Final

Phase IV
Field Sampling Plan
Addendum 1

University of California, Berkeley
Richmond Bay Campus
Former Richmond Field Station Site
Richmond, California

October 28, 2014

Prepared for
Office of Environment, Health & Safety
University of California, Berkeley
317 University Hall No. 1150
Berkeley, California 94720

Prepared by

TETRA TECH, INC.
1999 Harrison Street, Suite 500
Oakland, California 94612

REGISTERED GEOLOGIST
JASON D. BRODERSEN
No. 6262
STATE OF CALIFORNIA

Jason Brodersen, P.G., No. 6262

CONTENTS

1.0 PROJECT DESCRIPTION

UC Berkeley has been conducting investigation and cleanup actions at the Former Richmond Field Station (RFS) Site under oversight of the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), in compliance with the Site Investigation and Remediation Order, Docket No. IS/E-RAO 06/07-004 for the Richmond Field Station, dated September 15, 2006. The Order provides for investigation and cleanup of 96 acres of upland and 13 acres of tidal marsh and transition habitat within the RFS Site.

In response to the Order, UC Berkeley has prepared multiple planning and reporting documents. The Final Current Conditions Report (Tetra Tech, Inc. 2008) included a comprehensive summary of current conditions and data gaps at the site. The Final Field Sampling Workplan identified a phased-sampling strategy to address the data gaps (Tetra Tech 2010). Phases I, II, and III have been completed, and results are presented within the Final Site Characterization Report (Tetra Tech 2013). Phases IV and V will address remaining data gaps or any subsequent investigations.

The scope of Phase IV activities is presented in the Final Phase IV Field Sampling Plan (FSP) (Tetra Tech 2014) and consists of:

- Soil sampling in the Upland meadows (Big Meadow, EPA Meadow North, and West Meadow) to determine if historical industrial and commercial activities have impacted soil conditions.
- Exploratory excavation in the Bulb, within the Western Transition Area to identify a source of the magnetic anomaly reported in a 2006 magnetometer survey.
- Soil gas sampling to attempt to identify the source of carbon tetrachloride contamination in shallow groundwater at piezometer CTP in the Big Meadow to follow up previous investigations.
- Additional piezometers placement along the border of the Eastern Transition Area and the remediated portion of Western Stege Marsh, and to the west of the Biologically Active Permeable Barrier (BAPB), to evaluate groundwater in the vicinity of the BAPB.

The Phase IV FSP provided the physical setting, investigation purpose, history, previous investigations, and data quality objectives for the four activities listed above. The Phase IV FSP also provided the sampling process design and sampling methods for the soil sampling in the Upland meadows, soil gas sampling in the Big Meadow, and the additional piezometers within the Eastern Transition Area and Western Stege Marsh.

The exploratory excavation work, including any soil sampling and air monitoring, will be conducted by Cabrera Services, UC Berkeley's radiological consultant, under the supervision of the UC Berkeley, Office of Environmental Health and Safety, Radiological Safety. As such, Cabrera Services prepared the Draft Exploratory Excavation Work Plan outlining the excavation, sampling, and monitoring details; the work plan is included as Attachment 1 to this addendum. The Exploratory Excavation Work Plan includes the methodology and approach regarding:

- Mobilization and site preparation, including work zones, utilities, traffic control, decontamination, stockpiling sampling, waste management, and heavy equipment

- Pre-excavation assessment survey, including radiological survey, geophysical survey, and air monitoring

- Exploratory excavation procedures

- Documentation of the magnetic anomaly

- Collection of soil and drum samples

- Site controls, including erosion control measures, stormwater management, spill prevention and control measures, air monitoring, protection of native and cultural plant species, protection of marshland and nesting birds, and archeological monitoring

- Backfilling, site restoration, and demobilization

The Draft Exploratory Excavation Work Plan was submitted to the California Department of Public Health, Food, Drug and Radiation Safety, Radiologic Health Branch, on September 30, 2014, under UC Berkeley's RM License 1333-01. UC Berkeley received concurrence from the Radiologic Health Branch on October 24, 2014. DTSC provided comments on the draft addendum on October 22, 2014. Work to be conducted during the exploratory excavation will adhere to the final work plan included as Attachment 1 to this final addendum, as well as response to DTSC comments included as Appendix A to this final addendum.

2.0 PROJECT ROLES AND RESPONSIBILITIES

The project roles and responsibilities are presented in this section. Additional details regarding project organization for the radiologic support roles during the exploratory excavation are included in Attachment 1.

Name and Affiliation	Roles	Responsibilities
Greg Haet (UC Berkeley Office of Environment, Health & Safety)	Project Coordinator	Directs environmental health and safety compliance of the project. Receives notices, comments, approvals, and related communications from DTSC and forwards them to Respondents' representatives. Reports to and interacts with the DTSC for all Order tasks and/or public outreach.
Karl Hans (UC Berkeley Office of Environment, Health & Safety)	Project Scientist/On-Site Office of Environment, Health & Safety Coordinator	UC on-site environmental health and safety project coordinator at the Richmond Field Station. Assists in managing the project and interacting with DTSC and Respondents. Reviews all submittals and notifications to DTSC and other agencies for quality and completeness.
Carolyn Mac Kenzie (UC Berkeley Office of Environment, Health & Safety, Radiation Safety Team)	Radiation Safety Officer	Provides direction for implementation of radioactive materials and radiation monitoring conducted for the Bulb exploratory excavation.
Tony Mason, CHP (Cabrera Services)	Project Manager Project Health Physicist	Coordinates all site activities, oversees proper execution of the work, and provides UC and DTSC personnel with updates of field activities.
Site Manager/Superintendent (Cabrera Services)	Tony Mason	Supervises the field technician, equipment operator, and subcontractors. Oversees all excavation activities.
Site Safety and Health Officer/Site Radiation Safety Lead	John Cote	Implements the site-specific health and safety plan.
Jason Brodersen, P.G. (Tetra Tech, Inc.)	Project Consultant/Project Geologist	Provides direction and supervision of hazardous waste site cleanup work. Provides expert advice on environmental management during investigation and remediation phases of the project. Primary author and coordinator of completion of RFS Order-required reports and other technical deliverables.
Gene Barry, P.E. (4LEAF, Inc.)	Project On-Site Coordinator	Performs construction management and oversight duties during various construction phases of the project and other on-site activities. Assists the project consultant and project coordinators in managing project information and data and completing project deliverables.

3.0 REFERENCES

Tetra Tech, Inc. (Tetra Tech, formerly Tetra Tech EM Inc. from 1996-2012). 2008. Current Conditions Report, University of California, Berkeley, Richmond Field Station, Richmond, California. November 21.

Tetra Tech. 2010. Phase I Groundwater Field Sampling Workplan, University of California, Berkeley, Richmond Field Station, Richmond, California. June 2.

Tetra Tech. 2013. Final Site Characterization Report, Proposed Richmond Bay Campus, Research, Education, and Support Area and Groundwater within the Richmond Field Station Site. May 28.

Tetra Tech. 2014. Final Phase IV Field Sampling Plan, University of California, Richmond Bay Campus, Former Richmond Field Station Site, Richmond, California. October 6, 2014.

APPENDIX A

DTSC COMMENTS AND RESPONSE TO COMMENTS

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Miriam Barcellona Ingenito
Acting Director
700 Heinz Avenue
Berkeley, California 94710-2721

Edmund G. Brown Jr.
Governor

October 22, 2014

Mr. Greg Haet
EH&S Associate Director, Environmental Protection
Office of Environment, Health & Safety
University of California, Berkeley
University Hall, 3rd Floor, #1150
Berkeley, California 94720

Dear Mr. Haet:

The Department of Toxic Substances Control (DTSC) received the *Draft Phase IV Field Sampling Plan Addendum 1* (Addendum) for the University of California (UC), Berkeley, Richmond Bay Campus, Former Richmond Field Station Site, located in Richmond, California. The October 03, 2014 Addendum was prepared by Tetra Tech, Inc. and transmits to DTSC as an Attachment the September 30, 2014 document titled *Exploratory Excavation Work Plan, Exploratory Investigation for Magnetic Anomaly Source in Bulb* (Work Plan). The Work Plan, prepared by Cabrera Services Inc. for UC, is the subject of our review. Comments and recommendations based on our review are provided as attachments to this letter. Also attached are comments and recommendations on the Work Plan prepared by DTSC's industrial hygiene branch, and human and ecological risk branch.

As discussed with UC personnel, please prepare a response-to-comments type of reply rather than immediately amending the Work Plan. If you have any questions, please contact Lynn Nakashima at lynn.nakashima@dtsc.ca.gov or (510) 540-3839.

Sincerely,

Lynn Nakashima

Lynn Nakashima, Project Manager
Senior Hazardous Substances Scientist
Brownfields and Environmental
Restoration Program
Berkeley Office - Cleanup Operations

Mark Vest

Mark Vest, P.G.
Senior Engineering Geologist
Brownfields and Environmental
Restoration Program
Sacramento Office - Geologic Services

Enclosures

cc: next page

cc: Karl Hans
University of California, Berkeley
Environmental Health & Safety
317 University Hall, No 1150
Berkeley, California 94720

Jason Brodersen
Tetra Tech EM Inc.
1999 Harrison Street, Suite 500
Oakland, CA 94612

J. Michael Eichelberger, Ph.D.
Human and Ecological Risk Office
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Kimi Klein, Ph.D.
Human and Ecological Risk Office
Department of Toxic Substances Control
700 Heinz Avenue
Berkeley, CA 94710

Coby A. Graham
Department of Toxic Substances Control
700 Heinz Avenue
Berkeley, CA 94710

Attachment –

Department of Toxic Substances Control Comments to 09/30/2014 UC Phase IV Work Plan, Addendum I

Exploratory Excavation Work Plan

1. Page 2-4, Section 2.3.2 Geophysical Survey: Clarify whether the data generated by this geophysical survey will be logged and reported in the investigation report.

2. Page 2-5, Section 2.4 Exploratory Excavation Procedures:

   It is proposed in the plan that a single excavation should be completed, centered on the strongest magnetic anomaly. As illustrated below, the strongest anomaly measured by the magnetometer is not expected to be directly above the center of the metallic source but rather off-set to the south by some distance. Accordingly, the excavation must include the area north of the maximum anomaly. Figure 1, illustrating the anomaly and surrounding area, is attached for your reference.

   Rather than opening a 10 ft by 10 ft excavation, we recommend excavating three trenches extending across the anomaly as identified by the highest magnetometer readings. The trenches should traverse the anomaly in directions roughly perpendicular to the northwest-southeast anomaly trend and extend beyond the illustrated anomaly farther to the north or northeasterly directions than to south or southwesterly directions. Each trench can be backfilled before starting the next trench minimizing the amount of open excavation and associated stockpiled materials. Recommended trench locations are illustrated on the attached Figure 2.

Figure - Diagram of Magnetic Anomaly over a Burial Trench[1]

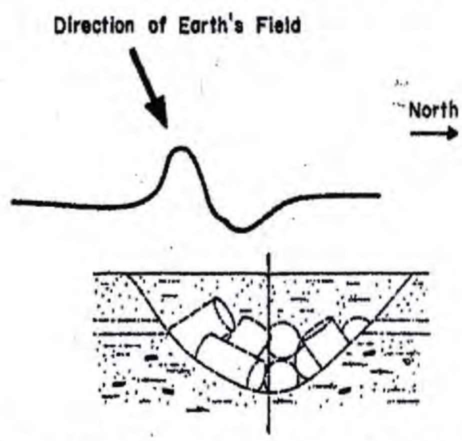


Figure 102. Diagram of magnetic anomaly over burial trench. Note that the peak anomaly may not necessarily lie over the center of the trench due to the angle of the earth's field.

[1] Source: Benson R., R.A. Glaccum, and M.R. Noel 1982. Geophysical Techniques for Sensing Buried Waste and Waste Migration. National Ground Water Association. 236 pp.

3. As per requirements in the California Business and Professions Code (Sections 6735 and 7835), the documents should be signed and/or stamped by a California registered civil engineer and/or professional geologist indicating their responsibility for engineering and/or geologic content of the documents.

4. Amend the references to the DTSC confirmation magnetometer survey to indicate that the survey has been performed and the anomaly location is confirmed. Two figures that are based on the survey are attached to this letter.

5. Page 2-8, Section 2.6 Collection of Soil and Drum Samples: State the type of sample container that will be used for suspected radiologic samples or refer to the relevant section of the document that includes this discussion.

6. Page 2-9, Site Restoration and Demobilization: Site restoration and erosion controls will need to be conducted as required by the site's Storm Water Pollution Prevention Plan (SWPPP).

7. Page 3-2, Section 3.3 Spill Prevention and Control Measures: DTSC recommends that California Office of Emergency Services *California Hazardous Materials Spill/Release Notification Guidance*, February 2014 be consulted and additional notification requirements be added to the plan. For example, the Local Unified Program Agency and other state and federal agencies need to be included.

8. Page 3-3, Section 3.7 Archeological Monitoring: If potential archeological resources are observed in the excavation, in addition to suspending work, a qualified archeologist needs to be called to evaluate the find and make recommendations.

Appendix B, Sampling and Analysis Plan

1. Page 2-4, Section 2.4.3.7 Sample Packaging and Shipping: Clarify whether there are any specific requirements for shipping of radioactive samples.

2. Page 2-4, Section 2.4.4 Decontamination of Sampling Equipment: Include analysis of one equipment blank per day to assess decontamination procedures of sampling equipment.

3. Operating Procedure for Subsurface Soil Sampling OP-352, Revision 3.0, Page 7 of 11, Section 7.2.4: Revise this section so that collection of soil samples for VOC analysis follows SW-846 Method 5035 to limit the potential for volatilization of VOCs.

4. Operating Procedure for Field Activity Documentation, OP-359, Revision 1.0, Attachment A, Cabrera Daily Repot: Please ensure that any shifts in wind direction throughout the day are noted on the OP 359, Field Activity Documentation Form.

Appendix C, Air Monitoring Plan

1. Table 1. Work Area Air Action Levels: Please explain the basis of the VOC action level of 5.0 parts per million.

Comments and Recommendations by the DTSC Human and Ecological Risk Branch

1. Attachment A: Perimeter Air Monitoring Plan, Section 2.1 Real-time Perimeter Dust Monitoring. Data measuring real-time air monitoring of dust will be downloaded daily onto a computer, and the data will be posted on the Richmond Bay Campus web-site within one week. If it is possible, these data should be posted daily, rather than 'within' a week, in order to proactively address community concerns about dust levels and adverse health effects.

2. Attachment A: Perimeter Air Monitoring Plan, Section 2.1 Real-time Perimeter Dust Monitoring. At the top of Page 2, a sentence should be added that two Personal Data Rams (PDRs) will be deployed at the perimeter, as stated in the Air Monitoring Plan.

3. The Air Monitoring Plan states that alpha and beta radiation will be monitored at the perimeter (Table 2 – Perimeter Air Action Levels). However, there is no mention of the instruments and method to be used to perform this monitoring in the Perimeter Air Monitoring Plan. Please explain or revise the perimeter air monitoring plan.

4. Hydrogen sulfide will be measured in the work area but not at the perimeter. Explain the rationale for not measuring this odiferous chemical at the perimeter.

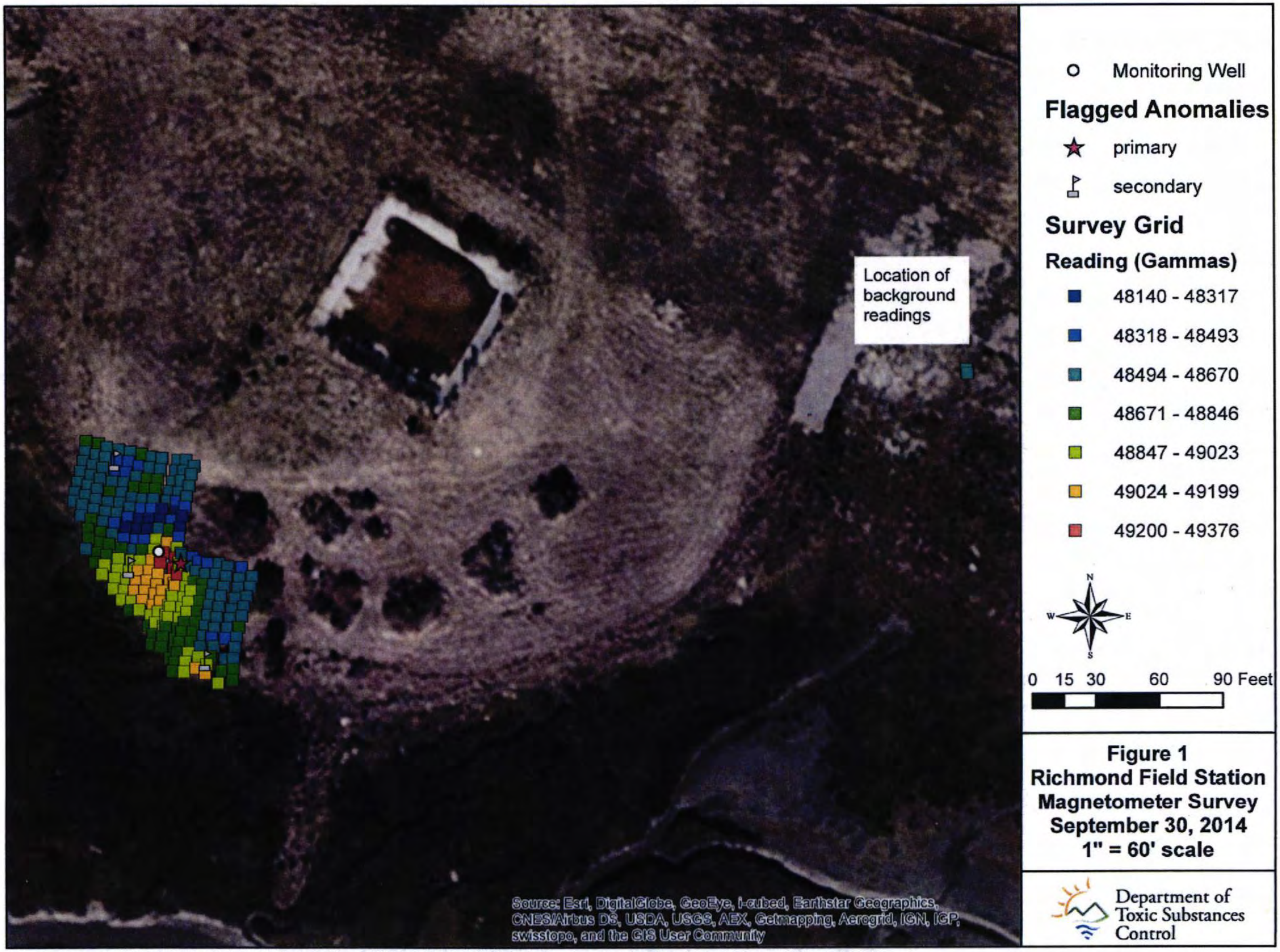
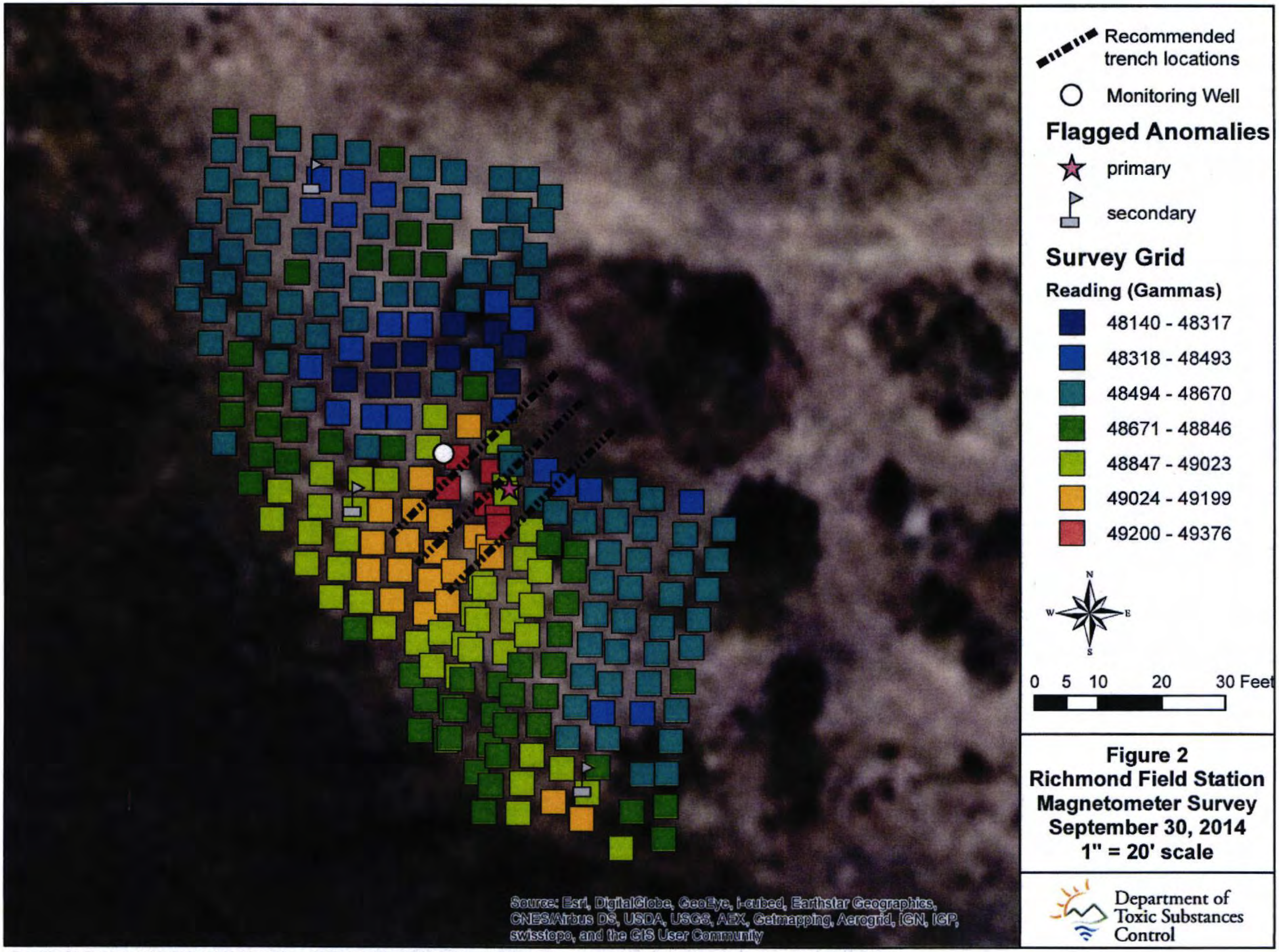


Figure 1
Richmond Field Station
Magnetometer Survey
September 30, 2014
1" = 60' scale

Coordinate System: NAD 1983 2011 StatePlane California III FIPS 0403 Ft US||Projection: Lambert Conformal Conic||Datum: NAD 1983 2011



Coordinate System: NAD 1983 2011 StatePlane California III FIPS 0403 Ft US||Projection: Lambert Conformal Conic||Datum: NAD 1983 2011

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Miriam Ingenito, Acting Director
700 Heinz Avenue, Suite 200
Berkeley, California 94710

Edmund G. Brown Jr.
Governor

DRAFT M E M O R A N D U M

TO: Lynn Nakashima
Senior Environmental Scientist
Brownfields and Environmental Restoration - Berkeley

FROM: Coby Graham
Associate Industrial Hygienist
Health and Safety Program (HSP) - Berkeley

DATE: October 20, 2014

SUBJECT: UC Berkeley, Richmond Field Station
Richmond, California
Air Monitoring Plan; Health and Safety Plan Review
PCA Code: 11018 Site Number: 201605-00

BACKGROUND

The Brownfields and Environmental Restoration Program (BERP), in Berkeley requested the HSP review the Health and Safety Plan addressing the exploratory excavation to investigate a sub-surface metal anomaly at the UC Richmond Field Station (Site), located in Richmond, California.

The Site is "located at 1301 South 46th Street, Richmond, California, along the southeast shoreline of the city of Richmond on the San Francisco Bay to the northwest of Point Isabel (see Figure 1) consisting of the Former Richmond Field Station (RFS) and the Regatta Property west of the Former RFS. The Former RFS is a 170 acre property consisting of 96 acres of upland areas that includes a remnant coastal terrace prairie, and 74 acres of tidal salt marsh, mudflats and transitional habitat." [EEWP § 1.0 (p. 1-1).] The Bulb is within the transition area of the Site and consists of a rounded Bay-ward extension. [See UC Berkeley, "Radioactive Materials Investigation: Historic Use Assessment Transition Area 'Bulb' Alleged Buried Drum Area" (May 2014) p. 4; SHSP § 3.1.3, p. 3-2.]

In early 2005, DTSC was informed that a former RFS employee claimed to have been instructed to transport drums of radioactive rocks from Lawrence Berkeley National Labs and the UC Berkeley campus to the RFS for burial in an area approximate to the

Bulb. The purpose of this exploratory excavation is to determine the source of a magnetic anomaly in the Bulb identified as a possible drum burial location. [See EEWP § 1.2, p. 1-3.]

Suspected contaminants of concern at the Site include volatile organic compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), Hydrogen sulfide, poly chlorinated biphenyls (PCBs), and potentially radioactive materials. [See SHSP § 3.1, pp. 3-2 to 3-3.]

DOCUMENTS REVIEWED

The HSP reviewed the "Air Monitoring Plan" and the "Site Specific Health and Safety Plan" for the "Exploratory Investigation for Magnetic Anomaly Source in Bulb". The HSP also consulted the "Exploratory Excavation Work Plan" and the "Sampling and Analysis Plan" to assist in its review of these plans. These documents were prepared by Cabrera Services, Inc.

Additionally, the HSP referred to the "Radioactive Materials Investigation: Historic Use Assessment Transition Area 'Bulb' Alleged Buried Drum Area" as prepared by UC-Berkeley to assist in its review.

These documents were received by the HSP reviewer on October 10, 2014.

GENERAL COMMENTS

The HASP is required to be a stand-alone document. The minimum required information necessary to ensure the health and safety of personnel on the "Site" must be contained within the HASP. The HASP may refer to other documents for community safety and health information, such as an air monitoring plan, which is often located in the work plan for a Site.

The Department of Toxic Substances Control (DTSC) has reviewed the HASP for conformance with Title 8, California Code of Regulations (T8 CCR), section 5192: "Health and Safety for Hazardous Waste Operations and Emergency Response"; and T8 CCR, subchapter 4 "Construction Safety Orders." The requirements of 29 CFR § 1910.120, T22 CCR, the California Health and Safety Code, as well as DTSC Policies and Procedures may also be considered in the DTSC review. Some of the general areas of concern include field safety issues such as electrical hazards (including overhead and buried electrical lines); confined spaces; excavations; controlling hazards through engineering, administrative, work practice controls and personal protective equipment; slip trip and fall hazards; lighting issues; heavy equipment safety; heat and cold stress; noise; radiation; and chemical hazards. Please note that in addition to the requirements of these citations, the employer is responsible for the implementation of an effective Injury and Illness Prevention Program which is required by T8 CCR, sections 1509 and 3203. The requirements of those sections have not been included in this review.

The HASP should apply to all contractors, sub-contractors, and regulatory personnel on-site. In the event that the HASP does not cover a contractor or sub-contractor, they must submit their own HASP to the DTSC for review. If the scope of work changes significantly, (an unanticipated chemical, physical, or biological hazard is discovered or introduced to the Site), then the new hazard must be addressed in an addendum to the HASP and submitted to the DTSC for review.

The DTSC review of the HASP does not constitute a guarantee that all potential hazards have been anticipated, recognized, and addressed, or that the HASP will be properly and safely implemented. The DTSC is unable to foresee every health and safety hazard in the work-place by reviewing the HASP. Effective implementation and regulatory compliance are the employer's responsibilities. Continuous surveillance of the Site and creation of an effective health and safety program by the employer will reduce work place injuries and liability.

The HASP was reviewed for scientific content and regulatory compliance. Minor grammatical or typographical errors that do not affect interpretation have not been noted; however, these errors, if any, should be corrected in future versions of the document.

An industrial hygienist from the DTSC may perform a field audit in order to confirm the implementation of the provisions and specifications presented in the HASP. The DTSC review of the HASP and field audit does not guarantee that the HASP will be properly implemented.

SPECIFIC COMMENTS

Please refer to the Cal/OSHA Pocket Guide for the Construction Industry (located at http://www.dir.ca.gov/dosh/dosh_publications/constguideonline.pdf) for helpful information pertaining to California's construction safety orders.

Air Monitoring Plan

2.0 Air Monitoring Strategy (p. 2-1).

Please include information from the SHSP in the air monitoring plan regarding oxygen and LEL monitoring. The air monitoring plan does not include monitoring provisions for oxygen and the LEL even though these concerns are addressed in the SHSP. [See SHSP § 5.6.3, Table 5-7, pp. 5-14 to 5-16.]

2.1 Laboratories and Testing Services, "Table 1. Work Area Air Action Levels" (pp. 2-1 to 2-2). [See also SHSP § 5.6.3, Table 5-7, pp. 5-14 to 5-16.]

Table 1 presents action levels based upon occupational exposure limits, and applies to both personal (breathing zone) and work area measurements and samples. Please provide the corresponding occupational exposure limits used to derive the action levels; DTSC typically sets the action level at 10 to 50 % of the occupational limit.

A table (DTSC Table A) has been provided with the applicable occupational exposure limits for this site based on the information provided.

DTSC Table A. Occupational Exposure Limits

Substance	CAS No.	Regulatory Limits		Recommended Limits	
		OSHA PEL	Cal/OSHA PEL	NIOSH REL	ACGIH 2014 TLV
		8-hour TWA (ST) STEL (C) Ceiling	8-hour TWA (ST) STEL (C) Ceiling	Up to 10-hour TWA (ST) STEL (C) Ceiling	8-hour TWA (ST) STEL (C) Ceiling
Benzene	71-43-2	1 ppm (ST) 5 ppm See 1910.1028	1 ppm (ST) 5 ppm See Section 5218	Ca 0.1 ppm (ST) 1 ppm See Appendix A	0.5 ppm (ST) 2.5 ppm
Coal tar pitch volatiles (benzene soluble fraction) (VOC)	65966-93-2	0.2 mg/m^3	0.2 mg/m^3	Ca 0.1 mg/m^3 (cyclohexane Extractable fraction) See Appendix A See Appendix C	0.2 mg/m^3 (as benzene soluble aerosol)
Chlorodiphenyl (42% Chlorine) (PCB)	53469-21-9	1 mg/m^3	1 mg/m^3	Ca 0.001 mg/m^3 See Appendix A	1 mg/m^3
Chlorodiphenyl (54% Chlorine) (PCB)	11097-69-1	0.5 mg/m^3	0.5 mg/m^3	Ca 0.001 mg/m^3 See Appendix A	0.5 mg/m^3
Hydrogen sulfide	7783-06-4	(C) 20 ppm	10 ppm (ST) 15 ppm (C) 50 ppm	(C) 10 ppm [10-min]	1 ppm (ST) 5 ppm
Particulates, Not Otherwise Regulated				See Appendix D	
- Total Dust		15 mg/m^3	10 mg/m^3		10 mg/m^3
- Respirable Fraction		5 mg/m^3	5 mg/m^3		3 mg/m^3
Radiation		1.25 Rems per calendar quarter	5 mRem/year	2 mRem/hr	50 mSv/year (5 Rem/year)
- α- & β-particles (airborne exposure)		2E-13 µCi/mL [DAC] (10 CFR 20, Appendix B, Table 1)	2E-13 µCi/mL [DAC] (10 CFR 20, Appendix B, Table 1)		
- γ-rays (airborne exposure)		1E-10 µCi/mL [DAC] (10 CFR 20, Appendix B, Table 1)	1E-10 µCi/mL [DAC] (10 CFR 20, Appendix B, Table 1)		

Occupational Exposure Limits from OSHA Annotated Table Z-1 (29 CFR 1910.1000), 29 CFR 1910.1096, 29 CFR 1926.53, 8 CCR § 5155 (Table AC-1), 8 CCR § 5076 (adopting 17 CCR § 30253 (incorporating 10 CFR §§ 20.1001 through 2402 and Appendices A through G with exceptions)), NIOSH's Pocket Guide to Chemical Hazards, NIOSH's "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (NIOSH 85-115), and ACGIH's 2014 TLVs and BEIs.

Action Level for VOCs should be based upon the OEL for Coal Tar Pitch Volatiles. Typically, if the VOC concentration exceeds the action level for Coal Tar Pitch Volatiles, then the appropriate step would be to screen for benzene to determine if exposure controls should be implemented or more protective PPE should be donned. Please note that NIOSH recommends SCBA, rather than APR, as respiratory PPE for benzene concentrations above the NIOSH REL.

2.1 Laboratories and Testing Services, "Table 2. Perimeter Air Action Levels" (p. 2-2). [See also SHSP § 5.6.3, Table 5-7, pp. 5-14 to 5-16.]

OSHA and NIOSH regulations should not be used to derive public exposure limits.

According to the Bay Area Air Quality Management District, "California's air quality standards are the most stringent and health-protective standards in the nation." Because this site is located in the Bay Area which has a Nonattainment designation for PM_{10} – 24-hour with respect to the California Standard of 50 µg/m^3, this concentration should be used to determine the action level for particulate matter at the site perimeter. [See 17 CCR § 70200.] In addition to the California Standard for PM_{10} – 24-hour, fugitive dust emissions from the site should also comply with the requirements found in Bay Area Air Quality Management District's ["BAAQMD"] Regulation 6, Rule 1 for Particulate Matter. Specifically, this rule restricts the visible emission of particulate matter.

Furthermore, the BAAQMD's Manual of Procedures, Volume VI, contains specific air monitoring procedures for different constituents – including volatile compounds, such as hydrogen sulfide, and particulates, such as lead – and contains procedures for instrumentation and siting which should be used for ground level monitoring for particulate matter at this site. Moreover, Appendix A of this volume of the Manual of Procedures includes information for meteorological monitoring.

Moreover, the air monitoring plan should include hydrogen sulfide in Table 2. The California Air Quality Standard for hydrogen sulfide is 0.03 ppm for 1-hour. Additionally, the OEHHA Reference Exposure Levels for hydrogen sulfide are 10 mg/m3 for chronic exposure and 42 mg/m3 for acute (1-hour) exposures.

A toxicologist familiar with this site may need to be consulted on the plan's action level to prepare a site-specific action level for PCBs to determine if the California PM_{10} – 24-hour Nonattainment Standard is protective of public health.

2.2 Air Monitoring Design (pp. 2-2 to 2-3).

Please refer to the recommendations in the BAAQMD's Manual of Procedures, Volume VI, Air Monitoring Procedures, for siting procedures and meteorological guidance. [Located at http://www.baaqmd.gov (Last Viewed on October 20, 2014).] Please, make any changes necessary to conform to these procedures, if applicable.

[See also EEWP § 3.1 Erosion Control Measurements, p. 3-1.]

The erosion control measurements found in the work plan should be related to the onsite air monitoring plan regarding dust measurements at the work zone and the perimeter with appropriate action levels to protect the public, including the health and safety of workers and the community. If instrument readings for dust control at the site exceed their respective action levels, then erosion control measures would need to be examined, increased, and/or implemented.

Health and Safety Plan

Executive Summary (p. iii).

Action Level for VOCs should be based upon the OEL for Coal Tar Pitch Volatiles. Typically, if the VOC concentration exceeds the action level for Coal Tar Pitch Volatiles, then the appropriate step would be to screen for benzene to determine if more protective PPE should be donned.

The action level for hydrogen sulfide should be set at 50% of the OEL to ensure than workers are protected against unnecessary exposures to hydrogen sulfide above the TLV.

Please explain how airborne PCB concentrations will be determined based on field measurements. Section 5.6, Chemical Exposure Monitoring, does not include information on field measurements for PCBs.

Please include information about gamma radiation in the summary table.

2.4 Site Radiation Safety Lead (pp. 2-2 to 2-3).

Please include information pertaining to the Authority and Qualifications of the Site Radiation Safety Lead ["SRSL"].

2.5 Employees (p. 2-3). [See also SHSP § 6.1 HAZWOPER Qualifications, p. 6-1.]

Please include information pertaining to the Qualifications of different employees; e.g., 40-hour HAZWOPER with current refresher courses, on-the-job training, etc....

2.7 Subcontractors (p. 2-4). [See also SHSP § 6.1 HAZWOPER Qualifications, p. 6-1.]

Please indicate any minimum qualifications.

2.8 Visitors (pp. 2-4 to 2-5).

Will HAZWOPER training be required for site visitors? If so, please indicate any minimum qualifications and areas where such training would be required.

3.1.3 Investigation Area Description (pp. 3-2 to 3-3).

Please include the maximum soil and groundwater concentrations for the Contaminants of Concern.

Given the maximum expected soil concentration of PCBs for the work area, the action level for worker protection based on the potential airborne concentration of PCB absorbed to dust can be calculated using the following equation:

$$[(\text{OEL in air in mg/m3}) \times (10^6 \text{ mg/kg})] / [(\text{Conc. in soil in mg/kg}) \times (\text{Safety Factor})]$$

Assume the safety factor is two (2).

3.2 Scope of Work (p. 3-3). [See also EEWP § 2.6, pp. 2-8 to 2-9.]

Per the requirements of 8 CCR § 5192(b)(4)(B), please include an activity hazard analysis for the collection of soil and drum sampling. These two activities are found in the work plan, yet no hazard analysis was included in the Site-Specific Health and Safety Plan.

3.2.1.2 Site Preparation (pp. 3-3 to 3-4). [See also EEWP § 2.2.6 Waste Management, p. 2-3; SAP § 2.4.1 Sampling Locations, p. 2-2.]

Please incorporate any applicable requirements found in 8 CCR § 5192(j) regarding handling drums, as they may apply to this work plan. In addition, please include an activity hazard analysis for drum handling.

The work plan states that any intact drums placed into secondary containment using a B-25 waste container "will be sampled [within 30 days] using all health and safety precautions (placed into a HEPA filtered tented containment or equivalent protection and opened by staff in Level A PPE)."[SAP § 2.4.1, p. 2-2.] Is there a Cabrera operating procedure with "all health and safety precautions" for sampling drums with potential radioactive materials inside secondary containment? If so, please include this document with the work plan and/or health and safety plan.

[See also EEWP § 2.2 Mobilization and Site Preparation, p. 2-1.]

Is an excavation or open-pit permit required from the city?

Excavation work and site preparation activities should follow the general requirements for Excavations found in Article 6 of the California Code of Regulations. [See 8 CCR Article 6, §§ 1539-1541.1 and appendices.]

According to the almanac for Berkeley, California, the expected times for sunrise for October 29 and 30 are 7:30 AM and 7:31 AM, respectively. Accordingly, regular site work hours for the activities in this work plan should be from 7:30 AM to 5:00 PM because "activities will only be conducted during daylight hours." Any work occurring prior to 7:30 would require illumination.

3.2.1.4 Excavation of Soils (p. 3-4).

[See also EEWP § 2.2.5 Stockpiling Area, p. 2-2.]

