left side of the screen and select "User." From this menu select "Mirion." You will be asked for a password. The password is: mgpfactory.

Once factory mode is enabled, there will be an extra display enabled to the right of the map display. This presents various items of live diagnostic data. There is likely other functionality that is also enabled, but this is an undocumented mode of operation – use at your own risk.

5.1.2 The instruments are susceptible to water/moisture damage and should only be operated in wet environments when appropriate protective precautions are implemented. The instruments should not be operated in very wet environments such as heavy precipitation.

5.1.3 The detector systems utilize a high voltage. Use caution when handling cables and other electrically powered elements of the systems; ensure elements are powered down before unplugging.

5.1.4 Refer to equipment manuals for additional information on maintaining, storing, moving, and shipping instructions.

5.2 Limitations

The instrument will not be operated in environments where the ambient temperature exceeds 40 °C or is less than 5 °C (104 °F and 41 °F, respectively).

5.3 Prerequisites

5.3.1 Qualifications

There are two levels of gamma spectrometry users: Gamma Spectrometry Analyst and Subject Matter Expert. Requirements and qualifications for each level are included in Attachment C of the Cabrera NDA Measurements Program Quality Systems Manual (OP-4201). Responsibilities given to personnel should be restricted to their qualifications.

5.3.2 Training

Initial training for each level is scheduled by the NDA group, as needed, and certification is issued upon successful completion of each level. Requirements for re-certification of each level are provided in Attachment C of the Cabrera NDA Measurements Program Quality Systems Manual (OP-4201) and must be obtained no later than 2 years from the previous re-certification. Responsibilities given to personnel should be restricted to their qualifications.

Personnel handling radioactive material are to be trained in accordance with Cabrera's administrative procedure, OP-5703, *Radiation Worker Training*, and take all appropriate precautions, as listed above.

5.3.3 Parameters

No adjustments will be made to the detector high voltage unless authorized by the SME/NMPL. Instrument settings will be set up by, or with the assistance of, an SME prior to, or at the beginning of the project. Creating or editing parameters should not be done without an SME and may void collected data.

5.3.4 Sample Containers

Prior to use or reuse, all sample containers (i.e., Marinelli beakers, etc.), tools, etc. must be clean and dry. All items that have been used previously must be washed to remove any trace of previously contained sample material. Any items that will not clean adequately must be discarded (as per the Laboratory Manager) to prevent reuse and the possibility of cross-contamination.

6.0 EQUIPMENT

6.1 Spir-Ace unit

6.2 Wall plug charging unit

6.3 Uninterrupted power supply (UPS)

6.4 USB cable that connects between the wall plug charging unit to a laptop for transferring data.

6.5 Mirion factory Spir-Ace manual

6.6 A small button check source, likely ^{137}Cs, may be present.

7.0 INSTRUCTIONS/PROCEDURE

7.1 Setup Preparation

The Spir-Ace will most likely have been set up prior to shipment by a Cabrera SME with appropriate nuclide libraries, efficiency calibrations, etc. **Section 7.8,** "Note on Positioning and Geometry for Field Measurements" has more information on appropriate counting geometries, efficiencies, and setting up measurements for counting. If you have questions, contact the SME.

The gamma spectrometry system should be placed in a location that minimizes vibration, electro-magnetic and radio frequency interferences. The location must provide adequate ventilation and temperature consistency.

7.2 Quick Start for Novice Users

7.2.1 Read through **Section 7.4.1**, "Basic Spir-Ace Startup and Operations" and **Section 7.4.2,** "Basic Guide to Navigating Spir-Ace Functions" of this document to familiarize yourself with the basic functionality of the instrument if you're not already familiar with it.

7.2.2 The Spir-Ace will most likely have been set up prior to shipment by a Cabrera SME with appropriate nuclide libraries, efficiency calibrations, etc. **Section 7.8,** "Note on Positioning and Geometry for Field Measurements" has more information on appropriate counting geometries, efficiencies, and setting up measurements for counting. If you have questions, contact the SME.

7.2.3 Turn on the Spir-Ace unit and let it boot up, as described in **Section 7.4.1**, "Basic Spir-Ace Startup and Operations"

7.2.4 Perform a fast energy recalibration by following the procedure in **Section 7.4.3**, "How to Perform a Fast Recalibration."

7.2.5 Acquire a background count by following the procedure in **Section 7.4.4**, "How to Perform a Background Count."

7.2.6 Set the sample acquisition time to 5 minutes (300 seconds) by following the procedure in **Section 7.5.1**, "How to Set the Preset Count Time."

7.2.7 If you're going to export sample count data via email, confirm/specify the target email address (i.e., the "To:" address) by following the procedure in **Section 7.5.7**, "How to Change or Edit the Email Addresses to Send Emailed Data to."

7.2.8 When you're ready to perform a measurement of a specific object or area, position the Spir-Ace in the appropriate location and orientation. See **Section 7.8**, "Note on Positioning and Geometry for Field Measurements" for information on appropriate counting geometries, efficiencies, and setting up measurements for counting. If you have questions, contact the SME.

7.2.9 To initiate a timed count, follow the procedure in **Section 7.4.5**, "How to Perform a Basic Field Measurement – Initiating a Count."

7.2.10 To review and email the count data to an intended target, follow the procedure in **Section 7.4.7**, "How to Review and Email Event Data in the Analysis Window." If you'd prefer to export the count data by connecting the Spir-Ace directly to a laptop with a USB cable, follow the procedure in **Section 7.4.8**, "How to Backup Spectrum Data to a Laptop Via USB."

7.3 Set up Check List for Expert Users

This section contains a short checklist of the things that need to be adjusted or configured on a Spir-Ace device prior to sending it out for deployment in the field.

Each of these items is described in detail in one of the sections or subsections within this document.

- Set the Alarm Limits; thresholds on count rate or dose rate to trigger user alarms.
- Set the Alarm Alerts; means by which the device alerts the user of an alarm.
- Check the Energy and Shape Calibration – at minimum do a Fast Recal before packing/shipping.
- Create (on a laptop) and side-load (via USB) any specific efficiency calibration that might be needed for a custom geometry.
- Set the default Nuclide Library for in-field use; if necessary, create (on-board Spir-Ace) a new library.
- Set the preset count time for user-initiated acquisitions.

7.4 Basic Operations

7.4.1 Basic Spir-Ace Startup and Operation

a. After unpacking the Spir-Ace and components, if possible, allow the instrument to equilibrate with ambient temperature in the measurement area for 30 minutes.

b. To turn the instrument on, press and hold the topmost black button (i.e., the Power button) for a few seconds until the Spir-Ace display illuminates. The display will cycle through a series of status messages – “Reading settings…,” etc. This startup routine will take about one minute to complete.

c. You may be presented with a message suggesting a fast recalibration if the instrument hasn’t been used in a week or longer. Dismiss this message by tapping “Later” on the touch screen with your fingertip or a stylus.

d. After the initial self-testing, the Spir-Ace will enter monitoring mode. You should see the following items on the screen:

   i. “Measuring…” across the top of the screen, indicating that the unit is powered on and monitoring the ambient radiation field.

   ii. A “G” indicator and a continually updating indication of current gamma dose rate in microrem per hour (µR/h).

   iii. Confirm Identification. Tapping this will start a timed spectrum acquisition and analysis. You can also initiate spectrum acquisition by pressing the bottom black (Acq) button.

   iv. Rolling time histogram. This displays a rolling time histogram of the count rate in counts per second in the detector.

   v. Multiple status indicators at the bottom of the screen (“Laboratory miscellaneous,” “BKG subtraction,” etc.). Particularly important is – at the bottom-right corner of the screen is the battery charge indicator, indicating the current charge level of the battery in percent.

e. Make sure that at least 25% of battery capacity is available if the unit is to be used for portable monitoring or data acquisition.

f. If you're not familiar with the basics of working with the Spir-Ace interface, you should review **Section 7.4.1**, "Basic Spir-Ace Startup and Operations."

g. It is strongly recommended that you perform a fast recalibration prior to doing any formal measurements, especially if the instrument has been newly unpacked or it if hasn't been used in several days. This process shouldn't take more than ten minutes, and it does require that you have access to a calibration check source. Possible check sources that the Spir-Ace can calibrate with are – 60Co, 137Cs, and 226Ra. Instructions on how to do a fast recalibration are in **Section 7.4.3**, "How to Perform a Fast Recalibration."

h. It is strongly recommended that you collect a background spectrum. This should be done at the beginning of each shift as well as whenever you make a substantial change to the environment where you will be operating the Spir-Ace (such as moving from a grassy field to a concrete pad or moving from indoors to outdoors). This process shouldn't take more than ten minutes. You need to situate the Spir-Ace away from any known non-background radiation such as check sources or known contaminated objects. Instructions on how to collect a background spectrum are in **Section 7.4.4**, "How to Perform a Background Count."

i. Note that the screen will turn off after roughly a minute of inactivity. You can also manually turn off the display by briefly pressing the topmost black button (i.e., the Power button). Even though the display might be powered off, the instrument is still powered on and working. This will allow you to walk around with the instrument in a low-power monitoring mode (e.g., stowed in your backpack, etc.). If a radiological transient or other radiological event occurs, the instrument will automatically wake up and alert you. This is described later in this document. To wake up the screen manually, briefly press the topmost black button (i.e., the Power button) until the screen turns on.

j. If the instrument detects the presence of a radionuclide or a count rate substantially higher than background, it will wake up and alert you. If this happens, the instrument will automatically log this as a radiological "event," and record the Global Positioning System (GPS) location, dose rate, and will acquire and save a gamma-ray spectrum for a long as the elevate count rate is present. You can also initiate a timed spectrum count as detailed immediately below in the next step of this procedure.

k. To initiate a count manually, press and hold the bottom black button (i.e., the Acq button). Alternatively, you can also tap the gray "Confirm identification" bar on the display. This will start a spectrum count for a pre-set acquisition time. Spectrum counts typically take five to ten minutes, and the data are automatically stored on the Spir-Ace for review, transmission, and backup later. Detailed instructions on acquiring, saving, and analyzing spectrum data are in **Section 7.4.5**, “How to Perform a Basic Field Measurement – Initiating a Count.”

l. To turn the instrument off, press and hold the topmost black button (i.e., the Power button) for a few seconds until the Spir-Ace presents a confirmation dialog asking if you want to turn off the device. With your fingertip or a stylus, tap on “OK.” The device will power off.

7.4.2 Basic Guide to Navigating the Spir-Ace Functions

a. To navigate through the basic functionality of the unit, use either your fingertip or a stylus on the screen, which is touch sensitive. While the Spir-Ace is powered on and monitoring, the “Measuring” and gamma dose rate indicator will always be seen at the top of the screen. In the middle portion of the screen, there are four basic displays that can be shown; you can cycle through these by swiping left or right with your fingertip or a stylus:

   i. Rolling time histogram. This displays a rolling time histogram of the count rate in counts per second in the detector. This can be useful for spotting transients of “hot spots” during a walkabout survey. This is the default display at power-up for the device, and it is the left-most (maximum swipe right) display.

   ii. Continually updating gamma-ray spectrum. If the Spir-Ace is running in passive monitoring mode (this is the normal condition), this spectrum updates twice per second and presents “data grabs” of only 0.5 seconds each, so there won’t be many counts visible. If a strong gamma-ray line is present in the radiation field, it may be visible in this spectrum. If a timed count is in progress, however, the total integrated gamma-ray spectrum is shown, updated as the count progresses. If gamma rays are identified, they are labelled within the spectrum display.

   iii. Radar display. This display utilizes the device’s on-board inertial sensor to detect changes in orientation of the device. It displays a radial histogram of count rate versus orientation. This can be useful as a “direction finder” for locating concentrated sources.

   iv. Map display. This display uses the device’s on-board GPS hardware to overlay an indication of radiological observations along your walking path onto satellite images of your local area. The availability of satellite imagery will depend on the device’s ability to connect to a Wi-Fi or cell network. This is the right-most (maximum swipe left) display.

b. To access more advanced functionality, bring up the Main Menu on the left-hand side of the screen. Advanced functions accessible from this menu are described in several of the later sections of this document. You can bring up the Main Menu in two ways:

i. Using your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.

ii. Using your fingertip or a stylus, tap on the three-bar icon in the lower-left corner of the screen.

Note: The Spir-Ace is configured to recognize multiple level of user – Operator, Advanced, Expert, etc. – which grants or restricts access to various functions and adjustments on the device. By default, the Spir-Ace powers up in “Operator” mode, which restricts access to the more advanced functions of the instrument. To access the advanced features, open the Main Menu as described immediately above, select the User menu item, then choose the “Expert” user mode.

c. At any time, you can initiate a count manually by pressing and holding the bottom black button (i.e., the Acq button). Alternatively, you can also tap the gray “Confirm Identification” bar on the display. This will start a spectrum count for a pre-set acquisition time. Spectrum counts typically take five to ten minutes, and the data are automatically stored on the Spir-Ace for review, transmission, and backup later. Detailed instructions on acquiring, saving, and analyzing spectrum data are in **Section 7.4.5,** “How to Perform a Basic Field Measurement – Initiating a Count.”

7.4.3 How to Perform a Fast Recalibration

To perform this operation, you will need a small calibration check source, roughly 1 microcurie in activity. Possible source nuclides are ^{60}Co, ^{137}Cs, and ^{226}Ra. The source does not need to be NIST traceable; a nominal activity source will suffice. If you do not have a check source available, the instrument can also use naturally occurring ^{40}K, which is present in nearly all building materials and soil.

a. Open the Main Menu – using your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.

b. From the Main Menu select the following chain of items – More : Calibration : Fast Calibration. You will be presented with the Fast Calibration window.

c. Tap the “Select source” button at the top of the window.

d. Select a source isotope. If you do not have a 60Co, 137Cs, or 226Ra source available, select “LaBr3” and the instrument will calibrate using naturally occurring 40K.

e. The display will show an example of what the expected peak from your nuclide should look like. Tap the “Start calibration” button at the bottom of the window.

f. The unit will acquire data for 3 to 5 minutes duration.

g. Once the acquisition is complete, the instrument should display a "Success" dialog indicating revised gain settings. You can dismiss this dialog by tapping "Exit."

7.4.4 How to Perform a Background Count

To perform this operation, you will need to situate the Spir-Ace away from any known non-background radiation such as check sources or known contaminated objects. Acquiring updated background information actually entails collecting two pieces of information – a background count rate and a background spectrum. The following steps lead you through both processes.

a. First, acquire a background count rate:

   i. Open the Main Menu – using your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.

   ii. From the Main Menu select the following chain of items – More : Background Update : Start background level acquisition. The instrument will acquire approximately 10 seconds of background count rate.

b. Next, acquire a background spectrum:

   i. Open the Main Menu – using your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.

   ii. From the Main Menu select the following chain of items – More : Background Update : Start background spectrum acquisition. The instrument will acquire 600 seconds (10 minutes) of background spectrum data. Once the acquisition is done, you will be presented with the spectrum just acquired; this spectrum will have automatically been saved as the current environmental background.

7.4.5 How to Perform a Basic Field Measurement – Initiating a Count

This procedure walks you through a basic data acquisition. You will initiate a count, and the Spir-Ace will acquire and store spectrum data for review and analysis later. The instrument will show you the spectrum as it is acquired, and it will perform basic analysis and nuclide identification on-board; however, detailed analysis of the data is best performed after exporting or emailing the acquired data onto a laptop. Nearly always, this will be the field measurement procedure you will use.

Note: The Spir-Ace considers any radiological acquisition, whether initiated by the operator as described here or initiated automatically as part of a radiological transient, as an "event" and stores the spectrum data as well as dose rate, GPS location, nuclide identification results, etc. on board for later analysis, offloading, or emailing.

Other auxiliary procedures elsewhere in this document that may be helpful are:

- **Section 7.4.7**, “How to Review and Email Event Data in the Analysis Window”
- **Section 7.5.1,** “How to Set the Preset Count Time”
- **Section 7.5.2**, “How to Set the Nuclide Library for Live Nuclide Identification (NID)”

a. Move the Spir-Ace unit to the area or item to be assayed. Ensure that the dose rate is within safe limits – be vigilant of your exposure time if the Spir-Ace reports a dose rate greater than 2,000 microrems/hour (i.e., 2 millirems/hour).

b. To initiate a count, either

   i. Tap the “Confirm Identification” bar near the top of the screen, or

   ii. Press the bottom black (Acq) button on the top face of the instrument chassis.

c. You will be presented with a status message (“Cumulation in Progress”) and a progress bar indicating the amount of time elapsed. Typical preset count times are roughly 3 – 5 minutes.

d. While the acquisition is ongoing, you can view the spectrum as it is acquired by swiping left/right in the main area of the screen to switch to the spectrum display.

e. You can let the acquisition run until the preset time is elapsed, or you can terminate the acquisition by tapping on the “Cumulation…” status message. Either way, once the acquisition is terminated, you will be presented with three options

   i. Resume – this will extend the acquisition by an additional preset count period.

   ii. Analysis – this will bring up the Analysis window (see below) allowing you to perform basic analysis on the accumulated data and to email the data to a Cabrera recipient.

   iii. Exit – this will return you to the main display; the data you just accumulated is still stored and can be examined/manipulated by bringing up the Analysis window later (see below).

7.4.6 How to Respond to a Radiological Transient Alarm

The Spir-Ace will wake up and alert you if it detects a transient – essentially, this is a gamma-ray signature above background or a high gamma-ray condition. When it does so, it will automatically start a spectrum acquisition for the duration that the above-background or high-gamma condition persists. You will be presented with an alarm status indicator in the top portion of the screen. You can acknowledge the alarm (i.e., silence the beeping) by tapping on the alarm status indicator. If you do not acknowledge the alarm, once the transient condition has ceased, you will be presented with an acknowledgement window with two choices.

a. Event detail – this will bring up the Analysis window (see below).
b. Ack – this will acknowledge the alarm and return you to the main display; the data just accumulated is still stored and can be examined/manipulated by bringing up the Analysis window later (see below).

You can also respond to the alarm by tapping the "Confirm Identification" bar near the top of the screen; this will initiate a timed spectrum acquisition. See also **Section 7.4.5**, "How to Perform a Basic Field Measurement – Initiating a Count."

Note: The Spir-Ace considers any radiological acquisition, whether initiated by the operator or initiated automatically as part of a radiological transient (as described here), as an "event" and stores the spectrum data as well as dose rate, GPS location, nuclide identification results, etc. on board for later analysis, offloading, or emailing.

Other auxiliary procedures elsewhere in this document that may be helpful are:

- **Section 7.4.7**, "How to Review and Email Event Data in the Analysis Window"
- **Section 7.5.5**, "How to Set the Alarm Limits"
- **Section 7.5.6**, "How to Set the Alarm Alerts (Sound, Flashing LED, Vibration)"

7.4.7 How to Review and Email Event Data in the Analysis Window

This section walks you through basic review, manipulation, and email functions that are available via the Analysis Window. Depending on the choices you made at the end of an acquisition (whether you initiated the acquisition, or it was initiated via a radiological transient), the Analysis Window may be opened automatically for you.

To bring up the Analysis Window manually at any time, perform the following:

a. Bring up the Main Menu on the left-hand side of the screen. This can be done two ways.
   i. Using your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.
   ii. Using your fingertip or a stylus, tap on the three-bar icon in the lower-left corner of the screen.
b. From the Main Menu, tap the History menu item.

This will open the list of stored radiological events that the Spir-Ace has logged. The list presents a lot of information about each radiological event – the time of the event, duration of the event, maximum gamma dose rate, and any nuclides identified. Note that all acquisitions are stored in this list – background calibration acquisitions, energy calibration acquisitions, acquisitions that were initiated by the operator, and acquisitions that were automatically initiated by a radiological transient.

Within the history list, different types of events are flagged with icons depending on how the event was initiated:

- User-initiated counts (events) are flagged with a stopwatch icon.
- Events initiated by a radiological transient are flagged with a radiation trefoil.
- Background calibration counts (events) are flagged with a human silhouette.
- Energy calibration counts (events) are flagged with a wrench icon.

Tap on the radiological event you want to examine. This will open the event data in the Analysis Window.

In the top portion of the Analysis Window is displayed basic information about the particular event you're looking at.

- The date and time of the event
- The duration of the event
- The GPS coordinates (latitude & longitude) where the event took place
- The ambient temperature registered by the device during the event
- The maximum and average gamma-ray dose rate during the event
- The total gamma-ray counts in the spectrum acquired during the event

Just above the middle of the Analysis Window is a menu bar which lets you select from multiple display options, which will be visible in the bottom half of the screen. The possible options are:

- **.SPE** – This displays the acquired gamma-ray spectrum. There are two cursors which you can reposition by dragging the cursors' flags left and right. The display will show you the location (in energy units) and the count rate (in cps) at both cursor's locations; it will also show you the centroid energy for the counts between the two cursors. You can zoom and scroll the spectrum left/right by pinching (in or out) and dragging within the spectrum window.

- **Peak** – This shows a list of peaks and associated identified nuclides (if any) that were found within the spectrum.

- **Map** – This shows a zoomable and scrollable satellite image of the GPS location where the radiological event occurred. You can zoom and scroll the image by pinching or dragging within the image.

- **Text** – This is a free-form text field where you can add text notes to the event. There are two circular buttons in the upper right corner of the text field.

- The pencil button allows you to enter and edit text notes associated with the event.
- The wireframe cube button allows you to associate a calibration with the event. When you tap this button, you will be presented with a list of calibration files stored on-board the instrument. Select the calibration you want and tap the “Export” button at the bottom of the list.

Note: You can also perform this operation using the “Genie Xport Geometries” menu option described below.

Note: If you want to email the event to a Cabrera reviewer as a Genie CAM file, you must associate a calibration with the event. Failure to do so will result in an incomplete dataset being emailed.

In the upper right corner of the Analysis Window is a three-dot menu icon. When you tap this icon, it will present you with a menu of other operations you can perform on the event data. The choices are:

- **Library** – This lets you choose the nuclide library to be used for NID analysis. When you choose this menu item, you will be presented with a list of nuclide libraries stored on-board the instrument.
- **Data Log** – This presents a list of the events stored on the instrument, organized in the form of a calendar. This can be useful for examining and organizing many radiological events over the span of weeks or months.
- **Send by email** – This lets you send the ensemble of data associated with the event to a Cabrera reviewer. When you select this menu option, you’ll be presented with a brief series of messages about the status of collecting and emailing the files; this process shouldn’t take more than about ten seconds.

Note: As of this writing (2020-July), the email is configured so as to come through a Cabrera email server account at **instrumentation@cabreraservices.com** so that when the targeted recipient/reviewer receives the emailed data, the “From:” address on that email will be this address.

Note: The exact data that is sent via email will depend on the type of count and what analysis has already been done on-board the Spir-Ace prior to sending the email. In particular, to ensure that the email includes a Genie2K CNF spectrum file, you must associate a calibration geometry with the event. You can do this in two ways

- Using the wireframe cube button within the Analysis Window “Text” field as described above.
- Using the “Genie Xport Geometries” menu selection described below.

- **Delete** – This will delete the current event from the list of events; you will be asked to confirm this operation before it’s actually deleted.

- **Genie Xport Geometries** – This allows you to associate a calibration with the event. When you select this menu option, you will be presented with a list of calibration files stored on-board the instrument. Select the calibration you want and tap the “Export” button at the bottom of the list.

Note: You can also perform this operation using the wireframe cube button in the Analysis Window “Text” field as described above.

Note: If you want to email the event to a Cabrera reviewer as a Genie CAM file, you must associate a calibration with the event. Failure to do so will result in an incomplete dataset being emailed.

Other auxiliary procedures elsewhere in this document that may be helpful are:

- **Section 7.5.2**, “How to Set the Nuclide Library for Live NID”
- **Section 7.5.7**, “How to Change or Edit the Email Addresses to Send Emailed Data to”
- **Section 7.6**, “Advanced Setup – Creating Custom Calibrations (On a Laptop)”

7.4.8 How to Backup Spectrum Data to a Laptop via USB

There are two ways to get spectrum data from the Spir-Ace. One way is to email the data as described in the previous section; this offers a very quick in-the-field turnaround but isn’t the fastest way to transfer a large number of spectra at once. The other way is to copy the files off in bulk, which is described here.

Note: All collected spectra are saved on the Spir-Ace as Genie2k .CNF files. However, by default, these .CNF files do not have an energy/shape calibration or an efficiency calibration. They can still be copied off via USB, but it will be necessary to perform the calibrations on the laptop. Alternatively, if you associate a Spir-Ace geometry with the count data (either via the Genie Xport Geometries menu item in the Analysis Window, or via the wireframe cube button in the Analysis Window “Text” field, both of which are described in the previous section).

Make sure the Spir-Ace is powered on.

Using the supplied USB cable connect the computer to the Spir-Ace. The USB connector on the Spir-Ace is on the right-side panel of the instrument; there is a small rubber plug sealing the connector.

Once the laptop connects and communicates with the Spir-Ace as a USB drive, navigate to the folder

SPIR-Ace : SD card : \SPIR-App\Genie Xport

All the Genie2k .CNF files are stored there, with timestamped file names and can be copied to the laptop or deleted as desired.

7.5 Utility and Setup Operations (On-Board the Spir-Ace)

Nearly all of these operations entail navigating through the Main Menu on the left side of the screen. The easiest way to bring up the Main Menu is to use your fingertip or a stylus, tap and hold on the left-hand edge of the screen, and then drag right.

Generally, if you change a parameter in one of the screens, you can either cancel or accept by tapping “Cancel” or “OK,” and this will dismiss the parameter screen and return you to the operating display screen.

To back out of the menu structure, tap the left arrow in the top left corner of the screen; each tap will back out one level of the menu tree.

Access to many of these options require that you be logged onto the Spir-Ace instrument as an “Expert” user. To do this, navigate through the menu chain

Main Menu : User (current user)

This brings up a list of user levels to choose from. Tap the “Expert” user to enable that level of access.

7.5.1 How to set the preset count time

From the Main Menu, navigate through the menu chain

Main Menu : More… : Spectrum Acquisition : End time condition

From here, use the slider or the +/− buttons to change the count time. Tap “OK” to accept.

7.5.2 How to set the nuclide library for live NID

This lets you choose the library that is used for ongoing (“live”) NID. This library can be changed for a specific radiological event using the functionality within the Analysis Window.

From the Main Menu, navigate through the menu chain

Main Menu : More… : Active Library

From here, tap on the name of the library you wish to use.

7.5.3 How to examine the list of nuclides in the current nuclide library

From the Main Menu, navigate through the menu chain

Main Menu : More… : (Current Library Name)

Note: That “Current Library Name” is the name of the currently active library, and the specific menu text will depend on which library is currently chosen; this menu item will be the one immediately below the “Active Library” menu selection. Tap on the (Current Library Name) menu item.

From here, you can view the list of nuclides that are in the current library. Tap “OK” to dismiss the list.