Although employee's will not be working in the trench, stockpiles and equipment should be placed and kept "at least 2 feet from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary." [See 8 CCR 1541(j)(2).]

[See also EEWP § 2.3.3 Air Monitoring, p. 2-4.]

Will instruments be capable of data-logging? If instruments are capable of data-logging, then this feature should be used and the information from this event provided to the department in a reasonable time after this activity has been completed.

4.3.1 Slips, Trips, Falls, and Protruding Objects (pp. 4-2 to 4-3). [See also Cabrera, OP-590, Elevated Work Platforms.]

According to Cabrera's operating procedure, OP-590, fall protection shall be worn when workers are in the aerial lift. [See Cabrera OP-585 § 7.1 (p. 6).] Will a safety harness be required for any workers conducting field activities near the excavation but not within the aerial lift? If so, at what distance to the open excavation would a worker be required to wear a safety harness?

4.3.7 Excavations and Trenches (p. 4-5). [See also Cabrera OP-583, Excavation and Trenching.]

Please ensure the requirements of 8 CCR §§ 1539 to 1541.1 are met, as they may apply to this work plan. For example, section 1541 requires employees involved in the excavation and exposed to excavation operation hazards to "be trained in the excavator notification and excavation practices required by this section and Government Code Sections 4216 through 4216.9." [8 CCR § 1541(b)(1)(D).]

4.3.10 Working at Heights (pp. 4-5 to 4-6). [See also Cabrera OP-585, Fall Protection.]

Please refer to 8 CCR § 1541(l) for California specific requirements for fall protection at excavations. How close will workers be to the edge or sides of the excavation? At what distance to the excavation's unprotected sides and edges would fall protection be utilized? Will an adequate physical barrier be provided to protect workers working near the excavation's edge?

4.3.11 Dust and Odor Control (p. 4-6).

Will hydrogen sulfide from the excavation be encountered in concentrations that would require odor control? Generally, a human nose can detect hydrogen sulfide in the air at very low concentrations. [See SHSP § 5.1.2, p. 5-2 ("The odor threshold is 0.008 ppm.").]

4.4.3 Poisonous Plants (pp. 4-8 to 4-9).

Poison Ivy and Giant Hogweed have not been reported at this site.

4.4.4 Insects (p. 4-9).

Lyme disease infected Western Black-Legged ticks have been found in Contra Costa county. [See California Department of Public Health, "Testing Results for Borrelia burgdorferi (Lyme Disease Agent) From Western Black-Legged Ticks (Ixodes pacificus)" (Updated through 2009) pp. 7-8.]

Black widow spiders are located throughout California. Their venom is a systemic venom that can cause various symptoms including severe muscle pain and cramps, weakness, sweating, headache, itching, nausea, difficulty breathing and high blood pressure. Black widow spiders generally prefer dark, quiet places, such as well boxes, electrical boxes, and storage sheds.

5.2.2 Radiation Surveys and Monitoring (pp. 5-5 to 5-7) and 5.3 Personnel Radiological Monitoring (p. 5-9). [See also EEWP § 2.4 Exploratory Excavation Procedures, p. 2-5; SHSP § 5.6.3, Table 5-7, pp. 5-14 to 5-16.]

Please include the information pertaining to radiological surveys found in section 2.4 of the EEWP into the SHSP by either incorporation into the text or reference/citation to the work plan. Specifically, the language pertaining to radiological surveys and work stoppages should be included into the SHSP.

Will dose rates be collected and monitored both at the surface at depth of the excavation and at the ground surface – or only in areas where employees are working? If the dose rate exceeds 50 mR/hr above background, at which location would this reading instigate a work stoppage, sampling, and backfilling the excavation? [See EEWP § 2.4, p. 2-5.] Should this metric also be incorporated into the SHSP?

5.6.3 Monitoring Procedures, Table 5-7: Work Zone Monitoring Procedures and Action Levels (pp. 5-14 to 5-16).

Please refer to previous comments on the Air Monitoring Plan with respect to the occupational exposure limits and the action level.

8.1 Personal Protective Equipment (p. 8-1). [See also AMP § 1.0 Introduction (p. 1-1).]

Cal/OSHA requires foot protection that meets the requirements of ASTM F 2412-05 and ASTM F 2413-05 for safety footwear purchased after January 26, 2007. For footwear purchased before January 26, 2007, protective footwear must meet the above standards or ANSI Z41-1999. [See 8 CCR § 3385.]

9.1 Emergency Action Plan (p. 9-1).

Please refer to 8 CCR § 5192(l) for the emergency response requirements at an uncontrolled hazardous waste site. Please make any necessary changes so that the Emergency Action Plan conforms to these requirements.

Please note that "[e]mployers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this subsection if they provide an emergency action plan complying with 8 CCR 3220 of the General Industry Safety Orders." [8 CCR §5192(l)(1)(B).]

CONCLUSIONS AND RECOMMENDATIONS

The submitted HASP is very thorough and well written; it also contains valuable information relating to occupational safety and health, as well as community health and safety. However, the areas where the HSP has requested additional information and/or clarification should be corrected or clarified and resubmitted for further review.

Future changes in the document should be clearly identified.

The HSP is available to discuss this document and related issues. Should questions arise contact Coby Graham at (510) 540-3934.

PEER REVIEW BY: ________________
Ryan Kinsella, MS, REHS, CIH
Senior Industrial Hygienist

Cal/OSHA requires foot protection that meets the requirements of ASTM F 2412-05 and ASTM F 2413-05 for safety footwear purchased after January 26, 2007. For footwear purchased before January 26, 2007, protective footwear must meet the above standards or ANSI Z41-1999. [See 8 CCR § 3385.]

9.1 Emergency Action Plan (p. 9-1).

Please refer to 8 CCR § 5192(l) for the emergency response requirements at an uncontrolled hazardous waste site. Please make any necessary changes so that the Emergency Action Plan conforms to these requirements.

Please note that "[e]mployers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this subsection if they provide an emergency action plan complying with 8 CCR 3220 of the General Industry Safety Orders." [8 CCR §5192(l)(1)(B).]

CONCLUSIONS AND RECOMMENDATIONS

The submitted HASP is very thorough and well written; it also contains valuable information relating to occupational safety and health, as well as community health and safety. However, the areas where the HSP has requested additional information and/or clarification should be corrected or clarified and resubmitted for further review.

Future changes in the document should be clearly identified.

The HSP is available to discuss this document and related issues. Should questions arise contact Coby Graham at (510) 540-3934.

PEER REVIEW BY: ____________
Ryan Kinsella, MS, REHS, CIH
Senior Industrial Hygienist

THE AMERICAN BOARD OF INDUSTRIAL HYGIENE
INCORPORATED
CERTIFICATION NUMBER
10039 CP
EXPIRES
6-1-2017
PENNSYLVANIA 1960
RYAN S. KINSELLA, CIH

Comments-Responses for Exploratory Excavation Work Plan, FINAL – October 2014
Comments Reviewed by Cabrera 10/24/14, Revised on 10/28/14

Comment Number	Section	Comment	*Response*
Reviewer: DTSC			
1	Page 2-4, Section 2.3.2	Clarify whether data generated by this geophysical survey will be logged and reported in the investigation report.	Data generated by the geophysical survey will be logged and reported in the investigation report.
2	Page 2-5, Section 2.4	Rather than opening a 10 ft by 10 ft excavation, we recommend excavating three trenches extending across the anomaly as identified in the highest magnetometer readings. The trenches should traverse the anomaly in directions roughly perpendicular to the northwest-southeast anomaly trend and extend beyond the illustrated anomaly farther to the north or northeasterly directions than to south or southwesterly directions. Each trench can be backfilled before starting the next trench minimizing the amount of open excavation and associated stockpile materials. Recommended trench locations are illustrated on the attached Figure 2.	Agree with comment. Excavation approach will be modified as described in the comment.
3	General	As per requirements of California Business and Professions Code (Sections 6735 and 7835), the documents should be signed and/or stamped by a California registered civil engineer and/or professional geologist indicating their responsibility for engineering and/or geologic content of the documents.	Agree with comment. Work Plan will be signed and stamped by a California registered civil engineer.
4	Section 2.1	Amend the references to the DTSC confirmation magnetometer survey to indicate that the survey has not been performed and the anomaly location is confirmed. Two figures that are based on the survey are attached to this letter.	Agree with this comment. The updates to the status of the DTSC confirmation magnetometer survey are noted. As agreed to by DTSC and UC Berkeley, Cabrera will not revise the Work Plan, but rather respond with suggested revisions to the Work Plan in this response to comments (RtC) table, the RtC table will be added as an addendum to the Work Plan, and these changes will be reflected during the field work.
5	Page 2-8, Section	State the type of sample container that will be used for	Samples collected for radiological analysis will be collected in 1 L

Comment Number	Section	Comment	*Response*
	2.6	suspected radiologic samples or refer to the relevant section of the document that includes this discussion.	widemouth plastic jars as described in Table 2 of the SAP.
6	Page 2-9, Section 2.8	Site restoration and erosion controls will need to be conducted as required by the site's Storm Water Pollution Prevention Plan (SWPPP).	Agree with comment.
7	Page 3-2, Section 3.3	DTSC recommends that California Office of Emergency Services *California Hazardous Materials Spill/Release Notification Guidance*, February 2014 be consulted and additional notification requirements be added to this plan. For example, the Local Unified Program Agency and other state and federal agencies need to be included.	Agree with comment. This guidance will be reviewed and is available on site, and all appropriate notifications will be made if necessary.
8	Page 3-3, Section 3.7	If potential archaeological resources are observed in the excavation, in addition to suspending work, a qualified archaeologist needs to be called to evaluate the find and make recommendations.	Agree with comment. This will be done.
9	SAP, Page 2-4, Section 2.4.3.7	Clarify whether there are any specific requirements for shipping of radioactive samples.	Agree with comment. These requirements have been added to Section 2.4 of the Work Plan. The following text was added, "All samples taken from the excavations that measure greater than background values with hand-held instrumentation will be treated with additional controls as needed. Additional controls to be used on samples confirmed to be containing radioactivity greater than normal background include the following: • Use of remote handling tools (i.e., shovel) when handling the unshielded sample, as appropriate. • Gamma spectroscopy performed to assess the predominate radionuclide, if feasible. • Bagging in plastic and labeling with a trefoil and identifying information. • Lead or plastic shielding (as appropriate) used to store the samples.

Comment Number	Section	Comment	*Response*
			• Secure temporary storage of the samples at the Richmond Field Station B128. • Off-site shipment in compliance with DOT regulations and the analytical lab criteria for acceptance for analysis, if needed."
10	SAP Page 2-4, Section 2.4.4	Include analysis of one equipment blank per day to assess decontamination procedures of sampling equipment.	All sampling protocols will be conducted consistent with the DTSC-approved quality assurance project plan, included as Appendix A of the Final Phase I Groundwater Sampling, Field Sampling Workplan, dated June 2, 2010. Equipment rinsate blanks will be collected in the event that non-dedicated sampling equipment is used; however, all samples will be collected with disposable equipment.
11	Operating Procedure for Subsurface Soil Sampling OP-352, Revision 3.0, Page 7 of 'l 1, Section7.2,4	Revise this section so that collection of soil samples for VOC analysis follows SW-846 Method 5035 to limit the potential for volatilization of VOCs.	All soil samples analyzed for VOCs will be collected per EPA Method 5035, as per the quality assurance project plan (Tetra Tech, 2010).
12	Operating Procedure for Field Activity Documentation, OP-359, Revision 'l .0, Attachment A, Cabrera Daily Report	Please ensure that any shifts in wind direction throughout the day are noted on the OP 359, Field Activity Documentation Form	Shifts in wind direction will be noted on the Daily Report.
13	AMP, Table 1	Please explain the basis of the VOC action level of 5.0 ppm.	Please see response to comment 19.
14	Attachment A: Perimeter Air Monitoring Plan, Section 2.1	Data measuring real-time air monitoring of dust will be downloaded daily onto a computer, and the data will be posted on the Richmond Bay Campus web-site within one week. [fit is possible, these data should be posted daily, rather than 'within' a week, in order to	Data will be posted on the Richmond Bay Campus web site (httP://rfs-env.berkeley.edu) during the next business day.

Comment Number	Section	Comment	*Response*
		proactively address community concerns about dust levels and adverse health effects.	
15	Attachment A: Perimeter Air Monitoring Plan, Section 2.1	At the top of Page 2, a sentence should be added that two Personal Data Rams (PDRs) will be deployed at the perimeter, as stated in the Air Monitoring Plan.	Agree with comment. A total of two PDRs will be used to monitor dust levels along the perimeter of the exploratory excavation area (one PDR located upwind and one PDR located downwind).
16	AMP, Table 2 - Perimeter Air Action Levels	However, there is no mention of the instruments and method to be used to perform this monitoring in the Perimeter Air Monitoring Plan. Please explain or revise the perimeter air monitoring plan.	Radiological air monitoring in the work area and perimeter of the work area is described in detail in the SHSP and Air Monitoring Plan.
17	AMP	Hydrogen sulfide will be measured in the work area but not at the perimeter. Explain the rationale for not measuring this odiferous chemical at the perimeter.	Hydrogen sulfide gas is not likely to be encountered during excavation activities. There has been an extensive history of odor and H_2S monitoring during previous excavations at the RFS that did not find odorous conditions that would warrant perimeter H_2S monitoring. The ACGIH TLV value of 1 ppm in the work area is sufficient to protect worker health. However, if H_2S is detectable in the Work Area, regular readings will be collected at the perimeter of the work zone.
18	AMP 2.0 Air Monitoring Strategy (p. 2-1)	Please include information from the SHSP in the air monitoring plan regarding oxygen and LEL monitoring. The air monitoring plan does not include monitoring provisions for oxygen and the LEL even though these concerns are addressed in the SHSP.	Entry will not be made into the trenches or confined spaces. Oxygen and LEL will be monitored in the work area using a 4-gas meter as described in the SHSP.
19	2.1 Laboratories and Testinq Services. "Table 1. Work Area Air Action Levels" (pp. 2-1to 2-2)	Table 1 presents action levels based upon occupational exposure limits, and applies to both personal (breathing zone) and work area measurements and samples. Please provide the corresponding occupational exposure limits used to derive the action levels; DTSC typically sets the action level at '10 to 50 % of the occupational limit. A table (DTSC Table A) has been provided with the applicable occupational exposure limits for this site based on the information provided.	Action levels were derived using the available COC data from soil and groundwater samples for the project location. Available information for the proposed excavation area does not indicate the presence of any known or suspected COCs, with the exception of 5.7 mg/kg of PCB (Aroclor 1248) in soil. As such, a conservative Cal/OSHA action level under 8 CCR Section 5218 of 0.5 ppm for VOC/SVOC (based on benzene), and 1 mg/m^3 of respirable dust, will be used as initial default values to be protective of employees. If the PID detects VOCs/SVOCs at 0.5 ppm, colormetric tubes, or equivalent, will be

Comment Number	Section	Comment	*Response*
		(Table provided) Action Level for VOCs should be based upon the OEL for Coal Tar Pitch Volatiles. Typically, if the VOC concentration exceeds the action level for Coal Tar Pitch Volatiles, then the appropriate step would be to screen for benzene to determine if exposure controls should be implemented or more protective PPE should be donned. Please note that NIOSH recommends SCBA, rather than APR, as respiratory PPE for benzene concentrations above the NIOSH REL.	used to determine if the PID detection is due to airborne benzene contamination. If benzene is confirmed, then the appropriate controls will be implemented per the SHSP. If benzene is not found, then 1.0 ppm will be the new conservative action level for VOCs/SVOCs. Coal Tar Pitch Volatiles are not known, or suspected, to be present in the soil and/or groundwater at the project location.
20	2.1 Laboratories and Testinq Services, "Table 2. Perimeter Air Action Levels" (p. 2-2).	OSHA and NIOSH regulations should not be used to derive public exposure limits. According to the Bay Area Air Quality Management District, "California's air quality standards are the most stringent and health-protective standards in the nation." Because this site is located in the Bay Area which has a Nonattainment designation for PMls - 24-hour with respect to the California Standard of 50 pg/m', this concentration should be used to determine the action level for particulate matter at the site perimeter. lSee 17 CCR S 70200.1 ln addition to the California Standard for PMro - 24-hour,fugitive dust emissions from the site should also comply with the requirements found in Bay Area Air Quality Management District's I'BAAOMD] Regulation 6, Rule 1 for Particulate Matter. Specifically, this rule restricts the visible emission of particulate matter. Furthermore, the BAAQMD's Manual of Procedures, Volume Vl, contains specific air monitoring procedures for different constituents - including volatile compounds, such as hydrogen sulfide, and particulates, such as lead - and contains procedures for	The only known or suspected COC present within the soils on the project site are 5.7 mg/kg of PCB (Aroclor 1248) in soil. Calculations indicate respirable dust levels would have to exceed 43,000 mg/m^3 before the action level for PCB's would be exceeded. A conservative action level of 1 mg/m^3 has been set for the work zone, with Stop Work at 5 mg/m^3. The ACGIH TLV of 1 ppm for Hydrogen Sulfide will be used for the site.

Comment Number	Section	Comment	*Response*
		instrumentation and siting which should be used for ground level monitoring for particulate matter at this site. Moreover, Appendix A of this volume of the Manual of Procedures includes information for meteorological monitoring. Moreover, the air monitoring plan should include hydrogen sulfide in Table 2. The California Air Quality Standard for hydrogen sulfide is 0.03 ppm for 1-hour. Additionally, the OEHHA Reference Exposure Levels for hydrogen sulfide are 10 mg/m3 for chronic exposure and 42 mg/m3 for acute (1-hour) exposures. A toxicologist familiar with this site may need to be consulted on the plan's action level to prepare a site-specific action level for PCBs to determine if the California PM_{10} - 24-hour Nonattainment Standard is protective of public health.	
21	2.2 Air Monitoring Design (pp. 2-2 to 2-3).	Please refer to the recommendations in the BAAQMD's Manual of Procedures, Volume Vl, Air Monitoring Procedures, for siting procedures and meteorological guidance.[Located at http://www.baaqmd.gov (Last Viewed on October 20, 2014).] Please, make any changes necessary to conform to these procedures, if applicable.	Agree with comment. No changes will be required to address this comment.
22		The erosion control measurements found in the work plan should be related to the onsite air monitoring plan regarding dust measurements at the work zone and the perimeter with appropriate action levels to protect the public, including the health and safety of workers and the community. If instrument readings for dust control at the site exceed their respective action levels, then erosion control measures would need to be examined, increased, and/or implemented.	Agree with comment. Dust control measures are described in Section 3.1.

Comment Number	Section	Comment	*Response*
23	HASP Executive Summarv (p. iii).	Action Level for VOCs should be based upon the OEL for Coal Tar Pitch Volatiles. Typically, if the VOC concentration exceeds the action level for Coal Tar Pitch Volatiles, then the appropriate step would be to screen for benzene to determine if more protective PPE should be donned. The action level for hydrogen sulfide should be set at 50% of the OEL to ensure than workers are protected against unnecessary exposures to hydrogen sulfide above the TLV. Please explain how airborne PCB concentrations will be determined based on field measurements. Section 5.6, Chemical Exposure Monitoring, does not include information on field measurements for PCBS. Please include information about gamma radiation in the summary table.	See responses to Comments 19 and 20.
24	2.4 Site Radiation Safety Lead (pp. 2-2 to 2-3).	Please include information pertaining to the Authority and Qualifications of the Site Radiation Safety Lead (SRSL).	The SRSL has authority to: - Verify that all operations are in compliance with the requirements of this SHSP. - Issue a "Stop Work Order" under the conditions set forth in this SHSP. - Temporarily suspend individuals from field activities for infractions against the SHSP pending consideration by the Project HP and the PM. In addition to being HAZWOPER-qualified, the SRSL is required to have Cabrera Radiation Worker training and have at least 5 years' experience in health physics and radiation protection.
25	2.5 Employees (p.2-3).	Please include information pertaining to the Qualifications of different employees; e.g.,40-hour HAZWOPER with current refresher courses, on-the-job training, etc.	All employees are required to have current medical clearance to perform their on-job duties, 40-hour HAZWOPER with current 8-hour refresher courses, and current Cabrera Radiation Worker training. Certificates will be present on-site.
26	2.7 Subcontractors (p. 2-4)	Please indicate any minimum qualifications.	All employees are required to have current medical clearance to perform their on-job duties, 40-hour HAZWOPER with current 8-hour refresher courses, and current Cabrera Radiation Worker training or

Comment Number	Section	Comment	*Response*
			Cabrera Radiation Awareness training. Current training certificates must be presented to the SSHO prior to accessing the EZ.
27	2.8 Visitors (pp. 2-4 to 2-5)	Will HAZWOPER training be required for site visitors? If so, please indicate any minimum qualifications and areas where such training would be required.	HAZWOPER training will be required for site visitors to enter the work zone (i.e., radiological controlled area) during active operations. Persons without this training would not be permitted in the zone during active operations. Cabrera can cease (temp stop work), and allow visitors to enter, with escort, and investigate, then retreat, and then resume operations.
28	3.1 .3 lnvestigation Area Description (pp. 3-2 to 3-3).	Please include the maximum soil and groundwater concentrations for the Contaminants of Concern. Given the maximum expected soil concentration of PCBs for the work area, the action level for worker protection based on the potential airborne concentration of PCB absorbed to dust can be calculated using the following equation: [(OEL in air in mg/m3) x (10^6 mg/kg)] / [(Conc. in soil in mg/kg) x (Safety Factor)] Assume the safety factor is two (2).	Please see response to comment #20. Complete analytical data from soil sampling results collected from the excavation area are presented in Tables 2 through 6 in the Final Phase IV Field Sampling Plan, dated October 6, 2014, prepared by Tetra Tech. The most current complete analytical data from groundwater samples collected from piezometer Bulb1 are presented in the Tables 7, 8, and 9 in the Draft 2014 Groundwater Sampling Results Technical Memorandum, dated July 31, 2014, prepared by Tetra Tech.
29	3.2 Scope of Work (p.3-3).	Per the requirements of 8 CCR S 5192(b)(4)(B), please include an activity hazard analysis for the collection of soil and drum sampling. These two activities are found in the work plan, yet no hazard analysis was included in the Site-Specific Health and Safety Plan.	There will not be any drum sampling performed. All samples of soil/solids will be collected directly from the excavator bucket. AHA #3 has been revised to include a step for soil sampling from bucket of excavator.
30	3.2.1.2 Site Preparation (pp. 3-3 to 3-4).	Please incorporate any applicable requirements found in I CCR S 5'192O regarding handling drums, as they may apply to this work plan. ln addition, please include an activity hazard analysis for drum handling. The work plan states that any intact drums placed into secondary containment using aB-25 waste container "will be sampled [within 30 days] using all health and safety precautions (placed into a HEPA filtered tented	Sampling of drums is not included in this proposed SOW. If a drum is located, the option to place the drum into the B-25 container for protection is allowed, but not opened or sampled. The B-25 container will be moved to a secure location and a plan for opening and sampling at a later date would be discussed further with the agencies before this work would proceed. Work Plan to be revised to remove any references to drum sampling activities.

Comment Number	Section	Comment	*Response*
		containment or equivalent protection and opened by staff in Level A PPE)."[SAP S 2.4.1, p.2-2.1 ls there a Cabrera operating procedure with "all health and safety precautions" for sampling drums with potential radioactive materials inside secondary containment? lf so, please include this document with the work plan and/or health and safety plan.	
31		ls an excavation or open-pit permit required from the city? Excavation work and site preparation activities should follow the general requirementsfor Excavations found in Article 6 of the California Code of Regulations. [See 8 CCRArticle 6, SS 1539-1541.1 and appendices.] According to the almanac for Berkeley, California, the expected times for sunrise for October 29 and 30 areT'.30 AM and 7:31 AM, respectively. Accordingly, regular site work hours for the activities in this work plan should be from 7:30 AM to 5:00 PM because "activities will only be conducted during daylight hours." Any work occurring prior to 7:30 would require illumination.	Cabrera's excavation subcontractor, Insight, has a current State of California Annual Trench/Excavation Permit and a General Engineering Contractor Haz Substances Removal Permit from Contractors State License Board. These will be maintained on-site.
32	3.2.1 .4 Excavation of Soils (p. 3-4).	Although employee's will not be working in the trench, stockpiles and equipment should be placed and kept "at least 2 feet from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary." See 8 CCR15410)Q).1	All soil stockpiles and equipment will be kept back a minimum of 2-3 feet from the edge of the excavation.
33	3.2.1 .4 Excavation of Soils (p. 3-4).	Will instruments be capable of data-logging? lf instruments are capable of data-logging, then this feature should be used and the information from this event provided to the department in a reasonable time after this activity has been completed.	Noted. GPS instrumentation is capable of data-logging, the magnetometer is not. Magnetometer survey data will be recorded manually during the excavation. All available data will be made available as soon as possible after internal quality review of the data is performed.

Comment Number	Section	Comment	*Response*
34	4.3.1 Slips, Trips, Falls. and Protrudinq Objects (pp. 4-2 to 4-3)	According to Cabrera's operating procedure, OP-590, fall protection shall be worn when workers are in the aerial lift. [See Cabrera OP-585 S 7 1 (p. 6).] Will a safety harness be required for any workers conducting field activities near the excavation but not within the aerial lift? If so, at what distance to the open excavation would a worker be required to wear a safety harness?	Perimeter boundaries will be defined using caution tape and/or radiation rope. Employees will not be permitted within 6 feet of a properly sloped or benched edge of the excavation, or within a distance equal to 2x's the depth of the excavation. As such, fall protection will not be required by ground personnel.
35	4.3.7 Excavations and Trenches (p.4-5). [See also Cabrera OP-583, Excavation andTrenching.]	Please ensure the requirements of 8 CCR SS 1539 lo 1541 .1 are met, as they may apply to this work plan. For example, section 1541 requires employees involved in the excavation and exposed to excavation operation hazards to "be trained in the excavator notification and excavation practices required by this section and Government Code Sections 4216 through 4216.9." [8 CCR S 1541(bX1XD).]	The designated Competent Person for the excavation operations will be the Excavation Subcontractor, who has the training and qualifications (experience) necessary to meet these requirements. Additionally, Cabrera management staff has the necessary training and qualifications to perform equal duties, plus OSHA 30-hour construction safety training.
36	4.3.10 Workinq at Heiqhts (pp. 4-5 to 4-6). [See also Cabrera OP-585, Fall Protection.]	Please refer to 8 CCR S 1541 (l) for California specific requirements for fall protection at excavations. How close will workers be to the edge or sides of the excavation? At what distance to the excavation's unprotected sides and edges would fall protection be utilized? Will an adequate physical barrier be provided to protect workers working near the excavation's edge?	See response to comment 34.
37	4.3.11 Dust and Odqr Control (p. 4-6).	Will hydrogen sulfide from the excavation be encountered in concentrations that would require odor control? Generally, a human nose can detect hydrogen sulfide in the air at very low concentrations. [See SHSP S 5.1.2, p. 5-2 ("The odor threshold is 0.008ppm.").I	This is not anticipated to be of a concern due to the history of not encountering odors in previous excavations at the site, and the fact that anything encountered would be from naturally decaying organic matter in the soil and or underlying vegetative material. Monitoring will be conducted in the work zone using a Multi-Rae, and an action level of 1 ppm (ACGIH TLV) has been established. See RTC #17.
38	4.4.3 Poisonous Plants (pp.4-8 to 4-9).	Poison lvy and Giant Hogweed have not been reported at this site.	Noted.
39	4.4.4 Insects (p. 4-	Lyme disease infected Western Black-Legged ticks have	Noted.

Comment Number	Section	Comment	*Response*
	9).	been found in Contra Costa county. [See California Department of Public Health, "Testing Results for Borrelia burgdorferi (Lyme Disease Agent) From Western Black-Legged Ticks (lxodes pacificus)" (Updated through 2009) pp. 7-8.1Black widow spiders are located throughout California. Their venom is a systemic venom that can cause various symptoms including severe muscle pain and cramps, weakness, sweating, headache, itching, nausea, difficulty breathing and high blood pressure. Black widow spiders generally prefer dark, quiet places, such as well boxes, electrical boxes, and storage sheds.	
40	5.2.2 Radiation Surveys and Monitorinq (pp. 5-5 to 5-7) and 5.3 Personnel Radiological Monitorinq (p. 5-9). [See also EEWP S 2,4 Exploratory Excavation Procedures, p. 2-5;SHSP S 5.6.3, Table 5-7, pp. 5-14 to 5-16.1	Please include the information pertaining to radiological surveys found in section 2.4 of the EEWP into the SHSP by either incorporation into the text or reference/citation to the work plan. Specifically, the language pertaining to radiological surveys and work stoppages should be included into the SHSP. Will dose rates be collected and monitored both at the surface at depth of the excavation and at the ground surface - or only in areas where employees are working? If the dose rate exceeds 50 mR/hr above background, at which location would this reading instigate a work stoppage, sampling, and backfilling the excavation? (See EEWP S 2.4, p.2-5.) Should this metric also be incorporated into the SHSP?	Dose rates will be collected at the ground surface, the general work area and within the pit during the excavation. If the dose rate exceeds 30 mR/hr above background, a work stoppage, sampling, and backfilling will be conducted.
41	5.6.3 Monitoring Procedures. Table 5-7: Work Zone Monitoring Procedures and Action Levels (pp.	Please refer to previous comments on the Air Monitoring Plan with respect to the occupational exposure limits and the action level.	See response to comments 19 and 20.

Comment Number	Section	Comment	*Response*
	5-14 to 5-16).		
42	8.'l Personal Protective Equipment (p. 8-1).	CaI OSHA requires foot protection that meets the requirements of ASTM F 2412-Q5 and ASTM F 2413-05 for safety footwear purchased after January 26, 2007 . For footwear purchased before January 26,2007, protective footwear must meet the above standards or ANSI Z41-1999. [See 8 CCR S 3385.]	Cabrera and its subcontractors will wear footwear meeting the standards described in the comment.
43	9.1 Emergency Action Plan (p. 9-1).	Please refer to 8 CCR S 5192(l) for the emergency response requirements at an uncontrolled hazardous waste site. Please make any necessary changes so that the Emergency Action Plan conforms to these requirements. Please note that "[e]mployers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this subsection if they provide an emergency action plan complying with 8 CCR 3220 of lhe General lndustry Safety Orders." [8 CCR 55192(l)(1)(B).]	Noted. Emergency Action Plan currently conforms. Cabrera employees and its subcontractors partaking in this SOW are not trained to be first responders.
		End of Comments	

ATTACHMENT 1

FINAL EXPLORATORY EXCAVATION WORK PLAN
CABRERA SERVICES

FINAL

Revision 1

Exploratory Excavation Work Plan

Exploratory Investigation for Magnetic Anomaly Source in Bulb

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
RICHMOND, CALIFORNIA

Project No: 19533A

Prepared for

University of California, Berkeley
Office of Environment, Health, and Safety
University Hall 3rd Floor
Berkeley, CA 94720

Prepared by

CABRERA SERVICES
RADIOLOGICAL•ENGINEERING•REMEDIATION

473 Silver Lane
East Hartford, CT 06118

October 2014

EXPLORATORY EXCAVATION WORK PLAN

UNIVERSITY OF CALIFORNIA, BERKELEY

RICHMOND FIELD STATION

RICHMOND, CALIFORNIA

Prepared by:

10/14/14

Greg Bright, RRPT
Project Manager/Scientist
(508) 315-6246

Date

Concurrence by:

10/14/14

Tony Mason, CHP
Project Health Physicist
(435) 604-0174

Date

10/21/14

Charles K. Duckworth, PE
Professional Engineer
(714) 678-6700

Date

REGISTERED PROFESSIONAL ENGINEER
CHARLES K. DUCKWORTH
Exp. 9-15-2015
No. C 34575
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS/ABBREVIATIONS

AMP	Air Monitoring Plan
bgs	below ground surface
BMPs	Best Management Practices
Cabrera	Cabrera Services Inc.
CCR	California Code of Regulation
CFR	Code of Federal Regulations
COPCs	Chemicals of Potential Concern
CRZ	contamination reduction zone
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ERRG	Engineering/Remediation Resources Group, Inc.
EZ	exclusion zone
FSP	Field Sampling Plan
ft	feet
NGVD	National Geodetic Vertical Datum
NRC	US Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PDR	personal data rams
PPE	Personal protective equipment
RFS	Richmond Field Station
SHSP	Site-Specific Health & Safety Plan
SSHO	site safety and health officer
SZ	support zone
UC Berkeley	University of California, Berkeley
µCi/mL	microcuries per milliliter
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
VOCs	volatile organic compounds
Work Plan	Exploratory Excavation Work Plan

1.0 INTRODUCTION

The University of California, Berkeley's (UC Berkeley) Richmond Bay Campus (RBC) is an academic teaching and research facility located at 1301 South 46th Street, Richmond, California, along the southeast shoreline of the city of Richmond on the San Francisco Bay to the northwest of Point Isabel (see Figure 1) consisting of the Former Richmond Field Station (RFS) and the Regatta Property west of the Former RFS. The Former RFS is a 170 acre property consisting of 96 acres of upland areas that includes a remnant coastal terrace prairie, and 74 acres of tidal salt marsh, mudflats and transitional habitat. The Former RFS has been used primarily for large-scale engineering research since the University acquired the property in 1950 and currently supports a range of research and resource conservation values.

UC Berkeley has contracted with Cabrera Services Inc. (Cabrera) to perform an exploratory excavation based on a geophysical survey conducted in November 2006 that identified a magnetic anomaly within the RBC. The geophysical survey was conducted in 2006 by the California Department of Toxic Substances (DTSC) staff based on information provided by an informant that approximately 30, 55-gallon drums containing ore-like material were buried at the site.

This Work Plan is intended to provide details on how the exploratory excavation will be implemented as described in the Phase IV Field Sampling Plan (FSP; Tetratech 2014), completed as part of ongoing investigation and cleanup actions at the Former RFS under oversight of the California Environmental Protection Agency, DTSC, in compliance with the Site Investigation and Remediation Order, Docket No. IS/E-RAO 06/07-004 for the RFS (RFS Order) dated September 15, 2006. This Work Plan is being submitted as an Addendum to the FSP.

Section 1.1 of this plan describes the site where the exploratory investigation will be performed. A general description of the field activities to be performed at the site is presented in Section 1.2. Section 1.3 presents the project schedule, and Section 1.4 describes the project organization. Section 2 outlines the procedures to be used during implementation of the exploratory investigation. Section 3 describes the environmental protection procedures to be followed during project work. The following documents are also provided as appendices to this plan:

- Appendix A – Site Specific Safety and Health Plan
- Appendix B – Sampling and Analysis Plan
- Appendix C – Air Monitoring Plan
- Appendix D – Historical Use Assessment

1.1 DESCRIPTION OF PROJECT SITE

Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the RFS. In 1950, UC purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering and later, other campus departments and private tenants. The RFS is currently subject to a State of California DTSC Site Investigation and Remediation Order (Docket No. ISE-RAO 06/07-004, dated September 15, 2006) due to the presence of legacy chemical contamination from industrial and UC operations. Portions of the RFS site have been remediated by excavation and off-haul of contaminated soils.

Several large former and existing chemical and industrial sites border the RFS property to the north, west, and east. A former Pacific Gas and Electric Company facility was located to the north of the RFS. The former Kaiser Shipyard and the Butler Steel Products facilities were located to the southwest of the RFS in the current location of the Marina Bay housing development. Bio-Rad Laboratories continues to be located to the west of the RFS.

The adjacent property to the east of RFS is the location of former chemical production operations previously owned by several entities, including Stauffer and Zeneca called the former Zeneca site. (Tetratech 2008). Historically, radioisotopes were used at the former Zeneca site for laboratory research and in 1950 uranium was melted for experimental purposes in an electron beam furnace at the Stauffer-Temescal Company located on site. Additionally, industrial processes relating to production of metal pentachlorides, superphosphate and aluminum sulfate were potential sources of residual naturally occurring radiological materials. A detailed description of the project site, previous investigations, and history of radiological use is provided in the *Historical Use Assessment* of the Transition Area "Bulb" Alleged Buried Drum Area (UC Berkeley, 2014) attached in Appendix D.

1.1.1 Investigation Area Description

The Transition Area (see Figure 2) of the RFS is a 5.5 acre area of fill material that was placed on top of historic Bay mud flats and early growth salt marsh patches beginning in the early 1950s and continuing until the early 1970s. The Transition Area is defined to the north by the former California Cap Company seawall (portions either removed or now under artificial fill placed at the site) and to the south by the current marsh high tide line (approximately 4.5 feet [ft] above mean sea level). The Transition Area was created with the placement of a City of Richmond sewer line in a pyrite cinder filled embankment in the 1940s and then with soil and other fill material beginning approximately 1953 and nearing completion in 1969, including the rounded Bay-ward extension that has historically been known as the "Bulb" (UC Berkeley, 2014).

Portions of the Transition Area have been subject to remediation. The western portion of the Transition Area has not been subject to remediation with the exception of a small removal action in October 2008 of four cubic yards of soil and solid waste approximately 200 ft from this investigation area. Fill in the Bulb ranges from 2.5 to 7.5 ft based on borings completed in 2002 with an average depth of 4.6 ft (Tetratech 2008 p.66).

The Bulb is a gently mounded area of soil covered with ruderal, generally non-native vegetation dominated by a perennial non-native bunchgrass Harding grass (*Phalaris aquatica*) and also containing native and non-native shrubs and forbs such as Coyote Bush, poison oak and fennel (UC Berkeley, 2014).

The border of the Bulb edge is the boundary of the jurisdictional salt marsh, designated at the high tide line elevation of 4.5-ft National Geodetic Vertical Datum (NGVD) 29, and common plants here include marsh gumplant, pickleweed and salt grass. The planned center of the excavation area is at an elevation of 7 ft NGVD. The Bulb slopes gently upward toward the center, reaching a maximum elevation of around 11 ft NGVD along the southern edge of the concrete mixing impoundment which was built during 2003 remediation for drying of sediment from marsh excavation. The Bulb is habitat for native and non-native flora and fauna. Typical fauna include Canada geese, skunks, ground squirrels, gray fox, raccoons, opossums, and feral cats. There are no known rare or threatened species of plants or animals in the upland Bulb, but the neighboring marsh is habitat for the Federally listed endangered Ridgway's Rail (*Rallus longirostris obsoletus*), which may at times use the shrubs at the marsh/Bulb interface as refugia. Therefore, obtrusive work such as performing exploratory excavations is prohibited in the Bulb during the rail breeding season which spans from February 1 to August 31. Groundwater in the excavation area is found approximately 4 ft below ground level and is anticipated to be tidally influenced (UC Berkeley, 2014).

In November 2006, DTSC completed a magnetometer survey of the Bulb using a Geometrics G-856 magnetometer. An anomaly roughly 20 by 36 ft was detected in the location shown on Figure 5. This area of this investigation will be refined during a magnetometer survey that will be conducted just prior to the exploratory excavation (UC Berkeley, 2014).