7.5.4 How to create a new nuclide library or edit an existing nuclide library

From the Main Menu, navigate through the menu chain

Main Menu : More… : Identification : Libraries Management

From here, you can edit an existing nuclide library by choosing from a list of libraries currently saved on the Spir-Ace, or you can choose to create a new nuclide library. You will be presented with an interface that allows you to select or deselect nuclides to include in the library being edited. You can cancel out of the editor without saving your changes, or you can save the edits to the library.

7.5.5 How to set the alarm limits

This lets you set the count rate and dose rate threshold values that will generate different levels of alarm on the device.

From the Main Menu, navigate through the menu chain

Main Menu : More… : Thresholds

This opens a window where you can set various thresholds. Tap the threshold you want to change and use the slider or the +/− buttons to change the count time. Tap “OK” to accept.

7.5.6 How to set the alarm alerts (sound, flashing LED, vibration)

This lets you set how the instrument will alert you if an alarm occurs. You can have the instrument beep (and adjust the volume), flash the LED on the top panel, or vibrate.

From the Main Menu, select the Alarm Indicators menu option.

This opens a window where you can enable/disable various alarm types and set the volume of the alarm beep (if enabled).

7.5.7 How to change or edit the email address to send emailed data to

From the Main Menu, navigate through the menu chain

Main Menu : More… : Reachback : Mailing Management

This opens a window where you can add or delete email addresses to receive event data emailed from the Analysis Window. To delete an email address, tap on that address to highlight it, then tap the minus (“—") button. To add an email address, tap on the plus (“+”) button.

7.6 <u>Advanced Setup – Creating Custom Calibrations (On a Laptop)</u>

This section contains more advanced details on setting up the Spir-Ace. It describes what’s necessary to create calibration files, containing energy, shape, and efficiency calibrations, and to load via USB onto the Spir-Ace instrument.

The Spir-Ace saves .CNF files that can be opened and analyzed on a laptop with Genie2k. However, by default, the .CNF files as created do not have energy, shape, or efficiency calibrations stored in them. This has two repercussions—the

.CNF files will not be included in the event data that is emailed from the device, and the .CNF files, if copied off of the Spir-Ace via USB, will need to be calibrated within Genie2k prior to full analysis. To change this, it is necessary to associate a calibration with the event data on-board the Spir-Ace. The Spir-Ace comes with calibrations for several generic geometries; but it is also possible to create your own calibrations and copy them onto the Spir-Ace via USB.

To do this, you will need to open any .CNF file within Genie2k on your laptop. Within this file, you will need to create three calibrations:

- Energy and shape calibrations – use the Calibrate : Energy Coefficients menu option to create the energy and shape calibrations. Recommended values for both calibrations are
    - Energy = 0 + 3.0 * Channel (i.e., zero intercept, 3 keV/channel slope)
    - FWHM = 0 + 0.9 * sqrt(E) (i.e., zero intercept, 0.9 slope)
- Efficiency calibration – use the Calibrate : Efficiency : By ISOCS/LabSOCS menu option to create an efficiency calibration. Within ISOCS, pick the “Spir-Ace LaBr3” detector. Define the desired geometry, energy list, etc. as with any ISOCS calibration. Give the calibration a meaningful and unique name because the text string you enter within ISOCS will be used as the geometry label on the menu for choosing geometries on board the Spir-Ace.

Once the calibrations have been performed on the file, save the calibration data in a dedicated calibration file using the Calibrate : Store menu option.

To be recognized by the Spir-Ace on-board operating app, it is necessary that the calibration file name have the serial number of the instrument as the leading characters, and there must be no spaces in the file name. As of this writing (2020-July) Cabrera has one Spir-Ace, with Serial Number 19015119. Thus, the file name must be something like

19015119_My_Geometry_Name.CAL

Once the file has been saved with the appropriate file name, copy it onto the Spir-Ace device. Using the supplied USB cable connect the computer to the Spir-Ace. The USB connector on the Spir-Ace is on the right-side panel of the instrument; there is a small rubber plug sealing the connector.

Once the laptop connects and communicates with the Spir-Ace as a USB drive, navigate to the folder

SPIR-Ace : Internal Storage (i.e., not the SD card) : \CamConverter

Copy the calibration (.CAL) file to this location and disconnect the USB cable.

Once this operation is completed, the new calibration will be available for use on the Spir-Ace, listed within the geometry selection menu with the geometry name you supplied in ISOCS.

7.7 Map of All Side Menu Tree Items

This section lists all of the items within the menu tree accessible via the Main Menu on the left side of the screen. This is to help you quickly navigate to whatever functionality you need.

- History - brings up list of radiological events stored on the Spir-Ace; you can select events from this list to bring up the Analysis Window.
- Data Log – brings up a calendar listing of radiological events stored on the Spir-Ace; this allows you to easily navigate through a longer history of events.
- Alarm Indicators – brings up dialog to enable/disable/adjust alarm indicators
    - Sound – on/off
    - Chirp – on/off
    - Volume – brings up volume slider
    - Vibrate – on/off
    - LED – on/off
- More… - brings up the Settings menu
    - Background Update – various operations related to the stored background data
        - Start Background Level Acquisition – acquires background count rate
        - Start Background Spectrum Acquisition – acquires background spectrum
        - Background Spectrum Duration – displays/edits current background acquisition time.
    - Display – various operations and adjustments related to the visual display
        - Night Mode – on/off
        - Brightness – adjusts screen brightness
        - Sleep – displays/edits current display sleep time (i.e., display goes dark after specified duration of inactivity)
    - == Acknowledge Alarm == (this is not a menu selection, just a header on the “More…” menu).
    - Show acknowledge alarm popup – on/off (turns on/off a popup window if an alarm occurs)

- Display time of the acknowledge popup – displays/edits displays current acknowledgement time for an alarm popup
- == Measurements on Top Panels == (this is not a menu selection, just a header on the “More…” menu)
- Gamma measurements – displays the gamma measurement types that appear on the main display screen
- Neutron measurements - displays the neutron measurement types that appear on the main display screen
- Measurement units – displays/edits the current units for main display screen measurements
- Trend curve autoscaling – on/off
- == Advanced == (this is not a menu selection, just a header on the “More…” menu).
- Active Library – brings up menu of defined on-board nuclide libraries to choose from for use during “live” nuclide identification
- [Menu item showing current nuclide library name] – brings up a list of the nuclides included in the current nuclide library.
- Thresholds – various options to view and set the current thresholds for detection, high alarm, and danger alarm
  - Gamma detection threshold (this is not a menu selection, just a header on the “Thresholds” menu)
  - Sigma (displays current gamma detection threshold in N-sigma) – brings up slider to adjust the current gamma detection threshold as an N-sigma value above stored background
  - Relative Dose Rate Threshold (displays current gamma relative dose rate threshold) - brings up slider to adjust the current gamma detection threshold as a dose rate value
  - Gamma High Alarm Threshold (this is not a menu selection, just a header on the “Thresholds” menu)
  - There are two menu selections — Sigma and Relative Dose Rate — that function the same as described above under the Gamma Detection Threshold adjustments.
  - Gamma Danger Threshold (this is not a menu selection, just a header on the “Thresholds” menu)

    - Protection Dose Rate Threshold (displays current gamma protection dose rate threshold) - brings up slider to adjust the current gamma protection threshold as a dose rate value
    - Neutron Danger Threshold (this is not a menu selection, just a header on the “Thresholds” menu)
    - Protection Count Rate Threshold (displays current neutron protection count rate threshold) - brings up slider to adjust the current neutron protection threshold as a count rate value

  - Spectrum Acquisition – various operations related to when and how the Spir-Ace instrument acquires and stores spectrum data

    - Sliding Period (displays current value) – brings up slider to adjust the current “sliding window” integration time
    - Start Acquisition Condition (displays current value) – brings up a radio button to choose the condition under which the Spir-Ace will initiate preset spectrum acquisition. Choices are
      - Manual only – spectrum acquired only when the user initiates it
      - Manual, detection, and high alarm – spectrum acquired upon user initiation or upon detection or high alarm event
      - Periodic – spectrum acquired automatically at regular time intervals
    - End Acquisition Condition (displays current value) – brings up a radio button to choose the condition under which the spectrum acquisition will end. Choices are
      - Time – spectrum acquisition will go for a preset elapsed time
      - Counts – spectrum acquisition will go until a preset total count are obtained
    - End Time Condition (displays current value) – brings up slider to adjust the elapsed preset time
    - End Count Condition (displays current value) – brings up slider to adjust the preset total counts

  - Expert (this is not a menu selection, just a header on the “More…” menu).

  - Energy stabilization

    - Forced Manual Gain (this is not a menu selection, just a header on the “Energy stabilization” menu)

    - Enable – on/off switch to enable manual gain adjustment
    - Manual gain value – brings up slider to adjust the manual gain value.

- Identification – various functions related to NID

    - Background Subtraction – on/off switch to turn on background spectrum subtraction
    - SNM Qualification – on/off switch to turn on special flagging if SNM nuclides are identified
    - Min Confidence Level Criteria – brings up slider to adjust the sensitivity of the NID algorithm
    - Libraries Management - brings up window to create/delete/edit new nuclide libraries
- Calibration – various functions related to the energy calibration, and the response of the instrument
    - Fast Calibration – brings up fast calibration window, which walks the user through a quick calibration, assumes the instrument is already calibrated and only needs “minor adjustment” to the calibration
    - Full Calibration – brings up full calibration window, which walks the user through a full calibration, performs a “from scratch” complete recalibration of the instrument
    - Gamma Dose Rate Calibration – brings up slider to adjust the relationship between a measured gamma count rate and a known dose rate
    - Neutron Dose Rate Conversion – brings up a slider to adjust the relationship between a measured neutron count rate and a known dose rate
- Management (this is not a menu selection, just a header on the “More…” menu).
- Date Time – brings up Android system dialog to set/adjust the system date and time
- Language – brings up Android system dialog to set/adjust the system language
- Radar Calibration – brings up Android system dialog to calibrate the on-board accelerometer
- Battery – allows choice to “end battery maintenance”
- Wireless – various operations related to wireless communication
    - Wi-Fi – brings up Android system dialog to set/adjust the Wi-Fi network communications

    - Mobile Data (this is not a menu selection, just a header on the “Wireless” menu).
    - Enable – switch to turn on/off mobile (cell) communications
    - SIM
    - Mobile Network
  - Users Management – allows configuration of different access levels for the device; it’s possible to restrict access to more advanced configuration features (e.g., “Expert” user access) via password etc.
  - Reachback – various operations related to sharing of radiological event data with external/off-site reviewers
    - Mailing Management – brings up window to define default email targets to whom to send event data when operator chooses to email data. Can set domain etc. As of this writing (2020-July) the server address (i.e., appears as the “from” email address in any data emailed out) is: instrumentation@cabreraservices.com
    - RadResponder settings – brings up window to adjust settings related to the RadResponder (US DHS/FEMA) reachback program.
  - Data Management – brings up listing/map of data and storage usage and availability on the Spir-Ace instrument
  - Supervision
    - Data Sending Period
    - No Alarm – brings up slider to adjust interval for automatic sending of data during periods of no alarm
    - During Alarm – brings up slider to adjust interval for automatic sending of data during periods of alarm
    - Supervision Service – brings up radio button to choose data transfer and supervision service. Choices are
      - None
      - SpirView mobile
      - FTP server
- Remote Display – information and settings related to tethering the Spir-Ace instrument with a smart phone or tablet running a dedicated Genie / Spir-Ace app
- User (displays current user logged in) – brings up menu to choose current user (access level)

- Shutdown Device – shuts down the Spir-Ace
- About – displays information about Android revision, firmware revision, etc.

7.8 Note on Positioning and Geometry for Field Measurements

Whenever possible, the Spir-Ace will be configured by the Project Health Physicist (HP), Subject Matter Expert (SME), or Nuclear Measurements Program Lead (NMPL) prior to shipment to the job site for use/deployment. This means that the instrument will have already been energy-calibrated, an appropriate nuclide library will have been configured and selected as the default library for use during analysis, and an appropriate suite of geometries (efficiencies) will have been loaded onto the device. The specific details of the library and geometries will depend on the specific requirements of the job; however, there are some typical configurations that are commonly used and applicable for many jobs.

There are two fundamental types of measurements that will be performed with the Spir-Ace. Which type of measurement to perform will depend on what radiological questions will be answered by the results of the Spir-Ace measurement.

- Identification measurement
  - What radionuclides are present in my sample?
    - It's important to have a good nuclide library to achieve reliable identification. See **Sections 7.5.2, 7.5.3,** and **7.5.4** for information on selecting, reviewing, and editing nuclide libraries on the Spir-Ace.
    - The geometry (efficiency) isn't as important for analysis.
- Quantification measurement
  - What radionuclides are present in my sample?

    It's important to have a good nuclide library to achieve reliable identification. See **Sections 7.5.2, 7.5.3,** and **7.5.4** for information on selecting, reviewing, and editing nuclide libraries on the Spir-Ace.
  - How much activity is present in my sample?
    - It's important to have a good geometry (efficiency) to achieve reliable quantification. See **Section 7.4.7** for information on assigning a pre-defined geometry to a particular set of measurement data.
    - The information below describes the most common counting situations and the pre-defined geometries stored on the Spir-Ace.

The data acquisition steps are the same for both types of measurement, but the post-acquisition analysis, driven by the radiological questions described above, will provide different results from the Spir-Ace measurement.

Apply one of the following default geometries whenever practicable. Consult the Project Health Physicist or SME for projects and measurements where default geometries are not applicable.