1.2 GENERAL DESCRIPTION OF EXPLORATORY EXCAVATION

UC Berkeley has tasked Cabrera to perform an exploratory excavation to identify the magnetic anomaly, and if steel drums are discovered, attempt to determine the contents if deemed safe by UC Berkeley staff. The exploratory excavation activities will be performed to determine the source of the magnetic anomaly and will be consistent with the January 2006 excavation at Meeker Beach conducted by contractors for DTSC (Engineering/Remediation Resources Group, Inc. [ERRG] 2006). Cabrera does not anticipate removal or opening any drum(s) during the exploratory investigation, but the possibility exists and contingency precautions will be in place. The exploratory investigation will consist of three excavation trenches 20 ft long and 2.5 ft wide to an approximate depth of 20 ft. Each trench will be located within the estimated footprint of the magnetic anomaly area, and will be excavated at depth intervals of one to two ft and surveyed with a radiological meter, photoionization detector (PID), and a magnetometer to evaluate subsurface conditions. Soil samples will be collected at the discretion of DTSC and UC Berkeley staff at varying depths and locations. If drums are discovered, additional samples of the drum contents may be collected and characterized through field tests and/or submittal of samples to an analytical laboratory.

The following tasks constitute the major components of the investigation:

- Mobilization and site preparation;
- Pre-excavation surface radiological and geophysical survey;
- Surgical excavation with periodic assessment surveys of subsurface conditions;
- Documentation of metal anomalies, if encountered;
- Collection of investigation samples (soil and, if deemed safe, drum contents);
- Backfilling the exploratory excavation with excavated materials and using on-site clean soil to bring back to original grade as necessary; and
- Demobilization.

No excavated material will be removed from the site during this exploratory investigation. Initial site activities will be performed in Level D personal protective equipment (PPE) and will be modified per the Site Specific Health and Safety Plan (Appendix A) and the Air Monitoring Plan (Appendix C) based on results of continuous real-time air monitoring of the breathing zone within the work area. Exceedance of actions levels as described in Section 2.1 of the Air Monitoring Plan will include upgrading to either Level C or Level B PPE.

1.3 PROJECT SCHEDULE

The field activities for the project are tentatively scheduled to begin on or about October 28, 2014 with mobilization and site preparatory activities pending approval of project documents. Exploratory excavation activities will be conducted over approximately one working day starting October 29, 2014, but October 30-31, 2014 will be reserved as possible excavation dates if the weather does not allow for trenching as planned on October 29. A project schedule is provided in Figure 3.

1.4 PROJECT ORGANIZATION

The Cabrera project team will consist of a project manager, Superintendent, a site safety and health officer (SSHO), equipment operator, field technician, and subcontractors. On-site subcontractors will include a geophysical surveyor, and an equipment operator. Off-site subcontractors will include analytical laboratories for radiological and chemical analysis. The Cabrera project manager will coordinate the site activities, oversee proper execution of the work, and provide DTSC personnel with updates of field activities. The Cabrera Superintendent will supervise the field technician, equipment operator, and subcontractors, and will oversee excavation activities. The Cabrera SSHO will implement the site-specific health and safety plan (Appendix A). The Cabrera project team will report to the UC Berkeley representative. The Cabrera project team will be supported, as needed, by the Corporate Health and Safety Manager. The lines of oversight and communication for the Cabrera project team are shown in Figure 4. All site activities will be coordinated with representatives of DTSC.

2.0 INVESTIGATION ACTIVITIES

Investigation activities will involve the excavation of a three trenches within the identified footprint to identify the metal anomaly located in November 2006 at the Bulb. Exploratory excavation activities to determine the source of the magnetic anomaly will be consistent with the January 2006 excavation at Meeker Beach conducted by contractors for DTSC (ERRG 2006). The following sections detail each of the major components identified in Section 1.2.

2.1 PRE-EXCAVATION MAGNETOMETER SURVEY

The magnetic anomaly identified during DTSC's 2006 magnetometer survey as shown on Figure 2 has been georeferenced using ArcGIS to place the map on top of the outline of the Bulb. Prior to excavation, DTSC will resurvey to relocate the anomaly using the same or similar equipment as was used for the 2006 survey.

2.2 MOBILIZATION AND SITE PREPARATION

To initiate field activities, all equipment and materials required for performance of the work will be mobilized to the site. The DTSC representative will be kept apprised of the mobilization schedule and progress, and exploratory investigation activities will begin only after mobilization has been completed. Excavation activities will be conducted outside of the Ridgway's rail breeding season (February 1 to August 31). Excavation will be scheduled during low tide events in order to minimize groundwater impact within the trench. Regular site work hours have been established as 7:00 a.m. to 5:00 p.m. Monday through Friday as necessary, and activities will only be conducted during daylight hours. Work performed outside of regular site work hours may be approved only by the UC Berkeley representative. The following subsections detail the mobilization and site preparation activities.

2.2.1 Work Zones

Work zones will be established, as shown in Figure 5, to isolate exploratory activities from adjacent non-work areas and any potential sensitive vegetation. No site grubbing is anticipated to be required before beginning work. Temporary construction barriers (consisting of fencing, A-frame barricades, and/or caution tape) will be erected to establish an exclusion zone (EZ) within the work area. Construction barriers will also control access to contaminant reduction zones (CRZs). Access to the EZ will be limited to appropriately trained personnel (training requirements are included in the Site-Specific Health and Safety Plan [SHSP]). A support zone (SZ) will be established outside the exclusion zones for storage of equipment and supplies. Access routes will be selected to avoid any sensitive habitat (the site will be inspected prior to and during activities to avoid impacts to the Ridgway's rail and any other sensitive species).

Perimeter air monitoring stations for potential dust and radiological contaminants will be established for particulate matter immediately surrounding the work zone and at a distance of approximately 200 ft from the work zone. Real-time personal air monitoring for volatile organic compounds (VOCs) and hydrogen sulfide (H_2S) will be conducted in the immediate vicinity of the exploratory excavation. Air monitoring procedures are detailed in the *Air Monitoring Plan*, included as Appendix C.

2.2.2 Utilities

Review of RBC utility maps indicates that subsurface utilities are not located within the work area; therefore, notification of Underground Services Alert will not be required before intrusive activities begin.

2.2.3 Traffic Control

Traffic controls are not anticipated at the site because waste is not being hauled off-site, but if it becomes necessary, controls will consist of placement of signs, flagmen, and barriers around project work zones and at applicable entry/egress areas to public roadways. Flagmen may also be used to facilitate traffic flow for all traffic entering and exiting the work site. Placement of signs, cones, and fencing may become necessary to warn of trucks entering and exiting the work areas, and to direct vehicular traffic.

2.2.4 Decontamination

Decontamination for the project will consist of personnel and small equipment monitoring (and potential) decontamination areas. Personnel decontamination facilities will include a wash area (boot wash, hand wash, emergency eyewash, etc.) placed at the EZ/CRZ interface. Small equipment, such as shovels and excavator buckets, will be cleaned and surveyed within a decontamination pad, before leaving the site. The decontamination pad will be constructed prior to any intrusive activities, and will be located in the CRZ. The decontamination pad will be lined with 10-mil high-density polyethylene (HDPE). Soil remaining on equipment will be removed by scraping and brushing the soil from the equipment onto the excavated soil stockpile while it is within the exclusion zone or at the decontamination pad adjacent to the excavation area. If dry-decontamination procedures are inadequate for heavy equipment, wet-decontamination will be performed at the decontamination pad. The decontamination pad will be modified with a berm to capture any generated rinsate during wet-decontamination and the resulting decontamination water will be stored in the portable holding tank. All decontamination procedures will comply with Spill Prevention and Control Measures included in Section 3.2.

In the event that radiological particulate is detected, the decontamination procedures will include a radiological survey of all equipment, tools, and personnel before and after decontamination. Depending on the level of contamination detected, dry decontamination may be preferred to reduce the amount of generated waste. All efforts will be made to reduce the amount of generated radiological contaminated waste.

2.2.5 Stockpiling Area

Excavated soil will be temporarily stockpiled on 10-mil plastic adjacent to the excavation during the exploratory investigation activities (Figure 5). Excavated fill material will be stockpiled separately from Bay mud. Erosion control measures for soil stockpiles are detailed in Section 3.2.

The excavated soil/debris will be placed back into the excavations upon completion of the excavations which is anticipated to be the same day. Bay mud will first be placed back into the excavation followed by the excavated overlying fill material. Cabrera will sample representative samples from the backfill as requested by UC Berkeley and DTSC in the field.

The stockpile area will be approximately 40 ft long by 20 ft wide. It will be of adequate size to store approximately 200 cubic yards (CY) of material. It is expected that approximately 120 CY of soils and debris will be removed during the excavation.

2.2.6 Waste Management

It is anticipated that the existing condition of any potential drums, due to exposure from saltwater submersion for approximately 30 years, will be severely corroded with little to no structural integrity. Remote health and safety monitoring (VOC and radiological monitoring) will determine the extent of sample collection and/or extraction of a drum and its contents. If the drums are found but they are severely corroded, then samples will be collected remotely, as possible, in the excavation using the excavator bucket per the SAP (Appendix B). All attempts will be made to collect a volumetric sample of the contents of the drum(s). If drums are found and they are intact and unopened, then a drum will be brought to the surface and loaded directly into a B-25 container on-site. Non-invasive surveys (i.e., gross gamma counting, in situ gamma spectroscopy) will be performed as possible. The lid to the B-25 container will then be secured and the B-25 container moved to the access-restricted drum storage area to the west of B110. Within 30 days, the drum will be sampled using all health & safety precautions (placed into a HEPA filtered tented containment or equivalent protection and opened by staff in Level A PPE). If needed, the drum and its contents will be moved to the campus Hazardous Materials Facility for eventual disposal after receiving the analytical data on the contents.

Groundwater infiltrating the excavation will be pumped out as needed into an on-site fractionation tank. This water will be sampled and analyzed as described in the SAP (Appendix B) to determine ultimate disposition.

Incidental waste as a result of the investigation such as used PPE and plastic will be collected, containerized and, after receiving the sample results, disposed of appropriately by UC Berkeley.

2.2.7 Heavy Equipment

Heavy equipment used for this project will consist of a tracked excavator and a water truck. Light-duty vehicles such as trucks and other support vehicles will also be used during the project. Fueling for the heavy equipment is not anticipated to be necessary on this short-duration excavation project. However, spill prevention measures are detailed in Section 3.2.

2.3 PRE-EXCAVATION ASSESSMENT SURVEY

Before any exploratory excavation work begins at the site, a preliminary surface radiological survey and geophysical (i.e. magnetometer) survey will be conducted to assess the work areas and confirm the location of the buried metal anomaly. Real-time personal air monitoring for VOCs, dust, radiological particulate, and H_2S, and perimeter dust and radiological monitoring will be conducted continuously as the exploratory investigation progresses. A description of the instrumentation used during the pre-excavation assessment survey and subsequent assessment surveys performed at specific depth intervals during excavation are described in the following sections.

2.3.1 Radiological Survey

The radiological survey will be performed along the surface of the proposed investigation area prior to excavation. The results of a radiological survey conducted on September 6, 2005 indicated readings indistinguishable from background levels which are shown in Table 2-1.

Following field mobilization and prior to exploratory investigation, the natural background levels of gamma and alpha/beta radiation will be measured to assist in establishing radiological action levels based on two times the natural background level for gamma radiation. The radiological action level will be either one of the following two situations:

Based on the planned activities and the forecasted conditions of the exploratory investigation, the instruments used for the assessment surveys and their survey purposes will be as follows:

- Ludlum 44-20 sodium iodide scintillation detector with a Ludlum 2221 scaler/ratemeter, or equivalents, will be used to survey for gamma radiation
- Ludlum Model 43-93 alpha/beta scintillation detector with a Ludlum 2360 scaler/ratemeter, or equivalents, to survey for alpha/beta radiation on objects such as equipment or personnel
- Ludlum Model 19, sodium iodide scintillation detector microR meter, or equivalent, to determine exposure levels for gamma radiation for health and safety purposes

The initial radiological survey will be performed over 100% of the proposed excavation areas with gamma sensitive equipment, at a survey rate not to exceed 0.5 ft per second. At every two foot lateral interval, an instantaneous measurement will be recorded.

Radiological surveys will be conducted on soil samples removed via the excavator bucket and the excavation bottom. A radiological survey will be conducted by suspending the meter above the excavation bottom surface with a telescopic handle. The survey will involve slowly surveying 100% of the newly exposed areas, at a pace not to exceed 0.5 ft per second, using both of the gamma sensitive instruments detailed above. Readings will be documented and conveyed to the Cabrera Project Health Physicist (HP). If significantly elevated readings are found, a sample of the soil may be retained for radiological analysis.

2.3.2 Geophysical Survey

The geophysical survey will use a Fisher TW-6 M-Scope split box inductive locator (or equivalent) which has a depth limitation of approximately 5 ft and a Schondstedt magnetometer with a depth limitation of 8 to 10 ft. Each instrument will be used along the proposed area of the exploratory excavation periodically to detect any metal debris below the excavation surface. As the excavation progresses, a remote geophysical survey instrument may need to be lowered into the excavation, in which case a MG230/235 Schonstedt Borehole Gradiometer with a depth limitation of 8 to 10 ft will be utilized. The results of the geophysical survey will be communicated to the Cabrera Superintendent.

2.3.3 Air Monitoring

Real-time air monitoring will be performed continuously in the breathing zone to assess health and safety conditions during the exploratory investigation and will be composed of the following instrumentation:

- MultiRae PID, or equivalent
- Mini-Ram (or equivalent) - Total particulate matter meter, or equivalent
- Jerome 631 H2S Analyzer / Gastech – LEL/O2/H2S meter

- Breathing zone (BZ) radiological air monitoring

The PID will also be used to monitor excavated soil for further assessment and potential sample location determination.

Dust monitoring will be performed at the perimeter of the work area to assess potential public health exposure. Dust monitoring instrumentation will be performed using the following instrumentation:

- Mini-Ram (or equivalent) - Total particulate matter meter, or equivalent
- High (Hi-Q)/low volume (LV-1) for radiological air monitoring

Further information for real-time air monitoring for evaluating breathing zone within the work area and perimeter air monitoring is found in Appendix C – Air Monitoring Plan.

2.4 EXPLORATORY EXCAVATION PROCEDURES

Following site preparation and the initial radiological and geophysical surveys, the exploratory excavation will begin. Due to tidal events that might flood the excavation, exploratory subsurface activities will coincide with low-low tide events.

Beginning in the center of the strongest part of the anomaly, a backhoe or small excavator will be used to dig three different trenches down to a maximum depth of 20 ft below ground surface (bgs). The size of the trench excavations will be approximately 20 ft long and 2.5 ft wide to an approximate depth of 20 ft. Each trench will be located within the estimated footprint of the magnetic anomaly area, and will be excavated at intervals of 1 to 2 ft and surveyed visually for signs of the metallic anomaly. If nothing is discovered in the initial excavation area, then the excavation may proceed radially from the center of the anomaly. The decision to proceed radially from the excavation will be made among the project team and stakeholders on-site (DTSC, UC Berkeley, and Cabrera) and will only occur if the Competent Person (Section 6.2.1 Appendix A) deems it safe to do so.

The trenches will be excavated at approximately one-two foot depth increments to allow for an assessment survey(s) at each interval. Each assessment survey will be composed of a radiological survey of the excavated soil and trench, and a geophysical survey of the trench. The radiological survey will be conducted at approximately 1-2 ft depth increments starting at 4 ft bgs. Subsurface measurements will take into account geometric effects. The procedures for the radiological survey are detailed in Section 2.3.1. The geophysical survey will be conducted approximately every two ft starting at 4 ft bgs. The procedures for the geophysical survey are detailed in Section 2.3.2. The depth increments for each survey may be adjusted based on field conditions and individual survey results.

If radiological surveys indicate sustained readings exceeding two times the background levels as determined in the preliminary radiological survey, then the excavation will be halted, the Cabrera Project HP and UC Berkeley RSO will be notified and a decision will be made as to whether to take a soil sample at that point and any further point as specified by the Cabrera Project HP and UC Berkeley RSO. The excavation will proceed and if there are visual indicators of a buried object, the excavation will attempt to identify the object. Dose rates will continue be collected as the excavation proceeds. If the dose rate is sufficient enough to perform an isotopic identification, then an in situ gamma spectroscopy will be performed. If sustained dose rates exceed 30 millirem per hour above background at the surface of the dig site, then the excavation will be stopped, samples will be collected using remote tools or the excavator bucket if feasible, and the excavations will be backfilled using a plastic liner, as feasible. The samples will be analyzed to determine the isotopic content. Based on this information, a remediation plan will be submitted at a later date.

All samples taken from the excavations that measure greater than background values with hand-held instrumentation will be treated with additional controls as needed. Additional controls to be used on samples confirmed to be containing radioactivity greater than normal background include the following:

- Use of remote handling tools (i.e., shovel) when handling the unshielded sample, as appropriate.
- Gamma spectroscopy performed to assess the predominate radionuclide, if feasible.
- Bagging in plastic and labeling with a trefoil and identifying information.
- Lead or plastic shielding (as appropriate) used to store the samples.
- Secure temporary storage of the samples at the Richmond Field Station B128.
- Off-site shipment in compliance with DOT regulations and the analytical lab criteria for acceptance for analysis, if needed.

Site workers will be briefed on the health and safety aspects involved with radiological sites during the tailgate health and safety meeting, and from the project site-specific health and safety plan (Appendix A).

Procedures for the exploratory investigation will be as follows:

- A one-two foot lift of soil will be removed and stockpiled on 10-mil plastic.
- A radiological survey performed by the HP technician and VOC and H_2S monitoring performed by the SSHO of the freshly exposed soil will be conducted. Following surveying of the excavated soil, the HP technician will then survey the excavation bottom. A geophysical survey may be conducted if a visual examination of the trench determines a necessity (e.g. debris not detected by magnetometer).
- Exploratory excavation will continue at approximately one-two foot intervals with assessment surveys performed at each interval. A geophysical survey will be conducted at approximately two foot intervals or less depending on site conditions and as determined by the Superintendent.
- Beginning at 4 ft bgs or as determined by the Competent Person (Section 6.2.1 Appendix A) radiological surveys and VOC monitoring will be performed on a representative sample obtained by the excavator bucket and placed at ground surface on 10-mil plastic. Remote radiological and geophysical surveys will then be performed by technicians standing in a manlift basket positioned over the center of the excavation at a height of two feet above the surrounding ground surface. The radiological survey will be conducted by a HP technician from the manlift basket positioned over the excavation by hanging the meter down to the excavation bottom surface with a telescopic handle. Geophysical surveys will then be conducted by the geophysical survey technician from the manlift by hanging a magnetometer into the excavation.

The above exploratory procedures will continue until one of the following conditions is met in each trench:

- Excavation depth of 20 ft is achieved

- Metal anomaly is identified
- Exceedance of action level for VOCs (see Appendix C Air Monitoring Plan)
- Exceedance of action levels for radiological material (see Appendix A SHSP, Table 5-7)
- Exceedance of the action level for H_2S (see Appendix C Air Monitoring Plan)
- Significant groundwater infiltration hindering visual observation or geophysical/radiological screening of soils in the excavation during exploratory investigation activities.

In all the above cases, soil samples will be collected per the SAP (Appendix B) from the exploratory trench as safely as conditions permit (i.e., collecting representative samples of soil in the excavation bucket).

Site conditions will be verified in the field as excavation progresses, and interval depths and sidewall slopes adjusted as needed by the Superintendent based on results of the assessment surveys and direction by a designated "Competent Person," familiar with the soil types, excavation methods, and Occupational Safety and Health Administration (OSHA) regulations. If sloughing is observed during excavation activities, unstable soils are identified in the field, or free water is observed entering the excavation, the designated Competent Person, in consultation with the Corporate Health and Safety Manager, will evaluate and determine the appropriate sloping requirements. At no time will personnel enter the trench if the depth of the excavated trench exceeds 4 ft bgs.

As materials are excavated, a field technician will remain in direct line of site with the excavator operator to guide operations. Field technicians will be trained to perform the required work for the project. Field technicians will also be trained in contingency response protocols (Section 2.11) should unforeseen wastes be encountered, and briefed on the possibility for archeological/cultural artifacts to be encountered.

Groundwater in the trenches may prohibit observation of excavation progress and geophysical assessment surveys therefore any exploratory excavation will be scheduled during low tide events in order to minimize groundwater impact within the trench. The anticipated depth of water intrusion during low tide events is approximately 12 to 20 ft bgs. If groundwater intrusion is significant enough to deter exploratory excavation activities, then digging will be halted, the depth of the trench recorded, a bottom soil sample collected per the project Sampling and Analysis Plan (SAP) (Appendix B) and backfill activities begun after concurrence with the UC Berkeley and DTSC representatives. Excavation activities will be scheduled after referring to the tide charts for the Richmond Inner Harbor. In all cases, the excavation will be backfilled prior to high tide events to avoid flooding of the excavation.

Efforts will be made to avoid disturbance of piezometer Bulb1; it is anticipated that the source of the anomaly will be determined before reaching the location of the piezometer. If necessary, the piezometer will be excavated, and a replacement piezometer will be installed in a nearby location according to the procedures established in the Quality Assurance Project Plan (Tetratech 2014).

The location of the stockpile area is discussed in Section 2.1.5, and erosion control procedures applicable to stockpiles are discussed in Section 3.1.

2.5 DOCUMENTATION OF METAL ANOMALY

As the exploratory excavation depth approaches (i.e., within one to two ft) the metal anomaly as indicated by increasing signal strength on the magnetometer the overburden will be carefully removed as not to disturb the anomaly until it is sufficiently uncovered to assist in visual identification. Assessment surveys, including radiological, VOC, and H_2S monitoring of the excavated soil surrounding the anomaly, will be conducted at an increased frequency to evaluate any significant changes to protect worker health and safety. As soil is excavated/removed from the surrounding anomaly, samples will be collected as requested by UC Berkeley Radiation Safety Officer (RSO), and DTSC in the field and assessed (i.e., field tested for gross gamma, alpha and beta) prior to any additional soil removal from the surrounding area of the anomaly.

As the source or depth of the anomaly is not known, the overburden will be carefully removed throughout the investigation as not to disturb the anomaly until it is sufficiently uncovered to assist in visual identification. Any small metallic debris that is encountered during trenching activities will be removed. If larger sources of the anomaly are discovered, and they are not drums (items such as rebar), then they will be removed, if practical. The Cabrera Health Physicist will be on site during all of the excavation activities to collect both real time radiologic data as well as soil samples that will be sent to a lab.

It is anticipated that the existing condition of any potential drums, due to exposure from saltwater submersion for approximately 30 years, will be severely corroded with little to no structural integrity. Remote health and safety monitoring (VOC and radiological monitoring) will determine the extent of sample collection and/or extraction of a drum and its contents. If the drums are found but they are severely corroded, then samples will be collected remotely, as possible, in the excavation using the excavator bucket per the SAP (Appendix B). All attempts will be made to safely collect a volumetric sample of the contents of the drum(s). If drums are found and they are intact and unopened, then a drum will be brought to the surface and loaded directly into a B-25 container on-site. Non-invasive surveys (i.e., gross gamma counting, in situ gamma spectroscopy) will be performed as possible. The lid to the B-25 container will then be secured and the B-25 container moved to the access-restricted drum storage area to the west of B110. Within 30 days, the drum will be sampled using all health & safety precautions (placed into a HEPA filtered tented containment or equivalent protection and opened by staff in Level A PPE). If needed, the drum and its contents will be moved to the campus Hazardous Materials Facility for eventual disposal after receiving the analytical data on the contents.

Cabrera will record field progress in logbooks, and will also photo-document progress using a digital camera.

2.6 COLLECTION OF SOIL AND DRUM SAMPLES

During the exploratory investigation, Cabrera staff will perform sample collection activities. Soil sampling for chemical and radiological contaminants will occur at the discretion of DTSC, the UC Berkeley RSO, and the Environmental Health & Safety Environmental Protection staff, while in the field based on evidence of staining or other indicators (smell, VOC detection, or radiation detection, etc.). The number of samples collected will be determined in the field. If a corroded drum is observed within the excavation, an additional sample will be collected either adjacent to or within the drum(s) using the excavator bucket (see Section 2.5). Samples will be submitted to an off-site laboratory for the following analyses:

- California Assessment Manual (CAM)-17 metals per Environmental Protection Agency (EPA) Method 6010/7470/7471

- volatile organic compounds (VOCs) per EPA Method 8260B
- semivolatile organic compounds (SVOCs) per EPA Method 8270C
- polychlorinated biphenyls (PCBs) and pesticides per EPA Method 8081/8082
- PAHs per EPA Method 8270SIM
- TPH-p (EPA Method 8015B)
- TPH-e (EPA Method 8015B)
- gamma spectroscopy per EPA Method 901.1 or equivalent
- alpha spectroscopy per method DOE HASL 300 or equivalent

All investigation soil/drum content samples collected will be field screened with a Ludlum 44-20 sodium iodide scintillation detector and Ludlum Model 43-93 (alpha/beta scintillation detector) to determine if the radiation readings are consistent with background levels. All confirmation samples will be collected, preserved, shipped, and analyzed in accordance with the SAP presented in Appendix B. A State-certified laboratory will analyze the investigation samples with a turn-around-time of 14 calendar days, with the exception of gamma spectroscopy for radium-226, which has a standard turnaround time of 30 calendar days.

Water collected during dewatering will be sampled and analyzed via the procedures listed above for radiological and chemical constituents in order to determine ultimate disposition of the water.

2.7 BACKFILLING

Backfilling will commence upon collection of investigation soil samples from the trenches, upon identification of the metal anomaly, the limits of the excavation described in Section 2.3 have been attained, or if groundwater infiltrates the excavation and visual inspection and/or surveying of the soil can no longer be performed. The trenches will be backfilled with the same soil/debris material that is excavated. Backfilling will be performed on the same day as the material is excavated to minimize further water infiltration and sloughing/destabilization of sidewall soils.

Backfill material will be placed and spread in horizontal loose lifts of uniform thickness not exceeding 12 inches. Each lift of soil material will be compacted using the backside of the excavator bucket to ensure that no significant voids are present within the excavation. If there is significant water infiltration into the excavation, then this water will be pumped into the on-site fractionation tank prior to backfilling.

2.8 SITE RESTORATION AND DEMOBILIZATION

After completion of all work elements, disturbed areas will be graded to pre-construction conditions and fencing, barricades, or caution tape demarking the work areas will be removed. Erosion control measures such as straw wattles or silt fence may be installed around the excavation area perimeter if potential visual contamination is observed during the investigation and as directed by DTSC. Cabrera will perform a thorough site inspection at the end of the project field work to ensure that all trash and construction materials generated during site activities have been removed from the site.

3.0 ENVIRONMENTAL PROTECTION PROCEDURES

There are several environmental protection procedures related to the exploratory investigation activities for the project site that are detailed in the following subsections:

3.1 EROSION CONTROL MEASURES

Potential sources of sediment that may be transported off-site by wind or water erosion are open excavations, soil stockpiles, and tracking of sediment off-site (from equipment or personnel). Best management practices (BMPs) to reduce this potential erosion include spraying water for dust control, covering soil stockpiles with plastic sheeting, and ensuring the adequate decontamination of heavy equipment and personnel before leaving the work area (as discussed in Section 2.1.4).

Water may be sprayed if necessary to suppress dust during excavation activities and the placement and movement of stockpiles. Water will be sprayed on the active face of the stockpile as necessary to ensure wind erosion is minimized. Dust control measures will be recorded daily on the field log forms. Over-watering, which could result in excessive runoff, will be avoided.

Soils will be placed on top of plastic sheeting with a minimum thickness of 10 mil. Stockpiled soil and debris will used to backfill the excavation on the same day that they are excavated. If this is not the case, soil stockpiles will be managed in accordance with the California Stormwater BMP Handbook (CASQA 2009). Stockpiled soils will be covered with polyethylene and/or waterproof tarps at the end of each day and during rain events to minimize the volume of impacted water and prevent erosion. Other erosion control methods may also be required if excavated soils are not backfilled on the same day, including silt fencing around the stockpile to prevent stormwater runon/runoff in accordance with procedure SE-1 of the Stormwater BMP Handbook (CASQA 2012).

Wind erosion is a potential cause of off-site transport of contamination. Work will be stopped whenever the sustained wind velocity exceeds 15 miles per hour, as measured by an on-site calibrated wind sock, anemometer, or equivalent.

3.2 STORMWATER MANAGEMENT

Stormwater management consists of diverting stormwater, controlling erosion and sediment, and performing inspections and maintenance over the duration of the project. In particular, appropriate best management practices for controlling stormwater and non-stormwater discharges will be implemented as necessary.

The following BMPs for stormwater control will be implemented:

- Identify routes of drainage into Western Stege Marsh and Meeker Slough, if applicable, that may be impacted by the construction work. Install sediment control systems to prevent runoff into these locations. Use fiber rolls, silt fence, straw bale barriers, and/or gravel inlet filters to control sediment.
- Delineate the work area to prevent heavy equipment from moving outside the work area and to ensure that soil is not disturbed outside the work area.
- To prevent rain from coming into contact with the stockpiled soil and to minimize wind dispersion of particulate matter, the stockpiles will be covered with a minimum 6 mil

polyvinyl chloride liner (or equivalent) and secured with sandbags or an approved biodegradable soil stabilization compound at the end of each work day.

- Potentially-contaminated water may be generated from excavation dewatering and/or collection of storm or rainwater entering excavations and EZs. This water will be collected in an on-site fractionation tank to facilitate project execution and prevent the spread of radiological and/or chemical contamination. Potentially contaminated water that is collected will be sampled and analyzed before disposition is determined with the concurrence of DTSC.

3.3 SPILL PREVENTION AND CONTROL MEASURES

Cabrera personnel are trained to contain and control minor spills. A hazardous materials spill kit including an 85-gallon polyethylene overpack, clay absorbent material, spill booms, absorbent pads, and shovels will be kept readily available at the project site. Cleanup of minor spills will be initiated immediately after a spill event occurs. In the event of a spill, the Cabrera project manager, Superintendent, and SSHO will be notified immediately, as discussed in the response procedures described in Section 8 of the Site-Specific Health and Safety Plan (Appendix A). The DTSC representative and UC Berkeley's Office of Environment, Health & Safety will also be notified immediately after a spill occurs.

If there is a minor spill, Cabrera personnel will promptly contain and clean the spill using the following procedures:

- If the spill occurs on paved or impermeable surfaces, it will be cleaned up using "dry" methods (i.e. absorbent pads or other material, and/or rags).
- If the spill occurs in a dirt area, it will be contained by constructing an earthen dike, digging up the impacted soil and placing it in a soil stockpile for disposal.

If the spill occurs while it is raining, the impacted area will be covered to minimize surface runoff from the area.

Examples of minor spills would include spilling diesel fuel during fueling operations (not expected during such a short mobilization), piercing a small container of liquid buried in the subsurface, or a vehicle accident where the gas tank is ruptured.

If there is a major spill at the work site, Cabrera personnel will immediately notify the DTSC representative and will initiate emergency response notifications (as listed in Table 9-1 of Appendix A; with appropriate approval from the DTSC representative). An example of a major spill would include breach of an unforeseen oil pipeline buried within the excavation areas.

3.4 AIR MONITORING

Air monitoring will consist of direct-reading instrumentation to measure total particulate levels (i.e., Mini-Ram, Dust-trak, etc.), radiation exposure level (i.e., microR meter), airborne radioactive particulate (i.e., breathing zone air monitoring), volatile organic compounds (i.e., PID), and hydrogen sulfide (i.e., H_2S meter) in the immediate work area. The monitoring frequency will be evaluated as data are collected and may be revised as the project progresses.

Air monitoring will be performed at the perimeter of the exploratory excavation areas to verify that dust control measures are adequate. Real-time air monitoring of total dust for chemical constituents will be performed using real-time aerosol monitors [MIE Personal Data Rams (PDRs), or equivalent] with data loggers to provide immediate information for the total dust levels present. The lower detection limit for the operating range of the PDR is 0.001 milligrams per cubic meters. The particle size maximum range of response for the PDR is 0.1 to 10 micrometers. The PDRs will be set to automatically log dust levels over 5-minute periods and will be visually checked approximately every hour during the work day and the value manually recorded in the field logs by Cabrera to verify equipment operation and compliance with the target action levels. The data will be downloaded into a computer daily and will be posted on the RBC Environmental Website (http://rfs-env.berkeley.edu) within one week.

Effluent radiological air monitoring will also be performed at the perimeter of the exploratory excavation areas. Air monitoring will be performed using high-volume or low-volume air samplers (determination to be made by the Project HP) and results will be evaluated against the limits listed in Appendix C – Air Monitoring Plan.

3.5 PROTECTION OF NATIVE AND CULTURAL PLANT SPECIES

The proposed excavation areas and their immediate surroundings are not anticipated to contain any sensitive native plant species that require protection. A survey of the exploratory excavation and access routes will be performed by UC Berkeley within a week of the work commencing to ensure that no sensitive species will be impacted during the work.

3.6 PROTECTION OF MARSHLAND NESTING BIRDS

The proposed activities will not be conducted during the nesting season of the Ridgway's rail (February 1 – August 31) to avoid adversely affecting special-status bird species. In addition a discussion of the Ridgway's rail will occur during each morning tailgate meeting. Also, a monitor familiar with the rail and the rail's habitats will be on site during site mobilization, excavation and demobilization. Work will be stopped if a bird is within 50 ft of the excavation.

3.7 ARCHEOLOGICAL MONITORING

Based on available information, exploratory investigation activities are not anticipated to impact archeological resources. If any potential archeological resources are observed in the excavation areas, then work in the immediate area will be suspended and the DTSC representative will immediately be notified. Work in the area will only resume after express permission from the DTSC representative.

4.0 REFERENCES

California Stormwater Quality Association (CASQA) 2009. Stockpile Management WM-3. California Stormwater BMP Handbook. November.

CASQA 2012. Silt Fence SE-1. California Stormwater BMP Handbook. July.

Engineering/Remediation Resources Group, Inc. (ERRG) 2006. *Exploratory Investigation Site Work Plan*, Richmond Marsh, Meeker Beach, Richmond, CA. January.

Tetra Tech, Inc. (Tetra Tech, formerly Tetra Tech EM Inc. from 1996-2012) 2008. *Current Conditions Report*, University of California, Berkeley, Richmond Field Station, Richmond, California. November 21.

Tetra Tech 2014. *Phase IV Field Sampling Plan.* University of California, Berkeley, Richmond Field Station, Richmond, California.

University of California, Berkeley, (UC Berkeley) 2014. *Radioactive Materials Investigation Historic Use Assessment Transition Area "Bulb" Alleged Buried Drum Area*. Richmond Field Station, Richmond, CA. May.