- Measuring a patch of ground (soil, sand, gravel).
    - A typical example of this is using the Spir-Ace to adjudicate a “hot spot” on the ground that has previously been located during a walk-over survey with a simpler hand-held instrument or with the CLASS.
    - Position the Spir-Ace over the patch of ground (“hot spot”) so that the detector points downwards towards the ground, axis of the detector is perpendicular to the ground, front face of the detector is parallel to the ground, front face of the detector is 30 cm above the ground.
    - Geometry pre-loaded on the Spir-Ace is “19015119_GroundPatch_30cm.CAL”
    - HP notes – this geometry assumes a 60 cm diameter, 15 cm deep cylinder of activity in soil at a density of 1.5 g/cm^3.
- Measuring a patch of hard surface (concrete, asphalt).
    - A typical example of this is using the Spir-Ace to adjudicate a “hot spot” on a hard surface such as concrete or asphalt that has previously been located during a walk-over survey with a simpler hand-held instrument or with the CLASS.
    - Position the Spir-Ace over the patch of concrete or asphalt so that the detector points towards the surface, axis of the detector is perpendicular to the surface, front face of the detector is parallel to the surface, front face of the detector is 30 cm from the surface.
    - Geometry pre-loaded on the Spir-Ace is “19015119_ConcretePatch_30cm.CAL”
    - HP notes – this geometry assumes a 60 cm diameter, 2 cm deep cylinder of activity in concrete at a density of 2.5 g/cm^3.
- Measuring a small volume (roughly 1 quart or 1 liter) of material.
    - A typical example of this is using the Spir-Ace to adjudicate a “hot object” (e.g., a radium deck marker) that has been excavated after having been previously located with a simpler hand-held instrument or with the CLASS. The hot object may be broken, rusted, leaking, or otherwise compromised, so it’s necessary to dig up not only the object but some of the surrounding material (soil, sand, gravel, asphalt, or liquid). This is then placed in a plastic container (resembling a restaurant take-out container) for containment and assay.
    - Another example is using the Spir-Ace to assay a small volume of potentially contaminated material that’s a representative sample of a larger body of material.

- Collect a sample of the material and place it in a 1 quart or 1 liter plastic container. Typical dimensions of such a container are roughly 4.25” diameter X 4” tall.
- Position the Spir-Ace so the detector points upwards and position the sample container so that it rests centered on the front face of the detector.
- Geometry pre-loaded on the Spir-Ace is “19015119_1L_Container_OC.CAL”
- HP notes – this geometry assumes a 10.8 cm diameter X 11 cm deep polyethylene container (wall thickness 0.15 cm) filled with soil at a density of 1.5 g/cm^3. The container is placed in contact with the face of the Spir-Ace.

- Measuring a small object.

  - A typical example of this is using the Spir-Ace to assay a potentially radioactive object that has been excavated and separated from its surrounding material.
  - Using gloves and appropriate radiological controls, separate the object to be measured from any surrounding material or remove the object from the surrounding soil.
  - Place the object (e.g., a radium deck marker, vial, pieces of metal or wire, small volume of material) in a plastic bag or container. Objects should not exceed 3 inches for the largest dimension.
  - Position the Spir-Ace so the detector points upwards and position the sample item so that it rests centered on the front face of the detector.
  - Geometry pre-loaded on the Spir-Ace is “19015119_SmallObject_OC.CAL”
  - HP notes – this geometry assumes a 7.5 cm diameter, 1 cm thick disk of concrete at a density of 2.0 g/cm^3, placed in contact with the face of the Spir-Ace.

- Measuring a 55-gallon drum of debris or individual objects.

  - A typical example of this is using the Spir-Ace to perform an overall quantification of debris or objects contained in the drum, nearly always for shipping or disposal purposes.
  - Position the Spir-Ace so the face of the detector is in contact with the side of the drum at the mid-height of the drum.
  - NOTE: If the drum is not 100% full, position the Spir-Ace at the mid-height of the actual waste in the drum.
  - If possible, perform three or four measurements at equal intervals spaced around the periphery of the drum so that the results can be averaged in

post-analysis. This will give a more accurate picture of the contents of the drum.

- Geometry pre-loaded on the Spir-Ace is “19015119_55GalDrum_OC.CAL”
- HP notes – this geometry assumes a standard 55-gallon drum 90% full of soil with a density of 2.0 g/cm^3 with the Spir-Ace in contact with the side of the drum.

8.0 REFERENCES

- Cabrera OP-4201 – *Operating Procedure for Non-Destructive Assay Measurements Program* (i.e., the NDA Measurements Program Quality Systems Manual).
- Canberra. 2000. Model 1300 Inspector 2000 Hardware Manual. Canberra Industries, Meriden, CT.
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- Canberra. 2002b. Model S573 ISOCS Calibration Software User’s Manual. Canberra Industries, Meriden, CT.
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9.0 RECORDS

- Daily QC Reports
- Weekly QC Trend Graph Plots
- Logbooks

10.0 ATTACHMENTS

None.

GSI ENVIRONMENTAL

SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)

End of Buchanan Street

Albany, California

APPENDIX C

ESFS-FO-PR-3110 Surface Soil Sampling

OPERATING PROCEDURE

FOR

SURFACE SOIL SAMPLING

OP-3110

(FORMERLY OP-351)

Revision 1.0
April 2021

Level of Use:
Information Use

APPROVALS	
President	*R. Flowers, PMP, CHMM*
Quality Assurance	*S. Liddy, CSP*
Health Physics	*M. Winters, CHP*
This procedure is the property of Cabrera Services Inc. and is considered approved and effective for the duration it is posted electronically to the Controlled Copy Document Repository.	

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History of Revisions		
Revision	**Month-Year**	**Description**
0	May 2012	OP-351 - Initial issue.
1.0	April 2021	Substantial (major) revision to update overall program elements to latest regulations, guidance, and industry practices. Formatting and renumbering per OP-2001. Renumbered to OP-3110. Subject Matter Experts for this revision are Dr. Brian Tucker and Ted Toskos, PG.

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1.0 PURPOSE

This procedure provides the methods that personnel will use when sampling surface soil. Adherence to this procedure will provide assurance that the analyses performed have accurate and reproducible results.

2.0 SCOPE/APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations. Personnel will utilize this procedure to sample surface soil for laboratory analysis unless otherwise directed through the Project Work Plans (WPs) [e.g. Field Sampling Plan (FSP), or Quality Assurance Project Plan (QAPP)]. Personnel must assure that the specifications of this OP agree with the specifications listed in the Project WPs. .

3.0 DEFINITIONS

3.1 Bucket Auger – Bucket augers (Exhibit 1) consist of a stainless steel "T" handle, detachable handle extensions, a helical cutting head and a bucket to collect the cuttings. They are an excellent choice for sample collection because they provide a relatively large sample volume in a short time and can sample discrete depth intervals. They are the recommended hand sampler for subsurface soil sampling beyond a depth of 6 inches to one foot.

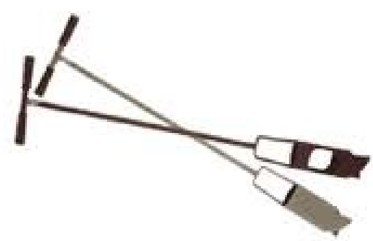

Exhibit 1: Bucket Augers

3.2 Post-Hole Digger – Post-hole diggers (Exhibit 2) have limited utility for subsurface soil sample collection because they are designed to cut through fibrous, rooted, and rocky soils. They cannot be utilized below a depth of approximately three feet.

Exhibit 2: Post-Hole Digger

3.3 Sampling Station – The exact spot from where the sample will be collected.

3.4 Seven Sample Wheel Method – A composite sampling method designed to determine the average concentration representative of the soil at a specific location.

3.5 Surface Soil – The uppermost layer of unconsolidated material at the ground surface. Unconsolidated material that is normally under water is considered sediment rather than soil. Wetlands, which don't have water at the ground surface for most of the year, have hydric soil, while marshes, which do have surface water for most of the year, have sediment.

For the purposes of environmental sampling, the thickness of the surface soil layer is typically designated by an applicable regulation. For example, in Pennsylvania and New York, surface soil is defined as extends extending from ground surface to two feet below ground surface. The Nuclear Regulatory Commission regards the upper 15 centimeters [6 inches] as the surface soil layer. Some projects define surface samples in different ways; verify the appropriate sampling horizon based on site/client-specific definitions of surface and subsurface samples in applicable work plans or as directed by the PM/FSM.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM) – The PM ensures that personnel are adequately trained in the use of this procedure and have access to a current copy (available on CCDR). The PM Provides the environmental scientist or technician with the specific scope of work for the monitoring event and will also provide the historical data necessary to inform the scientist or technician as to the conditions to expect.

4.2 Field Site Manager (FSM) – The FSM is responsible for: the execution of field activities in coordination with the PM; correctly applying the well construction, inspection and decommissioning guidance within this OP and entering information into the field notebooks.

4.3 Project Geologist/Lead Environmental Scientist – The Project Geologist, or Lead Environmental Scientist, is responsible for reading, understanding, and complying with the provisions of this procedure, and any state, or other regulatory requirements for the activities in this procedure. Any deviations from the prescribed protocols established with the project work plans shall be discussed with the PM and FSM, and changes documented in the project field notebook.

4.4 Project Personnel - Under the direction of the FSM, responsible for reading and complying with the provisions of this procedure. They must also be familiar with the Site Safety and Health Plan (SSHP) and the Project Work. Any deviations from the prescribed protocols established with the project work plans shall be discussed with the PM and FSM, and changes documented in the project field notebook.

5.0 PRECAUTIONS, LIMITATIONS AND PREREQUISITES

5.1 Precautions

The potential exposure to contaminants should be addressed in the SSHP and/or AHA, specifically the sections concerning personal protective equipment and respiratory protection. At a minimum, an unused pair of nitrile gloves will be donned prior to sampling at each station.

Sample media may contain residual radioactivity at sites were radionuclides are known/potential concerns. When radiological hazards are suspected, sampling must be done in accordance with the radiological elements of the SSHP/work plan or, for licensed activities, in accordance with the applicable Radiation Protection Program requirements – Consult with the RSO for guidance when radiological concerns may be present

Contact the State 'One Call' or 'Call-before-you-dig' service (dial 811 in most states) at least 48 hours in advance to have underground utilities marked. State regulations vary on the minimum excavation depth where prior notification is required, and site elevations can change over time, so locator services advise to contact them for line marking before any intrusive work regardless of depth. Use 'One Call' regardless of depth of sampling to limit liability.

"One Call" addresses only public utilities in public right-of-way. Some utilities (e.g. municipal sewers) do not participate in the "One Call" system. Invidual connections and private utilities on private property (e.g. underground conveyance lines at a factory site) will not be marked by "One Call". Engage the services of a private utility locator for these cases per accordance with OP-5608, Utility Clearance Isolation.

Samples suspected of containing high volatile organic compound (VOC) concentrations will be collected, handled and stored separately.

Samplers must use new, verified/certified-clean disposable or non-disposable equipment cleaned according to procedures contained in OP-3801 *Field Equipment Decontamination*, or otherwise as specified in the work plan.

5.2 Limitations

Certain options must be selected in advance. They include:

- Specify the sample depth interval, which is typically from 0 to 6 inches but may vary to a maximum depth of one to two feet. Certain analytical fractions (e.g. volatile organic compounds) are typically collected 18 to 24 inches below grade. Any such limitations should be defined in the sampling plan.If the station will be sampled as a discrete (or 'grab') sample or as a composite, in which case the 'seven sample wheel' method should be used.
- The method by which the sample will be collected (e.g. hand auger, geoprobe, hand trowel, etc).
- If the sample depth interval will be biased (based on field meter readings) or systematic (based on a pre-determined depth interval).

Determine whether there is conflicting client guidance with this method. Certain state regulations may prohibit the compositing of samples, while other state guidance has specific guidelines beyond the scope of this SOP. Federal guidelines for PCB sampling have specific requirements that are beyond the scope of this SOP.

5.3 Prerequisites

Review the project work plans (typically the Field Sampling Plan, Quality Assurance Project Plan, and Site Specific Health and Safety Plan). Equipment decontamination should be addressed in the work plans, which may reference OP-3801 *Field Equipment Decontamination*. Disposition of Investigation Derived Waste (IDW) must also be considered in the work plans, which may reference OP-3704 *Investigation Derived Waste Management*.

6.0 EQUIPMENT

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the required sample type (disturbed vs. undisturbed), and the soil type. Near-surface soils may easily be sampled using a spade, trowel, or scoop. Sampling at greater depths may be performed using a hand auger, or by direct-push technology. Soil sampling equipment may include the following:

- Sampling plan
- Maps/plot plan
- PPE
- Survey equipment
- Tape measure
- Survey stakes or flags
- Camera and film
- Stainless steel bowls
- Sample containers (usually provided by the analytical lab)
- Ziploc plastic bags
- Logbook
- Labels
- Chain-of-custody form
- Field data sheets
- Cooler(s)
- Ice (for most non-radiological samples)
- Vermiculite and/or bubble wrap
- Decontamination supplies and equipment
- Plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel
- Sampling wheel (see Figure 2-1)
- Bucket auger
- Post-hole digger

7.0 INSTRUCTIONS/PROCEDURE

7.1 General Requirements

7.1.1 The work plans should specify which of the three following methods will be used to acquire surface soil samples.

- Spoon sampling is an efficient method for collecting loose soils from the upper six inches. Spoon sampling is not appropriate for sampling volatile organic compounds.

- Auger sampling allows more precise collection of surface samples at greater depth and where soils are more consolidated.
- The Seven Sample Wheel Method is preferable when contaminants are suspected of being heterogeneously distributed at the sample point.

7.1.2 Reused equipment must be decontaminated between each use. Determine in advance whether single-use or decontaminated equipment will be used.

7.1.3 Unused sample may be returned to the sample hole from which it came unless otherwise directed by the work plans.

7.1.4 Always proceed from the least contaminated to the most contaminated station when sampling surface soil to minimize the potential for cross-contamination.

7.1.5 All sampling locations will be documented with a temporary marker so that sampling locations can be properly mapped.

7.1.6 All samples will be logged for lithology and other relevant information, such as evidence of contamination using Attachment A.

7.1.7 In most cases, samples will be homogenized after retrieval (except for VOC sampling). To improve the quality of the homogenized sample, follow the compositing considerations offered in *ASTM D6051-15 Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities*. Two possible homogenization options to consider for soil are the cone and quarter technique or use of a riffle splitter.

7.2 <u>Spoon Sampling</u>

7.2.1 Place a sheet of plastic on the ground near the sample station to work on.

7.2.2 Remove vegetation at the sample station by cutting or scraping it away with a pre-cleaned stainless steel trowel.

7.2.3 Use a pre-cleaned stainless steel spoon or trowel to scoop out a cylindrical sample of the soil to a depth of 6 inches (or to the depth specified in the work plans).

7.2.4 If sampling for VOCs, take a field reading for VOCs, using a PID or FID, and collect 5 grams of soil using an Encore™ sampler.

7.2.5 For sampling all other analytes, place the soil sample into a plastic bowl (if dedicated) or stainless steel bowl (which must be cleaned between uses). Take readings from the sample using the field meters specified in the work plans. Remove vegetation and stones larger than 1.25 inches (32 mm). If the sample consists of 30% or more of stones larger than this, consult with the PM. Do not sample surface cover materials, such asphalt or concrete, unless directed.

7.2.6 Mix the soil thoroughly to obtain a homogeneous, representative sample.

7.2.7 Using pre-cleaned stainless steel equipment or a disposable scoop, fill sample container(s). Wipe soil away from the lip and threads of the container and secure the cap(s).

7.2.8 Label the container, prepare Chain-of-Custody form and document your observations in the field logbook.

7.3 Auger Sampling

7.3.1 Place a sheet of plastic on the ground next to the sampling station to work on.

7.3.2 Use a pre-cleaned bucket auger or post-hole digger to remove a cylindrical sample of the soil throughout the specified sample interval.

7.3.3 A VOC sample may be collected from the middle of the depth interval. Take a PID or FID reading and collect 5 grams of soil using an Encore™ sampler.

7.3.4 Place the soil sample into a plastic bowl (if dedicated) or stainless steel bowl (which must be cleaned between uses). Remove vegetation and stones larger than 1.25 inches (32 mm). If the sample consists of 30% or more of stones larger than this, consult with the PM. Do not sample surface cover materials such asphalt or concrete unless directed.

7.3.5 Mix the soil thoroughly to obtain a homogeneous sample that represents the entire surface soil interval.

7.3.6 Using pre-cleaned stainless steel equipment or a disposable scoop, fill sample container(s). Wipe off the lip and threads of the container and secure the cap(s).

7.3.7 Label the container, prepare Chain-of-Custody form, and document your observations in the field logbook.

7.4 Seven Sample Wheel Method

7.4.1 Sampling wheels must be prepared in advance (Exhibit 3). These consist of templates cut from a plastic sheet or other impermeable material.

7.4.2 Place the sampling wheel over the sampling station so that the station aligns with the center hole of the wheel.

7.4.3 For VOC sampling, collect 5 grams of soil from each of the 7 substations of the sampling wheel using an Encore™ sampler. These subsamples must be mixed in the laboratory.

7.4.4 Proceed with the steps for either spoon sampling or auger sampling, except that all aliquots from seven substations are placed into the bowl. Each aliquot must have the same volume.

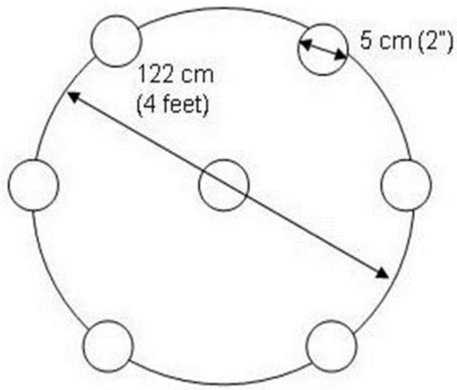

Exhibit 3: Sampling Wheel

7.4.5 Thoroughly mix the soil, removing vegetation and rocks larger than 1.25 inches. If the sample consists of 30% or more of stones larger than this, consult with the PM. Do not sample surface cover materials such asphalt or concrete unless directed.

7.4.6 Using pre-cleaned stainless steel equipment or a disposable scoop, fill sample container(s). Wipe off the lip and threads of the container and secure the cap(s).

7.4.7 Label the container, prepare a Chain-of-Custody form, and document your observations in the field logbook.

8.0 REFERENCES

- Cabrera OP-3704, *Investigation Derived Waste Management*
- Cabrera OP-3801, *Field Equipment Chemical Decontamination*
- Cabrera *OP-5608, Utility Clearance Isolation*
- *ASTM D6051-15, Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities*.

9.0 REQUIRED RECORDS

- Field Log Book
- Field Data Record – Surface/Subsurface Soil Sampling
- Chain-of-Custody forms

10.0 ATTACHMENTS

Attachment A – Field Data Record Surface/Subsurface Soil Sampling (Example)

Attachment A

Field Data Record
Surface/Subsurface Soil Sampling

CABRERA SERVICES
RADIOLOGICAL • ENVIRONMENTAL • REMEDIATION

FIELD DATA RECORD
SURFACE / SUBSURFACE SOIL SAMPLING

PROJECT ______________________ JOB NUMBER ______________ DATE ___________

LOCATION ID ______________ ACTIVITY TIME START ________ END ________ CONTAINER TIME __________

FIELD SAMPLE ID ______________________ QC SAMPLES COLLECTED ______________________

SAMPLE DATA

DEPTH OF SAMPLE __________ FT (BGS)

TYPE OF SAMPLE:
- ☐ DISCRETE
- ☐ COMPOSITE

TYPE OF SOIL:
- ☐ ORGANIC
- ☐ SAND
- ☐ GRAVEL
- ☐ CLAY
- ☐ OTHER

LOCATION COORDINATES

____

EQUIPMENT INFORMATION

EQUIPMENT USED:
- ☐ HAND CORER / AUGER
- ☐ S.S. SPOON
- ☐ S.S. SHOVEL / TROWEL
- ☐ S.S. SPATULA
- ☐ GEOPROBE
- ☐ OTHER __________

DECON FLUIDS USED:
- ☐ DI WATER N2 PURGE
- ☐ POTABLE WATER
- ☐ LIQUINOX SOLUTION
- ☐ OTHER ______________

RINSATE BLANK ID ______________

RADIOLOGICAL MEASUREMENTS AT SAMPLE LOCATION

BEFORE SAMPLE COLLECTION __________ cpm

AFTER SAMPLE COLLECTION __________ cpm

DETECTOR
Type: ______________
Serial No.: ______________

METER
Type: ______________
Serial No.: ______________

SAMPLE OBSERVATIONS (e.g., location, texture, color, odor, etc.)

SAMPLE ANALYSES

	PARAMETER	METHOD NUMBER	PRESERVATION METHOD	BOTTLE TYPE/ VOLUME REQUIRED	SAMPLE COLLECTED
☐	DEPLETED URANIUM (GAMMA SPEC)	EPA 901.1M	None	1 @ 16 oz. plastic	☐
☐					☐
☐					☐
☐					☐
☐					☐

NOTES

SAMPLED BY: ______________________________

RECEIVED BY: ______________________________

GSI Job No: 10008

SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)

End of Buchanan Street

Albany, California

APPENDIX D

ESFS-FO-PR-3801 Field Equipment Decontamination

ESFS-FO-PR-3801

Field Equipment Decontamination

Revision 0

Authored By:	Signature on File	6/4/2024
	Brian Naidus, ESFS Project Manager	Date
Reviewed By:	Signature on File	6/4/2024
	Greg Bright, ESFS Project Manager	Date
Approved By	Signature on File	6/4/2024
	Sean Liddy, ESFS H&S/QA Manager	Date

☒ Non-Proprietary
☐ Proprietary
☐ Restricted Information
☐ Safeguards Information
☐ Sensitive Security Information

Level of Use
☒ Information
☐ Reference
☐ Continuous

☒ New
☐ Title Change
☐ Revision
☐ Rewrite
☐ Cancellation

Effective Date 6/4/2024

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History of Revisions		
Revision	**Month-Year**	**Description**
0	June 2024	ESFS-FO-PR-3801 Rev0 - Initial issue.

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1.0 PURPOSE

The purpose of this Operating Procedure (OP) is to provide Energy*Solutions* Federal Services (ESFS) personnel with the guidance on implementing standards to be followed by field personnel conducting equipment decontamination.

All personnel responsible for environmental sampling are expected to know and understand the procedures outlined in this OP and to have a clear understanding of the objectives of each program so that deviations, when necessary, will be based on sound scientific judgment and program demands.

2.0 APPLICABILITY

The procedures presented here are applicable to the decontamination of field equipment. The methods may be modified by project-specific requirements. Client guidance and regulatory requirements will take precedence over the specifications in this procedure and shall be outlined in the Project Plans.

3.0 DEFINITIONS

3.1 IDW – Investigation Derived Waste

3.2 Project Plans - For the purposes of this procedure, a generic term describing the project implementing plans that contain the information associated with the requirements for monitoring well installation, inspection and decommissioning. These include, but are not necessarily limited to:

3.2.1 Project Work Plan (PWP) - The over-arching project plan used to manage both project execution and project controls. A primary use is to document planning assumptions and decisions including quality assurance and quality control (QA/QC) measures regarding data gathering and deliverables.

3.2.2 Field Sampling Plan (FSP) - Provides specific directions for conducting each separate field sampling activity and presents the rationale and design, for the work, as well as the field procedures for each specific activity required. Field operations and documentation are also described and may include discussions on field logbooks, photographic records, sample documentation, field analytical records, and procedures for their management and retention.

3.2.3 Quality Assurance Project Plan (QAPP) - Focuses primarily on the analytical methods and QA/QC procedures that are used to analyze and manage environmental samples and their resulting data. The QAPP also presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with sampling, data management and record retention.

3.2.4 Site Safety and Health Plan (SSHP) – Provides evacuation routes for the site and immediate area; site-specific safety information; Safety Data Sheets for any relevant chemicals of concern; and names and telephone numbers of common emergency contact personnel for the worksite. In addition, the SSHP may also contain decontamination methods and sampling activities required to monitor worksite safety and health.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water must be used from a known municipal or industrial water treatment system, and confirmation samples are required.

4.1.2 Reagent-Grade II Water, methanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or Teflon containers. These containers shall have Teflon caps or cap liners. Field personnel must assure that these materials remain free of contaminants. If any question of purity exists, new materials will be used.

4.1.3 Physical methods involving high pressure and/or heat should be used only as necessary and with caution since they can spread contamination and cause burns.

4.1.4 Know project-specific scope of investigation and the site specific decontamination methods outlined in the SSHP.

4.1.5 Be aware of waste disposal concerns for waste-water generated from the decontamination process.

4.2 Limitations – There are no special limitations associated with this procedure.

4.3 Requirements

4.3.1 The Field Site Manager (FSM) and the Project Geologist or Lead Environmental Scientist must understand the IDW sampling requirements outlined in the FSP and communicate any deviations to those sampling protocols with the PM.

4.3.2 Personal Protective Equipment (PPE), including any required respiratory protection, worn by personnel involved in decontamination activities shall be determined in accordance with the SSHP.

4.3.3 Decontamination cleaning solvent/solutions shall only be used in accordance with the directions and limitations listed on the manufacturer supplied Safety Data Sheet (SDS).

5.0 EQUIPMENT

- Long and short handled brushes
- Bottle brushes
- Drop cloth/plastic sheeting
- Paper towels
- Plastic or galvanized tubs or buckets
- Pressurized sprayers (H2O)
- Steam generator
- Solvent sprayers
- Aluminum foil
- Trash bags
- 55-gallon drums
- Tap water
- Alconox
- ASTM Type II Reagent Water
- Methanol and hexane
- Personal Protective Equipment (PPE)

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – The PM is responsible for the ensuring that personnel are adequately trained in the use of this procedure, and have access to a current copy (available on CCDR).

6.2 Field Site Manager (FSM) – The FSM is responsible for the execution of field activities; correctly applying the field equipment decontamination guidance within this OP, and entering information into the field notebooks.

6.3 Project Personnel - All project personnel involved in field equipment decontamination activities are responsible for reading, understanding, and complying with the provisions of this procedure. Any deviations from the prescribed protocols established with this OP and the project work plans shall be discussed with the PM and FSM, and changes documented in the project field notebook.

7.0 PROCEDURES

The following sections outline the proper procedures used to decontaminate sampling and drilling devices, such as split spoons, bailers, and augers that can be hand-manipulated, as well as larger pieces of equipment, such as trucks and excavators, used during remediation activities.

7.1 Contamination Reduction Corridor Set-up

A site is typically divided up into the following boundaries: Exclusion Zone (EZ), the Contamination Reduction Zone (CRZ), and the Support or Safe Zone (SZ). The decontamination line should be setup in the CRZ, and should be referred to as the Contamination Reduction Corridor (CRC). The CRC controls access into and out of the exclusion zone and confines decontamination activities to a limited area.