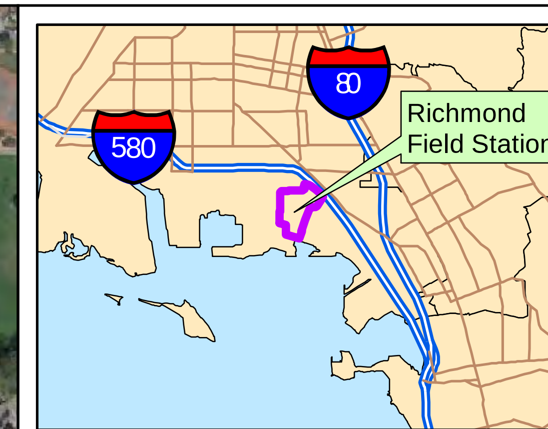
FIGURES

SITE LOCATION

RICHMOND FIELD STATION SITE
UNIVERSITY OF CALIFORNIA, BERKLEY
RICHMOND, CALIFORNIA

8/2014	PROJECT NO. 15-1003.00	Figure 1

Cabrera Services
1106 N. Charles St, 300
Baltimore, MD 21201



Legend

- Upland Area
- Transition Area
- Western Transition Area
- Eastern Transition Area (Remediated)
- Western Stege Marsh
- Western Stege Marsh (Remediated)

0 200 400 800
Feet

SITE LAYOUT

RICHMOND FIELD STATION SITE
UNIVERSITY OF CALIFORNIA, BERKLEY
RICHMOND, CALIFORNIA

8/2014	PROJECT NO. 15-1003.00	Figure 2

Cabrera Services
1106 N. Charles St, 300
Baltimore, MD 21201

ID		Task Name	Duration	Start	Finish
1		**Richmond Field Station Exploratory Excavation**	**100 days**	**Wed 8/27/14**	**Tue 1/13/15**
2		Notice To Proceed	0 days	Wed 8/27/14	Wed 8/27/14
3		**Plan Preparation**	**34 days**	**Wed 8/27/14**	**Mon 10/13/14**
4		Prepare and Submit Draft Work Plans	11 days	Wed 8/27/14	Wed 9/10/14
5		UCB Review and Comment	5 days	Thu 9/11/14	Wed 9/17/14
6		Prepare and Submit Draft Final Work Plans to DTSC	5 days	Thu 9/18/14	Wed 9/24/14
7		DTSC Review and Comment	10 days	Thu 9/25/14	Wed 10/8/14
8		Prepare and Submit Final Work Plans	3 days	Thu 10/9/14	Mon 10/13/14
9		Mobilization	1 day	Tue 10/28/14	Tue 10/28/14
10		Site Preparation	1 day	Wed 10/29/14	Wed 10/29/14
11		**Site Investigation**	**1 day**	**Thu 10/30/14**	**Thu 10/30/14**
12		Removal Activities	1 day	Thu 10/30/14	Thu 10/30/14
13		Demobilization	1 day	Fri 10/31/14	Fri 10/31/14
14		Receive Off-Site Laboratory Results	20 days	Fri 10/31/14	Thu 11/27/14
15		**Site Investigation Report**	**33 days**	**Fri 11/28/14**	**Tue 1/13/15**
16		Prepare and Submit Draft Report	10 days	Fri 11/28/14	Thu 12/11/14
17		UCB Review and Comment	5 days	Fri 12/12/14	Thu 12/18/14
18		Prepare and Submit Draft Final Report to DTSC	5 days	Fri 12/19/14	Thu 12/25/14
19		DTSC Review and Comment	10 days	Fri 12/26/14	Thu 1/8/15
20		Prepare and Submit Final Reports	3 days	Fri 1/9/15	Tue 1/13/15
21		Project Complete	0 days	Tue 1/13/15	Tue 1/13/15

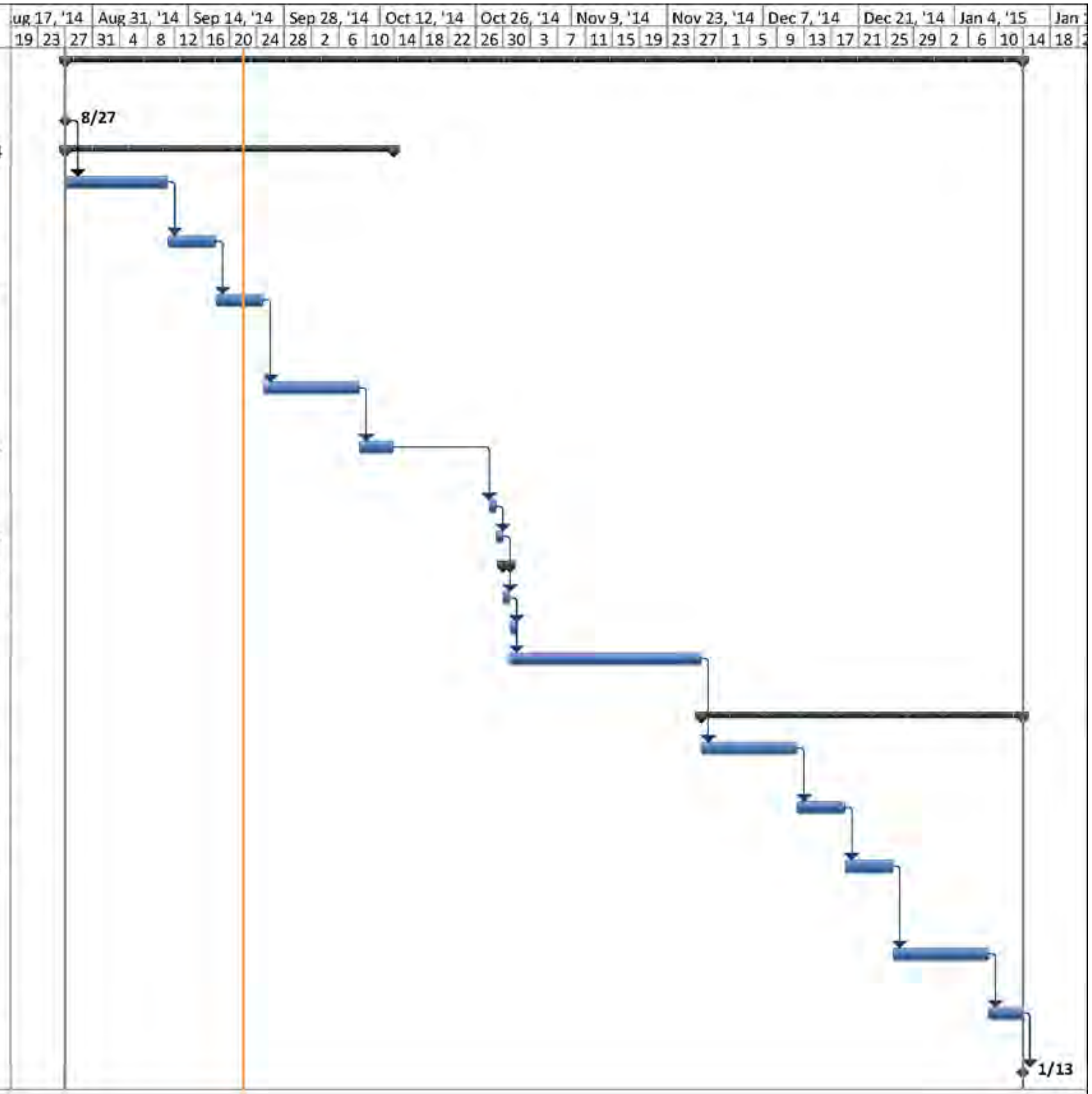


Figure 3: Project Schedule

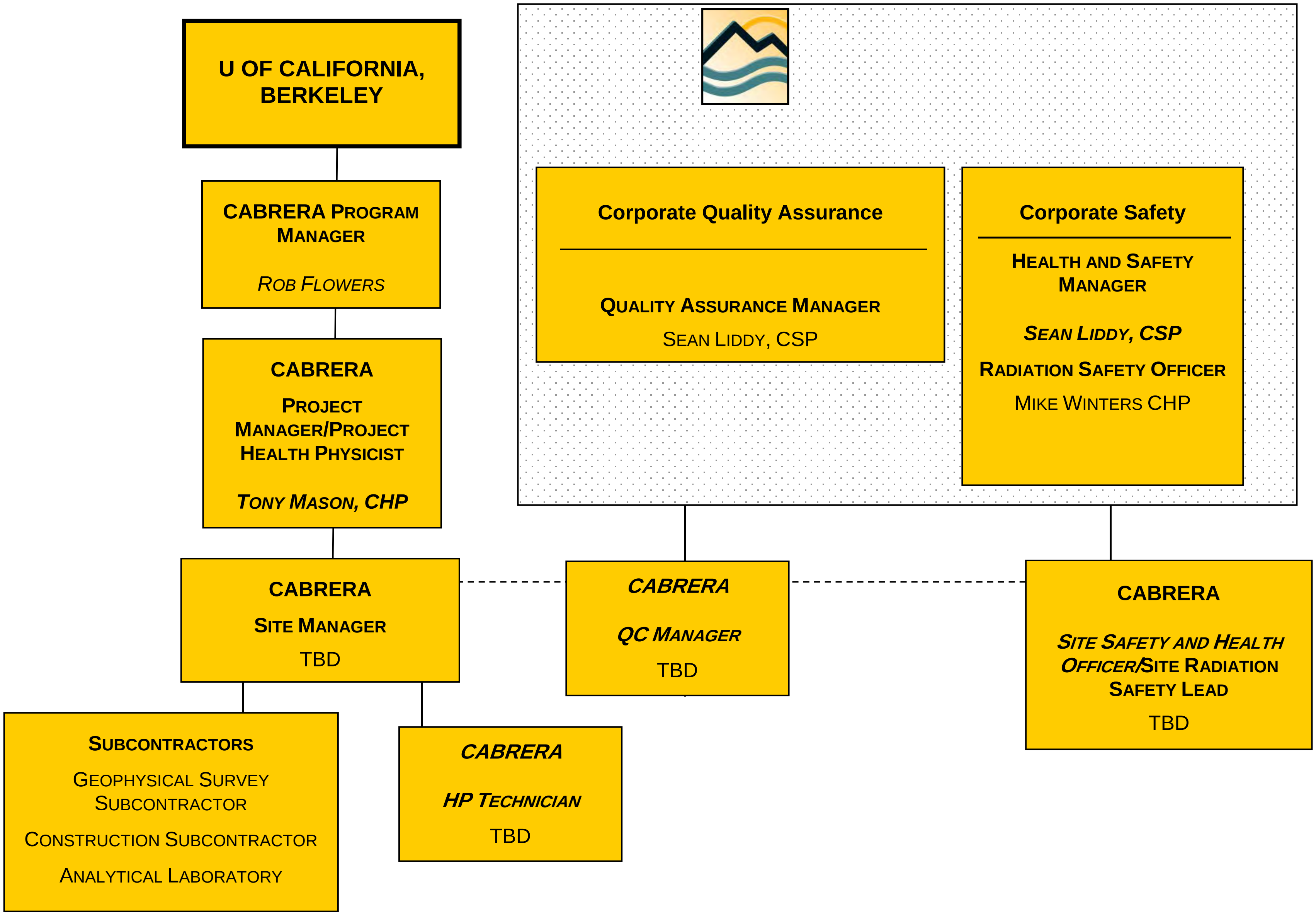
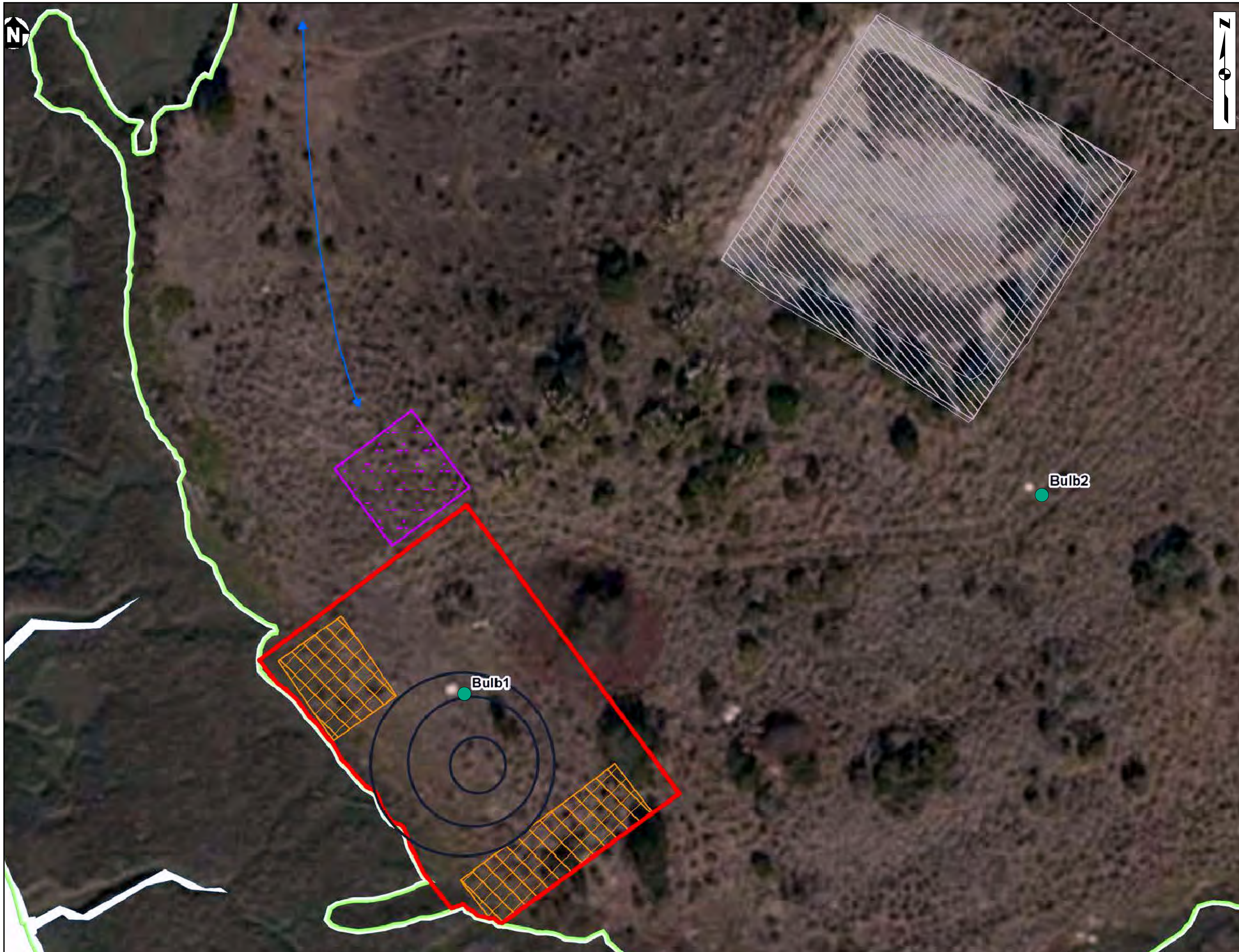
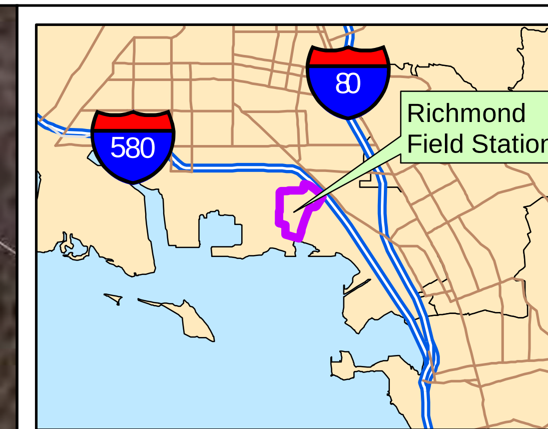


Figure 4: Project Organization Chart





Proposed Investigation Area [1]
Work Zone
Soil Stockpile
Support Zone
Asphalt/ Concrete Pad
Marsh Boundary
Surface Water
Piezometer Location
Access Route

Notes:
1. Starting with the innermost circle,
are will be investigated, stepping out
vertically and horizontally as necessary.

Estimated locations. Final Locations to be
presented in Attachment 1.

Reference: Magnetometer Survey at University
of California Richmond Field Station, Richmond
Department of Toxic Substance Control,
December 15, 2006.

0 10 20 40
Feet

**SITE WORK ZONE DETAIL FOR
ANOMALY EXCAVATION IN THE BULB**

**RICHMOND FIELD STATION SITE
UNIVERSITY OF CALIFORNIA, BERKLEY
RICHMOND, CALIFORNIA**

8/2014	PROJECT NO. 15-1003.00	Figure 5

Cabrera Services
1106 N. Charles St, 300
Baltimore, MD 21201

APPENDIX A

SITE-SPECIFIC HEALTH AND SAFETY PLAN

University of California, Berkeley
Project No: 19533A

SITE-SPECIFIC HEALTH & SAFETY PLAN

Revision 1

Exploratory Investigation for Magnetic Anomaly Source in Bulb

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
RICHMOND, CALIFORNIA

Prepared for:

University of California, Berkeley
Office of Environment, Health, and Safety
University Hall 3rd Floor
Berkeley, CA 94720

Prepared by:

Cabrera Services
473 Silver Lane
East Hartford, CT

October 2014

Cabrera Project No: 15-1003.00

Site-Specific Health & Safety Plan

This Site-Specific Health & Safety Plan (SHSP) was prepared for employees performing a specific, limited scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards, which may be encountered during the completion of this project, adherence to the requirements of the SHSP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve the SHSP for the UCB Richmond site. This SHSP has been written for the exclusive use of Cabrera, its employees, and subcontractors. The plan is written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Prepared by:

10/14/14
Date

Greg Bright, RRPT
Project Manager/Scientist
(508) 315-6246

Concurrence by:

10/14/14
Date

Sean Liddy, CSP
Health & Safety Manager
410-982-0726/443-553-1403

Tony Mason

10/14/14
Date

Tony Mason, CHP
Project Manager/Project Health Physicist
(435) 604-0174

EXECUTIVE SUMMARY

The purpose of this Site-Specific Health & Safety Plan (SHSP) is to address health and safety concerns related to Cabrera managed activities at the Richmond Field Station site, located at the University of California, Berkeley in Richmond, CA. The specific roles, responsibilities, authority, and requirements as they pertain to the safety of employees and the scope of services are discussed herein. The document is intended to identify known potential hazards and facilitate communication and control measures to prevent injury or harm. Additionally, provisions to control the potential for environmental impact from these activities are included where applicable.

SUMMARY TABLE	
Cabrera SOW	Cabrera conduct exploratory excavations (trenches) to identify a magnetic anomaly (suspected drums) at the project site. Cabrera will manage the site activities, including safety and quality, and provide field personnel (rad techs) for monitoring/screening of the soils.
Excavation Subcontractor SOW	Excavation subcontractor will be providing construction support to the project (excavator and operator)
Subtronic SOW	Subtronic will perform geophysical surveys at the site

PRIMARY PHYSICAL HAZARDS					
x	Underground Utilities	x	Elevated Work Platforms	x	Fall Protection
	Overhead Utilities	x	Slips, Trips/Walking Surface	x	Excavation & Trenching
x	Heavy Equipment Operations	x	Manual Lifting		Working adjacent to Railway

CHEMICAL HAZARDS, MONITORING, ACTION LEVELS		
COC	**MONITORING**	**ACTION LEVELS**
VOCs	PID with 10.6eV	Upgrade to Level C at 5 ppm above background in work zone
Hydrogen sulfide	Hydrogen sulfide meter	Upgrade to Level B at 1 ppm (sustained, i.e. greater than 2 minutes) above background within the breathing zone
PCBs	Personal Data-Ram	Upgrade engineering controls at 1 mg/m^3 above upwind (background) concentrations
Alpha and beta radiation	Effluent hi-volume air monitoring	Upgrade engineering controls at 1E-15 µCi/mL
Alpha and beta radiation	Breathing zone air monitoring	Upgrade to Level C at 2E-13 µCi/mL

All staff are bound by the provisions of this SHSP and are required to participate in a preliminary project safety meeting to familiarize them with the anticipated hazards and respective onsite controls. The discussion will cover the entire SHSP subject matter, putting emphasis on critical elements of the plan; such as the emergency response procedures, personal protective equipment, site control strategies, and monitoring requirements. In addition, daily tailgate safety meetings will be held to discuss: the anticipated scope of work, required controls, identify new hazards and controls, incident reporting, review the results of inspections, any lessons learned or concerns from the previous day.

TABLE OF CONTENTS

ATTACHMENTS

FIGURES

TABLES

LIST OF ACRONYMS AND ABBREVATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
BEI	Biological Exposure Index
bgs	below ground surface
°C	degrees Centigrade
Cabrera	Cabrera Services, Inc.
CFR	Code of Federal Regulation
CIH	Certified Industrial Hygienist
CPR	Cardiopulmonary Resuscitation
CQAM	Corporate Quality Assurance Manager
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
dBA	Decibels (A-weighted scale)
DEET	N,N-Diethyl-meta-toluamide
DoD	Department of Defense
DOT	Department of Transportation
DPT	Direct Push Technology
DQCR	Daily Quality Control Report
EAP	Employee Assistance Program
EE/CA	Engineering Evaluation/Cost Analysis
eV	electron volt
EM	engineer manual
EZ	exclusion zone
°F	degrees Fahrenheit
ft	feet
FM	Fire Marshal
FSM	Field Site Manager
GFCI	ground fault circuit interrupter
H_2S	hydrogen sulfide
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and Safety
HSM	Health and Safety Manual
IDW	Investigation Derived Waste
lbs	pounds
kg	kilogram
km/hr	kilometer per hour
kV	kilovolts
μg/kg	micrograms per kilogram
mph	miles per hour
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
OEL	Occupational Exposure Limits
OHSM	Occupational Health & Safety Manager
OHSMS	Occupational Health & Safety Management System
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyls
PID	photoionization detector
PM	Project Manager
PPE	Personal Protective Equipment
ppm	parts per million
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RFS	Richmond Field Station
RSO	Radiation Safety Officer
SSHO	Site Safety and Health Officer
SHSP	Site Safety and Health Plan
SVOC	Semi-Volatile Organic Compound
SZ	Support Zone
TLV	Threshold Limit Value
UC Berkeley	University of California, Berkeley
UL	Underwriters Laboratory
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

WBGT	Wet Bulb Globe Thermometer
Work Plan	Exploratory Excavation Work Plan
WNV	West Nile Virus
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This Site-Specific Health and Safety Plan (SHSP) (including Attachments A-D) provides a general description of the levels of personal protection and safe operating guidelines expected of each employee or subcontractor associated with the environmental services being conducted at the Richmond Bay Campus (RBC) site, located at the University of California, Berkeley in Richmond, California. This SHSP also identifies physical, chemical and radiological hazards known to be associated with the Cabrera-managed activities addressed in this document.

SHSP supplements will be generated as necessary to address any additional activities or changes in site conditions, which may occur during field operations.

1.1 GENERAL

This SHSP establishes the work practices necessary to ensure protection of personnel assigned to perform onsite activities, as well as the local community and the environment during project implementation. The objective of this SHSP is to anticipate, identify, evaluate, and control safety and health hazards, and, in addition to provide emergency response procedures relative to operations conducted at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential for accident or injury.

This SHSP presents Cabrera safety and health procedures that project personnel and subcontractors will follow in performing site activities. The procedures presented herein are designed to reduce the risk of exposure to physical, chemical, and radiological hazards at the site. The procedures in this SHSP are applicable to all Cabrera personnel as well as subcontractor personnel involved in site work. In the event of a conflict pertaining to health and safety between the contract requirements, the subcontract agreement between the subcontractor's H&S procedures, and the Cabrera SHSP, the most stringent requirement(s) will apply.

Field activities specified in the WP shall be performed in accordance with applicable policies and procedures from Cabrera's Corporate Occupational Health & Safety Management System (OHSMS; Attachment A), other applicable site health and safety (H&S) regulations, Occupational Safety and Health Administration (OSHA) requirements, and other applicable Federal, State, and local statutes. Onsite personnel shall follow the health & safety guidelines specified in this SHSP, be alert to potential changes in site hazards, and exercise reasonable caution at all times.

1.2 PROJECT POLICY STATEMENT

Cabrera is committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We are also committed to protecting and preserving the natural environment in which we operate. The safety of persons and property is of vital importance to the success of this project and accident prevention measures shall be taken toward the avoidance of needless waste and loss. It shall be the policy of this project that all operations be conducted safely. Onsite supervisors are responsible for those they supervise by maintaining a safe and healthy working environment in their areas of responsibility, and by fairly and uniformly enforcing safety and health rules and requirements for all project personnel. Subcontractors shall comply with the requirements of this SHSP, provisions contained within the contract document and all applicable rules, requirements and health, safety and environmental regulations. All practical measures shall be taken to promote safety and maintain a safe place to work. Contractors are wholly responsible for the prevention of accidents on work under their direction and shall be responsible for thorough safety and loss control programs and the execution of their own safety plans for the protection of workers.

1.3 REFERENCES

This SHSP conforms to the regulatory requirements and guidelines established in the following documents:

- Title 29, Part 1910 of the Code of Federal Regulations (29 CFR 1910), *Occupational Safety and Health Standards* (with special attention to Section 120, *Hazardous Waste Operations and Emergency Response*).
- Title 29, Part 1926 of the Code of Federal Regulations (29 CFR 1926), *Safety and Health Regulations for Construction*.
- OSHA 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response;
- National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, Publication No. 85-115, 1985.
- Nuclear Regulatory Commission Standards (NRC), 10 CFR 19-171;
- EPA, Standard Operating Safety Guides, July 1988;
- American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values and Biological Exposure Indices (latest edition);
- California Division of Occupational Safety and Health (Cal/OSHA), Title 8 California Code of Regulations (CCR), Chapter 4, Subchapter 7, General Safety Orders;
- Cal/OSHA, 8 CCR Chapter 4, Subchapter 4, Construction Safety Orders; and
- Cal/OSHA, 8 CCR Section 3203.1, Illness and Injury Prevention.

2.0 PROJECT HEALTH & SAFETY ORGANIZATION

2.1 PROJECT MANAGER

The Project Manager (PM), Tony Mason, has overall management authority and responsibility for all site operations, including safety. The PM will provide the Field Site Manager with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations.

2.2 FIELD SITE MANAGER

The Field Site Manager (FSM) has the overall responsibility and authority to direct work operations at the job site according to the provided work plans. The PM may act as the FSM while on site.

2.2.1 Responsibilities

The site supervisor is responsible to:

- Discuss deviations from the work plan with the Site Safety and Health Officer (SSHO) and PM.
- Discuss safety issues with the PM, SSHO, and field personnel.
- Assist the SSHO with the development and implementation of corrective actions for site safety deficiencies.
- Assist the SSHO with the implementation of this SHSP and ensuring compliance.
- Assist the SSHO with inspections of the site for compliance with this SHSP and applicable SOPs.

2.2.2 Authority

The site supervisor has authority to:

- Verify that all operations are in compliance with the requirements of this SHSP, and halt any activity that poses a potential hazard to personnel, property, or the environment.
- Temporarily suspend individuals from field activities for infractions against the SHSP pending consideration by the SSHO, the Health & Safety Manager (HSM), and the PM.

2.2.3 Qualifications

In addition to being Hazardous Waste Operations and Emergency Response (HAZWOPER)-qualified (see Section 4.1), the FSM is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 CFR 1910.120 (e)(4).

2.3 SITE SAFETY & HEALTH OFFICER

2.3.1 Responsibilities

The Site Safety & Health Officer (SSHO) is responsible to:

- Update the site-specific SHSP to reflect changes in site conditions or the scope of work. SHSP updates must be reviewed and approved by the Health & Safety Manager.
- Be aware of changes in Cabrera Safety Policy.
- Monitor the lost time incidence rate for this project and work toward improving it.
- Inspect the site for compliance with this SHSP and the SOPs using the appropriate audit inspection checklist provided by the Cabrera HSM.
- Work with the FSM and PM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contact the HSM for technical advice regarding safety issues.
- Provide a means for employees to communicate safety issues to management in a discreet manner (i.e., suggestion box, etc.).
- Determine emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Check that all site personnel and visitors have received the proper training and medical clearance prior to entering the site.
- Establish any necessary controlled work areas (as designated in this SHSP or other safety documentation).
- Present tailgate safety meetings and maintain attendance logs and records.
- Discuss potential health and safety hazards with the FSM, HSM, and the PM.
- Select an alternate SSHO by name and inform him/her of their duties, in the event that he/she must leave or is absent from the site. The alternate SSHO must be approved by the PM.

2.3.2 Authority

The SSHO has authority to:

- Verify that all operations are in compliance with the requirements of this SHSP.
- Issue a “Stop Work Order” under the conditions set forth in this SHSP.
- Temporarily suspend individuals from field activities for infractions against the SHSP pending consideration by the HSM and the PM.

2.3.3 Qualifications

In addition to being HAZWOPER-qualified, the SSHO is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 CFR 1910.120 (e)(4).

2.4 SITE RADIATION SAFETY LEAD

The Site Radiation Safety Lead (SRSL) assists the SSHO in implementation of the SHSP as it pertains to the Radiological concerns on-site (the SRSL and SSHO positions may be dualhatted). The SRSL provides direct supervision of field staff ensuring that personnel adhere to the requirements of this SHSP. The SRSL has the following additional responsibilities:

- Coordinate with the PM, HSM and Corporate Radiation Safety Officer (RSO) regarding monitoring procedures and action levels for ionizing radiation concerns
- Provide consultation to the SSHO on matters pertaining to radiation.
- Ensuring compliance with applicable regulations concerning the handling and transportation of radioactive material.
- Provide radiation training to on-site personnel who may be exposed to ionizing radiation.

The SRSL and the SSHO may be the same individual.

2.5 EMPLOYEES

2.5.1 Employee Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the SHSP and other applicable safety policies, and clarifying those areas where understanding is incomplete.
- Providing feedback to health and safety management relating to omissions and modifications in the SHSP or other safety policies.
- Notifying the SSHO, in writing, of unsafe conditions and acts.

2.5.2 Employee Authority

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood.
- The right to refuse to work on any site or operation where the safety procedures specified in this SHSP or other safety policies are not being followed.
- The right to contact the SSHO or HSM at any time to discuss potential concerns.
- The right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions

2.6 HEALTH & SAFETY MANAGER

The Occupational Health & Safety Manager (OHSM), Sean Liddy, is the Cabrera Corporate Safety Manager assigned to provide guidance and technical support for the project. Duties include the following:

- Approving this SHSP and any required changes.
- Approving the designated SSHO.
- Reviewing all personal exposure monitoring results.

- Investigating any reported unsafe acts or conditions.

2.7 SUBCONTRACTORS

Each subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required personnel protective equipment (PPE) and all required training.

Cabrera considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to the Cabrera PM, FSM, and SSHO for review prior to the start of onsite activities, if required.

Hazards not listed in this SHSP but known to any subcontractor, or known to be associated with a subcontractor's services, must be identified and addressed prior to beginning work operations. The Cabrera authorized representative has the authority to halt any subcontractor operations, and to remove any subcontractor or subcontractor employee from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

2.8 VISITORS

Authorized visitors (e.g., client representatives, regulators, Cabrera management staff, etc.) requiring entry to any work location on the site will be briefed by the FSM and/or SSHO on the hazards present at that location. This SHSP specifies the minimum acceptable qualifications, training and personal protective equipment which are required for entry to any controlled work area. Visitors will be escorted at all times at the work location and will be responsible for compliance with these, and their employer's health and safety policies/requirements, at all times.

2.8.1 Visitor Access

Visitors to any HAZWOPER controlled-work area must comply with the health and safety requirements of this SHSP and demonstrate an acceptable need for entry into the work area. All visitors desiring to enter any controlled work area must observe the following procedures:

1. A written confirmation must be received by Cabrera documenting that each of the visitors has received the proper training and medical monitoring required by this SHSP. Verbal confirmation can be considered acceptable provided such confirmation is made by an officer or other authorized representative of the visitor's organization.
2. Each visitor will be briefed on the hazards associated with the site activities being performed and acknowledge receipt of this briefing by signing the appropriate tailgate safety briefing form.
3. All visitors must be escorted by a Cabrera employee.

If the site visitor requires entry to any EZ, but does not comply with the above requirements, all work activities within the EZ must be suspended. Until these requirements have been met, entry will not be permitted.

Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

3.0 SITE INFORMATION & SCOPE OF WORK

All work will be performed in accordance with the applicable Statement of Work (SOW) and associated Project Work Plan developed for project site. Deviations from the listed SOW will require that the OHSM review changes made to this SHSP, to ensure adequate protection of personnel and other property.

The following is a summary of relevant data concerning the project site, and the work procedures to be performed. The Project Work Plan prepared by Cabrera as a companion document to this SHSP provides more detail concerning both site history and planned work operations.

3.1 SITE INFORMATION

This section provides a general description and historical information associated with the site. The planned area of operations/investigation for the proposed SOW is in the "Bulb" area of the site.

3.1.1 General Description

The University of California, Berkeley's (UC Berkeley) RBC is an academic teaching and research facility located at 1301 South 46th Street, Richmond, California, along the southeast shoreline of the city of Richmond on the San Francisco Bay to the northwest of Point Isabel (see Figure 1) consisting of the Former Richmond Field Station (RFS) and the Regatta Property west of the Former RFS. The Former RFS is a 170 acre property consisting of 96 acres of upland areas that includes a remnant coastal terrace prairie, and 74 acres of tidal salt marsh, mudflats and transitional habitat. The Former RFS has been used primarily for large-scale engineering research since the University acquired the property in 1950 and currently supports a range of research and resource conservation values.

3.1.2 Site Background/History

Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the RFS. In 1950, UC purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering and later, other campus departments and private tenants. The RFS is currently subject to a State of California DTSC Site Investigation and Remediation Order (Docket No. ISE-RAO 06/07-004, dated September 15, 2006) due to the presence of legacy chemical contamination from industrial and UC operations. Portions of the RFS site have been remediated by excavation and off-haul of contaminated soils.

Several large former and existing chemical and industrial sites border the RFS property to the north, west, and east. A former Pacific Gas and Electric Company facility was located to the north of the RFS. The former Kaiser Shipyard and the Butler Steel Products facilities were located to the southwest of the RFS in the current location of the Marina Bay housing development. Bio-Rad Laboratories continues to be located to the west of the RFS.

The adjacent property to the east of RFS is the location of former chemical production operations previously owned by several entities, including Stauffer and Zeneca called the former Zeneca site. (Tetratech 2008). Historically, radioisotopes were used at the former Zeneca site for laboratory research and in 1950 uranium was melted for experimental purposes in an electron beam furnace at the Stauffer-Temescal Company located on site. Additionally, industrial processes relating to production of metal pentachlorides, superphosphate and aluminum sulfate were potential sources of residual naturally occurring radiological materials (UC Berkeley, 2014).

3.1.3 Investigation Area Description

The Transition Area (see Figure 2) of the RFS is a 5.5 acre area of fill material that was placed on top of historic Bay mud flats and early growth salt marsh patches beginning in the early 1950s and continuing until the early 1970s. The Transition Area is defined to the north by the former California Cap Company seawall (portions either removed or now under artificial fill placed at the site) and to the south by the current marsh high tide line (approximately 4.5 feet [ft] above mean sea level). The Transition Area was created with the placement of a City of Richmond sewer line in a pyrite cinder filled embankment in the 1940s and then with soil and other fill material beginning approximately 1953 and nearing completion in 1969, including the rounded Bay-ward extension that has historically been known as the “Bulb” (UC Berkeley, 2014).

Portions of the Transition Area have been subject to remediation. The western portion of the Transition Area has not been subject to remediation with the exception of a small removal action in October 2008 of four cubic yards of soil and solid waste approximately 200 ft from this investigation area. Fill in the Bulb ranges from 2.5 to 7.5 ft based on borings completed in 2002 with an average depth of 4.6 ft (Tetratech 2008 p.66).

The Bulb is a gently mounded area of soil covered with ruderal, generally non-native vegetation dominated by a perennial non-native bunchgrass Harding grass (*Phalaris aquatica*) and also containing native and non-native shrubs and forbs such as Coyote Bush, poison oak and fennel (UC Berkeley, 2014).

The border of the Bulb edge is the boundary of the jurisdictional salt marsh, designated at the high tide line elevation of 4.5-ft National Geodetic Vertical Datum (NGVD) 29, and common plants here include marsh gumplant, pickleweed and salt grass. The planned center of the excavation area is at an elevation of 7 ft NGVD. The Bulb slopes gently upward toward the center, reaching a maximum elevation of around 11 ft NGVD along the southern edge of the concrete mixing impoundment which was built during 2003 remediation for drying of sediment from marsh excavation. The Bulb is habitat for native and non-native flora and fauna. Typicall fauna include Canada geese, skunks, ground squirrels, gray fox, raccoons, opossums, and feral cats. There are no known rare or threatened species of plants or animals in the upland Bulb, but the neighboring marsh is habitat for the Federally listed endangered Ridgway’s Rail (*Rallus longirostris obsoletus*), which may at times use the shrubs at the marsh/Bulb interface as refugia. Therefore, obtrusive work such as performing exploratory excavations is prohibited in the Bulb during the rail breeding season which spans from February 1 to August 31. Groundwater in the excavation area is found approximately 4 ft below ground level and is anticipated to be tidally influenced (UC Berkeley, 2014).

In November 2006, DTSC completed a magnetometer survey of the Bulb using a Geometrics G-856 magnetometer. An anomaly roughly 20 by 36 ft was detected in the location shown on Figure 5. This area of this investigation will be refined during a magnetometer survey that will be conducted just prior to the exploratory excavation (UC Berkeley, 2014).

Suspected Contaminant of Concern (COC) on the project site are listed below.

Contaminants	Soil (mg/kg)	Groundwater (ug/l)
VOCs and SVOCs	Low Level	Trace
Hydrogen Sulfide	Low Level from former marsh areas	Trace
PCBs	Low Level	Trace
Radiological	Low Level	Trace

3.2 SCOPE OF WORK

UC Berkeley has tasked Cabrera to perform an exploratory excavation to identify the magnetic anomaly, and if steel drums are discovered, attempt to determine the contents if deemed safe by UC Berkeley staff. The exploratory excavation activities will be performed to determine the source of the magnetic anomaly and will be consistent with the January 2006 excavation at Meeker Beach conducted by contractors for DTSC (Engineering/Remediation Resources Group, Inc. [ERRG] 2006). Cabrera does not anticipate removal or opening any drum(s) during the exploratory investigation, but the possibility exists and contingency precautions will be in place. The exploratory investigation will consist of three excavation trenches 20 ft long and 2.5 ft wide to an approximate depth of 20 ft.. Each trench will be located within the estimated footprint of the magnetic anomaly area, and will be excavated at depth intervals of one to two ft and surveyed with a radiological meter, photoionization detector (PID), and a magnetometer to evaluate subsurface conditions. Soil samples will be collected at the discretion of DTSC and UC Berkeley staff at varying depths and locations. If drums are discovered, additional samples of the drum contents may be collected and characterized through field tests and/or submittal of samples to an analytical laboratory.

3.2.1 Tasks

The names and descriptions of tasks to be completed during field work during the exploratory excavation at the RFS are listed below.

3.2.1.1 Mobilization/Demobilization

Mobilization and demobilization represent limited pre and post-task activities. These activities include driving to and from the site; initial site preparations for limited activities, such as instrument quality control measurements and utility markout; and post-work activities, such as general housekeeping and packing equipment and supplies into trucks. This activity does not represent any intrusive activities.

3.2.1.2 Site Preparation

Site preparation includes installation of plastic sheeting and silt fence around the perimeter of the soil stockpile area, and set-up of exclusion zones (EZs), contamination reduction zones (CRZs), and support zones (SZs).

No utilities are present in the area of excavation and permission has been obtained by the authorizing authority for the RFS to excavate. If the potential for unidentified or suspected utilities occurs during site preparation activities, a private third-party utility locator will be brought in to assist with the identification and location of such infrastructure.

If drums are found and they are intact and unopened, then a drum will be brought to the surface and loaded directly into a B-25 container on-site. Non-invasive surveys (i.e., gross gamma counting, in situ gamma spectroscopy) will be performed as possible. The lid to the B-25 container will then be secured and the B-25 container moved to the access-restricted drum storage area to the west of B110. Within 30 days, the drum will be sampled using all health & safety precautions (placed into a HEPA filtered tented containment or equivalent protection and opened by staff in Level A PPE). If needed, the drum and its contents will be moved to the campus Hazardous Materials Facility for eventual disposal after receiving the analytical data on the contents.

3.2.1.3 Pre-Excavation Assessment Survey

Before any exploratory excavation work begins at the site, a preliminary surface radiological survey and geophysical survey will be conducted to assess the work areas and confirm the location of the buried metal anomaly. This will involve non-intrusive walk-over surveys of the area using hand held and cart pulled (manual) geophysical instrumentation to collect data on the subsurface anomalies and proposed excavation areas.

3.2.1.4 Excavation of Soils

Cabrera will excavate approximately 120 cubic yards of soils from the Bulb area directly over the metal anomaly. Soils will be stockpiled and used as backfill the same day it is excavated. The equipment operator will be supported by a technician who will perform spotting activities, provide traffic control, and general housekeeping activities on the site. Confirmation sampling of the excavations will be performed under this task as well. All samples will be collected remotely with the excavator. Personnel will not enter the excavations at any time. Real-time air monitoring for volatile organic compounds (VOCs), particulate matter, and hydrogen sulfide (H_2S) will be conducted continuously as the exploratory investigation progresses.

Beginning at 4 ft bgs or as determined by the Competent Person (Section 6.2.1 Appendix A) radiological surveys and VOC monitoring will be performed on a representative sample obtained by the excavator bucket and placed at ground surface on 10-mil plastic. Remote radiological and geophysical surveys will then be performed by technicians standing in a manlift basket positioned over the center of the trench at a height of two feet above the surrounding ground surface. The radiological survey will be conducted by a HP technician from the manlift basket positioned over the trench by hanging the meter down to the excavation bottom surface with a telescopic handle. Geophysical surveys will then be conducted by the geophysical survey technician from the manlift by hanging a magnetometer into the trench.

3.2.1.5 Equipment Decontamination

Cabrera and subcontractor personnel will perform decontamination of equipment used to perform work within controlled work areas. Decontamination procedures will dry techniques (brushing and wiping) as much as possible to avoid the generation of wastewater.

3.2.1.6 Backfilling/Site Restoration

The trenches will be backfilled on the same day as the excavation for safety purposes. Backfilling will be performed as described in the Work Plan. Site restoration will involve the final grading of the site, surface cover installation, removal of temporary fencing and erosion control materials, and the disposal of construction debris.

3.2.1.7 Additional Work Operations

Operations at the site may require additional tasks not identified in this section or addressed in Attachment B, Activity Hazard Analysis (AHA). Before performing any task not covered in this SHSP an AHA must be prepared, and approved by the OHSM.

4.0 GENERAL SAFETY RULES & PHYSICAL HAZARDS

4.1 GENERAL SAFETY RULES

All site personnel shall conduct themselves in a safe manner and maintain a working environment that is free of additional hazards, in adherence to all applicable safety rules/regulations and maintain proper housekeeping practices at all times.

4.1.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.1.2 Smoking, Eating, or Drinking

Smoking, eating and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any Cabrera site. Eating or drinking must be in an approved area. Smoking is prohibited on all University of California property.

4.1.3 Personal Hygiene

The following personal hygiene requirements will be observed:

<u>Water Supply</u>: A water supply meeting the following requirements will be utilized:

Potable Water - An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.

Non-Potable Water - Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

Non-Potable Water
Not Intended for Consumption

<u>Toilet Facilities</u>: A minimum of one toilet will be provided for every 20 personnel on site, with separate toilets maintained for each sex except where there are less than 5 total personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities on-site facilities are not required.