The CRC boundaries should be conspicuously marked. The far end (closest to the EZ) is the equipment drop zone, located just inside of the hotline (the boundary between the EZ and the CRZ). The size of the CRC depends on the number of stations in the decontamination process, overall dimensions of the work zones, and amount of space available at the site. Whenever possible, it should be a straight line. Anyone in the CRC should be wearing the level of protection designated for the decontamination crew.

7.2 Decontamination Methods for Field Sampling and Small Equipment

All equipment will be brought to the designated equipment drop zone in preparation for decontamination. The decontamination of most smaller sized equipment and tools, including field sampling supplies, can be accomplished using a series of 5-gallon buckets or catch pans to collect/hold rinse water and debris.

This method relies on the use of surfactants and chemicals to neutralize, dissolve or degrade the hazard of the contamination, making it less harmful through solutions, and is typically conducted in conjunction with physical removal using a brush. The following decontamination methods should be used for sampling equipment and smaller auxiliary equipment:

1. Using a designated brush, scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent.

2. Rinse the equipment with copious quantities of potable water followed by ASTM Type II Reagent Water. High-pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water.

3. Rinse equipment with pesticide-grade methanol (as required by the FSP and/or QAPP).

4. Rinse equipment with pesticide-grade hexane (as required by the FSP and/or QAPP).

5. Air dry the equipment on a clean surface or rack, such as Teflon, stainless steel, or oil-free aluminum, elevated at least two feet above ground.

If the sampling device will not be used immediately after being decontaminated, it can be wrapped in oil-free aluminum foil, or placed it in a closed stainless steel, glass, or Teflon container.

7.3 Decontamination Methods for Large Equipment

Equipment should be inspected upon its arrival on-site to ensure it is clean of any contaminants that may have been transported from off-site, minimizing the potential for cross contamination. Equipment should be inspected to insure that all oils greases, hydraulic fluids, etc. on the surface of the have been removed, and all seals and gaskets are intact with no fluid leaks.

Upon completion of activities within the EZ, equipment will be brought to the designated Equipment Drop area in preparation for decontamination. A secondary parallel CRC may be required for the entry and exit of heavy equipment, and may require the construction of a decontamination pad for wastewater and debris collection. These decontamination pads may be pre-manufactured fabric-reinforced polybutylene liners with curbs, or they may be constructed on-site using polyethylene sheeting and lumber (2x4 or equivalent). Decontamination pads should be constructed so there is a sump to collect/pump rinse water into proper storage containers.

The selection of the correct decontamination method for larger equipment depends on many factors, including the type and level of contamination present on the site. In many cases, gross contamination can be removed by physical means involving dislodging/displacement, rinsing, wiping off, and evaporation. The most common methods are gross brush techniques and steam cleaning. Refer to site specific Project Plans for the prescribed site specific methodology.

7.3.1 Gross Brush Techniques

This method of decontamination relies on the physical removal of debris from the equipment using a brush, or other tool, designed to dislodge the debris from the surface of the equipment. The following steps should be followed to ensure proper decontamination using gross brush removal techniques:

1. Pull equipment on to decontamination pad and ensure pad curbs are intact and upright.

2. Use brush or other designated tools to physically remove debris from surfaces of equipment (ie, truck bed rails, tailgate, excavator bucket).

3. Visually inspect surfaces for presence of residual contamination.

4. Conduct sampling/screening of equipment surfaces as required by project plans to ensure equipment is adequately decontaminated.

5. After inspection, and any required sampling/screening equipment should proceed out of the CRC and into the SZ.

6. Debris left on the decontamination pad should be collected and returned to the EZ for proper disposal, or treated as IDW.

7.3.2 Steam Cleaning

As with gross brush techniques, steam cleaning relies on the physical removal of debris from the equipment, however; this is accomplished using high pressure water spray and heated water. The following steps should be followed to ensure proper decontamination using gross brush removal techniques:

1. Pull equipment on to decontamination pad and ensure pad curbs are intact and upright.

2. Use of hot-water (100 degrees C) high-pressure washer (water may be augmented with surfactants for cleaning) to physically remove debris from surfaces of equipment (ie, truck bed rails, tailgate, excavator bucket).

3. Conduct a final rinse using clean potable water.

4. Visually inspect surfaces for presence of residual contamination.

5. Conduct sampling/screening of equipment surfaces as required by project plans to ensure equipment is adequately decontaminated.

6. After inspection, and any required sampling/screening equipment should proceed out of the CRC and into the SZ.

7. Debris left on the decontamination pad should be collected and returned to the EZ for proper disposal, or treated as IDW. Water and cleaning solutions should be collected and properly stored as IDW, or treated on-site, per accordance with project plans.

Refer to ESFS-SH-PR-5506, Hand & Power Tools, for precautions regarding the safe use of power washing equipment.

7.3.3 Decontamination Methods for Drill Rig and Downhole Equipment

Any portion of the drilling equipment that is over the borehole (Kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) shall be steam cleaned (soap and high pressure hot water) and brushed (as needed) to remove all soil and other material which may have come from other sites before being brought on-site.

All downhole drilling equipment (tools, rods, augers, bits, well casing etc.) shall be steam cleaned with soap and brushed (as needed) to remove particulate matter and surface films. Hollow-stem augers, drill rods, casing, etc., that are hollow or have holes that transmit water or drilling fluids will be cleaned on the inside by brushing or steam cleaning. This will be followed by a generous tap water high pressure rinse (or steam cleaning w/o soap) to remove soap residue.

Drilling equipment that is cleaned will be placed on racks or sawhorses at last two feet above the floor of the decontamination pad. Remove from the decontamination pad and cover with clean, unused plastic.

8.0 REFERENCES

- ESFS-FO-PR-3704, *Investigation Derived Waste Management*
- ESFS-SH-PR-5506, *Hand & Power Tools*
- 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response
- EPA, Standard Operating Procedure No. 2006, 1994, Sampling Equipment Decontamination
- Field Standard Operating Procedures for the Decontamination of Response Personnel {FSOP 7}. EPA Office of Emergency and Remedial Response. Hazardous Response Support Division, Washington. DC. January 1985.US 1998).

9.0 REQUIRED RECORDS

- Field Logbook
- Equipment Calibration certificates and daily checks

10.0 ATTACHMENTS

None.

SOIL SAMPLING AND ANALYSIS PLAN
Former Albany Landfill (Albany Bulb)
End of Buchanan Street
Albany, California

APPENDIX E

ESFS-FO-PR-3304, Air Sampling Pumps

ENERGYSOLUTIONS

ESFS-FO-PR-3304

Air Sampling Pumps

Revision 0

Authored By:	Signature on File Brian Naidus, ESFS Project Manager	6/3/2024 Date
Reviewed By:	Signature on File Greg Bright, ESFS Project Manager	6/3/2024 Date
Approved By	Signature on File Sean Liddy, ESFS H&S/QA Manager	6/3/2024 Date

☒ Non-Proprietary
☐ Proprietary
☐ Restricted Information
☐ Safeguards Information
☐ Sensitive Security Information

Level of Use
☒ Information
☐ Reference
☐ Continuous

☒ New
☐ Title Change
☐ Revision
☐ Rewrite
☐ Cancellation

Effective Date 6/3/2024

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History of Revisions		
Revision	**Month-Year**	**Description**
0	June 2024	ESFS-FO-PR-3304 Rev0 - Initial issue.

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1.0 PURPOSE

This Operating Procedure (OP) provides the methods Energy*Solutions* Federal Services (ESFS) will use when calibrating, operating, and using air sampling pumps to determine airborne particulate concentrations in personnel breathing zones and general area monitoring.

2.0 SCOPE/APPLICABILITY

The protocols presented here apply to the ESFS operations that require air monitoring on personnel, in general areas, or both, using air pumps equipped with filter cassettes. Sample operations that may require its use include soil excavations, building demolitions, perimeter compliance monitoring, and other assessments of the health and safety conditions.

3.0 DEFINITIONS

3.1 Liters per Minute (L/min) – Volumetric flow rate of air drawn through the pump.

4.0 RESPONSIBILITIES

4.1 Occupational Health & Safety (OH&S) Manager - The OH&S Manager will be responsible for review and final approval of the SSHP, and ensure that the SSHP complies with all federal, state, client, and local health and safety requirements. If necessary, the OH&S Manager will modify specific aspects of the SSHP to adjust for on-site changes that affect safety.

4.2 Project Manager (PM) – Responsible for ensuring that the assigned personnel are familiar with this procedure and have access to a copy of this procedure.

4.3 Field Site Manager (FSM) – Responsible for ensuring proper implementation of this procedure. When the SSHO is not on-site the FSM will act as the authorized representative for issues relating to health and safety.

4.4 Site Safety & Health Officer (SSHO) – Responsible for making sure that all field activities are carried out in accordance with the SSHP. The SSHO must ensure that all field employees read, understand, and execute operations in accordance with this operating procedure.

4.5 Field Technicians – Responsible for understanding and complying with this procedure, as well as documenting monitoring results.

5.0 PRECAUTIONS, LIMITATIONS AND PREREQUISITES

5.1 Precautions

None.

5.2 Limitations

Personal sampling pumps are essential tools for sampling airborne contaminants. However, the determination of airborne concentrations requires accurate knowledge of the volume of air sampled. This value depends upon the constancy of the flow rate of the pump, and upon the reliability of the means of measuring that rate.

The built-in rotometers on pumps are not precision flow instruments and cannot be used to determine a pump's flow rate. These provide only an approximation. Flow rates must be measured with primary standards which are traceable to national standards. Electronic calibrators are such devices where measurements are based on the unchanging physical dimensions of an enclosed volume. Any air sampling pump that does not have its flow rate measured by a traceable calibration device must be calibrated using an electronic calibrator prior to use.

5.3 Prerequisites

None.

6.0 EQUIPMENT

- Air Sampling Pumps (high and/or low volume)
- Calibration Equipment
    - DryCal® DC-Lite calibrator (or equivalent)
    - Rotameter
- Sampling media (dependent on type of contaminant)
    - Filters or pre-filters
    - Impinger solutions
    - Sorbent tubes
- Sampling Train Attachments
    - Tubing
    - Multiple tube holders
    - Impingers
    - Cyclone assemblies
    - Filter cassettes.

7.0 PROCEDURE

7.1 Instrument Calibration

7.1.1 Establish Sampling Train

Prepare an appropriate sampling train as specified by the sampling method for the contaminant in question. Ensure that the internal pump battery is fully charged, that the pump is in the appropriate mode (high or low flow) for the desired flow rate, and that any necessary flow accessories (such as pressure controllers) are in place. With flexible tubing, connect the outlet of the sampling media (filter cassette, sorbent tube, impinger, etc.) to the inlet of the pump.

Test the sampling train for leaks by blocking the inlet with your finger and checking to see that the flow rate is zero. A flow rate greater than 0.1 L/min indicates an unacceptable leak.

7.1.2 Adjusting the Regulator for high (>500mL/min) or low (5 to 500mL/min) flow rates

For certain types of air sampling pumps, adjustments can be made to switch between high and low flow rates. Below are instructions for adjusting flowrates on SKC pumps. Adjustment techniques may vary slightly for different brands.

For high flow rates, remove the small brass cap screw on the top of the pump that is covering the regulator valve. Turn the exposed screw clockwise until it stops (do not over-tighten). Replace the cap screw. The pump is now ready for high flow sampling after calibration.

For low flow rates (less than 1.0 L/min), start the pump using the on/off switch. Press “Start/Hold” to stop the flow, then press “Flow and Battery Check” to restart the pump. Check the upper left corner of the LCD display for the battery status. It should indicate “Battery OK”. If not, recharge the battery before proceeding. Using the flow adjust screw on the front panel of the pump just to the left of the “on/off” switch; adjust the flow until the built-in rotometer reads the desired/prescribed flow rate.

Remove the small brass cap screw on the top of the pump that is covering the regulator valve and turn the exposed screw four to five turns counterclockwise. Replace the cap screw. Press “Flow and Battery Check” to place the pump in “hold” mode, then press “Start/Hold” to place the pump in “running” mode. Connect a single adjustable low flow holder containing the flow adjustment screw to the pump intake using ¼” tubing. The pump is ready for low flow sampling after calibration.

7.1.3 Calibrating the flow rate

Air pump flow rates will be calibrated using a DryCal® DC-Lite calibrator. Press the <ON> button to turn the DC-Lite unit “on”.

- Note 1: An initializing screen will be displayed first showing the computer revision number, then the standard flow display screen will be displayed.
- Note 2: The DC-Lite has an “energy saving” 5-minute inactivity shut-off feature

The flow source and the DC-Lite should be connected with tubing and both instruments should be turned "on". Allow approximately 5 minutes for the pump to run and become stabilized. The connecting air flow ports are located on the right side of the unit. The lower port is for suction (outlet) and the upper port is for pressure (inlet). The sampling medium should also be connected in-line just after the outlet of the DryCal® DC-Lite.

Use the auto-repeat mode and obtain a minimum of three 10-reading averages to accurately determine flow rate. Record this on sampling data sheet.

NOTE: FLOW RATES WHEN SAMPLING FOR AIRBORNE RADIOLOGICAL CONTAMINANTS MUST BE CALIBRATED AT 4.0 L/MIN.