<u>Washing Facilities</u>: Employees will be provided washing facilities (e.g., buckets with water and soap) at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the Exclusion Zone, prior to breaks, and at the end of daily work activities.

4.1.4 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for Cabrera personnel. Under no circumstances will any employee be present alone in a controlled work area. For areas not in controlled work areas, a remote check-in/check-out procedure will be established between the affected worker and the FSM and/or SSHO. The established protocols (visual and/or verbal confirmations at established time intervals) will be followed at all times.

4.2 STOP WORK AUTHORITY

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions. Whenever any employee determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the employee is authorized and required to stop work, which shall be immediately binding on all affected Cabrera employees and subcontractors.

Upon issuing the stop work order, the employee shall consult with the FSM and/or SSHO who in-turn shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the OHSM has concurred that workplace conditions meet acceptable safety standards.

4.3 PHYSICAL HAZARDS

The following physical hazards are anticipated to be present on the site. Additional hazards may be noted on the AHA developed for the individual tasks.

4.3.1 Slips, Trips, Falls, and Protruding Objects

A variety of conditions may exist that may result in injury from slips, trips, falls, and protruding objects. Slips and trips may occur as a result of wet, slippery, or uneven walking surfaces. To prevent injuries from slips and trips, always keep work areas clean; keep walkways free of objects and debris; and report/clean up liquid spills. Serious injuries may occur as a result of falls from elevated heights. Always wear fall protection while working at heights of 6 feet or greater above the next lower level. Protruding objects are any object that extends into the path of travel or working area that may cause injury when contacted by personnel. Always be aware of protruding objects and when feasible remove or label the protruding object with an appropriate warning.

Slippery, uneven footing and tripping hazards will likely be present at the site. Be vigilant, avoid puddles, and wear footwear with slip resistant soles.

Walk around, not over or on top of debris or trash piles. When carrying equipment, identify a path that is clear of any obstructions. It might be necessary to remove obstacles to create a smooth, unobstructed access point to the work areas on site.

Maintaining a work environment that is free from accumulated debris is the key to preventing slip, trip and fall hazards at construction sites. Essential elements of good housekeeping include:

- Orderly placement of materials, tools and equipment out of walkways;

- Placing trash receptacles at appropriate locations for the disposal of miscellaneous rubbish; and,
- Prompt removal and secure storage of items that are not needed to perform the immediate task at hand.

Refer to the AHA for the task/activity involving slip/trip/fall hazards for additional details.

4.3.2 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials. Refer to the AHA for the task/activity involving housekeeping issues for additional details.

4.3.3 Manual Lifting

Most materials associated with investigation and remedial activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. Whenever possible, use mechanical assistance to lift or move materials and at a minimum, use at least two people to lift, or roll/lift with your arms as close to the body as possible. Refer to the AHA for the task/activity involving manual lifting hazards for additional details.

4.3.4 Utility Hazards

Various forms of underground and/or overhead utility lines may be encountered during site activities. Review of RBC utility maps indicates that subsurface utilities are not located within the work area; therefore, notification of Underground Services Alert will not be required before intrusive activities begin. If conditions changes, utility clearance will be performed, as well as obtaining authorization from all concerned public utility department offices (refer to OP-589, *Utility Clearance and Isolation* in Attachment A). If necessary, a private locating service will be used in the event that the One Call service will not locate underground utilities within the property limits.

Should intrusive operations cause equipment to come into contact with utility lines, the SSHO and the Occupational Health & Safety Manager (OHSM) will be notified immediately. Work will be suspended until the applicable utility agency is contacted and the appropriate actions for the particular situations can be taken.

Overhead power and utility lines may be present on, or adjacent to, the site and represent a potential hazard during the mob/demobe of equipment and supplies. During site operations, ensure equipment operators, truck drivers, and signal person(s) are aware of overhead power lines and maintain a minimum of 10 feet between the lines and any equipment. Any deviation from the minimum safe distance noted in the table below must be approved by the OHSM.

Table 4-1: Minimum Voltage-Safe Distances

Voltage	Distance
0 to 50 kV	10 feet

Voltage	Distance
51 to 200 kV	15 feet
201 to 350 kV	20 feet
351 to 500 kV	25 feet
501 to 650 kV	30feet
651 to 800 kV	35 feet
801 to 950 kV	40 feet
951 to 1100 kV	45 feet

kV = kilovolts

All temporary electric installations (site trailer, subpanels) will comply with OSHA (29 CFR 1926, Subpart K, and 29 CFR 1910, Subpart S) guidelines. Only qualified and competent individuals (licensed electrician) will provide electrical service/servicing.

Refer to the AHA for the task/activity involving utility hazards for additional details.

4.3.5 Electrical hazards

Electrical and powered equipment may be used during a variety of site activities. Injuries associated with electrical and powered equipment include electric shock, cuts/lacerations, eye damage (from flying debris), and burns. To reduce the potential of injury from the hazards associated with electrical and powered equipment, always comply with the following:

- Use ground fault circuit interrupters (GFCIs) when using electrical powered tools/equipment. GFCIs prevent electrical shock by detecting the loss of electricity from a power cord and/or electrical device.
- Ensure generators are properly grounded, including the use of a grounding rod, driven to a depth of 3-feet.
- Wear ANSI-approved (Z87.1) safety glasses. Face shields may be required to provide additional face protection from flying debris.
- Wear appropriate work gloves. Work gloves may reduce the severity of burns and cuts/lacerations.

All temporary electric installations (site trailer, subpanels) will comply with OSHA (29 CFR 1926, Subpart K, and 29 CFR 1910, Subpart S) guidelines. Only qualified and competent individuals (licensed electrician) will provide electrical service/servicing. Refer to the AHA for the task/activity involving electrical hazards, and OP-567, for additional details.

4.3.6 Heavy Equipment and Vehicle Operations

Heavy equipment and site vehicles present serious hazards site personnel. Blind spots, failure to yield, and other situations may cause heavy equipment/vehicles to come into contact with personnel. To reduce the possibility of contact between equipment/traffic and personnel, always adhere to the following:

- Personnel must wear a high visibility, reflective safety vest at all times when working near heavy equipment and/or other vehicle traffic.

- Personnel must always yield to equipment/vehicle traffic and stay as far as possible from all equipment/vehicle traffic. Always maintain eye contact with operators.
- When feasible, place barriers between work areas and equipment/vehicle traffic.
- Always ensure reverse warning alarms are working and louder than surrounding noise. Personnel must report inoperative reverse warning alarms.
- Ensure Daily Equipment Safety Inspections are being performed and documentation filed at the site.

Refer to the AHA for the task/activity involving the use of the specified Heavy Equipment and OP 584, for additional details.

4.3.7 Excavations and Trenches

Excavations and trenches present workers with a variety of hazards. If not properly sloped, shored, or boxed, trench walls may collapse and trap workers under the weight of the soil. Soil contaminants and other chemical hazards (e.g., carbon monoxide from equipment/vehicles) may result in a hazardous atmosphere. Confined space entry procedures may need to be followed if the potential for a hazardous atmosphere exists. Buried utilities may exist where excavations/trenches will be placed. Always contact the local utility locator service prior to beginning excavations. Refer to the AHA and OP-583 for additional details.

4.3.8 Confined Space Entry

Confined space entry is not anticipated for this site. If confined spaces are identified, the SSHO and/or FSM will inform all employees of the location of confined spaces and prevent unauthorized entry.

4.3.9 Aerial Lifts

The use of aerial lifts presents a unique set of hazards to employees using, and working around the equipment. Proper training on the safe usage of the specific type of lift being utilized is essential to the safe execution of work tasks with the equipment. Besides the daily inspections and safe usage of the equipment, there are numerous other safety related issues that need to be assessed during their use, to include fall protection, safe working surfaces, and overhead power lines. Refer to the AHA for aerial lift operations and attached OP (OP-590) for additional details.

4.3.10 Working at Heights

Fall Protection - Fall Protection Systems shall comply with OSHA Regulations (Standards – 29 CFR) Standard # 1926.502 Fall Protection Systems Criteria and Practices and OSHA Standard # 1926.502(d) – 1926 Subpart M App C Personal Fall Arrest Systems.

Specifically, anyone working in an area exposed to a fall greater than 6 feet must use appropriate fall protection. Such protection includes: guardrail systems, safety net systems or personal fall arrest systems. Other protection methods include hole-covers, positioning devices, equipment guards, fences and barricades. Fall protection shall be provided as required in OSHA Regulations 29CFR1910 and 29CFR1926, reference: standard 1926.501 Duty to Have Fall Protection.

Work above a height of 6 feet requires a fall protection system. This project requires 100% tie off using full-body harness (Class III or IV) with dual shock-absorbing lanyard (shorter than fall distance and a maximum 6 ft. long) equipped with double-locking hooks connected to a proper tie-off attachment point capable of handling potential fall loads of 5,000 pounds.

Fall protection systems classified as "job made" (not purchased approved fall prevention devices from a fall protection supplier) shall be designed by a Registered Professional Engineer. Fall protection or restraining methods shall be in place when employees are within 6 feet of the leading or exposed edge, where a fall hazard exceeding 6 feet exists, such as during decking activities, inspecting structures, climbing, trenching, etc.

Refer to the AHA for the task/activity involving fall hazards, and OP-585, for additional details.

4.3.11 Dust and Odor Control

Specific controls will be in place to prevent dust generation. If dust is observed reaching or approaching the site boundary, activities causing the dust will be immediately stopped. Dust control measures (water spray, soil covers, slower work pace, or change in work activities) will be deployed prior to resuming work. Corrective measures will be documented in the daily report.

Due to the nature of the contaminant at the site, odors are not anticipated to be of concern. In the event that an odor complaint is received, the FSM and/or SSHO will immediately assess site conditions and determine the probable cause or causes. Appropriate odor mitigation measures will be deployed. These measures may include covering sediment piles, deploying odor suppressing foam, implementation of air monitoring or discontinuing activities that are generating the odor. Corrective measures will be documented in the daily report.

4.3.12 Spill Prevention

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. The following procedures will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy dri) shall be available at each work site (more as needed).

- All hazardous commodities in use (i.e. fuels) shall be properly labeled.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.

4.3.13 Noise Exposure Monitoring

When heavy equipment is in operation, it will be necessary to ensure that each exclusion zone fully encompasses all areas where hazardous noise levels are present (85dBA or greater). If the sound pressure level exceeds 85 dBA (est.) at any location along the site perimeter, the exclusion zone boundary will be adjusted to fully encompass this region. All personnel working inside of the EZ will be required to wear hearing protection during the operation of heavy equipment. Refer to AHA for the specific activity for appropriate PPE.

4.3.14 Traffic Control

During certain work tasks, the establishment of traffic control to adequately protect workers and the public may be required on-site. Site specific requirements will be determined by the FSM and/or SSHO on a case-by-case basis. Only approved traffic control devices per accordance with the Manual of Uniform Traffic Control Devices (MUTCD) will be used on public road ways per accordance with the applicable State regulatory guidance.

General traffic control precautions include placing a work vehicle between your worksite and oncoming traffic whenever possible. Not only is it a large, visible warning sign, but also if an oncoming car should fail to yield or deviate, the parked vehicle rather than your body would absorb the first impact of a crash. Turn the vehicle wheels so that if it was struck, it would swing away from the worksite. When using cones or other devices to modify traffic flow, ensure use of the proper taper length and device spacing to provide adequate warning distance to on-coming motor vehicles. In addition, proper PPE is to be worn during traffic operations, to include hardhat and high-visibility vests. Refer to AHA for the specific activity for appropriate traffic control measures.

4.4 BIOLOGICAL HAZARDS

It is anticipated that numerous biological hazards will be present on the project site. Poisonous plants may be found along the tree lines, and adjacent to monitoring wells, along with ticks and other biting insects. Stinging insects, such as bees and wasps may build nests inside of monitoring wells or be within proximity of the work zone. Below is a discussion of the most common biological hazards found on project sites, and those anticipated to be of concern here.

4.4.1 Small Mammals

Working in the field either directly or indirectly with small mammals have inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.

The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).

Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

4.4.2 Venomous Animals

Some animals have the ability to inject venom. These include: various types of spiders, and snakes. The two more venomous spiders likely to be encountered are the Black Widow and Brown Recluse. Both spiders like dark conditions. The Black Widow prefers moist conditions, and the Brown Recluse dry. Other spiders possess venom but they are not harmful to humans.

Snakes have limited distributions, and generally avoid humans, so in most areas you are unlikely to encounter them.

If bitten by any of these animals special care should be taken to treat the wound as it may lead to complications due to the toxin. A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency. Bites from a black widow should be treated as medical emergencies. All other bites should be reported, proper first aid implemented, and the wound progression tracked.

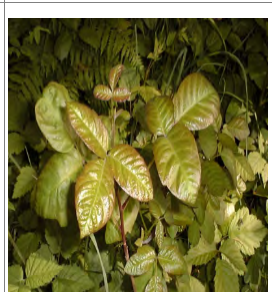
4.4.3 Poisonous Plants

Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin; therefore it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Staff should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can result in severe scarring, blindness or even death.

Plants that field staff should recognize and take precautions to avoid include: Poison Sumac, Poison Ivy (terrestrial and climbing), Poison Oak, Giant Hogweed (or Giant Cow Parsnip), Wild Parsnip, Devil's Club and Stinging Nettle. Many others are extremely poisonous to eat (e.g., Poison Hemlock; Water Parsnip) – do not eat anything that has not been identified.

A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying not to eat any berries or plants that you are not absolutely sure of their identity. Examples of common poisonous or irritating plant species, common to the United States, are shown in the table below.

Table 4-2: Hazardous Plant Identification Guide

Poison Ivy • Grows in West, Midwest, Texas, East • Several forms – vine, trailing shrub, or shrub • Three leaflets (can vary 3-9) • Leaves green in summer, red in fall • Yellow or green flowers • White berries	 
Poison Oak • Grows in the East (NJ to Texas), Pacific Coast • 6-foot tall shrubs or long vines • Oak-like leaves, clusters of three • Yellow berries	 

<table>
<tr>
<td>

Giant Hogweed

- Grows from MI to VA, found in western NY
- 8- to 14-feet tall
- Small, white flowers form a large flat-topped umbel
- Leaves up to 5-feet across, lobed and deeply incised

</td>
<td>

</td>
</tr>
</table>

4.4.4 Insects

Insects for which precautionary measures should be taken include: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, and European Fire Ant.

Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.

Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will insert mouthparts to drink blood. Most serious concern is possibility of contracting Lyme disease which is spread by the Black-legged or Deer Tick. Occasionally a tick can cause Tick Paralysis if it is able to remain feeding for several days. Full recovery usually occurs shortly after the tick is removed.

The Fire Ant is spreading and often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

4.5 HEAT AND COLD STRESS

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat/cold stress and watch fellow employees for signs of heat/cold stress.

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress as outlined in OP-563, Heat Stress, and OP-564, Cold Stress.

4.5.1 Responding to Heat-Related Illness

The guidance below will be used in identifying and treating heat-related illness.

Table 4-3: Identification and Treatment of Heat-Related Illness

Type of Heat-Related Illness	Description	First Aid
Mild Heat Strain	The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring.	• Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids. • If an air-conditioned spot is available, this is an ideal break location. • Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms.
Heat Exhaustion	Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily.	• Immediately remove the victim from the work area to a shady or cool area with good air circulation (*avoid drafts or sudden chilling*). • Remove all protective outerwear. • Call a physician. • Treat the victim for shock. (*Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing*). • If the victim is conscious, it may be helpful to give him/her sips of water. • Transport victim to a medical facility ASAP.
Heat Stroke	The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly and death is imminent if exposure continues. Heat stroke can occur suddenly.	• Immediately evacuate the victim to a cool/shady area. • Remove all protective outerwear and as much personal clothing as decency permits. • Lay the victim on his/her back w/the feet slightly elevated. • Apply cold wet towels or ice bags to the head, armpits, and thighs. • Sponge off the bare skin with cool water. • The main objective is to cool without chilling the victim. • Give no stimulants or hot drinks. • Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide onsite treatment of the victim and proper transport to a medical facility.

4.5.2 Responding to Cold-Related Illness

Considering the region of the country and the consistently warm climate year-round, cold-related illness is unlikely. If these conditions change, the SSHO will notify the HSM and appropriate measures will be taken to avoid thermal injury due to cold exposure.

4.6 ULTRAVIOLET HAZARDS

The 2013 historical UV Index for the San Francisco, CA area showed that worker's UV exposures were in the HIGH category beginning in March and lasting until October with worker's exposures in the EXTREME category in July. Workers performing field work outdoors may be susceptible to sunburn if not properly protected with sunscreen or protective clothing and hats. Skin can burn in minutes when the UV Index is VERY HIGH. Protective measures are advisable.

4.7 WEATHER HAZARDS

The SSHO will be attentive to daily weather forecasts for the project area each morning. Predicted weather conditions of potential field impact are to be included in safety briefings and the AHA for that day. Weather changes should initiate a review and updates as necessary. Weather-related hazards will directly correlate to the type of weather involved. Hot, dry weather may cause greater dust emissions, particularly during intrusive activities. Rain may increase slip/trip hazards, particularly for ground workers.

Severe weather can occur with little warning. Employees will be vigilant for the potentials for storms, lightning, high winds, and flash flood events. Additionally, lightning strikes during electrical storms could also be a potential hazard. The following procedures will be implemented once thunder is heard or lightning spotted:

1. If thunder is heard, all site personnel are to be alert of any visible lightning flashes. The SSHO will observe the storm front and track the direction it is moving. The SSHO will continue to observe the storm front until it passes or until the prevailing direction is determined to be away from the site.
2. If lightning is observed, the FSM or SSHO are to be notified. When the next lightning flash is observed, a "second" count shall be initiated from the time the lightning is observed until the thunder from the strike is heard.
3. The following action guidelines shall be implemented once the "second" count is ≤ 30 seconds:
   a) "second" count > 30, the FSM or SSHO will continually observe the storm front. If the front is moving away, work will continue. If the front is moving towards the site, the FSM will initially place workers on alert for potential evacuation.
   b) "second" count ≤ 30, the FSM will issue the evacuation command and all workers are to report to the break/lunch trailer. Work can be re-initiated once the front has passed by and thunder has not been heard for 30 minutes.
4. If lightning is observed and the storm front is moving away from or around the site and is > 20 miles away, work will be permitted to continue. The location of the storm can be confirmed via internet access to a local weather website that has a Doppler radar tracking system.

5.0 CHEMICAL & RADIOLOGICAL HAZARDS

5.1 CHEMICAL EXPOSURE HAZARDS

The following is a discussion of the hazards presented to worker personnel during this project from on-site chemical and radiological hazards known, suspected or anticipated to be present on site. Cabrera has based its evaluation on available data and maximum concentrations reported for the project site. The contaminants identified in Table 3-1 (Section 3) have been evaluated for exposure potential and those contaminants of concern (COC) that have the potential to exceed will be discussed in this SHSP. The COCs that have the potential to exceed their PEL have been listed below. If there is any information that is contrary to Cabrera's conclusions in this SHSP, it is anticipated that the client will provide this information prior to the initiation of site activities.

5.1.1 Organic Solvents

Organic solvents are toxic because of the physical characteristics which permit them to solubilize fats, lipids, and grease. Solvents are toxic to humans because they are solvents. At some concentration, all organic solvents are asphyxiates. Acute exposure risks are depressive and narcotic effects on the central nervous system.

Neurotoxic effects of organic solvents have been known for a long time. Neurasthenic syndromes, including fatigue, concentration difficulty, loss of memory, general irritability, and alcohol intolerance have been described as well as several cases in which chronic symptoms revealed more or less permanent injuries to the nervous system. However, it may be assumed that the amount of exposure was higher in the past than it is now, due to awareness of the work environment and control of health risks.

The mechanisms by which the effects on the nervous system are produced remain largely unclear. Mutagenic activity in the various test systems has been demonstrated for benzene, styrene, trichloroethylene and certain chlorinated ethanes. Chromosome changes have been noted in workers exposed to benzene, benzene-toluene mixture, trichloroethylene, styrene, and in cases where there has been a mixed exposure to solvents, etc., in laboratories. Trichloroethylene, perchloroethylene, dichloroethane, carbon tetrachloride, methylene chloride and chloroform have all proved carcinogenic in conventional tumor induction tests on mice and rats.

Epidemiological studies of tumors have been done on persons exposed at work to trichloroethylene, benzene, and styrene. Benzene has long been known as a leukomogenic substance.

Fetal damage and spontaneous abortions are suspected to be related to exposure to solvents. This is of particular interest, since many women are exposed to solvents in their work.

Effects on other organs include the acute cardiac rhythm disturbances which have been described in connection with high exposure to certain solvents. The effects of benzene on the blood-forming bone-marrow is well known. Similar effects have been reported with other aromatic solvents; however, benzene contamination may have been the cause. Carbon disulfide has been reported to cause an increased incidence of chronic heart disease.

Exposure to carbon tetrachloride and certain chlorinated ethanes produce acute effects on the liver, as also does consumption of ethyl alcohol. These substances may also cause chronic liver damage. A slight or moderate increase in liver values in groups exposed to solvents is sometimes noted in health examinations, but is hard to evaluate.

Exposure to solvents has also been shown to be more common in cases of chronic glomerulonephritis than in control groups. Exposure to high concentrations of organic solvents in the air causes localized eye irritation. Certain lens changes have also occurred.

The drying effect of solvents on the skin is a very common occurrence. As stated previously, solvents remove fats and lipids from cellular membranes causing them to dry out and give a cracked appearance.

5.1.2 Hydrogen Sulfide

CAS 7783-06-4; RTECS MX1225000; UN 1053

H2S, hydrogen sulfide, is a flammable, colorless gas with a characteristic rotten-egg odor. The odor threshold is 0.008 ppm. Synonyms are sulfuretted hydrogen, hydrosulfuric acid, stink damp.

Hydrogen sulfide is used in the synthesis of inorganic sulfides, sulfuric acid, and organic sulfur compounds, as an analytical reagent, as a disinfectant in agriculture, and in metallurgy. It is generated in many industrial processes as a by-product and also during the decomposition of sulfur-containing organic matter, so potential for exposure exists in a variety of situations. Hydrogen sulfide is found in natural gas, volcanic gas, and in certain natural spring waters.

It may also be encountered in the manufacture of barium carbonate, barium salt, cellophane, depilatories, dyes, and pigments, felt, fertilizer, adhesives, viscose rayon, lithopone, synthetic petroleum products; in the processing of sugar beets; in mining, particularly where sulfide ores are present; in sewers and sewage treatment plants; during excavation of swampy or filled ground for tunnels, wells, and caissons; during drilling of oil and gas wells; in purification of hydrochloric acid and phosphates; during the low temperature carbonization of coal; in tanneries, breweries, slaughter-houses; in fat rendering; and in lithography and photoengraving

The transitional PEL is a ceiling value of 20 ppm. The final rule PEL(1) and REL are 10 ppm (14 mg/m3), and the ACGIH TLV is 1 ppm.

Routes of entry are via inhalation of gas, ingestion, eye and skin contact. Signs and symptoms of acute exposure to hydrogen sulfide may include tachycardia (rapid heart rate) or bradycardia (slow heart rate), hypotension (low blood pressure), cyanosis (blue tint to skin and mucous membrane), cardiac palpitations, and cardiac arrhythmias. Dyspnea (shortness of breath), tachypnea (rapid respiratory rate), bronchitis, pulmonary edema, respiratory depression, and respiratory paralysis may occur.

Neurological effects include giddiness, irritability, drowsiness, weakness, confusion, delirium, amnesia, headache, sweating, and dizziness. Muscle cramping, tremor, excessive salivation, cough, convulsions, and coma may be noted. Nausea, vomiting, and diarrhea are commonly seen. Exposure to hydrogen sulfide gas may result in skin irritation, lacrimation (tearing), inability to detect odors, photophobia (heightened sensitivity to light), and blurred vision. Harmful effects of short-term exposure are as follows:

- Inhalation - Levels of 20 ppm may cause headache, loss of appetite and dizziness. 50 ppm may cause muscle fatigue. 300 ppm may cause muscle cramps, low blood pressure, and unconsciousness after 20 minutes. Levels of 500 ppm can cause immediate loss of consciousness, slowed respiration and death in 30 to 60 minutes. At levels of 700 ppm and above, respiratory paralysis and death can occur in seconds. Non-fatal cases may recover fully or may experience abnormal reflexes, dizziness, sleep disturbances and loss of appetite that last for months or years.

- Skin - Readily absorbed. May cause irritation, reddening and swelling. Contact with liquid can cause freezing burns.
- Eyes - Irritation may be felt at levels as low as 0.1 ppm. Levels of 1 ppm and above can cause irritation, pain, tearing, and increased light sensitivity. Liquid may cause freezing burns.

Hydrogen sulfide's strong odor, noticeable at low concentrations, is a poor warning sign as it may cause olfactory paralysis, and some persons are congenitally unable to smell H2S. Accidental exposure may occur when workers enter sewage tanks and other confined areas in which hydrogen sulfide is formed by decomposition. Workers, therefore, should not enter enclosed spaces without proper precautions and real-time air monitoring. At concentrations above the PEL, Level B is required. Determination in air is via OSHA Method ID141.

5.1.3 Polychlorinated biphenyl (PCB)

CAS 42% chlorine 53469-21-9; RTECS TQ1356000

CAS 54% chlorine 11097-69-1; RTECS TQ1360000

Polychlorinated biphenyls (PCBs) are a series of technical mixtures, consisting of many isomers and compounds that vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins. The variability is based upon the degree of chlorination (and location of chlorine atoms) on the diphenyl rings that act as the skeleton for PCBs. The name Aroclor® 1221, 1233, 1242, 1248, 1254, 1260 etc. correspond as to the percentage that the diphenyl rings have been instituted, i.e., 21%, 33%, 42%, etc. The most commonly encountered PCBs are chlorodiphenyl (42% chlorine) [Aroclor® 1242] and chloridiphenyl (54% chlorine) [Aroclor® 1254]. These compounds are light, straw-colored liquids with typical chlorinated aromatic odors; 42% chlorodiphenyl is a mobile liquid and 54% chlorodiphenyl is a viscous liquid. Chlorodiphenyl (42% chlorine) boils between 617^{o} and 691^{o} and freezes at -2^{o}F. Chlorodiphenyl (54% chlorine) boils between 689 ^{o} and 734 ^{o} F and freezes at 50^{o}F. The synonyms for PCBs are chlorodiphenyls, Aroclors, and Kanechlors. Names further defining PCBs, based upon chlorine substitution are Aroclor® 1221, 1232, 1242, 1248, 1254, 1260, 1262, 1268, 2565, 4465, 5442, 5460 and Kanechlor 300, 400, 500. PCBs are incompatible with strong oxidizers.

PCBs are used alone and in combination with chlorinated naphthalenes. They are stable, thermoplastic, and nonflammable, and find chief use in insulation for electric cables and wires, in the production of electric condensers, as additives for extreme pressure lubricants, and as a coating in foundry use. PCBs are one member of a class of chlorinated aromatic organic compounds which are of increasing concern because of their apparent ubiquitous dispersal, persistence in the environment, and tendency to accumulate in food chains, with possible adverse effects on animals at the top of food webs, including man. The OSHA PEL and ACGIH TLV are 1 mg/m3 for chlorodiphenyl 42% Cl and 0.5 mg/m3 for 54% Cl. The NIOSH REL for both 42% and 54% are 0.001 mg/m3. The IDLH level is 5 mg/m3.

Routes of entry are via inhalation of fume or vapor and percutaneous absorption of liquid, ingestion, eye and skin contact. Harmful effects from short term exposure are as follows:

- Inhalation - May produce irritation to nose, throat, and lungs. Levels above 10 mg/m^3 are reported to be unbearable. Inhalation may contribute significantly to all symptoms of long term exposure.
- Skin - Absorption is moderate. Contributes significantly to all symptoms of long term exposure. Sensitized individuals may develop a rash after 2 days exposure by contact or inhalation.
- Eyes - May produce irritation. Levels of 10 mg/m^3 are severely irritating
- Ingestion - Absorption in the digestive system contributes significantly to all symptoms of long term exposure. There are no reported deaths of humans due to a single ingestion. However, experiments in animals suggest that ingestion of 6 to 10 fluid ounces would cause death to a healthy 150 pound adult.

Long term exposure to PCBs at high levels of 1 to 10 mg/m^3 may produce a burning feeling in the eyes, nose and face; dry throat; lung and throat irritation; nausea, dizziness, chloracne, and the aggravation of existing acne. Liver damage and digestive disturbance have been reported in some individuals. OSHA has identified PCBs as a dermal carcinogen. PCBs may impair the function of the immune system. PCBs at high levels have been shown to produce cancer and birth defects in laboratory animals. Whether PCBs produce these effects in humans is not known.

North and MSA do not approve the use of APRs for protection against 42% and 54% chlorodiphenyl as a Determination in air is via collection on a particulate filter or with a florisil tube, adhering to NIOSH Method 5503 for PCBs' vapor. However, if it is a particulate concern via adhering to soil, level C with HEPA filters can be used.

5.1.4 HEAVY METALS

As a group, the heavy metals (including lead, arsenic, chromium, nickel, cadmium, and selenium) are toxic to a number of organs and organ systems in the body, including the liver, kidneys, blood-forming organs (primarily located in the bones), and the CNS (especially lead). Acute exposure to metals can produce such symptoms as stomach distress and vomiting, mental confusion and sluggishness, heart palpitations, breathing difficulties, and renal (kidney) failure. Chronic exposures can be characterized by deterioration in function of the liver and kidneys, CNS degradation, and abnormal changes in blood cell counts (especially white blood cells). Exposure to chromium may also lead to formation of lung and gastric cancers.

The primary route of exposure to heavy metals of concern during this project is contact with contaminated soil and water, which can lead to entry through open wounds or contamination and ingestion of food. Preventing this route of exposure necessitates the use of dust control measures, administrative controls (e.g., no consumption of food/beverages in the work area or smoking/chewing tobacco), chemically-protective gloves, and decontamination procedures.

5.2 RADIOLOGICAL HAZARDS

The Cabrera Radiation Safety Program (Cabrera 2013) contains all current Corporate radiation safety procedures and will be implemented to protect worker health and safety during remedial support activities. The RSO ensures that contamination control activities are effective, samples and areas are not cross-contaminated, workers and the environment are protected, and that activities comply with established radiological procedures. It also ensures that worker doses are maintained as low as reasonably achievable (ALARA) in accordance with Cabrera's State of California Radiation Safety Program (RSP). This will require methods to identify and prevent the release of potentially contaminated items from radiologically controlled areas. Methods and programs used to protect the workers, Site visitors and the environment are discussed in the following sections.

5.2.1 Radiation Work Permits

The Radiation Work Permit (RWP) serves as a tool in protecting workers from the radiation hazards per Cabrera's RSP. In this permit, the levels of personal protective equipment (PPE) will be detailed, as well as the levels of radioactive materials expected, general area dose rates, airborne radioactivity levels, total and removable radioactivity limits, and other pertinent information. If any of the radioactivity levels on the RWP are exceeded, the SRSL will contact the RSO immediately. The RSO has the authority to stop work if there is an exceedance of the radioactivity levels on the RWP. The RSO, SRSL, and PM will agree on the appropriate action to be taken (i.e. additional administrative controls, increased PPE, etc.) before work can continue.

5.2.2 Radiation Surveys and Monitoring

Contamination surveys, which include removable contamination (i.e., wipe) and total radioactivity (i.e., direct measurement) surveys on equipment and other potentially contaminated items originating from radiological control areas, will be performed per CABRERA SOP, OP-001, *Radiological Surveys Rev. 3.0*. Contamination surveys will be conducted upon arrival/receipt on-site of equipment that will enter any SZ, on equipment, waste containers, and personnel prior to leaving a CRZ, and surfaces to determine that materials, working surfaces, equipment, and personnel are not contaminated with radioactive material above the levels. The SRSL will identify areas subject to routine smear surveys to be analyzed for gross alpha and gross beta contamination. These areas could include, but are not limited to, the following areas:

- CRZ access/egress points,
- Personnel and vehicle traffic areas within the Radiological Controlled Area (RCA), which is the same as the EZ
- Intermodal load out and staging locations,
- On-site laboratory, instrument, and source room(s) floors and countertops,
- Admin area floor, desktops, and work surfaces, and
- Break area floor and tabletops.

Table 5-1 provides examples of instruments (or their equivalent) that will be used to perform frisking, direct measurements, and smear counting:

Table 5-1: Instrumentation

INSTRUMENT	DETECTOR	RADIATION DETECTED	FUNCTION
Ludlum Model 3 ratemeter	Ludlum Model 44-9 Geiger-Mueller	Alpha-beta-gamma	Frisking - personnel, equipment, surfaces
Ludlum Model 2360 scaler/ratemeter	Ludlum Model 43-93 scintillator	Alpha-beta	Direct contamination & frisking - personnel, equipment, surfaces
Ludlum Model 2929 dual channel scaler	Ludlum Model 43-10-1 scintillator	Alpha-beta	Smear and air filter counting
Bicron MicroRem	Integral scintillator	Gamma	Dose equivalent rates

Contamination surveys will be performed with direct measurements for total radioactivity and smear surveys for removable contamination. Direct measurements are performed using a calibrated and daily source checked radiation detection instrument capable of detecting alpha, beta, and gamma radiations.

Smears will be collected over a finite surface area, ideally 100 square centimeters (cm^2), and analyzed using on-site counting equipment for alpha and beta radioactive contamination per CABRERA SOP,OP-004 *Unconditional Release of Materials from Radiological Control Areas, Rev. 2.0*.

Dose rates exceeding levels identified in the Radiation Work Permit will trigger a reevaluation by the SRSL prior to continuing work.

The required minimum detectable activity (MDA) of these instruments will be 50% of the applicable acceptable surface contamination limits listed for equipment and materials, as practicable. For example, the MDA for removable alpha contamination would be 20 x 0.5 or 10 disintegrations per minute per 100 square cm ($dpm/100cm^2$) based on the project acceptable removable surface contamination limit. Survey and counting instruments are source checked on a daily basis and their performances tracked on spreadsheets or control charts. The sources for daily source counts will be handled per CABRERA SOP, OP-009, *Use and Control of Radioactive Check Sources, Rev. 1.0*. Procedures for calibration and operation of the instruments are in CABRERA SOP, OP-020, *Operation of Contamination Survey Meters Rev 1.0* and SOP, OP-021 *Alpha-Beta Counting Instrumentation, Rev. 1.0*.

Geiger-Mueller detectors may be used to detect beta-gamma surface activity for personnel monitoring. These detectors will detect surface contamination when held within one-half inch of the skin or clothing surface and slowly scanned over the surface. When using the detector for personnel monitoring, the detector shall be used in a background radiation level of less than 100 counts per minute (cpm). If background levels are greater than 100 cpm, the instrument shall be relocated to an area of lower background radiation levels or the area shall be shielded to reduce the background.

Alpha scintillation detectors may be used to detect alpha activity by holding the detector as close as possible (preferably within one-quarter of an inch) to the surface while slowly scanning. For detection of low-level alpha activity, the detector should be held in one position at key locations such as hands, bottoms of shoes, and nose/mouth for approximately five seconds while listening for audible clicks.

Surveying for personnel contamination is the responsibility of individuals who are trained and qualified as radiation workers. Health physics technicians shall survey all other personnel. The instructions for using the equipment, the acceptable limits of contamination, and actions to be taken if any individual exceeds the limits shall be addressed by the SRSL prior to work activities within a RCA. The instructions summarized in Table 5-2, shall be adhered to for personnel frisking at all times.

Table 5-2: Guidelines for Frisking Performance

GENERAL REQUIREMENTS AND PERFORMANCE
1. Verify that the instrument is in service, set to the lowest scale, and the audio output can be heard during frisking.
2. Frisk the hands before picking up the detector.
3. Hold the beta-gamma detector less than ½-inch and the alpha detector approximately ¼-inch from the skin/clothing surface.
4. Move the detector over the skin/clothing surface at a rate of approximately one detector width per second.
5. Perform the frisk in the following order: • Head (pause at the mouth and nose for approximately 5-seconds). • Neck and Shoulders • Arms (pause at each elbow) • Chest and Abdomen • Back, Hips, and Seat of pants • Legs (pause at each knee) • Shoe Tops • Shoe Bottoms (pause at sole and heel) • Personal and supplemental dosimeters.
6. If the count rate increases, pause for 5 to 10 seconds over the area to provide adequate time for instrument stabilization and response.
7. If the count rate increases to a value greater than 2-times background or the instrument alarms, remain in the area and notify a HP technician or the SRSL.
8. The whole body frisk should take 2 to 3 minutes depending on the sizes of the detector's active area and the person. When completed, return the detector to its holder. The detector should be placed on the side or face-up to allow the next person to frisk their hands before handling the detector.

5.2.3 Airborne Radioactivity Surveys

Radiological airborne hazards may be generated by excavation of contaminated soils during exploratory activities. Therefore, air sampling will be performed during these work activities to monitor occupational airborne concentrations. Airborne contamination surveys will be provided utilizing breathing zone (BZ) air samplers at approximately 4 liters per minute (lpm), low-volume air samplers (LV) at flow rates of approximately 80 lpm, or high-volume (HV) air samplers at flow rates of approximately 15 cubic feet per minute). The selection of HV versus LV will be based on flow rates; estimated standard run times, total volume of air collected during standard monitoring durations, and required instrument detection capabilities to ensure compliance with regulatory and project-specific limits. Air sampling will be performed in accordance with CABRERA SOP, OP-002, *Radioactive Air Sampling and Analysis Rev. 1..0* More details on radiological air sampling is included in the Air Monitoring Plan (Appendix C of the Work Plan).

5.2.4 Contamination Control Measures

Contamination controls provided during characterization activities may include physical barriers, such as stanchions and rope boundaries, along with standard ingress/egress points and frisking stations. Radiological posting of active remediation areas will be performed in accordance with Cabrera SOP, OP-019, *Radiological Posting Rev. 0*.

5.2.4.1 Acceptable Surface Contamination Levels

Limits for removable contamination on materials and equipment are provided in Table 1 of NRC Federal Guidance Directive FC 83-23, "*Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct Material, Source, or Special Nuclear Material*." (NRC, 1983). If radioactive contamination is found on materials and equipment, reasonable efforts shall be made to remove all contamination before the items are released from RCAs. Table 4-3 summarizes acceptable surface contamination levels derived from FC 83-23.

Table 5-3: Acceptable Surface Contamination Levels

Radionuclide[a]	**Acceptable Surface Contamination Levels (dpm[1]/100 cm^2)**	
	Removable[b,c]	**Total (fixed plus removable)**[b,d]
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	20 α	100 α
Th-natural, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	200 β-γ	1,000 β-γ
U-natural, ^{235}U, ^{238}U, and associated decay products	1,000 α	5,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above.[e]	1,000 β-γ	5,000 β-γ
Tritium and tritiated compounds [f]	10,000	N/A

[1] dpm – disintegrations per minute

a. Taken from Table 1 of NRC Federal Guidance Directive FC 83-23. This table is extracted from 10 CFR 835, appendix D. The values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where surface contamination by both alpha- and beta/gamma-emitting nuclides exists, apply the limits established for alpha- and beta-gamma-emitting nuclides independently.

b. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

c. The amount of removable radioactive material per 100 cm2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note: The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and 228Ra, 227Ac, 228Th, 230Th, 231Pa and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

d. The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide *G* if: (1) From measurements of a representative number *n* of sections it is determined that 1/n å *Si* ³ *G* where *Si* ³ *G* is the dpm/100 cm^2 determined from measurement of section *i*; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm2 area exceeds 3*G*.

e. This category of radionuclides includes mixed fission products, including the ^{90}Sr which is present in them. It does not apply to ^{90}Sr which has been separated from the other fission products or mixtures where the ^{90}Sr has been enriched.
f. Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore a "Total" value does not apply.

5.3 PERSONNEL RADIOLOGICAL MONITORING

5.3.1 Dosimetry

It is not expected that work within and around the areas to be excavated will pose a significant radiation dose hazard to project personnel. It is not expected that this project and associated activities will have the potential to exceed Dose Limits as described in 10 CFR 20 Subpart C (NRC, 2008), yet the dig site represents an unknown, so as to err on the cautious side, dosimetry will be issues to the workers with direct access to the dig site. In addition, active radiation monitoring will be implemented during all phases of site work. Active radiation exposure monitoring (e.g. radiation surveys) will be performed using handheld instrumentation.

5.3.2 External Radiation Monitoring

Dose rate surveys will be used to monitor the radiological working conditions over the course of the project. Surveys will include routine monitoring and operational health physics coverage to ensure that radiological conditions remain within acceptable limits as defined in this SHSP. Survey areas will include, but are not limited to, the following:

- General work areas around the exterior of the EZ;
- Within the SZ; and
- Within rental vehicles.

A Bicron MicroRem meter (or equivalent) will be used to perform dose rate surveys.

5.3.3 Internal Dose Monitoring

There is a potential for internal exposure to site ROCs during excavation and debris/materials handling. Initial internal dose monitoring will be performed via air sampling to ensure that any unforeseen airborne hazards are detected and evaluated promptly during intrusive activities.

5.4 DECONTAMINATION

5.4.1 Equipment Contamination Surveys

Contamination surveys will be accomplished using direct frisk and loose contamination (smear) survey methods. The direct frisking method is performed using calibrated and daily source checked instrumentation capable of detecting alpha and beta-gamma radiations. The loose contamination survey method employs a contamination collection smear that removes loose contamination over approximately 100 cm^2 surface area of potentially contaminated surfaces. The smear samples, in turn, are analyzed in a calibrated field laboratory instrument. Equipment contamination surveys will be performed in compliance with CABRERA SOP *OP-001, Radiological Surveys*.

5.4.2 Contamination Controls

Contamination controls provided during sample collection activities will include physical barriers such as rope boundaries along with standard ingress/egress points. Equipment and tools potentially contaminated by sample collection activities will be controlled until release criteria have been met.

Waste packages will be screened for removable radioactivity and evaluated against the limits in Table 5-3 as they leave the RCAs by CABRERA health physics personnel to avoid cross-contamination in the building.

5.4.3 Survey Forms

Survey forms will be used to record the results of fixed/loose contamination surveys associated with equipment and tools used during sample collection activities.

Completed survey forms will be forwarded to the SRSL or SM as appropriate, for data validation.

5.4.4 Personnel Decontamination

Methods and procedures for decontamination will follow CABRERA SOP, OP-243, *Personnel Frisking and Decontamination Rev. 2.0.* Contamination may be removed from personnel clothing by patting the affected area with tape and resurveying to determine if additional decontamination is necessary. If contamination cannot be reduced to levels below the applicable levels and ALARA, the clothing will be removed from service for disposal as low-level radioactive waste. Where radon contamination is suspected, health physics (HP) personnel may remove and secure the clothing to allow time to ventilate and decay, then re-survey at a later time to determine if contamination is below applicable levels and ALARA.

Only HP personnel and qualified medical personnel are permitted to decontaminate personnel with skin contamination. The following protocols will be adhered to when performing skin decontamination:

1. Survey the affected area and record the types and initial levels of contamination.
2. If possible, remove particles of contamination with tape and save the particles for evaluation.
3. Attempt localized washing with warm water and soap, ensuring the contamination is not spread to uncontaminated parts of the body. Resurvey the affected area to determine if the contamination has been reduced to levels below the applicable levels and ALARA.
4. If contamination persists, decontamination attempts and resurveys may be repeated multiple times but should stop if these methods are ineffective or skin irritation occurs.
5. If area cannot be decontaminated sufficiently with soap and water, the area may be covered (e.g., with plastic or by wearing latex gloves) to allow contamination to remove itself through perspiration.
6. Contaminated wounds of any kind will be decontaminated under the supervision of the SRSL or Lead HP. Severe wounds will be decontaminated under the supervision of medical personnel.
7. Personnel skin contamination must be reported to the RSO to determine if a skin dose assessment must be performed.
8. The results of bodily contamination must be recorded on a Personnel Contamination Report. At a minimum, the information provided in this report will consist of:
    - Employee name, date, social security number , RWP number, project, supervisor,
    - When contamination occurred, description of the cause, where happened/what specific task,
    - How could contamination have been prevented/corrective actions,

- Survey data – surveyor, instrument information, pre-decontamination, after each decontamination attempt, radionuclide/form, decontamination method(s), whole body results (if applicable),
- A human figure (front and back views) to locate contamination,
- Affected employee's and RSO or SRSL signatures with signature dates, and
- A comments/additional information section.

The information requested in this report must be provided as completely and accurately as possible for evaluation of subsequent actions, personnel dose, and for required documentation. This report shall be maintained in the employee's radiation exposure file.

Emergency medical care should be administered immediately for injuries affected by radioactive materials. Medical treatment of injuries shall take precedence over radiological considerations. The SRSL and project HP staff will provide medical personnel with any necessary radiological support in regards to contamination control and monitoring of the patient and medical staff. The treatment of radiologically contaminated injuries should include:

- Treatment of contaminated wounds by medically qualified individuals,
- Monitoring of wounds, bandages, and medical instruments and equipment for contamination, and
- Radionuclide identification.

5.4.5 Personnel Contamination Evaluation

Evaluation by a qualified individual (e.g., the SRSL or RSO) is required to accurately assess the need for immediate medical action when personnel contamination exceeds the levels (above background) shown in Table 5-4. Contamination evaluation will be performed in accordance with CABRERA SOP, OP-243, *Personnel Frisking and Decontamination*.

Table 5-4: Personnel Contamination Limits

LOCATION	BETA-GAMMA CONTAMINATION (DPM/100CM²)	ALPHA CONTAMINATION (DPM/100CM²)
Facial	5,000 (Total)	1,000 (Total)
Nasal or Mouth Smear	1,000	20
Open Wound Smear	1,000	20

1. An in-vivo and/or in-vitro examination shall be required in the following circumstances:
   a. Nasal, mouth, or open wound smears exceeding (above background):
      - 20 dpm alpha, or
      - 1,000 dpm beta-gamma
   b. Any detectable radioactivity on nasal or mouth smears (above background) and:
      - Skin or clothing contamination exceeding 1,000 dpm alpha, or 5,000 dpm beta-gamma
   c. Facial contamination exceeding (above background):
      - 1,000 dpm alpha, or
      - 5,000 dpm beta-gamma

2. A skin dose calculation shall be required if skin contamination exceeds background by:
   - 1,000 dpm alpha, or
   - 5,000 dpm beta-gamma

Internal dosimetry evaluations at levels of contamination lower than the above may be required by the RSO.

When in-vivo examinations are required as a result of an incident, the RSO shall be immediately notified and the affected person(s) shall be transported directly to a whole body counter facility as soon as practicable after the incident. When in-vitro examinations are required as a result of an incident, the RSO shall be immediately notified and the affected person(s) shall continue supplying samples until directed to stop.

5.4.6 Equipment Decontamination Protocols

Sample collection equipment will be decontaminated prior to deployment to minimize cross-contamination. Decontamination procedures can be found in CABRERA SOP, *OP-018, Decontamination of Radioactivity from Equipment and Tools,* and will meet the criteria presented in Section 5.2.4.

5.4.7 Applicability of Surveys

At a minimum, direct and loose surveys will be performed under the following conditions.

- All sampling equipment in an CRZ will be surveyed prior to leaving the site.
- All material brought into a CRZ will be surveyed prior to being removed from the zone or bagged and disposed of as Investigative Derived Waste. This includes wastes expected to be designated as non-radiological wastes, such as the partition walls that are being removed prior to residual radioactivity removal.
- To ensure that samples sent to off-site laboratory do not have surface contamination in excess of allowable limits, sample containers will be surveyed prior to placement in containers for shipment to off-site laboratories, and the exterior of sample containers will be surveyed prior to shipment to off-site laboratories. Dose rate, removable, and total activity will be measured using survey instrumentation and evaluated against the limits in Table 5-4.

Additional surveys will be performed at the direction of the RSO.

5.5 ALARA

The ALARA principle is to maintain personnel exposures to ionizing radiation as low as is reasonably achievable consistent with the purpose for which the activity is undertaken, taking into account technologies, and the economics of improvements in relation to benefits to the public health and safety and other societal and socioeconomic considerations. There will be no radiation exposure without a commensurate benefit.

There will be no minors (under age 18) or declared pregnant workers performing work activities with ionizing radiation for CABRERA at this site thus limiting radiation doses to those set forth for adults.

CABRERA's RSP has set administrative action levels for exposure to ionizing radiation for the site based on the TEDE that is the sum of the deep dose equivalent and the committed dose equivalent to any organ or tissue. The ALARA Occupational Dose Limits are the action levels at which RSO intervention and potential additional engineering controls will be instituted for future dose abatement. The TEDE will be reviewed for each individual upon receipt of the calculated internal doses and compared to the action level. Table 5-5 summarizes the action level requiring a formal job review.

Table 5-5: ALARA Formal Job Review for Following Conditions

Work Conditions
1. Any individual dose is expected to exceed 25 millirem (mrem). 2. The collective dose for the job exceeds 0.1 person rem. 3. Airborne exposures exceed 12 DAC-hrs. per week for any single individual. 4. General area dose rates exceed 1 mrem/hr. 5. Contamination levels exceed 100 times the values in "Surface Activity Guidelines" (RSP) 6. Use of supplemental engineering controls (HEPA filter systems, glove bags, tents, and other similar devices) and respiratory protection to reduce potential internal exposures. 7. Installation, removal, or modification or temporary shielding.

5.6 CHEMICAL EXPOSURE MONITORING

The following section discusses the monitoring procedures and action levels to be implemented on-site during activities that involve potential exposure to the above listed COCs. The derived action levels are intended to provide maximum protection to employees by allowing adequate warning time to upgrade PPE, in an effort to avoid exposure.

5.6.1 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone.

If ambient levels are measured which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (barricades, warning signs, and mitigative actions to limit, etc.) must be implemented prior to commencing activities at the specific work area.

Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of SSHO and/or HSM.

Reasons to upgrade:

- Known or suspected presence of dermal hazards.
- Occurrence or likely occurrence of gas, vapor, or dust emission.
- Change in work task that will increase the exposure or potential exposure to hazardous materials.

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected.
- Change in site conditions that decrease the potential hazard.
- Change in work task that will reduce exposure to hazardous materials.

5.6.2 Monitoring Equipment

Monitoring shall be performed within the work area on site in order to detect the presence and relative levels of toxic substances. The data collected throughout monitoring shall be used to determine the appropriate levels of PPE. Table 5-6 specifies the real-time monitoring equipment, which will be used for this project.

Table 5-6: Monitoring Parameters and Equipment

INSTRUMENT	MANUFACTURER/MODEL*	SUBSTANCES DETECTED
Photo Ionization Detector (PID)	RAE Systems Mini-RAE or Multi-RAE (min. 10.6 eV bulb)	Petroleum hydrocarbons Organic Solvents
Combustible Gas Indicator (CGI) or Multi-gas Detector May be combined with individual or multi-gas detectors.	RAE Systems Multi-RAE	Explosively Oxygen (O_2) Carbon Monoxide (CO) Hydrogen Sulfide (H_2S)
Particulate Monitor **For total dust**	MIE Model PDM-3 mini-RAM	Aerosols, mist, dust, and fumes
Radiation Meter	Ludlum Survey Meter (Model 19)	Gamma Radiation

*Or similar unit, as approved by the OHSM

5.6.3 Monitoring Procedures

The monitoring procedures shown below will be followed during all excavation and sampling activities.

Table 5-7: Work Zone Monitoring Procedures and Action Levels

PARAMETER	LOCATION AND INTERVAL	RESPONSE LEVEL (Meter units/ppm above background)	RESPONSE
Hydrocarbons, VOCs, SVOCs (Total by PID)	Continuous in the worker's breathing zone or in the immediate work area for sustained reading of 2 minutes in duration. **Refer to Air Monitoring plan for perimeter monitoring action levels.**	< 5 ppm	Level D work and continue monitoring (not applicable for initial assessment of unknown drums or containers.
		≥ 5 ppm	Contact the SSHO, and if no potential for change in conditions exist (drum/container activities increasing airborne levels), don Level C (GME/P100 cartridges or equivalent chemical cartridge combined with P100) and continue monitoring.
		Initial entry or opening/sampling unknown drums/containers	Stop Work. Not consistent with chemical contamination and concentrations identified in the specifications. Based upon the inconsistency, additional chemical specific

PARAMETER	LOCATION AND INTERVAL	RESPONSE LEVEL (Meter units/ppm above background)	RESPONSE
		≥ 10 ppm	monitoring and/or upgrade to Level B may be required. Consult with FSM, SSHO, and OHSM. Apply cover to excavated material and/or excavation.
Oxygen Levels (multi-gas detector)	In the breathing zone/work area within the confined space prior to and continuously during entry or in the immediate work area during intrusive activities involving impacted materials.	19.5 – 23.5 percent (%) O_2	Continue work and monitoring. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		< 19.5 or > 23.5 percent (%) O_2	Cease work, exit the work area or confined space and contact the SSHO.
Carbon Monoxide (multi-gas detector)	In the breathing zone/work area prior to and during operation of equipment with combustion motors.	< 25 ppm	Continue work and monitoring. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		≥ 25 ppm	Cease work, exit the work area or confined space and contact the SSHO.
Hydrogen Sulfide (multi-gas detector)	In the breathing zone/work area within the confined space prior to and continuously during entry or in the immediate work area during intrusive activities involving impacted materials.	< 1 ppm	Continue work activities. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		≥ 1 ppm	Cease work, exit the area or confined space, and contact the SSHO.
Explosive Atmospheres (multi-gas detector)	In the breathing zone/work area prior to and during entry in to container/drum, impacted work area or confined space.	< 10% LEL	Continue work activities. If significant changes exist in this acceptable range, contact the SSHO to investigate the potential for contributing factors.
		≥ 10% LEL	Cease work, exit the area or confined space, and contact the SSHO.
Dust, Mist, Aerosols (Respirable dust levels)	Continuous during intrusive activities involving impacted materials. **Perimeter monitoring requirements outlined in Air Monitoring Plan.**	< 1 mg/m^3 (Sustained for more than 2 minutes)	Continue Level D work and continue monitoring.
		≥ 1 mg/m^3 (Sustained for more than 2 minutes)	Upgrade to Level C PPE. Contact the PM and SSHO, implement mitigation measures, and continue Level C (minimum GME/P100 cartridges or equivalent chemical cartridge combined with P100) and continue monitoring.
		≥ 5 mg/m^3 (Sustained for more than 2 minutes)	Temporarily cease work operations, contact the PM and OHSM to discuss improving site mitigation measures.

PARAMETER	LOCATION AND INTERVAL	RESPONSE LEVEL (Meter units/ppm above background)	RESPONSE
Alpha and beta radiation	In the breathing/work zone continuously during intrusive activities involving impacted materials.	< 2E-13 µCi/mL	Continue work activities. If significant changes exist in this acceptable range, contact the SRSL to investigate the potential for contributing factors.
		≥ 2E-13 µCi/mL	Improvement of site mitigation measures required. Temporarily cease operations, apply dust control measures and wait for levels to subside. Upgrade to Level C may be required.
Gamma radiation	Ongoing monitoring during excavation activities	Twice normal background with successive readings showing significantly increasing levels (successive readings, i.e. soil samples collected at 0.5 ft to 1.0 ft distances from original sample location) or 1,000 microrem per hour (µrem/hr)	Stop excavation and notify Cabrera HP, DTSC, and UC Berkeley RRSO

5.6.4 Monitoring Equipment Calibration

All instruments used will be calibrated at the beginning and end of each work shift, in accordance with the manufacturer's recommendations. If the owner's manual is not available, the personnel operating the equipment will contact the applicable office representative, rental agency or manufacturer for technical guidance for proper calibration. If equipment cannot be pre-calibrated to specifications, site operations requiring monitoring for worker exposure or off-site migration of contaminants will be postponed or temporarily ceased until this requirement is completed.

5.6.5 Personal Sampling

Should site activities warrant performing personal sampling (breathing zone) to better assess chemical exposures experienced by Cabrera employees, the SSHO, under the direction of a Certified Industrial Hygienist (CIH) will be responsible for specifying the monitoring required. Within five working days after the receipt of monitoring results, the SSHO will notify each employee, in writing, of the results that represent that employee's exposure. Copies of air sampling results will be maintained in the project files.

If the site activities warrant, the subcontractor will ensure its employees' exposures are quantified via the use of appropriate sampling techniques. The subcontractor shall notify the employees sampled in accordance with health and safety regulations, and provide the results to the SSHO for use in determining the potential for other employees' exposure.

6.0 TRAINING & QUALIFICATION REQUIREMENTS

6.1 HAZWOPER QUALIFICATIONS

Personnel performing work at the job site must be qualified as HAZWOPER workers (unless otherwise noted in specific AHAs or by the SSHO), and must meet the medical monitoring and training requirements specified in 29 CFR 1910.120.

If site monitoring procedures indicate that a possible exposure has occurred above the OSHA permissible exposure limit (PEL), employees may be required to receive supplemental medical testing to document any symptoms that may be specific to the particular materials present.

6.2 SITE-SPECIFIC SAFETY TRAINING

All personnel are required to remain current in all of their required training and evaluate their need for additional training when there is a change in work. In addition to the general health and safety training programs, personnel will be required to complete any supplemental task specific training developed for the tasks to be performed. Administration and compliance with the requirements for additional task-specific training will be the responsibility of the PM. Any additional required training that is completed will be documented and tracked in the project files.

6.2.1 Competent Person Training Requirements

In order to complete the planned scope of work, an (OSHA conformance) competent person must be designated to perform the required daily on-site inspections of operations and/or equipment. By definition, a competent person is someone who, by combination of training and experience, is capable of identifying existing and predictable hazards in surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization and resources to take prompt corrective measures to eliminate them. The competent person may be a Cabrera (if responsible for supervising that activity) or subcontractor employee. Designated competent person(s) for this project are shown in Table 6-1:

Table 6-1: Task-Specific Competent Persons

Employee Name	Organization	Area of Competency
TBD	Cabrera Services, Inc.	Fall Protection (29 CFR 1926 Subpart M)
TBD	TBD	Excavation & Trenching (29 CFR 1926 Subpart P)
TBD	TBD for excavation and Cabrera for aerial lift ops	Heavy Equipment (29 CFR 1926 Subpart O)

Note: By identifying an employee as a "competent person", that person has now been authorized to take prompt corrective measures to eliminate hazards.

TBD: To be determined. Competent persons will be determined as the field effort gets closer.

6.3 RADIATION WORKER TRAINING

In addition to the site-specific safety training described above, each employee and subcontractor requiring access to the EZ is required to provide evidence of radiation safety training attendance within the past 12 months. Those who have not received radiation safety training will receive such training after initial mobilization to the site. This training shall be in conformance with

Cabrera SOP AP-009, *Radiation Worker Training Rev. 1.0* and will include topics required by NRC Title 10 Part 20 (10 CFR 20) (NRC, 2009). These topics include:

- Familiarity with this RPP and other project-specific procedures for the identification of radiological hazards and controls necessary to maintain personnel, environment and public exposure to radiological hazards at the Site as low as reasonably achievable (ALARA);
- Radioactive material present or suspected of being present at the Site, including type, form and radionuclide content;
- Health and safety hazards associated with the radioactive material and radionuclides present at the Site and potential exposure pathways;
- Site-specific procedures for handling, transporting, inspecting, sorting, packaging, storing and securing radioactive materials;
- Specific radiological controls applicable to the Site, project activities and radiological hazards present;
- Worker responsibility to report unsafe acts or procedures which might result in unnecessary exposure to radiation or radioactive material;
- Worker response to on-site events and occurrences with radioactive material; and
- Worker's rights and responsibilities with respect to working with radioactive material.

6.4 TAILGATE MEETINGS

Prior to the commencement of daily project activities, a tailgate meeting will be conducted by the SSHO to review the specific requirements of this SHSP, and any applicable AHA. Attendance at the daily tailgate meeting is mandatory for all employees covered by this SHSP and must be documented on the attendance form (Attachment C). All safety training documentation is to be maintained in the project file by the SSHO.

6.5 HAZARD COMMUNICATION

Hazardous materials that may be encountered as existing on-site environmental or physical/health contaminants during the work activities are addressed in this SHSP and their properties, hazards and associated required controls will be communicated to all affected staff and subcontractors.

In addition, any employee or organization (contractor or subcontractor) intending to bring any hazardous material onto the site must first provide a copy of the item's Material Safety Data Sheet (MSDS) to the SSHO for review and filing. MSDS may not be available for locally-obtained products, in which case some alternate form of product hazard documentation will be acceptable if so determined by the SSHO, in consultation with the HSM.

All personnel shall be briefed on the hazards of any chemical product they use, and shall be aware of and have access to all MSDS.

All containers on site shall be properly labeled to indicate their contents. Labeling on any containers not intended for single-day, individual use shall contain additional information indicating potential health and safety hazards (flammability, reactivity, etc.).

Attachment D provides copies of MSDS for those items planned to be brought on site at the time this SHSP is prepared. This information will be updated as required during site operations.

6.6 HAZARDOUS, SOLID, OR MUNICIPAL WASTE

If hazardous, solid, and/or municipal wastes are generated during any phase of the project, the waste shall be accumulated, labeled, and disposed of in accordance with applicable Federal, State, Provincial, Territorial and/or local regulations. Consult the PM and/or FSM for further guidance.

6.7 CLIENT SPECIFIC SAFETY REQUIREMENTS

The client has specified no additional health and safety requirements.

6.8 Cabrera HEALTH & SAFETY PROGRAM

Personnel may be exposed to a variety of chemical, physical, and radiological hazards resulting from task or equipment-specific activities. The controls for many of these hazards are discussed in the SOPs found in the Cabrera Radiation Safety Program and Occupational Health & Safety Management System, and copies of the applicable procedures may be found in Attachment A. Below is a list of the applicable SOPs related to the project:

- Radiation Safety Program – California, June 2014
- Radiological Surveys, OP-001
- Radioactive Air Sampling and Analysis, OP-002
- Unconditional Release of Materials from Radiological Control Areas, OP-004
- Use and Control of Radioactive Sources, OP-009
- Decontamination of Radioactivity from Equipment and Tools, OP-018
- Radiological Posting, OP-019
- Operation of Contamination Survey Meters, OP-020
- Alpha-Beta Counting Instrumentation, OP-021
- Personnel Frisking and Decontamination, OP-243
- Incident & Near Miss Reporting, OP-512
- Heat Stress Prevention, OP-563
- Hand & Power Tool Safety, OP-566
- Electrical Safety, OP-567
- Excavation & Trenching, OP-583
- Heavy Equipment Operations, OP-584
- Fall Protection, OP-585
- Utility Clearance & Isolation, OP-589
- Elevated Work Platforms, OP-590

6.9 ACTIVITY HAZARD ANALYSIS

Activity Hazard Analyses (AHAs) have been completed for all tasks identified in the Work Plan:

- Mobilization/Demobilization
- Pre-Excavation Assessment Surveys
- Exploratory Excavation/Backfilling
- Aerial Lift Surveys

As a result of unanticipated work activities or changing conditions, additional AHAs may be required. All additional AHAs will be reviewed and approved by the OHSM.

7.0 SITE CONTROL

7.1 GENERAL

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location, and if required, will be established directly prior to the work being conducted. Diagrams designating specific controlled work areas will be drawn on site maps, posted in the support vehicle or trailer and discussed during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made. General examples of zone layouts have been developed for drilling and earth moving activities (e.g., excavating, trenching, etc.) and are attached to this section.

7.2 CONTROLLED WORK AREAS

Each HAZWOPER controlled work area will consist of the following three zones:

- Exclusion Zone: Contaminated work area.
- Contamination Reduction Zone: Decontamination area.
- Support Zone: Uncontaminated or "clean area" where personnel should not be exposed to hazardous conditions.

Each zone will be periodically monitored in accordance with the air monitoring requirements established in this SHSP. The Exclusion Zone (EZ) and the Contamination Reduction Zone (CRZ) are considered work areas. The Support Zone (SZ) is accessible to the public (e.g., vendors, inspectors).

7.2.1 Exclusion Zone

The Exclusion Zone is the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc. This area must be clearly marked with hazard tape, barricades or cones, or enclosed by fences or ropes. Only personnel involved in work activities, and meeting the requirements specified in the applicable AHA and this SHSP will be allowed in an Exclusion Zone.

The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with sample collection activities.

> **Excavation Activities**. A distance of 50 feet plus the maximum swing radius of the equipment (minimum) will be cleared in all directions from the equipment and the location where the excavated soil is deposited. The cleared area will be sufficient to accommodate movement of necessary equipment and the stockpiling of spoils piles. Vehicles and other hard barriers should be used where applicable to protect employees and public.

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the EZ and CRZ). If such an entry should occur, the trespasser should be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated, as necessary, or containerized as waste prior to leaving (through the CRZ only).

7.2.2 Contamination Reduction Zone

The Contamination Reduction Zone is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination.

7.2.3 Support Zone

The Support Zone is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. The Support Zone shall have minimal potential for significant exposure to contaminants (i.e., background levels) and should be situation up-wind of the EZ.

Employees will establish a Support Zone (if necessary) at the site before the commencement of site activities. The Support Zone would also serve as the entry point for controlling site access.

7.3 SITE ACCESS DOCUMENTATION

If implemented by the PM, all personnel entering the site shall complete the “Site Entry/Exit Log” located at the site trailer or primary site support vehicle.

7.4 SITE SECURITY

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards.
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site.
- Prevent theft.
- Avoid interference with safe working procedures.

To maintain site security during working hours:

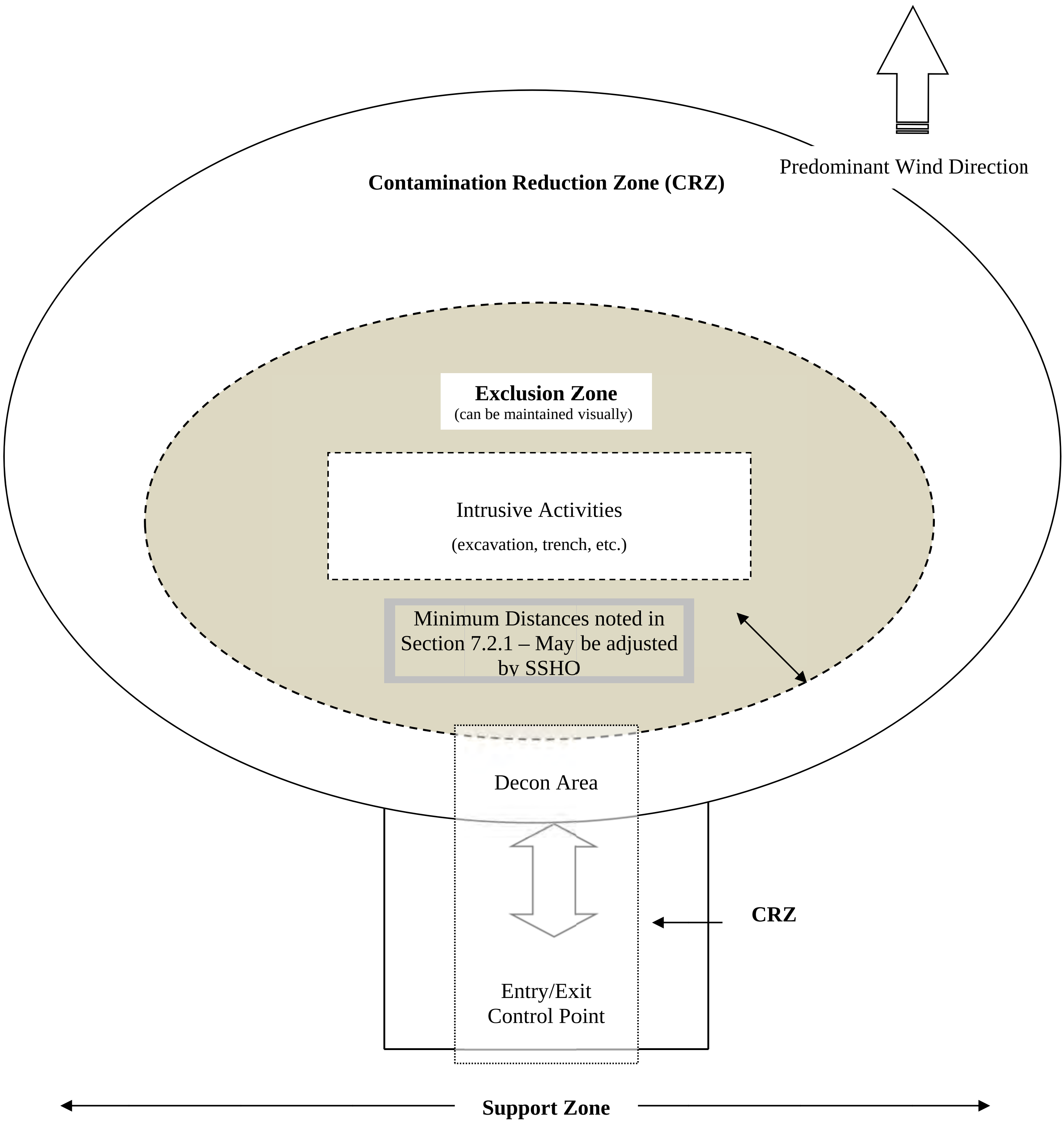
1. Maintain security in the Support Zone and at access control points.
2. Establish an identification system to identify authorized persons and limitations to their approved activities.
3. Assign responsibility for enforcing authority for entry and exit requirements.
4. When feasible, install fencing or other physical barrier around the site.

5. If the site is not fenced, post signs around the perimeter and whenever possible, use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures.
6. Have the PM approve all visitors to the site. Make sure they have valid purpose for entering the site. Have trained site personnel accompany visitors at all times and provide them with the appropriate protective equipment.

To maintain site security during off-duty hours:

1. Secure all equipment, offices, and lock all gates and access point to site.
2. If necessary, use security guards to patrol the site boundary.
3. Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.

Figure 7–1: Typical Site Control Layout



8.0 PERSONAL PROTECTIVE EQUIPMENT & DECONTAMINATION

8.1 PERSONAL PROTECTIVE EQUIPMENT

The purpose of personal protective equipment (PPE) is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. *OP-561, Personal Protective Equipment* lists the general requirements for selection and usage of PPE. Table 8-1 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual AHAs.

By signing the acknowledgment form of this SHSP, the employee agrees having been trained in the use, limitations, care and maintenance of the PPE to be used at the project site. If training has not been provided, employees are to inform the SSHO before signing.

Table 8-1: Personal Protective Equipment

TYPE	MATERIAL	ADDITIONAL INFORMATION
Minimum PPE		
Safety Vest	ANSI Type II high-visibility	Must have reflective tape/be visible from all sides
Boots	Leather	ANSI approved safety toe
Safety Glasses		ANSI Approved; ≥98% UV protection
Hard Hat		ANSI Approved; recommended wide-brim
Work Uniform		No shorts/cutoff jeans or sleeveless shirts
Additional PPE:		
Hearing Protection	Ear plugs and/ or muffs	In hazardous noise areas
Leather Gloves		If working with sharp objects or powered equipment.
Protective Chemical Gloves	Nitrile	During handling of all potential COC impacted media.
Protective Chemical Coveralls	Tyvek	For use where contact potential with COC impacted media exists.
Protective Chemical Boots	Rubber Overbooties or dedicated rubber boots	For use where contact potential with COC impacted media exists.
Level C Respiratory Protection	MSA (Full Face or equivalent) equipped with GME/P100	Upgrade based on air monitoring requirements established in Section 5.0.
Sunscreen	SPF 30 or higher	
Fall Protection	Harness, lanyard	ANSI approved; to be worn when working from elevated platform

8.2 PPE DOFFING AND DONNING (UTILIZATION) INFORMATION

The following information is to provide field personnel with helpful hints that, when applied, make donning and doffing of PPE a more safe and manageable task:

- Never cut disposable booties from your feet with basic utility knives as this may result in unintended lacerations to skin. Use a pair of safety scissors or other approved cutting device (cut above and parallel with the work boot) to start a cut in the edge of the booty, then proceed by manually tearing the material down to the sole of the booty for easy removal.

- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Have a "buddy" check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.
- Never perform personal decontamination with a pressure washer.

8.3 DECONTAMINATION

8.3.1 General Requirements

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the Exclusion Zone (EZ).

All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the Support Zone (SZ).

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable Material Safety Data Sheet (MSDS) must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored and disposed of in accordance with site-specific requirements determined by site management.

8.3.2 Personal/Equipment Decontamination

All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE, support devices (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

Personnel decontamination should consist of the following glove removal procedure:

1. For Overbootie Removal
   - Grasp top of overbootie and roll downward (inside out)
   - Using gloved hands, place booties in receptacle
2. For Suit Removal
   - Unzip suit and remove arms, turning inside-out
   - Slide suit down, over waist
   - Slide suit downward over legs, and step out
   - Using gloved hands, grasp inside of suit, and place in receptacle.
3. For Glove removal:
   - Grasp the cuff of the dominant hand and pull glove over the bulk of the hand, leaving the fingers inside the glove.
   - Use the dominant hand to grasp the cuff of the non-dominant hand and pull the glove completely off (inside-out) and place inside of the dominant hand glove.
   - Once removed, employee should only touch the inside material of the dominant hand glove.
   - Thoroughly wash hands.
4. For APR Removal
   - Remove cartridges and place in receptacle
   - Loosen straps, grasp back strap and face piece, and doff mask
   - Decon mask and hang to dry

All employees who are expected to don respiratory protection must have successfully passed a qualitative or quantitative fit-test within the past year for the brand, model and size respirator they plan to don. If worn, respirators will be cleaned after each use with respirator wipe pads and will be stored in plastic bags after cleaning. Respirators will be thoroughly cleaned using disinfectant material within one week following any respirator use. Refer to the cleaning instructions provided with the respirator or specified in the OSHA regulations at 29 CFR 1910.134.

8.3.3 Equipment Decontamination

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
- Hoses, buckets of water or garden sprayers for rinsing;

- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
- Metal or plastic cans or drums for the temporary storage of contaminated liquids; and
- Paper or cloth towels for drying.

For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination. Before heavy equipment and trucks are taken offsite, the FSM and/or SSHO will visually inspect them for signs of contamination. If contamination is present, the equipment must be decontaminated

For equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in EZ.
2. Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
3. Rinse equipment.
4. Visually inspect for remaining contamination.
5. Follow appropriate personal decontamination steps outlined above.

All decontaminated equipment shall be visually inspected for contamination prior to leaving the Contaminant Reduction Zone (CRZ). Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

9.0 EMERGENCY RESPONSE PLANNING

9.1 EMERGENCY ACTION PLAN

Although the potential for an emergency to occur is remote, an emergency action plan has been prepared for this project should such critical situations arise. The primary type of onsite emergency that may occur is physical injury or illness to a member of the Cabrera team. The Emergency Action Plan (EAP) will be reviewed by all personnel prior to the start of field activities. A test of the EAP will be performed within the first three (3) days of the project field operations. This test will be evaluated and documented in the project records.

Three major categories of emergencies could occur during site operations:

1. Illnesses and physical injuries (including injury-causing chemical exposure)
2. Catastrophic events (fire, explosion, earthquake, or chemical)
3. Workplace Violence, Bomb Threat
4. Safety equipment problems

9.1.1 Emergency Coordinator

The duties of the Emergency Coordinator (EC) include:

- Implement the EAP based on the identified emergency condition
- Notify the appropriate project and safety personnel of the emergency (Table 9-3)
- Verify emergency evacuation routes and muster points are accessible
- Conduct routine EAP drills and evaluate compliance with the EAP

9.1.2 Site-Specific Emergency Procedures

Prior to the start of site operations, the EC will complete Table 9-1 with any site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

Table 9-1: Emergency Planning

Emergency	Evacuation Route	Muster Location
Chemical Spill	Upwind [at least 300 feet]	On 46th Street near the guard shack at the entrance to the RFS property
Fire/Explosion	Along the site access road (northwest)	On 46th Street near the guard shack at the entrance to the RFS property
Tornado/Severe Weather	Along the site access road (northwest)	On 46th Street near the guard shack at the entrance to the RFS property
Lightning	Along the site access road (northwest)	Vehicle
Additional Information		
Communication Procedures	Direct verbal communications. Must be supplemented when voices cannot be clearly perceived above ambient noise levels and when a clear line-of-sight cannot be maintained. Cabrera personnel will bring a mobile phone to the site to ensure that communications with local emergency responders is maintained, when necessary.	
CPR/First Aid Trained Personnel	TBD	
Site-Specific Spill Response Procedures	Chemicals brought onsite will be limited to fuel for vehicles and small quantities of laboratory preservatives. In the event of a minor spill, sorbent material will be placed on the spill and then transferred to a container for disposal. Field personnel will immediately notify the FSM who in turn will notify the PM.	

9.2 SPILL CONTAINMENT PROCEDURE

Work activities may involve the use of hazardous materials (i.e. fuels, solvents) or work involving drums or other containers. If anything beyond these procedures are required, a site specific spill reporting card/procedure must be developed for the site. Procedures outlined below will be used to prevent or contain spills:

- All hazardous material will be stored in appropriate containers
- Tops/lids will be placed back on containers after use.
- Containers of hazardous materials will be stored appropriately away from moving equipment.

At least one spill response kit, to include an appropriate empty container, materials to allow for booming or diking the area to minimize the size of the spill, and appropriate clean-up material (i.e. speedy dri) shall be available at each work site (more as needed).

- All hazardous commodities in use (i.e. fuels) shall be properly labeled.
- Containers shall only be lifted using equipment specifically manufactured for that purpose.
- Drums/containers will be secured and handled in a manner which minimizes spillage and reduces the risk of musculoskeletal injuries.

9.2.1 Environmental Spill/Release Reporting

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported to the FSM and PM. In determining whether a spill or release must be reported to a regulatory agency, the FSM will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, applicable regulatory permit, and/or client-specific reporting procedures.

9.3 SAFETY ACCIDENT/INCIDENT REPORTING

All accidents and incidents that occur on-site during any field activity will be promptly reported to the SSHO and FSM immediately, per accordance with Cabrera's incident reporting procedures. For all life threatening and medical emergencies, dial 911 and/or refer to the emergency hospital directions/route. For all non-life threatening emergencies, the OHSM must be contacted for discussion prior to visiting the prescribed occupational clinic.