7.2 Selection of Employee

Select the employee to be sampled and discuss the purpose of the sampling. Inform the employee when and where the equipment will be removed. Stress the importance of not removing or tampering with the sampling equipment. Instruct the employee to check the sampler periodically to verify that it is working and notify the supervisor or the Site Safety and Health Officer (SSHO) if the air sampler requires attention or temporary removal.

7.3 Instrument Operation

7.3.1 Begin Sampling

- Place the sampling equipment on the employee so that it does not interfere with work performance. Attach the collection device (filter cassette, charcoal tube, etc.) to the shirt collar or as close as practical to the nose and mouth of the employee, i.e., in a hemisphere forward of the shoulders with a radius of approximately six to nine inches. The inlet should always be in a downward vertical position to avoid gross contamination. Position the excess tubing so that it does not interfere with the work of the employee.
- Turn on the pump and record the starting time.
- Observe the pump operation for a short time after starting to make sure it is operating correctly.
- Record the information required by the Air Sampling Data Form (Attachment A).

7.3.2 Monitoring

- Check the pump every two hours. More frequent checks may be necessary when heavy filter loading is possible. Ensure that the sampler is still assembled properly and that the hose has not become pinched or detached from the cassette or the pump. For filters, observe for symmetrical deposition of particulate on the filter, unexpected large particles, or other evidence of sample tampering with the sample or pump. Record the flow rate and any relevant observations.

- Periodically monitor the employee throughout the workday to ensure that sample integrity is maintained and cyclical activities and work practices are identified. Turn off or remove sampling pumps immediately prior to an employee leaving a potentially contaminated area (such as when he/she goes to lunch or on a break in a clean area). If these areas also appear contaminated and are considered part of the workplace, continue sampling and assess the need for surface contamination measurements.
- If practical, take photographs and detailed notes concerning visible airborne contaminants, work practices, potential interferences, movements, and other conditions to assist in determining appropriate engineering controls.
- Prepare blank(s) during the sample period for each type of sample collected. One blank will suffice for up to 20 samples for any given analysis/sampling period except asbestos, which requires a minimum of two field blanks. The blanks should be opened but not used to take samples (charcoal tubes, filters etc.). They should be handled in the same manner as any sampling media used in sampling air contaminants, with the exception that no air is drawn through them.

7.4 Sample Cassette Collection

Remove the collection device from the pump and seal it. The seal should be attached across sample inlet and outlet.

Prepare the samples for analysis. If the samples are to be mailed to the analytical laboratory, use bubble sheeting as packing. Put identifying paperwork in every package. Do not send samples in plastic bags or in envelopes.

7.5 Post Operational Flow Rate Checks

After the pump has been used, reattach the sampling media originally used to calibrate the flow rate. Using the DC-Lite, measure the flow rate as described in previous sections. Record this value as the “post-sample” flow rate. Compare the pre-sample and post-sample flow rates to ensure that the two flow rates do not differ by more than 5%. The average of the pre-sample and post-sample flow rates should be reported to the analyst along with other relevant data including sampling time.

8.0 REFERENCES

- OSHA Technical Manual, Section II: Chapter1, Personal Sampling for Air Contaminants
- SKC Universal MTX Air Sampling Pump Operating Instructions
- DryCal® DC-Lite Manual, Bios International Corp.

9.0 REQUIRED RECORDS

- Data collected on the Air Sampling Data Form should be saved to the project folder files.
- Laboratory data from the samples shall be saved to the project folder files.
- Notification of sampling results shall be made to the individual employees assigned to the air sampling pumps, and these records shall be kept both in the project files and forwarded to the OH&S Manager for inclusion into the employee's personnel files.
- Field Log Book

10.0 ATTACHMENTS

- Attachment A - Air Sampling Data Form

Attachment A

Air Sampling Data Form

ESFS-FO-PR-3304, Operation of Air Sampling Pumps, F1

Air Sampling Data Form

Project Information		
Project Name:	**Project Number:**	**Date:**
Work Description:		
Sampler's Name:	**Monitoring Purpose:** ☐ Breathing Zone ☐ Area ☐ Perimeter ☐ Other (Specify)	

Instrumentation	
Sample Method Number:	**Sample Media:**
Comments:	

Chemicals of Concern (COCs)		
Refer to SSHP for list of COCs		
Analyte 1:	**Analyte 2:**	**Analyte 3:**
Analyte 4:	**Analyte 5:**	**Analyte 6:**

Monitoring Results

Sample ID	Pump #	Air Flow Calibration (L/min)			Time - Minutes			Volume (Liters)	Sampler's Initials	Results		Remarks
		Pre	Post	Avg	Start	Stop	Total			Amount (mg)	Conc. ppm, mg/m^3	Location, employee name/#

Field Notes:

Comments:

GSI Job No: 10008

SOIL SAMPLING AND ANALYSIS PLAN

Former Albany Landfill (Albany Bulb)

End of Buchanan Street

Albany, California

APPENDIX F

OP-3802, Unconditional Release of Materials and Equipment from Radiological Controls

OPERATING PROCEDURE

FOR

Unconditional Release of Materials and Equipment from Radiological Controls

OP-3802

(FORMERLY OP-004)

Revision 3.0
January 2021

Level of Use: Information Use APPROVALS	
President	*R. Flowers, PMP, CHMM*
Quality Assurance	*S. Liddy, CSP*
Health Physics	*M. Winters, CHP*
This procedure is the property of Cabrera Services Inc. and is considered approved and effective for the duration it is posted electronically to the Controlled Copy Document Repository.	

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History of Revisions		
Revision	**Month-Year**	**Description**
0	-	OP-004, Unconditional Release of Materials and Equipment from Radiological Control Areas - Initial issue.
1.0	July 2005	Substantial (major) revision to update overall program elements to latest regulations, guidance, and industry practices.
2.0	April 2013	Substantial (major) revision to update overall program elements to latest regulations, guidance, and industry practices.
3.0	January 2021	Substantial (major) revision to update overall program elements to latest regulations, guidance, and industry practices. Provides all new guidance on performing unconditional release surveys based on MARSAME guidance and surveys designed to identify residual radioactivity inconsistent with background instead of comparison with a regulatory action level above background. Renumbered OP-3802 to conform to 4-digit series as outlined in OP-2001.

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1.0 Purpose

This procedure establishes the process to assess residual radioactivity potential in materials & equipment used to support radiological work prior to release for unrestricted use from radiological controls at temporary job sites.

This procedure addresses assessment of items as “impacted or non-impacted”; methods to “exclude” specific items/surfaces from survey requirements; methods for planning and implementing MARSAME-based surveys to demonstrate impacted surfaces meet appropriately selected screening levels for clearance (SLC); document requirements and; approach to disposition the item(s) based on assessment outcome and cost-benefit analyses.

2.0 Scope/Applicability

This procedure applies to M&E specifically used during temporary job site activities conducted under a Cabrera RPP. Materials and equipment taken in Radiologically Controlled/Restricted Areas generally require “assessment” prior to unrestricted release. The assessment generally leads to “exclusion” of items that do not require survey due to residual surface radioactivity (AU/RSO determination); surveys for “clearance” of those impacted items that were not completely excluded potential and; disposition (i.e., decontaminate, dispose of as waste, release from radiological controls.)

This procedure may be used for existing M&E at client sites under very specific conditions and limitations that may require regulator concurrence; consult with the RSO prior to use of this procedure to support unrestricted release of existing material at client sites. The RSO shall review applicable license conditions or site plan requirements and determine if regulator pre-approval is required to use this procedure.

This procedure applies to M&E impacted by residual surface radioactivity, **NOT** volumetric radioactive material. If residual volumetric activity is suspected consult with the RSO for guidance on proper disposition of the M&E in accordance with stakeholder accepted criteria for the temporary job site or applicable license.

This procedure does **NOT** apply to personnel exiting RCAs established or controlled under a Cabrera radioactive materials license (refer to OP-3403, *Personnel Frisking and Decontamination*).

This procedure does **NOT** apply to survey and unconditional release of real property (unless called for by applicable regulator-accepted work control documents).

3.0 Definitions

3.1 Accessible Surface: A surface that can be easily reached or obtained for the purposes of performing a measurement or collecting a sample.

3.2 Ambient Radiation: Radiation currently present in surrounding area that may change with season, time, location, weather, and environmental conditions.

3.3 Background Radiation: Radiation from cosmic sources; naturally occurring radioactive material including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. “Background radiation” does not include radiation from source, byproduct or special nuclear materials regulated by the Nuclear Regulatory Commission (10 CFR § 20.1003).

3.4 Background Threshold Value (BTV): A not-to-exceed value estimating the upper boundary of a randomly collected data set representing a single statistical population (e.g., background).

3.5 Categorization: The act of determining whether M&E are impacted or non-impacted.

3.6 Classification: The act or result of separating impacted M&E or survey units into one of three designated classes. The process of determining the appropriate level of survey effort based on estimates of activity levels and comparison with SLC.

3.7 Critical Value (SC): The minimum measured value required to give a specified probability that a positive (non-zero) amount of radioactivity is present in the material being measured.

3.8 Difficult to Access Surface: A surface that is not measurable without preparation. Preparation may be relatively simple (e.g., cleaning), complicated (e.g., disassembly), or not practicable (e.g., complete destruction of the object).

3.9 Disposition: The future use, fate, or final location for M&E.

3.10 Gray Region: The range of radionuclide concentrations of radioactivity between the discrimination limit and the SLC where the consequence of decision errors is relatively minor.

3.11 Impacted: Materials and equipment with a reasonable potential to contain radionuclide concentrations or radioactivity above background. Impacted items require clearance surveys prior to release from radiological controls.

3.12 Lower Bound of the Gray Region (LBGR): The radionuclide concentration or level of radioactivity corresponding with the lowest value in the range where the consequence of decision errors is relatively minor. For unconditional release surveys the LBGR is background or zero.

3.13 Non-impacted: Materials and equipment where there is no reasonable potential to contain radionuclide concentrations or radioactivity above background. Non-impacted items are typically excluded from clearance surveys prior to release from radiological controls.

3.14 Radiologically Controlled Area (RCA): Synonymous with “Restricted Area”; an area established to protect individuals from exposure to radiation/radioactive materials.

3.15 Screening Levels for Clearance (SLC): The radionuclide concentration or level of radioactivity corresponding to the disposition criterion allowing for unrestricted release from radiological controls. Also referred to as the "Action Level (AL)" in this procedure.

3.16 Surficial Radioactive Material: Radioactive material distributed on any of the surfaces of a solid object. Surficial radioactive material may be either removable by non-destructive means (e.g., casual contact, wiping, brushing, washing) or fixed to the surface.

3.17 Upper Bound of the Gray Region (UBGR): The radionuclide concentration or level of radioactivity corresponding with the highest value in the range where the consequence of decision errors is relatively minor.

3.18 Upper Simultaneous Limit (USL): The upper boundary of the largest value in a data set.

4.0 Responsibilities

4.1 Radiation Safety Officer / Certified Health Physicist

Performs periodic assessment of procedure implementation as an element of periodic program reviews.

Provides technical interpretations of program requirements/guidance.

4.2 Project Health Physicist/Authorized User

Select appropriate measurement techniques and instrumentation based on radionuclides of concern, physical characteristics of M&E, levels of radioactivity inside the RCA, and other site conditions.

Determine when reference background area measurements are required and identify appropriate reference background areas.

Identify and approve SLCs.

Select final disposition option based on survey results.

Reviews and dispositions associated survey record

Direct corrective actions for any identified deficiencies during survey review.

Consult with the RSO/CHP when guidance is needed.

4.3 Radiation Safety Support Staff

Reviews the item proposed for release (sufficiently clean and dry to survey and prepares survey approach.

Consults with AU/RSO, as needed, to ensure the specific item's survey design is sufficient to address potential for residual radioactivity including inaccessible surfaces.

Conduct radiological surveys and document results.

Release M&E based on survey results and as directed by this procedure. For complex items, AU concurrence should be obtained prior to release.

5.0 Precautions, Limitations, and Prerequisites

5.1 Precautions

Unsealed radioactive materials can spread through direct contact or by airborne particulate resuspension & deposition on nearby surfaces. RSSS should consider potential pathways for cross-contamination when determining the scope of clearance surveys and where to perform biased measurements.

When internally deposited residual radioactivity is suspected (e.g., in pumps or motors), measurements of air intake plenums or intake filters serve as good confirmatory indicators of residual radioactivity potential.

Radon daughter products may build-up on surfaces with high air flow or on surfaces subject to static charge (e.g., hardhats). RSSS should consider potential for radon daughters (from natural sources) when initially evaluating unexpected positive results for both alpha and beta residual radioactivity and, perform and document recounts, as appropriate, to assess if the results are false positives. Regardless of radon daughter presence, SLC must be met prior to clearance.

Porous materials (e.g., wood, paper, cardboard) may contain volumetric radioactivity from infiltration or penetration and are more difficult to justify for unconditional release using this operating procedure. These types of materials should be excluded from entering the RCA when practicable; adequately covered to eliminate potential for contact with unsealed radioactive materials or considered waste.

5.2 Limitations

This procedure applies to fixed and removable contamination on accessible surfaces.

The selected survey instruments, counting parameters, and conditions should be capable producing a calculated MDC (as shown in OP-3407/3408) less than or equal to the SLC. Consider extending count times or moving to lower background areas when MDCs exceed the SLC in measurements that are below the critical level (Sc).

5.3 Prerequisites

Use caution to avoid contacting potentially energized components when conducting M&E surveys – watch for warning labels.

6.0 Equipment

None.

7.0 Instructions

7.1 Categorize the M&E as "impacted" or "non-impacted" – Non-impacted M&E are excluded from clearance survey requirements.