A draft copy of the Cabrera Incident Report will be provided to the OHSM before the end of the shift, and a final copy with all required supporting documentation with 48 hours. Client specific reporting procedures and reporting timeframes must also be completed in conjunction with internal requirements. All accidents/incidents will be investigated to determine root cause, and corrective action, in an effort to prevent any possible reoccurrence.

If any employee of a subcontractor is injured, documentation of the incident will be accomplished in accordance with the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the SSHO within 48 hours after the accident has occurred. Copies of all subcontractor incident investigations will be provided to the SSHO within five (5) days of the accident/incident.

Table 9-2: Emergency Contacts

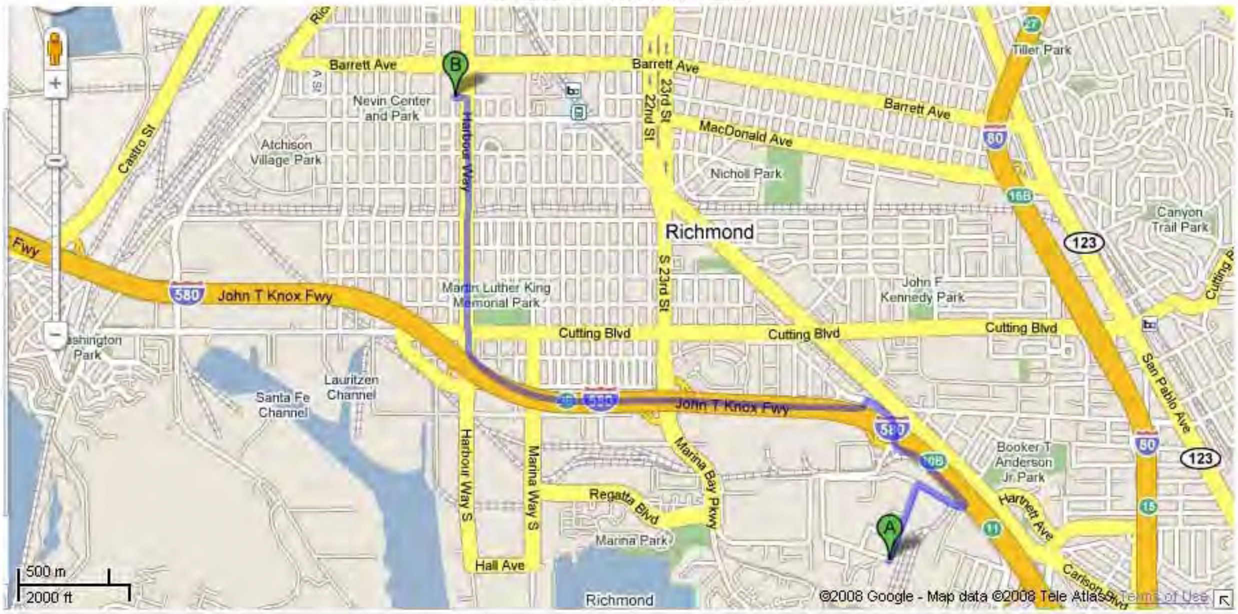
Emergency Coordinators / Key Personnel			
Name	**Title/Workstation**	**Telephone Number**	**Mobile Phone**
Karl Hans	Client Contact	510-643-9574	N/A
Carolyn Mac Kenzie	UCB Radiation Safety Officer	510-643-7976	925-876-9375
Tony Mason	Project Manager	435-604-0174	435-655-1009
TBD	Field Site Manager	N/A	N/A
TBD	Site Safety & Health Officer	N/A	N/A
Sean Liddy, CSP	Health & Safety Manager	410-982-0726	443-553-1403
N/A	HzM/DG Shipping Expert	N/A	N/A

Organization / Agency	
Name	**Telephone Number**
Police Department (local)	911 or (510) 620-6655
Fire Department (local)	911 or (510) 307-8031
Ambulance Service ***(EMT will determine appropriate hospital for treatment)***	911 or (510) 307-1558
Emergency Hospital ***(Use by site personnel is for emergency {911} cases only)*** Kaiser Permanente, Richmond 901 Nevin Avenue Richmond, California	Emergency - (510) 307-1566/ (510) 307-1555
Emergency Hospital Route: See Figure 9-1	
Poison Control Center	(800) 222-1222
National Response Center	(800) 424-8802
CHEMTREC	(800) 424-9300
RCRA, Superfund &EPCRA Hotline	(800) 424-9346

Public Utilities	
Name	**Telephone Number**
USA North 811	811

Figure 9-1: Emergency Hospital Route/Detail Map

EMERGENCY INFORMATION
POST ON SITE



A: **Richmond Field Station**
B: **Kaiser Hospital**

Route to Hospital:

1. Head northeast on S 46th St toward Meade St/Seaver Ave 0.3 mi
2. Turn right at Meade St/Seaver Ave 0.2 mi
3. Slight left at S 47th St 69 ft
4. Turn left at Meade St 0.3 mi
5. Turn right at Erlandson St/Syndicate Ave (signs for I-580 W/San Rafael) Continue to follow Erlandson St 0.2 mi
6. Turn left to merge onto I-580 W 1.0 mi
7. Take exit 9B for Harbour Way N 0.4 mi
8. Merge onto S Harbor Way/Harbour Way S (signs for Cutting Blvd/Downtown) Continue to follow Harbour Way S 0.9 mi
9. Turn left at Nevin Ave

Destination will be on the right 230 ft

SOURCE: MODIFIED FROM http://maps.google.com/

Note: This sheet must be posted on site

Figure 9-2: Occupational Clinic Route/Detail Map

1301 S 46th St

Richmond, CA 94804

Get on I-80 E from S 46th St, Meade St, Bayview Ave and Carlson Blvd

1.7 mi / 4 min

Follow I-80 E to Hilltop Dr. Take the exit toward Hilltop Mall-Auto Plaza from I-80 E

4.8 mi / 5 min

Continue on Hilltop Dr. Drive to Hilltop Mall Rd

0.8 mi / 2 min

11. Turn left onto Hilltop Dr

0.6 mi

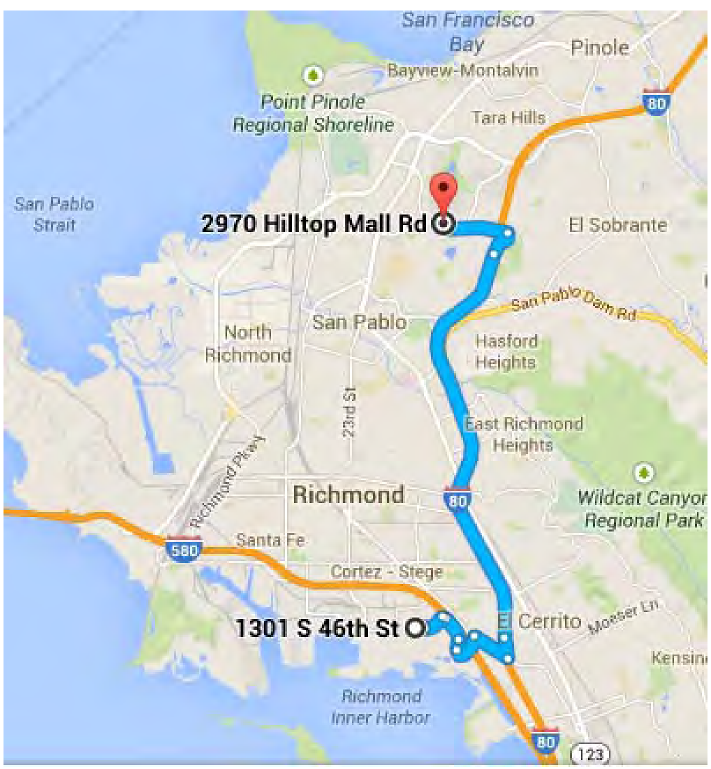
12. Turn right onto Shane Dr

0.1 mi

13. Turn left onto Hilltop Mall Rd

184 ft

2970 Hilltop Mall Rd



10.0 PERSONNEL ACKNOWLEDGEMENT

By signing below, the undersigned acknowledges that he/she has read and reviewed the Cabrera Site Health & Safety Plan for the Richmond Field Station site. The undersigned also acknowledges that he/she has been instructed in the contents of this document and understands the information pertaining to the specified work, and will comply with the provisions contained therein.

PRINT NAME	SIGNATURE	ORGANIZATION	DATE

Attachment A

Cabrera Occupational H&S Management System/Procedures

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

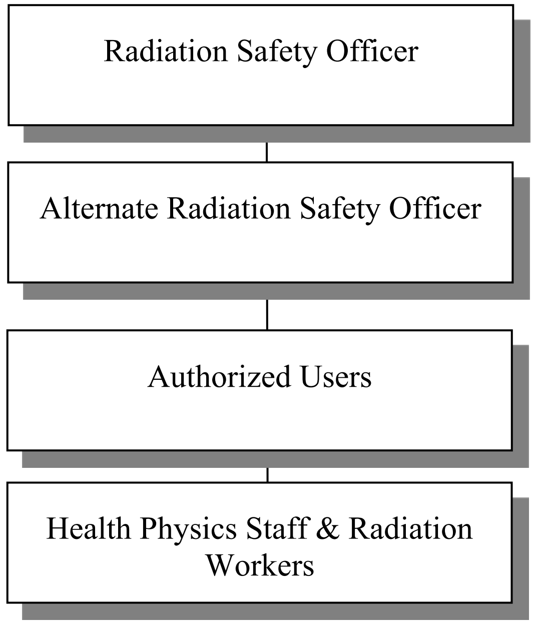


Figure 1. Cabrera Services, Inc. Radiation Safety Program Organizational Chart

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:

8.5 $\varepsilon_T = \varepsilon_i * \varepsilon_S$ 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.

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

RADIOLOGICAL SURVEYS

OP-001

Revision 3.0

Reviewed by:

David Wunsch

David Wunsch, Quality Assurance Manager

4/8/13

Date

Approved by:

Henry W. Siegrist

Henry Siegrist, CHP, PE, Radiation Safety Officer

4/8/13

Date

1.0 PURPOSE

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

2.0 APPLICABILITY

2.1 This procedure provides the requirements and general guidelines for identifying, scheduling, and performing routine, radiation, contamination, and airborne surveys by radiation safety personnel. Remediation and facility areas that are radiologically controlled (restricted areas) due to the potential for fixed or transferable contamination are considered for routine survey performance.

2.2 The following types of surveys may be performed using this procedure:

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

2.3 This procedure does not include survey requirements for radiation generating devices and survey requirements specified in radiation work permits (RWPs).

2.4 Approved work plans may require more or fewer surveys and controls to be applied at the site than described in this procedure.

3.0 DEFINITIONS

3.1 Radiological Control/Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

3.2 Contamination Survey – A survey technique to determine fixed and removable radioactive contamination on components and facilities.

3.3 Radiation Survey – 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.

3.4 As Low As Reasonably Achievable (ALARA) – An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as the technical, economical and practical considerations permit.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Instruments used to perform routine surveys should be operated in accordance with the respective operating procedures or manufacturer's recommendations.

4.1.2 Large area smears (LAS) may be used to augment (but not replace) the one hundred square centimeter (100 $cm^{2)}$ smear survey. LAS may be counted with a Ludlum Model 3 and 44-9 probe or Ludlum Model 2224-1 and 43-93 probe or equivalent. LAS are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing smears on an item easily identified as contaminated.

4.1.3 Personnel performing routine surveys must be logged in on a RWP in accordance with AP-012, *Radiation Work Permits* (if applicable).

4.1.4 Audible response instruments should be used during direct scan surveys.

4.1.5 The instruments used for routine surveys must be within current calibration and must have had a performance test check performed daily, or before use, in accordance with the instrument's operating procedure.

4.2 Limitations

4.2.1 The maximum probe speed during direct scan surveys of surfaces must be 3 centimeters per second (cm/sec).

4.2.2 The probe face must be held within ¼ inch of the surface being surveyed for alpha radiation, and within ½ inch of the surface being surveyed for beta-gamma radiation.

4.2.3 If an instrument used to perform routine surveys fails operational checks, it will be removed from service. Data collected during the period of instrument failure must be evaluated by the Radiation Safety Officer (RSO) or duly authorized representative.

4.2.4 Posting of radiological control areas must be performed in accordance with OP-019, *Radiological Posting*.

4.3 Requirements

4.3.1 Individuals performing surveys will obtain and review any previous surveys performed in the area, or on the object, to determine radiation conditions that may be encountered.

4.3.2 Only qualified individuals will perform surveys. Qualification will be determined on a case-by-case basis by the Project Manager, Radiation Safety Officer or their duly authorized representative. Qualification considers prior training, experience, and certifications such as Radiation Protection Technician or National Registry of Radiation Protection Technologists.

4.3.3 Survey samples must be analyzed in a low-background area, whenever practical, to ensure achieving the required sensitivity of measurements.

4.3.4 At a minimum, dose rate surveys must be performed in locations where workers are exposed to radiation levels that might result in: radiation doses in excess of 10% of the occupational dose limits – or – where an individual is working in a dose rate area of 2.0 millirem per hour (mrem/hr), or more.

4.3.5 Prevent access to unrestricted areas if contamination is found and immediately notify the RSO or duly authorized representative.

5.0 EQUIPMENT

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

5.2 Instruments used to perform routine surveys will be used in accordance with the applicable CABRERA administrative and operational procedures.

5.3 Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments; although equipment counting efficiencies may be determined by qualified CABRERA personnel.

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) - The PM is responsible for ensuring that personnel assigned the task of performing routine surveys are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

6.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in performing radiation and contamination surveys. The RSO can also assist in the interpretation of the results obtained during surveys.

6.3 Site Radiation Safety Lead (SRSL) - During field assignments, the SRSL is responsible for ensuring that this procedure is implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technicians (RPT) - The RPT performing radiation and contamination surveys are responsible for understanding and complying with this procedure.

7.0 PROCEDURE

7.1 Safety Considerations

The safety requirements specified in the job specific Health and Safety Plans (HASPs) and work plans, the Radiation Safety Program (RSP), and other safety documentation must be adhered to when performing surveys.

7.2 Initial Preparations

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

7.2.1 Obtain appropriate survey instruments and assure daily quality control (QC) checks have been performed prior to instrument use.

7.2.2 Obtain necessary forms, smears, and protective clothing, which will be used during the survey.

7.2.3 Plan any strategy for performing the survey before entering the area to reduce exposure time within the area.

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

7.3 Radiation Surveys

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

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

- Scan the entire surface area of the area, item, or container with a Micro-R or equivalent meter and record locations and readings on the Survey Form, in Attachment B, or an equivalent form.

- Measure the exposure rate at 30 centimeters from all surfaces or sides of the area, item, or container and record the location and readings on the Survey Form, in Attachment B, or an equivalent.
- Large waste containers used for shipment of bulk quantities of soil debris etc., may have a single dose rate measurement per accessible side of the container for ALARA purposes. DOT regulations may require additional dose rate measurements prior to shipping which is not covered by this procedure. Note readings on the Survey Form or an equivalent.

7.3.3 Facility Surveys – This survey technique may be used to release facilities (buildings, etc.) to "unrestricted" status or to determine the status of facilities requiring decontamination and decommissioning. Final release of a facility will be established using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance.

- Establish a 1 meter by 1 meter grid system [or another work plan-approved grid] for the facility surfaces and use a marking system that assigns a unique number/letter to the center of each grid section. Graphically illustrate the location of the grid system on the Survey Form, in Attachment B, or an equivalent.
- Using a Micro-R Meter or equivalent obtain radiation levels at 1 meter from the grid center point and at contact with the grid center point. Record the reading on the Survey Form, in Attachment B, or an equivalent. If elevated readings are noted, scan the surface of the grid and note the location of any elevated readings with a marker on the form.
- Obtain Micro-R or equivalent readings from locations surrounding the facility, or within the facility, which do not contain activity. This establishes a background level for comparison to the reading taken above.

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

- Establish a 10 meter by 10 meter grid system of the area to be surveyed [or another approved grid as provided by the work plan] using surveyor stakes or equivalent, which are numbered with a unique number/letter to identify the center of each grid. List the locations of the "gridded" system on the Survey Form or an equivalent.
- Using a Micro-R meter or equivalent, obtain radiation levels at 1 meter above the ground surface in the center of the grid. Record all readings on the Survey Form or an equivalent.

- Survey the remainder of the grid at the surface using an "S" pattern for the instrument. If elevated readings are noted above or below the grid center point reading, subdivide the grid into additional sub-grids and obtain readings at 1 meter above the ground surface. Record all readings on the Survey Form or an equivalent.

7.4 Contamination Surveys

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

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

- If the area, item, or container contains alpha activity, scan the area with an alpha probe at ¼ inch above the surface. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent.
- If the area, item, or container contains beta activity, scan the area with a beta probe at approximately ½ inch above the surface to be surveyed and obtain reading following meter stabilization. Record meter reading on the Survey Form or an equivalent. The surface of a container can only be directly surveyed for beta activity if the radiation level from the container does not significantly elevate the beta probe background. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent.
- Provide transferable smear contamination survey on the area, item or container by performing 100 cm^2 smears, at routine intervals, on the subject area, item, or container.
- Large waste containers used for shipment of bulk quantities of material will have one or more contact readings taken at routine intervals on the accessible sides of the container. Note total (fixed plus transferable) contamination readings on the Survey Form or an equivalent. **Note:** DOT regulations may require additional survey points.
- For large waste containers used for shipment of bulk quantities of material for disposal (or other large items such as soil moving equipment), determine the transferable surface contamination by taking LAS. Use Masslinn cloth or equivalent material to obtain a

LAS representative of the potentially contaminated area. Count the LAS, in a low background area, using alpha and beta detection equipment. If no transferable contamination above limits is found on the LAS, take several confirmatory 100 cm^2 smears at routine intervals on the object and count smears for alpha and beta activity. Record results on the Survey Form or an equivalent. **Note:** DOT regulations may require additional survey points.

Note: The presence of activity above transferable limits on a LAS signifies potential contamination. Determine actions to be taken with the RSO or SRSL.

7.4.3 Facility Surveys – This survey technique is used to aid in the release of facilities (buildings etc.) to "unrestricted" status or determine status of facilities requiring decontamination and decommissioning. Final release of a facility will be established using MARSSIM guidance.

- The grid system established in Section 7.3.3 will also be utilized for contamination surveys.
- Hold the beta probe at approximately ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on the Survey Form or an equivalent.
- If the readings are at background levels, randomly scan the remainder of the grid, concentrating on cracks, floor/wall joints, top of horizontal surfaces, ventilation ducts and grills, and other areas that might collect radioactive materials. Mark any locations above the release criteria on the Survey Form or an equivalent.
- If readings are at or near the release levels, scan grid surface and identify the portion of the grid that is above the release criteria. Note these areas on the survey form and mark the area of the grid with spray marker (or equivalent) on the Survey Form or an equivalent. Repeat steps 8.3.4 with an alpha probe at ¼ inch above the grid center point. If sufficient documentation of previous history is known about the facility and contamination is known not to be present, the alpha survey may not be required.
- One smear sample from a 100 cm^2 area will be taken in each grid. If the above survey found no elevated readings in the grid, the smear sample will be taken in the center of the grid. If elevated levels readings are identified the smear sample will be taken from the area where the highest reading was obtained.
- Each smear sample will be labeled with the grid location and counted for alpha and beta activity in the sample counter. The smear sample results will be recorded on the Survey Form or an equivalent.

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

- The grid system established in Section 7.3.4 will be utilized for contamination surveys.
- Hold the beta probe at ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on the Survey Form or an equivalent.
- If readings are at background levels, randomly scan the remainder of the grid. Mark any locations above release criteria on the Survey Form or an equivalent.
- If readings are at or near the release levels scan the grid surface and identify portion of the grid that is above release criteria. Note these areas on the Survey Form or an equivalent.
- Areas contaminated with radioactive materials may require soil sample analysis to determine the activity concentration. The quantity and location of samples will be determined on a case-by-case basis.

7.5 Frequency and Requirements for Routine Surveys

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

7.5.1 Radiation Surveys

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

7.5.2 Contamination Surveys

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

7.5.3 Airborne Surveys

Airborne survey frequency, locations, and methods are determined by the RWPs and by the RSO/SRSL.

7.6 Identifying and Scheduling Routine Radiological Surveys

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

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

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

Type of Survey

• Radiation	R
• Contamination	C
• Area TLD	T
• Air Sample	A

Example: DRC-1
Where:

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

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

7.6.4 Routine Survey Schedules should be indicated on form in Attachment A or an equivalent. Task Leaders may elect alternate methods of determining the information contained on the Routine Survey Schedule.

7.7 Using ALARA Principles for Scheduling and Performing Surveys

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

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

7.8 Performance of Routine Surveys

7.8.1 RPTs and qualified individuals will perform routine surveys in accordance with the applicable operational procedure.

7.8.2 Upon completion of a routine survey, the RPT will initial and date the appropriate Survey Form.

7.9 Periodic Evaluation of Routine Surveys

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

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

7.10 Management Notification

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

8.0 REFERENCES

- Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, Subpart E,*Radiological Criteria for License Termination*
- Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, Subpart F,*Surveys and Monitoring*
- Title 10, Code of Federal Regulations, Part 20.2103, *Records of Surveys*
- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- AP-010, *Personnel Protective Equipment Used Within Radiological Controlled Areas*, Cabrera Services Inc., Operating Procedure
- AP-012, *Radiation Work Permits*, Cabrera Services Inc., Operating Procedure
- OP-019, *Radiological Posting*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-021, *Alpha-Beta Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-022, *Operation of Ionization Chambers* , Cabrera Services Inc., Operating Procedure
- OP-023, *Operation of Micro-R Meters*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

9.1 Survey records should include the following, at a minimum:

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

9.2 Routine Survey Schedule

9.3 Survey Form

10.0 ATTACHMENTS

- Attachment A – Routine Survey Schedule
- Attachment B – Survey Form

Attachment A

Routine Survey Schedule

Routine Survey Schedule

Survey Designation	Location of Survey

Prepared By: ______________________________ Date: ____________

Reviewed By: ______________________________ Date: ____________

Attachment B

Survey Form

Survey Form

Location: Site:	RWP#	Survey #	Survey Type:	pg. 1 of __

Smear (CPM/100 cm^2) Direct Count (CPM/Direct Frisk)						circle one
No.	α	β	No.	α	β	
1			26			
2			27			
3			28			
4			29			
5			30			
6			31			
7			32			
8			33			
9			34			
10			35			
11			36			
12			37			
13			38			
14			39			
15			40			
16			41			
17			42			
18			43			
19			44			
20			45			
21			46			
22			47			
23			48			
24			49			
25			50			

Comments	Surveyed By:	Date:	Instrument	Serial #	α Eff.	β Eff.	α Bkg.	β Bkg	γ Bkg	Cal. Due		Key	
												■	A/S Location
												-	Boundary
												○	Smear
												□	Dose Rate _______ /hr
	Reviewed By:	Date:										*	Direct Reading CPM/direct frisk
												△	Grab Sample

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

RADIOACTIVE AIR SAMPLING AND ANALYSIS

OP-002

REVISION 1.0

Reviewed by:

4/12/2013

David Wunsch, Quality Assurance Manager | Date

Approved by:

Henry Siegrist 4/12/2013

Henry Siegrist, CHP, PE, Radiation Safety Officer | Date

1.0 PURPOSE

This procedure provides the methods Cabrera Services Inc. (CABRERA) uses in the operation of air samplers and the calculation of radioactive particulate activity in air samples. This procedure describes the methods used to calculate Derived Air Concentration (DAC)-hour exposures to workers. Adherence to this procedure will provide a reasonable assurance that the surveys performed have accurate and reproducible results.

2.0 APPLICABILITY

This procedure will be used by CABRERA personnel to operate air samplers during surveys and work activities at customer facilities as well as calculate and record DAC-hour exposures to workers.

Air samples are considered when the alpha and beta contamination on facility surfaces, equipment and waste packages exceed the contamination limits specified in Table 1 of the Radiation Safety Program (RSP) and included as Attachment C of this procedure. Air monitoring will be performed in areas where there exists potential to exceed 10 percent (%) of any radionuclide DAC.

3.0 DEFINITIONS

3.1 Restricted Area – An area where access is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted areas do not include areas used as residential quarters, but separate rooms in a residential building may be set apart as restricted areas.

3.2 Smear Sample Survey – A survey technique using filter paper smears to determine quantities of alpha and beta emitting radioactive material which can be removed from facility surfaces and waste packages.

3.3 Air Sample Survey – A survey technique which collects particulates from a known volume of air and determines the concentrations of radioactive materials associate with airborne particles.

3.4 Annual Limit on Intake (ALI) – The ALI of radioactive materials is the smaller amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year (40 hours per work week for 50 weeks) that would result in a committed effective dose equivalent (CEDE) of 5 rem (0.05 Sievert [Sv]) or a committed dose equivalent (CDE) of 50 rem (0.5 Sv) to any individual organ or tissue.

3.5 Derived Air Concentration (DAC) – DAC is the concentration of a given radionuclide in air which, if breathed by “reference man” for a working year (40 hours per week for 50 weeks) under the conditions of light work (inhalation rate of 1.2 cubic meters of air per hour), results in an air intake of one ALI.

3.6 DAC-hour – The product of the concentration of radioactive material in air, expressed as a multiple of the DAC for each nuclide, and the time of exposure to that nuclide in hours; 2,000 DAC-hours represents one ALI.

3.7 Airborne Radioactivity Area – A room, enclosure, or area in which the radioactive material is dispersed in the form of dusts, fumes, mists, particulates, or vapors, and the concentration of the dispersed radioactive material is in excess of:

- The DACs specified in Table 1 Column 3 of Appendix B, Title 10, Code of Federal Regulations, Part 20 (10 CFR 20), 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% of the ALI, or 12 DAC-hours.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Air samples run at altitudes in excess of 5,000 feet need to consider pressure adjustments for altitude and recorded flow-meter readings.

4.1.2 Air sample media will tear if the filter comes into contact with water. Outdoor sampling requires special consideration to ensure an effective sample is obtained.

4.2 Limitations

Air samplers should only be operated in temperatures between -4^0 F to 122^0F.

4.3 Requirements

4.3.1 Air sampler inspections will be performed by qualified Health Physics personnel.

4.3.2 The alpha and beta counter used to count air samples will be calibrated daily with a known radioactive source with activity traceable to the National Institute of Standards and Technology (NIST).

4.3.3 Radiation Protection Technologists (RPTs) performing air sampling and analysis will review all applicable forms for accuracy and completeness. Entries on all pertinent forms must be dated and initialed, by the RPT performing the air sampling and analysis, to be valid.

4.3.4 The RSO or duly authorized representative will review any applicable completed forms for accuracy and completeness.

5.0 EQUIPMENT

- Low volume general area sampler: LV-1
- High volume air sampler: HI-Q
- Personal Breathing zone samplers: BZ

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensuring that personnel assigned the task of air sampling and air analysis know and understand this procedure and are adequately trained with the specific instrument(s) being used to perform surveys.

6.2 Radiation Safety Officer (RSO) – Monitoring compliance with this procedure and training personnel in the use of the air sampling and air sampling analysis equipment. The RSO can also assist in the interpretation of the results obtained during surveys.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is the RSO's duly authorized representative for radiological issues when the RSO is not onsite, and is responsible for ensuring that this procedure is properly implemented.

6.4 Radiation Protection Technician(s) (RPT) – The RPT(s) performing air sampling and air sampling analysis are responsible for knowing, understanding and complying with this procedure.

7.0 PROCEDURE

7.1 Initial Preparation

7.1.1 Select the air sampler to be used, for the type of sample to be used, and verify that the instrument has a currently valid calibration. If the work area contains radioiodine or tritium, contact the RSO for special sampling procedures before proceeding.

- Area air samples are collected with a low volume air sampler (LV-1) having airflow capability of 20 to 100 liters per minute (LPM) and are routinely set at 80 LPM.
- Area air samples are collected with high volume air samplers (HI-Q) having airflow capability of 10 to 50 cubic feet per minute (CFM) and are routinely set at 15 to 40 CFM, depending upon the filter size used.
- Breathing zone (BZ) air samples are normally collected using BZ, or lapel air samplers, which have an airflow capability of 1 to 5 LPM

and are calibrated and set at 4 LPM for radiological air sampling. **Note:** Settings should not be changed.

- All air sampling devices will be calibrated to ensure accurate sample volumes are collected. The frequency of calibration will not exceed one (1) year.

7.1.2 Attach the air sampling head to the intake of the low volume sample pump or to the Tygon tubing of the lapel sampler.

7.1.3 Obtain the filter paper, to be used in the sample, and mark the back side of the filter with a unique number or mark, to represent the clean side of the filter. During the collection and handling of air sample filter papers, caution must be used to prevent the samples from being cross-contaminated by radioactive materials.

7.1.4 Place the filter paper in the holder and position the sampler, as indicated below.

- Area air samples are collected by placing the sample head at a distance of 3 to 6 feet above the floor and as close to the work area, as practical. If there is airflow in the work area, the sampler should be placed “downwind” of the area where there is the greatest potential for radioactive material to be suspended in air.
- BZ/lapel air samples are collected from the workers breathing zone. The sample head is attached to the shoulder of the worker with the sample head facing forward. The sample head will be no further than 12” from the breathing zone. The Tygon tubing connecting the sample head to the pump is run down the back of the worker with the sample pump attached to the workers belt.

7.2 Collecting the sample

7.2.1 When the sample head with filter is in position, start the low volume or high volume sample pump and adjust the flow rate to the highest practical flow rate that can be maintained without flow rate fluctuations. BZ/lapel air samplers are not to be adjusted but rather be left at the calibration setting of 4 LPM following manufacturer maximum recommended flow rates.

7.2.2 Record the time the sample was started and the initial flow rate of the sample pump on Attachment A, Air Sample Data Sheet. Approved electronic templates may be used in place of this form as long as the equivalent information is provided, as described in this procedure.

7.2.3 If possible, identify the radionuclides, which will be encountered in the work area and record the radionuclides along with the DAC for each radionuclide in the space provided on the Air Sample Data Sheet. If a mixture of radionuclides is present, the DAC used in the calculations of

DAC-hours will be the most restrictive concentration.

7.2.4 Collect the sample for the maximum time possible, which represents the exposure encountered by the worker.

7.2.5 At the end of the collection period, note the flow rate of the sample pump and record this flow rate and the time, which the sampling stopped on the Air Sample Data Sheet. Collection times must be sufficient to achieve required MDA/MDCs for the radioisotope(s) of concern.

CAUTION: Be sure not to remove activity from the sample surface. Handle the filter with care (tweezers should be used if possible).

7.2.1 Remove the sample filter and place the filter in an individual envelope or poly bag to ensure no possibility of contamination by other sources of radioactivity.

7.2.2 Record the names of workers who were in the area and the time spent in the work area on the Daily Air Sample Record, in Attachment B. Approved electronic templates may be used in place of this form as long as the equivalent information is provided, as described in this procedure.

7.2.3 Determine the average sample flow rate by adding the initial sample flow rate and the final sample flow rate and dividing by 2. Record the average flow sample flow rate in the space provided on the Air Sample Data Sheet.

7.2.4 Calculate the total air volume sampled by multiplying the average flow rate in cubic centimeters per minute by the total minutes the sampler operated using the indicated spaces on the Air Sample Data Sheet.

7.3 Determining Minimum Detectable Activity (MDA) – During calculations or air concentrations in the following sections, the MDA for each analysis is calculated to determine the statistical significance of the calculated air concentrations.

7.3.1 For each air concentration calculation (alpha and beta) in the following sections, calculate the MDA using the following formula:

$$MDA\ in\ \mu Ci/cm^3 = \frac{\frac{k_\alpha^2}{T_{s+b}} + 2\left[k_\alpha\right]\sqrt{\frac{R_b}{T_b} + \frac{R_b}{T_{s+b}}}}{(2.22\times 10^6)(E)(V)}$$

Where:

E = Counter efficiency in CPM/DPM

R_b = Background Count Rate in CPM

T_b = Background Counting Time in Minutes

T_{s+b} = Sample Counting Time in Minutes

V = Sample Volume in cm^3

$2.22X10^6$ = Disintegrations per minute per microCurie (DPM/μCi)

k_α = 1.645 for a confidence level of 95% and 1.96 for a confidence level of 99%

7.3.2 If the MDA is larger than 10% of the DAC, recount the background for a longer time and/or increase the sample count time to lower the MDA. (The maximum count time should not exceed 1 hour for background and 30 minutes for the sample). Enter the MDA for each air concentration calculated in the space provided on the Air Sample Data Sheet.

7.4 Initial Air Sample Analysis – The initial analysis of air samples provides the air concentrations for short-lived radionuclides and a first estimate of the long-lived air concentrations. In situations where there is a potential for worker intakes to exceed 40 DAC-hours in a week, or if the radionuclides of interest are short-lived, air sample results should be available before work resumes the following day.

7.4.1 Air particulate samples are to be analyzed, at a minimum, for gross alpha and gross beta activity using a Ludlum Model 2929 Dual Channel Scaler or equivalent.

7.4.2 Place the air sample collection media in the sample counter with the upstream collection side toward the detector. Count the air sample and calculate the sample activity and record results on appropriate form(s).

7.4.3 Record the alpha and beta sample DPM results in the Air Sample Data Sheet.

7.4.4 Calculate the alpha and beta air concentrations using the following formula. Adjustments due to alpha self-absorption are made, as appropriate.

$$\text{Air Concentration } (\mu Ci/cc) = \frac{\alpha \text{ or } \beta\ DPM}{(2.22\times10^{6}\ DPM/\mu Ci)(SampleVolume(cm^3))}$$

7.4.5 Enter the alpha and beta air concentrations on the Air Sample Data Sheet in the space provided for the initial air concentrations.

<u>Note</u>: If air sample concentration is greater than 10% of the DAC value, notify the RSO or duly authorized representative for further instructions.

7.4.6 If the air concentration is less than 10% of the most restrictive DAC, no further analysis of the air sample is required. If the air concentration exceeds 10% of the DAC concentration, proceed with the analysis in section 7.5.

7.5 Air sample analysis for long-lived radionuclides – This analysis allows for decay of naturally occurring radionuclides and provides for correcting air concentrations for naturally occurring radionuclides.

7.5.1 Particulate samples will be analyzed for gross alpha and gross beta following a 30-minute delay to account for radon decay, and again at 4 hours, if necessary, to allow for further decay using a Ludlum Model 2929 Dual Channel Scaler or equivalent.

7.5.2 Place the air sample in the sample counter with the collection side toward the detector. Count the air sample and calculate the sample activity and record results on appropriate form(s).

7.5.3 Record the alpha and beta sample DPM results in the Air Sample Data Sheet.

7.5.4 Calculate the alpha and beta air concentrations using the following formula. Adjustments due to self-absorption are made as appropriate.

$$\text{Air Concentration } (\mu Ci / cc) = \frac{\alpha \text{ or } \beta \text{ } DPM}{(2.22 \times 10^{6} \text{ } DPM / \mu Ci)(SampleVolume(cm^3))}$$

7.5.5 Enter the alpha and beta air concentrations, on the Air Sample Data Sheet, in the space provided. If the 30-minute decay air concentration is below 10% of the DAC, no further analysis is required.

7.5.6 If the 30-minute air concentration is above 10% of the DAC value, recount the air sample following 4 hours of decay from the time the sample was stopped. Calculate the air concentration using the formula in step 7.5.4 and record the air concentrations in the space provided for the 4-hour decay air concentration on the Air Sample Data Sheet.

- If the 4-hour air concentration is below 10% of the DAC value, no further analysis is required.
- If the concentrations are above 10% of the DAC value, recount after 24 hours and document on the Air Sample Data Sheet.
- If the air concentrations exceed 10% of the DAC values, notify the RSO or duly authorized representative for further instructions. Save the air sample for possible further analysis.
- For air samples, which exceed 10% of the DAC values, an exposure is assigned to the workers residing in the area where the sample was taken.

7.6 Assignment of DAC-hour exposures to workers

7.6.1 For air samples which exceed 10% of the DAC values, calculate the workers DAC-hour exposure using the following formula:

$$\text{Exposure in DAC-hours} = \frac{A \times B}{C}$$

Where:

A = Area or Lapel air sample concentration in microCurie per cubic centimeter (μCi/cm$^{3)}$

B = Hours worker was in the calculated air concentration

C = DAC air concentration in μCi/cm^3 from regulatory reference.

7.6.2 Enter the DAC-hour exposure on the column provided on the Air Sample Data Sheet. If respiratory protection was used during the exposure period, contact the RSO or duly authorized representative for the protection factor used to adjust DAC-hour exposure.

8.0 REFERENCES

- Title 10, Code of Federal Regulations, Part 20, *Standards for Protection Against Radiation*.
- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-021, *Alpha-Beta Sample Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, *Air Sampling in the Workplace*, Regulatory Guide 8.25, (1992).
- U.S. Nuclear Regulatory Commission, Consolidated Guidance About Material Licenses, *Vol.11 - Program-Specific Guidance About Licenses of Broad Scope*, NUREG-1556, (1999).
- CABRERA Effluent Monitoring Work Instruction, Pohakuloa Training Center, PTA-W1-001, 02 December 2010

9.0 REQUIRED RECORDS

- Air Sample Data Sheet (written or electronic)
- Daily Air Sample Record (written or electronic)

10.0 ATTACHMENTS

- Attachment A – Air Sample Data Sheet
- Attachment B – Daily Air Sample Record
- Attachment C – Contamination Limits

Attachment A

Air Sample Data Sheet

Air Sample Data Sheet

Sample # ____________________ Date _____________________

Description: ____

Radionuclides: ______________________ DAC value: __________________________

______________________ DAC value: __________________________

______________________ DAC value: __________________________

Initial sample flow rate: ______________ Time sampler on: ______________________

Final sample flow rate: ______________ Time sampler off: ______________________

Average sample flow rate: ___________ Total sample time:_________________ hours

Total sample volume: _______________ cm^3

30 min Air Concentration:

Alpha = _____________ μCi α/cm^3 Beta = ____________ μCi β/cm^3

MDA = _____________ μCi α/cm^3 MDA = ____________ μCi β/cm^3

4 Hour Decay Air Concentration:

Alpha = _____________ μCi α/cm^3 Beta = ____________ μCi β/cm^3

MDA = _____________ μCi α/cm^3 MDA = ____________ μCi β/cm^3

24 Hour Decay Concentration:

Alpha = _____________ μCi α/cm^3 Beta = ____________ μCi β/cm^3

MDA = _____________ μCi α/cm^3 MDA = ____________ μCi β/cm^3

Attachment B

Daily Air Sample Record

Daily Air Sample Record

Worker Name	**Sample Date**	**Count Date**	**Time In**	**Time out**	**Total time (Hrs.)**	**Concentration ($\mu Ci/cm^3$)**	**DAC-Hour Exposure**

Attachment C

Contamination Limits

Contamination Limits from Table 1 of RSP

RADIONUCLIDE	ALLOWABLE SURFACE CONTAMINATION ($DPM/100\ CM^2$)	
	REMOVABLE	FIXED + REMOVABLE
Transuranics, Ra-226, Ra-228, Th-230, 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	5000
Beta-Gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	1000	5000

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

UNCONDITIONAL RELEASE OF MATERIALS FROM RADIOLOGICAL CONTROL AREA

OP-004

REVISION 2.0

Reviewed by:

4/12/13

David Wunsch, Quality Assurance Manager — Date

Approved by:

Henry Siegrist — 4/12/2013

Henry Siegrist, CHP, PE, Radiation Safety Officer — Date

1.0 PURPOSE

The purpose of this procedure is to specify requirements for releasing surface contaminated material and equipment from Radiological Controlled Areas (RCA) under Cabrera Services Inc (CABRERA) control. This procedure sets forth the requirements for release of these items from controlled areas at CABRERA project field sites.