7.1.1 M&E (or portions) that did not enter an RCA and was not used in direct contact with unsealed radioactive materials are non-impacted and excluded from clearance survey.

7.1.2 M&E (or portions) inside an RCA with no reasonable potential for residual radioactivity exceeding background may be considered non-impacted and excluded from clearance survey. The RSSS should consult with the AU/RSO as needed prior to release excluded items and document the exclusion decision with sufficient details to support decision.

7.1.3 M&E used in direct contact with unsealed radioactive materials or, used inside an RCA without documentation of a non-impacted categorization decision are impacted and require a survey.

7.2 Describe the M&E

7.2.1 Objects with less than 1,000 cm^2 (160 in^2) of impacted surface area are small objects. Objects with greater than 1,000 cm^2 of impacted surface area are large objects. Exact measurements are typically not necessary but, the surveyor should use conservatism in estimates.

7.2.2 Estimate the inherent value of the M&E. If disposal of the M&E requires fewer resources than performing a complex survey necessary to meet all requirements of this procedure, the surveyor may recommend disposition as waste without additional effort. As these situations arise, Project Management (PM, AU/RSO) for the temporary job site should be consulted to provide guidance on disposition options (i.e., complex survey versus waste disposition).

7.2.3 Identify radiations of interest (alpha, beta, gamma) based on radionuclides of potential concern listed in the project documents. If radionuclides of potential concern are not provided in project documents consult the AU/RSO for additional instructions. “Difficult-to-detect” radionuclides of concern (i.e., those that decay with maximum beta energy less than 0.15 MeV and radionuclides that decay by electron capture or isomeric transition) require further consultation with the RSO, or designated Project HP, to ensure they are accounted for in the survey methodology or determination of SLCs.

7.2.4 Notify the AU/RSO if there is a potential for volumetric contamination (porous surfaces) or a potential for contamination on difficult-to-access surfaces.

7.2.5 If necessary and practicable, disassemble the M&E to ensure all impacted surfaces are accessible for survey. Disassembly of complex M&E or components with stored energy potential shall be done by/under the direct observations of a subject-matter expert. Consult with the Site Safety & Health Officer or M&E Subject Matter Expert to ensure energy sources are adequately deenergized or protected from discharge prior to conducting surveys. Do not contact potentially energized systems!

7.2.6 Determine if contamination is uniformly distributed over impacted surfaces or if there is a reasonable potential for contamination to be limited to small areas of elevated activity.

7.2.7 If necessary, segregate the M&E based on physical size, inherent value, radiations of interest, and distribution of contamination.

a. Communicate all potential issues to the PHP/AU prior to performing surveys.

7.3 Determine the Screening Levels for Clearance

7.3.1 New York / NRC Jurisdiction: For decommissioning-related activities under NYS/NRC jurisdiction, refer to the approved decommissioning plan. For other activities or when the DP does not provide screening levels for clearance of M&E, refer to the levels provided in the license activity-governing Radiation Safety Manual (e.g., OP-5010, Table 2).

7.3.2 DOE: For temporary job locations at sites controlled by DOE release limits for personal property SHALL be developed and approved prior to survey as described in DOE Order 458.1. Section 4.k(6)(f)1.b states the surface contamination limits from former DOE Order 5400.5 (MARSAME Appendix E, Table E.2) may be applied until replaced or revised as described in DOE Order 458.1. Cabrera will use MARSAME Appendix E, Table E.2 as SLC for release of M&E from DOE temporary job site activities unless alternative site/task-specific authorized release limits are specified in work control documents.

7.3.3 California Jurisdiction: For temporary job locations using Cabrera's CARML the SLC will be as defined in a regulator accepted work control document; absent a defined SLC, clearance will be based on a background threshold value (BTV) based on reference background conditions or baseline surface measurements collected prior to the M&E's use in a radiologically controlled/restricted areas. In these cases, the BTV will be calculated as: (a) the mean plus three standard deviations, (b) the critical value of the net count (as shown in OP-3407/3408) or (c) the 95% USL calculated using the "BTV Module" in EPA's ProUCL software.

7.3.4 Convert the selected SLC from dpm/100 cm^2 into counts per minute (cpm) using the following equation:

$$Net\ CPM = \frac{N_S}{t_S} - \frac{N_B}{t_B} = SLC \times \varepsilon_t \times \frac{A}{100\ cm^2}$$

Where:

N_S = Sample Counts

N_B = Average Background Counts

t_S = Sample Count Time (minutes)

t_B = Background Count Time (minutes)

SLC = Screening Level Criteria (dpm/100 cm^2)

ε_t = Total Efficiency (see OP-3402)

A = Probe Active Area (cm^2)

The SLC may be converted to total counts (as observed on the typical instrument) by adding the net cpm value to the average background cpm value, and then multiplying by the sample count time (t_S).

7.4 Selection of Appropriate Detector, Meter, and Count Time.

Consult with the PHP/AU/RSO for guidance, as needed. The MDC should be determined to ensure SLCs are achievable using the planned combination of equipment selected, actual background conditions, and count time settings; consult with the PHP/AU/RSO for guidance, as needed to ensure MDCs are within established data quality objectives.

7.4.1 Calculate the MDC as described in OP-3407/3408 based on the selected instrument.

7.4.2 Estimates of background counts should represent ambient background at the location where the clearance surveys are performed at the time they are being conducted.

- The background count time (t_B) for all clearance surveys shall be equal to or longer than the sample/measurement count time (t_S); both count times shall be at least one minute.
- The background count time (t_B) for surveys of large items should be 10x the sample/measurement count time (t_S) to ensure adequate precision in the average background level.

7.4.3 Note that swipe counting may be conducted in any area provided the background is as low as reasonably achievable and reasonably stable.

7.4.4 Estimates of total efficiency should be obtained using OP-3402, *Calculating Alpha and Beta Total Efficiency for Field Instruments*.

7.4.5 Adjust the sample count time and background count time, if necessary, to ensure the MDC is less than or equal to the SLC.

7.5 Survey Small Objects with Fixed and Removable Surface Activity

7.5.1 Position detector so it covers as much of the accessible surface as practicable.

7.5.2 Collect data as described in OP-3407, *Operation of Contamination Survey Meters* using the count time for total activity selected in Step 7.4.

7.5.3 Record the survey results and surveyor details in an RSO-approved form/log.

7.5.4 Perform sufficient measurements of total activity to cover 100% of the accessible surface.

7.5.5 Use a disc smear (typically two-inch diameter) to collect a removable activity sample at each location a total activity measurement was performed. OP-3102, *Wipe Sampling Procedure* describes the proper method for collecting removable activity samples including special circumstances. Swabs may be used for areas too small to swipe with a disc smear. Swab use should be noted on the survey from when used. Cloth disc smears are typically used unless analysis will be by liquid scintillation counting or digestion radiochemistry were alternate media (e.g., wet paper smears) prescribed by the AU/RSO/work control document are used.

7.5.6 Count each smear using an appropriate sample counter as described in OP-3408, *Alpha-Beta Counting Instrumentation*. For most applications, gas-flow proportional or scintillation counting is adequate. Use the count time for removable activity determined in Step 7.4.

7.5.7 Record the alpha and beta smear counts as described in the approved work/decommissioning plan, on a survey form (OP-3601, *Radiological Surveys* provides an example survey form), or in a field logbook. ALL M&E CLEARANCE SURVEY ACTIVITIES MUST BE DOCUMENTED!

7.6 Determine Minimum Number of Measurement Locations for Large Objects

7.6.1 For the purposes of clearance surveys and conservatism in the process, The Null Hypothesis is that “the M&E contains residual surface radioactivity that exceeds the SLC.

7.6.2 The Type I and Type II decision error rates are set equal to 0.05 to be consistent with the acceptable decision error rates used to calculate the MDC values in MARSAME. If stakeholders prescribe alternate error rate values, consult with the PHP/RSO for guidance.

7.6.3 The relative shift can be estimated using the following equation, assuming Poisson counting statistics:

$$Relative\ Shift = \frac{\Delta}{\sigma} = \frac{SLC\ (net\ cpm\ from\ Step\ 7.3.4)}{\sqrt{N_S}/t_S}$$

Where:

Δ = width of gray region (SLC – Bkgd, cpm)

σ = standard deviation of sample counts equal to the SLC, equal to the AL in units of total counts from Step 7.3.4.

7.6.4 Use Table A.2b in MARSAME Appendix A to look up the minimum number of survey unit measurements that correspond to the next lowest relative shift value below the calculated relative shift.

- If the relative shift is between 1 and 3 use the following table to determine the minimum number of survey unit measurements.

Number of Survey Unit Measurements ($\alpha = \beta = 0.05$)

Relative Shift	Number of Msmnts	Relative Shift	Number of Msmnts	Relative Shift	Number of Msmnts
1.0	32	1.5	18	2.0	13
1.1	28	1.6	16	2.25	11
1.2	24	1.7	15	2.5	11
1.3	22	1.8	14	2.75	10
1.4	19	1.9	13	3.0	10

- If the calculated relative shift is any value greater than 3, use 3 to ensure a minimum of 10 survey unit measurements.
- If the calculated value is any value less than 1, consult with the PHP/RSO for guidance.

7.7 Survey Large Objects with Fixed and Removable Surface Activity

7.7.1 Identify systematic or random locations representing the accessible surface of the object being evaluated for unconditional release. Use the minimum number of locations identified in Step 7.6.

7.7.2 Identify bias locations based on professional judgement to investigate all locations where residual radioactivity would likely be present based on the use of the object and the radioactivity at the site.

7.7.3 Collect data as described in OP-3407, *Operation of Contamination Survey Meters* using the count time for total activity determined in Step 7.4.

7.7.4 Record the alpha and beta counts as described in the approved work/decommissioning plan, on a survey form (OP-3601, *Radiological Surveys* provides an example survey form), or in a field logbook.

7.7.5 Use a disc smear to collect a removable activity sample at each location a total activity measurement was performed. OP-3102, *Wipe Sampling Procedure* describes the proper method for collecting removable activity samples.

7.7.6 Record the alpha and beta smear counts as described in the approved work/decommissioning plan, on a survey form (OP-3601, *Radiological Surveys* provides an example survey form), or in a field logbook.

7.8 Evaluate Survey Results

7.8.1 Compare results against applicable SLCs. Limited recounting of measurement locations or smears may be conducted for those results nearest to an SLC to verify results do not exceed an SLC.

7.8.2 The item may be released when all results are verified below SLCs and any requested/required AU/PHP/RSO concurrence is obtained. The surveyor should complete the survey documentation and obtain concurrence for complex items prior to release.

7.8.3 If any final result exceeds an SLC, the item remains impacted by residual surface radioactivity requiring controls until adequate decontamination and additional survey prior to clearance.

7.9 Disposition Options for M&E with Surface Radioactive Material Exceeding SLCs

7.9.1 Small inexpensive objects may be identified as investigation derived waste and disposed of in accordance with a project-specific waste management plan.

7.9.2 Objects with higher intrinsic value may be decontaminated as described in OP-3805, *Decontamination of Radioactivity from Equipment and Tools* and resurveyed using this SOP.

7.9.3 Objects with high intrinsic value (e.g., heavy equipment) may have:

a. A separate unconditional release survey plan prepared for that piece of equipment

b. A dose assessment performed to demonstrate compliance with 10 CFR § 20.1301, 10 NYCRR § 16.7, 12 NYCRR § 38.19, or 17 CCR § 30253, which is inclusive of 10 CFR § 20.1301. For DOE sites a dose assessment may be performed as described in DOE Order 458.1.

c. Continued use with radiological controls maintained.

8.0 References

- 10 CFR § 20.1301, *Dose Limits for Individual Members of the Public*
- 10 CFR § 20.1501, *General, Requirements for Surveying and Monitoring*
- 10 CFR § 20.2103, *Records of Surveys*
- 10 NYCRR § 16.7, *Radiation Dose Limits for Individual Members for the Public*
- 10 NYCRR § 16.10, *Inspections, Surveys, Checks and Tests; Vacating Installations; Securing Radiation Sources*
- 10 NYCRR § 16.17, *Records*
- 12 NYCRR § 38.19, *Radiation Dose Limits for Individual Members of the Public*
- 12 NYCRR § 38.22, *Surveys, Checks, and Tests*
- 12 NYCRR § 38.28, *Records*
- 17 CCR § 30253, *Standards for Protection Against Radiation*
- DOE Order 458.1, *Radiation Protection of the Public and the Environment*

- NUREG-1575, Supp. 1, *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME)*
- OP-3805, *Decontamination of Radioactivity from Equipment and Tools*
- OP-3401*, HP Instrument General Quality Control Procedure*
- OP-3402*, Calculating Alpha and Beta Total Efficiency for Field Instruments*
- OP-3601*, Radiological Surveys*
- OP-3407*, Operation of Contamination Survey Meters*
- OP-3408*, Alpha-Beta Counting Instrumentation*

9.0 Required Records

Survey records shall be maintained for three years unless project documents provide other instructions (10 CFR § 20.2103, 10 NYCRR § 16.17, 12 NYCRR § 38.28 or 17 CCR § 30253, which is inclusive of 10 CFR § 20.2103).

Survey records should include:

- Diagram or photo of the object(s) released (to support release decisions for large complex surveys) with specific locations where wipe tests were performed
- List of M&E surveyed
- Background radiation levels with appropriate units
- Survey results with appropriate units with all results exceeding the SLC identified
- Make and model number of instruments with calibration date details
- Surveyor name, survey date
- Other details, as directed by work control document or the RSO.

10.0 Attachments

None.