2.0 APPLICABILITY

2.1 This procedure provides instructions for CABRERA field personnel for performing release surveys of items controlled as contaminated or potentially contaminated with radioactive materials.

2.2 Using these survey techniques, the procedure ensures that materials released from contaminated or potentially contaminated areas will meet the release criteria applicable to the license conditions, facility requirements, or in specified regulations/guidance required by regulatory agencies of the federal or state government.

2.3 Release of large items, such as waste containers used to ship bulk quantities of soil and waste for disposal, are further covered by the CABRERA procedure OP-001, *Radiological Surveys*.

2.4 Sealed check sources having activity less than listed in Schedule B, of 10 CFR 30.71 (Title 10 of the Code of Federal Regulations Part 30.71), are considered exempt quantities and are not covered by this procedure.

3.0 DEFINITIONS AND ABBREVIATIONS

3.1 Activity – The rate of disintegration (transformation) or decay of radioactive material. The units of activity for the purpose of this procedure are Becquerel (Bq) or microCuries (μCi).

3.2 Contamination – Deposition of radioactive material in any place where it is not desired. Contamination may be due to the presence of alpha particle, beta particle or gamma ray emitting radionuclides.

3.3 Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

3.4 Fixed Contamination – Radioactive contamination that is not readily removed from a surface, by applying light to moderate pressure, when wiping with a paper or cloth disk smear or Masslinn.

3.5 Minimum Detectable Activity (MDA) – For purposes of this procedure, MDA for removable radioactive contamination is defined as the smallest amount of sample activity that will yield a net count, with a 95% confidence level, based upon the background count rate of the counting instrument used.

3.6 Release for Unconditional Use – A level of radioactive material below which an item/object is determined to be acceptable for use without restrictions. Under normal circumstances, authorized limits for residual radioactive material are set equal to, or below, the values specified in NRC Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*.

3.7 Survey – 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.

3.8 Survey Exempt Materials – Prior to leaving a RCA, all materials that exit must be surveyed. Items exempt from this rule are those that remain enclosed, in a sealed container, while in the RCA. Although its contents are exempt, the container must still be surveyed. For example, if a flashlight is used in a RCA, the exterior of the flashlight must be surveyed. However, the batteries are considered survey exempt materials if they were kept enclosed, in the sealed casing, and did not contact radiological material.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Ensure that all instruments used to perform release surveys are operated in accordance with their respective operating procedure or the manufacturer’s operating manual.

4.1.2 Large area smears (LAS) may be used to augment (but not replace) the 100 square centimeters (cm^2) smear survey. The LAS may be counted with the Ludlum Model-3 and 44-9 probe or Ludlum 2224-1 and 43-93 probe or equivalent. LAS are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing smears on an item easily identified as contaminated.

4.1.3 A document package, for equipment/items that are unconditionally released, should include the following:

- Radiological Survey Form for radiation or contamination surveys.
- Unconditional Release of Equipment and Items Log.
- Daily instrument quality control (QC).
- Any calculations or templates used to determine the total and transferable surface contamination levels.

4.1.4 The release documents should contain the following information:

- Completed Radiological Survey Forms with the date of the survey.
- Description or identification of the item(s).
- The release approval of the Radiation Safety Officer (RSO) or their duly authorized representative.

4.1.5 Ensure that radiation/contamination surveys are performed in accordance with OP-001, *Radiological Surveys*.

4.1.6 Ensure that items identified as radioactive, during the release survey, are controlled in accordance with OP-019, *Radiological Posting*.

4.1.7 Ensure that personnel performing release surveys are logged in on a Radiation Work Permit, in accordance with AP-012, *Radiation Work Permits* (if applicable).

4.1.8 Ensure that instruments used for release surveys are within current calibration and will have a response check performed daily, or before use, in accordance with the instrument's operating procedure or manufacturer's operating manual.

4.1.9 Ensure that items presented for release are direct scanned in an area of low background.

4.2 Limitations

4.2.1 The maximum probe speed, during direct scan surveys of surfaces, will be 3 centimeters per second (cm/sec).

4.2.2 The probe face will be held within: ¼ inch of the surface being surveyed for alpha radiation; and, ½ inch of the surface being surveyed for beta-gamma radiation.

4.2.3 During direct radiation scans, the meter probe will be held at the proper distance with allowance for the meter reading to stabilize.

4.2.4 If an instrument used to perform release surveys fails any operational checks, it will be removed from service. Data collected, during the period of instrument failure, must be evaluated by the RSO or duly authorized representative.

4.3 Requirements

4.3.1 Audible response instruments must be used during direct scan surveys.

4.3.2 Instrumentation used for surveys will be checked each day, prior to use, with standards and verified to have current valid calibration.

4.3.3 When releasing a large volume of materials, a program may be established, under the discretion of the RSO or their duly authorized representative, to ensure by second check that no radioactive material has been released to the public or the environment.

4.3.4 Surveys performed for the release of material will be documented on a Radiation and Contamination Survey and/or on an Unconditional Release of Equipment or Items Survey (see Attachment A).

4.3.5 The Radiation Protection Technician (RPT) performing the survey will review the Unconditional Release of Equipment and Items Log and all other applicable forms for accuracy and completeness.

4.3.6 Entries on Unconditional Release of Equipment and Items Log and all other pertinent forms must be dated and initialed, by the RPT performing the survey, to be valid.

5.0 EQUIPMENT

There is no special equipment required for this procedure.

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Responsible for ensuring that personnel assigned the task of surveying materials know this procedure, are adequately trained in its use, and have ready access to a copy.

6.2 Radiation Safety Officer (RSO) – Responsible for verifying that personnel are trained in the use of contamination survey meters, described in this procedure, and comply with procedure requirements. The RSO or their duly authorized representative (a) reviews all applicable forms for accuracy and completeness and (b) signs/dates the release approval documentation.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technician (RPT) – Responsible for performing the surveys described in this procedure. The RPT performing the survey will review the Unconditional Release of Equipment and Items Log, and all other applicable forms, for accuracy and completeness. The RPT ensures the use of the most current, approved version of these documents.

7.0 PROCEDURE

7.1 Release Limits for Gross Activity (Unknown Isotopes)

Exhibit 1: Release limits from NRC Regulatory Guide 1.86

EMISSION	REMOVABLE (dpm/100 cm$^{2)}$)[1]	TOTAL[2] (dpm/100 cm$^{2)}$)
Alpha	20	100
Beta-Gamma	200	1000

[1] dpm/100 cm^2 = disintegrations per minute per 100 square centimeters
[2] fixed and removable

Note: If **all** of the constituents of the contamination are known **and** documented on the release documents, the applicable release limits are derived from Table 1 of the NRC Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*.

7.2 Inaccessible Surfaces

7.2.1 Items with inaccessible internal surfaces should be disassembled, as completely as possible, to facilitate release surveys. Items with inaccessible surfaces will not be unconditionally released unless evaluated by the RSO, the duly authorized representative, or a designated evaluator who must authorize and document the release.

7.2.2 The following guidance will be used when performing evaluations for equipment/items with inaccessible surfaces:

- Review the history of the item and where it was used.
- Review the actual release survey.
- Review the determination of the radiological conditions in the area the item has been used or stored.
- Consider the use of gamma radiation sensitive detectors such as Sodium Iodide (Thallium activated) [NaI(TI)] or its equivalent. **Note:** These detectors may indicate internal contamination that a beta sensitive detector may not detect. This is due to the beta detector's lack of sensitivity to photon emissions, as well as the inability of beta emissions to penetrate through many surfaces.

7.2.3 Equipment, which has internal combustion engines, is not readily disassembled. Airborne data, equipment running time, and survey of motor air filters provide sufficient information to make a determination of potential internal contamination.

7.3 Materials considered dangerous, fragile, or not readily smearable – due to their physical or chemical nature – will not be unconditionally released unless evaluated, on a case-by-case basis, in a manner consistent with Section 7.2.2. Evaluation for release will be performed **only** by a designated evaluator who must authorize and document the release.

7.4 Survey Exempt Materials

Writing implements, flashlights and other small personal items brought into and used in contaminated areas will be surveyed by frisking, when leaving a controlled area, in the same manner as a personnel whole body frisk. Items defined as survey exempt materials (see Section 3.8) do not require frisking to be released.

7.5 Survey and Action Levels

7.5.1 Upon receipt of an item presented for release, attempt to determine the history:

- Its purpose,
- Current and past use,
- Location(s) the item was used or stored (contaminated or airborne area),
- Whether it was ever used for work with radioactive material or used in an area where radioactive material was used or stored.

Note: This knowledge of the item history should provide the surveyor with information helpful in performing the release survey.

7.5.2 Perform radiological surveys using protective clothing (e.g., gloves) if loose contamination is suspected, in accordance with OP-001.

- Perform a direct scan of all accessible areas of the item and determine the total and transferable (loose) radioactive material present, in accordance with OP-001.
- If the presence of radioactive contamination is indicated at levels exceeding Regulatory Guide 1.86 (or Section 7.1 above for unknown isotopes), the item or material is considered contaminated and will not be released until it is decontaminated. Control these materials in accordance with OP-019.

Note: Items presented for release will be direct scanned in an area of low background (≤ 100 counts per minute) when practical. The RPTs performing release surveys will determine if the background is acceptable for direct scan of the item.

7.5.3 If the direct radiation scan indicates radioactive material on the surface of the item is less than the limits of release for total activity, proceed to 7.5.5.

7.5.4 If the scan indicates radioactive material on the surface is greater than regulatory limits for total activity, the item cannot be unconditionally released until it is decontaminated.

7.5.5 Perform sufficient 100 cm^2 smears on the item to ensure that the contamination survey is representative of the item's surface area. OP-001 provides further guidance on large waste containers (also refer to Section 4.1.2).

7.5.6 Count and document the smear results in compliance with OP-001 and OP-021, *Alpha-Beta Counting Instrumentation*.

- Record smear(s) data on the radiological Survey Form.
- Determine transferable contamination levels.

- If the smear results indicate transferable activity below the release limits, proceed to step 7.5.7.
- If the smear results indicate transferable activity above the release limits, the item cannot be released until it is decontaminated.

7.5.7 If the item has internal or inaccessible surfaces, CABRERA personnel will disassemble the item and either (a) repeat Steps 7.5.2 through 7.5.6 or (b) have the item evaluated for release by a designated evaluator who has sufficient knowledge to perform radiological surveys on items presenting difficult geometries.

7.5.8 If the item meets the release limits or is evaluated as meeting the unconditional release criteria, complete the Unconditional Release of Equipment and Items Log. The RSO or their duly authorized representative should review the release documents and approve release before allowing an item(s) to leave the controlled area.

7.5.9 If items are identified as radioactive during the release survey, contact the RSO or their duly authorized representative as soon as possible.

7.5.10 Any vehicle or container, with removable contamination exceeding the Department of Transportation limits, will be brought to the attention of the RSO or their duly authorized representative for release or acceptance approval, as appropriate.

7.5.11 Dose rate surveys, which exceed 0.2 micro-Roentgens per hour, will be brought to the attention of the RSO or their duly authorized representative for release or acceptance approval, as appropriate.

7.6 The results of either radiation or contamination surveys will be documented on a Radiological Survey Forms.

8.0 REFERENCES

- Title 10, Code of Federal Regulations, Part 20, *Standards for Protection Against Radiation*.
- AP-010, *Personnel Protective Equipment Used Within Radiological Control Areas*, Cabrera Services Inc., Operating Procedure
- AP-012, *Radiation Work Permits*, Cabrera Services Inc., Operating Procedure
- AP-016, *Radioactive Material Tracking*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-009, *Use and Control of Radioactive Check Sources*, Cabrera

Services Inc., Operating Procedure

- OP-019, *Radiological Posting*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-021, *Alpha-Beta Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-023, *Operation of Micro-R Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, Consolidated Guidance About Material Licenses, *Vol.11 - Program-Specific Guidance About Licenses of Broad Scope*, NUREG-1556, (1999).
- U.S. Nuclear Regulatory Commission, *Termination of Operating Licenses for Nuclear Reactors*. Regulatory Guide 1.86, (1974).

9.0 REQUIRED RECORDS

- Unconditional Release of Equipment and Items Log
- Radiation and contamination surveys on Radiological Survey Forms
- Daily instrument QC documentation (e.g., logs/forms)
- Any calculations or templates used to determine the total and transferable surface contamination levels.

10.0 ATTACHMENTS

Attachment A - Unconditional Release of Equipment and Items Log

Attachment A

Unconditional Release of Equipment and Items Log

UNCONDITIONAL RELEASE OF EQUIPMENT AND ITEMS LOG

Project Name ________________________________Project Number______________

Item/ Equipment Released	Comments	Survey #	Surveyor Initials	Date

Reviewed By: ________________________________ Date: _________

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

USE AND CONTROL OF RADIOACTIVE SOURCES

OP-009

REVISION 1.0

Prepared/Reviewed by:

4/12/2013

David Wunsch, Quality Assurance Manager

Date

Approved by:

Henry Siegrist

Henry Siegrist, CHP, PE, Radiation Safety Officer

4/12/2013

Date

1.0 PURPOSE

This procedure describes methods for control of instrument check sources and the methods used by Cabrera Services Inc. (CABRERA) to evaluate sources for the potential of leaking radioactive material. These sources are used to ensure proper radiation detection instrument operation.

2.0 APPLICABILITY

2.1 This procedure will be used by Cabrera personnel for use and control of radioactive sources used for portable radiation detectors and will also be used when leak testing licensed radioactive sources, as defined in the Cabrera NRC License, and other RSO requested source leak testing.

2.2 Adherence to this procedure will provide reasonable assurance that: personnel exposures will be below specified limits; sources will not be lost or misplaced; personnel will remain free of contamination; and, contamination will not be spread beyond any designated contaminated areas. In addition, it will provide a reasonable assurance that leak testing, of radioactive sources, meets the requirements of Title 10, Code of Federal Regulations, Part 20 (10 CFR 20) and Cabrera's NRC license.

3.0 DEFINITIONS

3.1 Restricted Area – An area, to which access is limited by the licensee, for protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted areas do not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

3.2 Leak Test – A survey technique used to determine the presence of removable activity from the surface of a sealed source.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 When performing a leak test on licensed-quantity sources, use specific license procedures.

4.1.2 If licensed-quantity sources are being inspected, the RSO or duly authorized representative will determine any additional precautions (e.g., finger rings, etc.).

4.1.3 Sealed sources of activity may exhibit high dose rates. Ensure that a thorough dose rate survey has been performed documented prior to beginning any leak test evaluation.

4.1.4 The window area of an alpha-beta detector may be covered with a thin window and may be easily punctured. Avoid surveying areas which have protruding fragments that may puncture the detector face. Remove the protruding fragments, if possible, before surveying. Upon removal of the leak test sample, analyze the sample away from the source. If the sample yields a high-count rate compared to background, assume the source to be leaking and provide appropriate controls to limit contamination spread.

4.2 Limitations

4.2.1 Storage location(s) of radioactive sources will be approved by the RSO, or duly authorized representative, for protection against loss, leakage, or dispersion by the effect of fire or water.

4.2.2 This procedure does not apply to pure gamma emitters not emitting alpha or beta particles – contact the RSO for guidance.

4.2.3 A Radiation Work Permit (RWP) must be generated for leak testing of non-exempt sources or sources exceeding contact dose rates of 100 mrem/hr gamma or 1,000 millirad/hr beta. For instructions on how to generate an RWP refer to AP-012.

4.3 Requirements

4.3.1 Individual source quantities shall not result in exceeding license limits.

4.3.2 The methods specified in this procedure will be reviewed annually to ensure compliance with the requirements of the CABRERA NRC License to measure leakage from sealed radioactive sources.

4.3.3 The leak test shall be capable of detecting the presence of 0.005 microcuries of removable activity to comply with the NRC requirements of the CABRERA Radioactive Material License.

4.3.4 Ensure accountability and direct control of sources at all times when unlocked and in use. Minimize the number of people in the area of the source during the leak test to reduce exposure and maintain work areas as low as is reasonably achievable (ALARA). If high radiation area controls are necessary, the source must either be locked or guarded.

4.3.5 Only qualified CABRERA Radiation Worker personnel may use or have possession of CABRERA radioactive sources.

4.3.6 Only CABRERA NRC Material License Authorized Users or CABRERA Designees as provided for by written authorization may provide leak tests on licensed radioactive sources.

4.3.7 The quality of leak test analyses is dependent upon the quality of the wipe and the quality of analysis. Periodic evaluation of the process and analysis methods shall be conducted to ensure appropriate methods are used and this procedure is followed.

4.3.8 The RSO or duly authorized representative shall review completed forms for accuracy and completeness.

5.0 EQUIPMENT

- Ludlum 2929 or equivalent
- Remote smear handling assembly
- Liquid cleaner (if recommended by source manufacturer)
- Smears
- Portable radiation detection equipment
- Calibration sources

6.0 RESPONSIBILITIES

6.1 Radiation Safety Officer (RSO) – Responsible for verifying that personnel comply with this procedure and are trained with respect to radioactive source use, as described in this procedure. The RSO ensures that CABRERA personnel performing this procedure are qualified by training and experience to perform its requirements.

6.2 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues. The CABRERA NRC Material License Authorized User or Designee conducting leak tests of licensed radioactive sealed sources is responsible to comply with the provisions of this procedure

6.3 Radiation Protection Technician (RPT) – Responsible for the control and use of exempt radioactive check sources.

7.0 PROCEDURE

7.1 Action Levels

7.1.1 Source Inventory

- A physical source Inventory is conducted at intervals not exceeding six months. The RSO or duly authorized representative shall be notified immediately if it has been determined that a source is missing and an immediate search shall be conducted. Loss of licensed radioactive sources may require NRC notification by the RSO.

- The RSO shall be immediately notified of any new radioactive sources controlled or purchased by CABRERA projects. Such sources include both exempt and non-exempt sources.

7.1.2 Source Leak Tests

- Sealed sources shall be tested for leakage at intervals not to exceed that specified on the certificate of registration issued by the NRC under 10 CFR 32.210 or equivalent regulations of an Agreement State.
- Sealed sources designed to primarily emit alpha particles shall be tested for leakage at intervals not to exceed 3 months.
- In the absence of a certificate from a transferor indicating that a leak test has been made within the interval specified by the NRC, a leak test will be performed by CABRERA personnel prior to putting a non-exempt source into use.
- Sealed sources need not be tested if they contain only tritium; only a radioactive gas; have a half-life of less than 30 days; or contain no more than 100 microcuries of beta-gamma or 10 microcuries of alpha emitting material. Sealed sources not being used and that are in storage do not need a leak test. However a leak test must be performed prior to transferring the source to another person. No source shall go untested for a period of more than 10 years.

7.1.3 Source Leakage

If a source is suspected to have lost its integrity, the RSO or duly authorized representative shall be notified immediately and a leak test shall be performed.

7.1.4 Storage Area Radiation Levels

Radiation levels shall be maintained at less than 2 millirem per hour (mrem/hr) on any accessible surface where the radioactive sources are stored. Notify the RSO or duly authorized representative if radiation levels exceed 2 mrem/hr.

7.2 Inventory List

The inventory list will be reviewed/updated at least once every six months, or whenever a new source is received or a source is disposed of to ensure inventory records are updated. Prior to disposing of a source, approval should be obtained from CABRERA's Corporate RSO. The results shall be recorded on the Source Inventory form (Attachment A), or equivalent, and shall be retained in the project files as well within the corporate source file for a period of not less than five years.

7.3 Storage

Radioactive sources and licensed radioactive sources will be stored in fire resistant containers when not in use. Such containers will be used at the worksite and for routine storage of the sources at CABRERA offices.

7.4 Leak Test Initial Preparations

7.4.1 Select a work area free of radioactive contamination to conduct the leak test.

7.4.2 Select instruments that have a Minimum Detectable Activity (MDA) capable of detecting at least 0.005 microcuries (μCi) of the radionuclide of concern.

7.4.3 If a wet wipe test is anticipated, prepare distilled water in a container, as appropriate, for the source being tested. Specific solutions may be mentioned in vendor documentation. If they are, use the solutions required by the vendor.

Caution: Do not directly smear unsealed sources, such as depleted uranium plates or fragile mylar windows covering sources. Rather, smear the areas around such sources, such as the holder and container or box holding such sources.

7.4.4 Inform the RSO or duly authorized representative of the source to be leak tested. The RSO or duly authorized representative will evaluate the test and may provide additional precautionary measures to ensure protection of people and equipment in the work area.

Caution: Do not touch or get extremely close to an exposed source of high specific activity. Sealed sources of high specific activity may cause high contact dose rates, resulting in high shallow dose equivalents to the extremities.

7.4.5 Use remote means to smear the outside surface of the source, using cloth or paper, for any high activity sources as described by the cautionary note. This smear will be the leak test sample that is analyzed for activity associated with a potentially leaking source. Wipe the outside surfaces of the source, up to and including, a total area of 100 cm^2.

7.4.6 Be cautious when handling leak test samples in order to prevent the spread of contamination, should the sample have loose radioactivity on it from a leaking source.

7.4.7 Minimize the time period conducting the leak test. In a well-planned test, the exposure time will be short.

7.4.8 If the source emits particle radiation, a very thin window will typically cover the radioactive material. Take special precautions to prevent damage to the window during leak testing.

7.4.9 Wear rubber or latex gloves when handling the leak test samples or equipment associated with the test.

7.5 Smear Analysis Using a Portable Instrumentation Probe

To maintain the calibrated detection efficiency, the detector probe must be held at the appropriate height, determined using calibration, when counting a leak test smear. This generally means ½ inches or less for alpha and low energy beta particles.

7.6 Smear Analysis Using Alpha-Beta Sample Counting Equipment

The leak test sample shall be analyzed by a method, which will ensure detection of at least 0.005 μCi of the radionuclide of interest. Existing CABRERA procedures and templates shall be used as practical to ensure appropriate analysis and documentation of results.

Note: If the activity estimation determines the leak test sample to be in excess of the leak test limit of 0.005 microcuries, then label the source as unusable to prevent further spread of activity. Conduct a detailed survey of the leak test work area to ensure that activity from the source has not spread beyond the capsule of the source and immediately contact the RSO.

7.7 Performing Leak Tests

7.7.1 Leak tests are performed on licensed radioactive sources received in the field prior to use. A leak test may also be performed on exempt quantity sealed sources, in the event a source is suspected of having a loss of encapsulation or other possible leakage.

7.7.2 A visual inspection of the source shall be made for physical damage. If an area of the source is noticeably damaged, perform the leak test in that area.

7.7.3 Determine the extent of source leakage by one of the following methods:

- Dry Wipe Test – This test will be performed on encapsulated sources or adjacent surfaces of plated or foil sources. The sources shall be wiped with a dry disc smear applying moderate pressure. (**Note**: Never wipe the surface of a plated or foil source.) Removal of any radioactive materials from the source or adjacent surfaces (i.e., source leakage) will be determined by counting the filter paper with appropriate instrumentation.

- Wet Wipe Test – This test will be performed on encapsulated sources only. The entire surface of the source shall be wiped with a disc smear moistened with distilled water, applying moderate pressure. Removal of any radioactive material from the source will be determined by counting the filter paper with appropriate instrumentation after the filter paper has dried out.

7.7.4 When any contamination or leak test reveals the presence of 0.005 μCi or greater of removable contamination, the source shall be retested.

The source will be either repaired, if possible, or disposed of as radioactive waste if the second test is unsatisfactory. The results of leak tests for the sources are recorded on the Source Leak Test Data Sheet (Attachment B) and shall be retained for a minimum of five years.

7.8 Source Storage Area Survey

The on-contact radiation level exterior to the location where the sources are stored shall be maintained at less than 2 mrem/hr on any accessible surface. A radiation survey of the storage location shall be performed at least quarterly and after the receipt of any additional sources.

8.0 REFERENCES

- AP-012, *Radiation Work Permits*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-021, *Alpha-Beta Sample Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-022, *Operation of Ionization Chambers*, Cabrera Services Inc., Operating Procedure
- OP-023, *Operation of Micro-R Survey Meters,* Cabrera Services Inc., Operating Procedure
- OP-187, Records Management, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, Consolidated Guidance About Material Licenses, *Vol.11 - Program-Specific Guidance About Licenses of Broad Scope*, NUREG-1556, (1999).

9.0 REQUIRED RECORDS

9.1 The RSO or duly authorized representative prepares and maintains a source file which shall, at a minimum, consist of the following:

- Procurement history of each source, including copies of seller certification;
- Status change (damage, sale or transfer, disposal, or recalibration);
- Completed "Source Inventory" Form; and,
- Any other correspondence related to the sources.

9.2 Records of leak tests shall be kept in units of microCuries (uCi) and shall be maintained for five years.

10.0 ATTACHMENTS

Attachment A – Source Inventory

Attachment B – Sealed Source Leak Test Data Sheet

Attachment A
Source Inventory

SOURCE INVENTORY

Radionuclide	Undecayed Activity, μCi)	Serial Number/Bar Code	Date of Inventory	Location of Source	Performed by (initials) Date of inventory

Comments____
____
____

Date Performed: ______________________ Reviewed by: __________________________________

Attachment B
Source Leak Test Data Sheet

Source Leak Test Data Sheet

Source Information Source ID Number____________

Source Manufacturer: ____________________________ Date of Assay: _______________

Source Model Number: ______________________ Source Serial #_______________

Activity of Source at Assay Date: ________ microcuries Source Today: _______ microcuries

Radionuclide name: ____________________________ Half-life of radionuclide__________

Leak Test Sample Information

Location of Leak Test Work Area ____

Describe the method of leak testing: ____

Instrument/Serial Number: ____

Detector/Serial Number: ______________________ Calibration Due Date: _______________

Alpha Detection Efficiency: ________ c/d Beta Detection Efficiency _______c/d

Background count time: _______ min.

Background alpha counts _____ Background beta counts _________

Alpha MDA: ___________microcuries Beta MDA: ________microcuries
(MUST BE LESS THAN 0.005 microcuries)

Sample total alpha counts___________ Sample Total beta counts: ______________

Sample count time: ________ min.

Leak test sample activity: _________microcuries alpha _________microcuries beta

Leak Test Result – Check all boxes that apply

- ❑ The leak test sample is in excess of the 0.005 microcuries alpha or beta limit
- ❑ The leak test sample is below the 0.005 microcuries limit
- ❑ The source has been controlled to prevent the spread of activity.

Source Leak Test Performed by: _____________________________ Date: _____________

Leak Test Analysis Conducted by: ___________________________ Date: _____________

Radiation Safety Officer: ___________________________________ Date: _____________

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

DECONTAMINATION OF RADIOACTIVITY FROM EQUIPMENT AND TOOLS

OP-018

REVISION 1.0

Reviewed by:

4/12/13

David Wunsch, Quality Assurance Manager — Date

Approved by:

Henry Siegrist — 4/12/2013

Henry Siegrist, CHP, PE, Radiation Safety Officer — Date

1.0 PURPOSE

This procedure establishes the requirements for decontamination of equipment, material, and tools used at Cabrera Services Inc., (CABRERA) field projects that become contaminated with radioactive material.

2.0 APPLICABILITY

This document applies to all CABRERA personnel involved in the decontamination. Each decontamination operation is unique; thus, this procedure provides general, effective decontamination techniques and guidelines to be used by CABRERA field personnel.

3.0 DEFINITIONS

3.1 Decontamination – The processes whereby contamination can be safely and effectively removed from equipment tools and materials.

3.2 Herculite – Herculite is a brand name plastic or polyethylene floor covering and containment material used for decontamination operations.

3.3 Material Safety Data Sheet (MSDS) – Sheets providing information and limitations about chemicals and products that is issued by the manufacturer.

3.4 Radiation Work Permit (RWP) – A document generated by Health Physics to provide:

- A description and scope of the work to be performed;
- Existing radiological conditions in the work area;
- Limitations placed upon the scope of work;
- Maximum radiological limits allowed;
- Measures to be employed to protect the worker(s); and
- Special instructions to workers and RPT personnel for the work to be performed.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Decontamination of contaminated tools or equipment will be performed under the direction of an RPT. The RPT will provide direction in accordance with this procedure, and the RWP.

4.1.2 Decontamination activities will be performed within a controlled area.

4.1.3 Controls to contain the spread of loose contamination, during the decontamination activity, will be planned and established prior to the decontamination of equipment, material, and tools.

4.2 Limitations

4.2.1 This procedure may not be applicable or readily applied to decontaminating surfaces composed of porous materials such as wood or concrete. It is therefore not the preferred operating procedure for decontaminating building surfaces.

4.2.2 Protective clothing worn, by the personnel involved in decontamination activities, will be determined in accordance with the RWP.

4.2.3 Decontamination cleaning solvent/solutions will only be used in accordance with the directions and limitations listed on the manufacturer supplied MSDS.

4.2.4 Respiratory protection devices, required by the RWP for decontamination operations, will be selected and used in accordance with the provisions of CABRERA procedure AP-006.

4.3 Requirements

4.3.1 Instrumentation used in the surveys will be checked with standards daily and verified to have current calibration records.

4.3.2 A pre-job briefing will be held to instruct RPTs and other personnel of the conditions of the RWP. All personnel performing work in the decontamination work area will sign the RWP prior to work.

4.3.3 Radiation and contamination surveys will be performed in accordance with the provisions of CABRERA procedure OP-001.

4.3.4 Release of equipment, materials, and tools from the decontamination work area will be performed in accordance with the provision of CABRERA procedure OP-004.

4.3.5 Operations conducted using this procedure will be reviewed for compliance at least annually.

5.0 EQUIPMENT

Appropriate Personal Protective Equipment (PPE) and decontamination equipment includes, but is not limited to:

- Herculite
- Decontamination rags
- Cleaning solutions

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensures that personnel assigned the task of decontamination know and understand this procedure, are adequately trained in its use, and have access to a copy.

6.2 Radiation Safety Officer (RSO) – Training of personnel in the decontamination techniques and performing radiation surveys described in this procedure; and ensures that technicians are qualified by training and experience to perform the requirements of this procedure.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, ensures that this procedure is properly implemented. When the RSO is not on site, the SRSL will act as the RSO’s duly authorized representative for radiological issues.

6.4 Radiation Protection Technologist(s) (RPT) – Performing the surveys of decontaminated items, and ensuring that radioactive material is not released to the public or the environment.

7.0 PROCEDURE

7.1 Pre-Decontamination Preparation

7.1.1 The SRSL will initiate decontamination work instructions.

7.1.2 A radiological survey will be performed by an RPT on any item or object that is to be removed from a controlled area.

7.1.3 If radiological survey results indicate that an RWP is required for decontamination, the RSO or duly authorized representative will write the RWP in accordance with CABRERA procedure AP-012.

7.1.4 If a survey indicates that decontamination is required, the item should be bagged, wrapped, or contained under the direction of health physics staff. The RPT will label the item with all pertinent information.

7.1.5 The SRSL will approve or disapprove the decontamination operation based on conditions of the RWP and the cost effectiveness of the operation versus disposal costs.

7.2 Establishment of the Decontamination Work Area

7.2.1 The RSO or duly authorized representative and the SRSL will determine a location for the decontamination area.

7.2.2 Once a location has been established, the decontamination area will be set-up, by the RPT, under the direction of the SRSL.

7.2.3 The decontamination area should consist of the following:

- Covered (or equivalent) floor surfaces. A double layer of Herculite (or equivalent) may be laid on the floor at the direction of Health Physics staff.
- Covered (Herculite or equivalent) wall surfaces, if applicable.
- Engineering controls (HEPA ventilation, vacuum cleaners,

containment tent walls glove bags, etc.), if applicable.

- Engineering controls will be determined on the basis of the ALARA consideration section of the RWP.

<u>Note</u>: All possible engineering controls will be utilized when feasible to minimize the need for respiratory protection equipment.

- Use of safe, sturdy workstations with contamination resistant surfaces and tables that will support decontamination attempts on heavy pieces of equipment.
- Adequate supply of overhead light, adequate electrical/compressed air supply for the operation of electrical/pneumatic driven decontamination equipment.
- Adequate supply of CABRERA approved cleaning solutions and solvents along with an adequate supply of decontamination equipment, such as:
    - Light duty decontamination equipment such as paper wipes, paper towels, masselin towels, etc.
    - Medium to heavy-duty decontamination equipment such as scrub pads, wire brushes steel wool, files, sandpaper, etc.
    - Fully stocked hand tool kit for disassembly of contaminated equipment.
    - Radioactive material storage bags, stickers, etc.
    - Buckets, barrels or drums for the storage of contaminated liquids, sludges, or slurries, if applicable.
    - Blotter paper or sorbent, if applicable.
    - Approved absorbent material such as oil dry, if applicable.
- Storage drums/bags for the storage of contaminated protective clothing under direction of Health Physics staff.
- Proper surveillance instruments (air monitor/sampler, contamination monitor, friskers, dose rate meter, etc.) in accordance with the RWP.
- Adequate supply of personal protective clothing gloves respiratory equipment, etc.
- Step-Off or Double Step-Off Pad, in accordance with the provision of the RWP.
- A designated area, within the decontamination area, for the segregation of radioactive waste.

7.2.4 Once the decontamination area has been established and stocked for operation, the bagged and/or wrapped contaminated or controlled equipment should be placed in the decontamination work area by the technician, under the direction of the SRSL and RPT. Contaminated or controlled items should always be escorted, under the direction of a RPT, to the decontamination area.

7.3 Decontamination

7.3.1 After the decontamination area has been posted, and area access controls established, all requirements of the RWP will be observed.

7.3.2 The preparation for decontamination of a particular tool, material, or piece of equipment will be performed, as follows:

- Position the wrapped item so that the written information on the label/wrapping is visible.

Note: Junior RPTs may operate survey instruments for decontamination monitoring purpose. RPTs will oversee Junior RPTs when survey instruments are in use.

CAUTION: Survey instruments to be used in a known or suspected contaminated area should be protected (wrapped in plastic, poly, etc.) against possible contamination before use.

- The RPTs will direct the removal of the item from the wrapping in such a manner (rolling plastic, poly, etc.) to control the spread of contamination.
- An item that is highly contaminated with loose contamination should be misted with an approved liquid such as demineralized water. The water vapor will wet down the particulate contamination and help prevent the possibility of generating airborne contamination.
- Once the item has been removed from the wrapping and has been properly positioned, discard the wrapping as radioactive waste.

7.3.3 The following decontamination techniques should be considered for the decontamination of equipment, materials, and tools:

- Any equipment with inaccessible areas will be dismantled so that all surfaces are accessible for decontamination and survey.
- Decontamination will be performed in a safe, effective manner.
- The RPT will be notified immediately if the job conditions change (e.g. suspected asbestos found, presence of mercury in a switch or a light bulb, a fluid leak, or any other special circumstances).
- An RPT (or qualified individual) will be assigned as a fire watch if any spark creating decontamination techniques (grinding, etc.) are used and there are combustible materials in the area. There will be

a dedicated fire extinguisher located within the decontamination work area.

- The decontamination area will remain organized and free of debris with the RPT enforcing the "clean-as-you-go" policy, whenever necessary.
- A HEPA vacuum cleaner may be used during the decontamination operation.

7.3.4 Smearable Contamination Removal

When the item is properly positioned for decontamination and the pre-survey has been completed, perform the following:

- Moisten the surface of the item with an approved liquid (e.g. demineralized water).
- Fold a paper or cloth wipe into sections, using one surface of the wipe gently wipe contamination off in one direction away from the user's body. This should reduce the possibility of personnel contamination.
- Re-fold the paper or cloth wipe so that a clean surface is available (this should prevent cross-contamination) and continue until item is ready for survey.
- For some materials, duct tape will effectively remove smearable contamination. Wrap the duct tape loosely around the gloved hand with the adhesive side out. Roll the tape over the contaminated area and re-survey.

7.3.5 Fixed Contamination Removal

There are many techniques that can be used to remove fixed contamination. The general idea is to remove the material, which is fixing the activity to the surface, or remove a very thin layer of the surface material. The techniques selected for a particular decontamination operation is at the discretion of the SRSL and the RPT. The techniques can be divided into the following categories:

- Light hand decontamination
- Abrasive hand decontamination
- Power tool decontamination
- Machine decontamination (use of abrasive bead blasters, grit blasters, high pressure water wash systems, etc.). The specific implementation of these techniques is not included within the scope of this procedure.
- Cleaning solutions/solvents (use of ultrasonic cleaners, acid baths,

electropolishing, etc.). The specific implementation of these techniques is not included within the scope of this procedure.

7.3.6 Light hand decontamination consists of using many of the same techniques as 7.3.4 of this procedure.

7.3.7 Abrasive hand decontamination will be performed in the following manner:

- Remove as much smearable contamination as possible.
- Moisten the surface of the item(s) to contain contamination.

CAUTION: Abrasive measure should only be applied to surfaces that are not critical for operation of devices, which must be restored to working condition. Abrasion of machined surfaces should be minimized if the device is intended to provide its designed operation.

- Use an abrasive cleaning tool (e.g. sandpaper, steel wool, steel brush, hand grinder, etc.) to loosen fixed contamination. Clean in one direction only and clean Away from the body to prevent personnel contamination.
- Continue to moisten the surface of the item(s) to contain contamination.
- Remove as much smearable contamination as possible.
- Re-survey.

7.3.8 Power tool decontamination will be performed in the following manner only as a last resort decontamination effort. The use of engineering controls must be used and must be under the guidance of the SRSL/RPT.

Note: When using power tools, always consider the potential of injury due to the hazards involved. Power tools will be used cautiously and in accordance with the manufacturer's recommendations.

Some of the electric power tools that can be used in decontamination operations are:

- Drills to drill out contaminated areas, to disassemble contaminated components and when used with grinding wheels or disks, may be used as an abrasive tool.
- Saws to separate contaminated pieces from clean pieces.
- Grinders to grind fixed contamination form surfaces.
- Electric screwdrivers used in the disassembly of component parts.

7.3.9 Power tool decontamination will be performed in the following manner:

- Using a spray bottle, moisten the surface of the item lightly to contain contamination.

CAUTION: Do not use electric power tools on a wet working surface. Keep liquids away from electric power tools.

- Whenever feasible a containment device (e.g. glove box or bag etc.) should be used to contain the spread of contamination when using power tools for decontamination operations.
- Use the power tool to remove fixed contamination. Clean in one direction only and clean away from the body to prevent personnel contamination.
- Re-survey.

7.4 Post-Decontamination

7.4.1 If the decontamination was successful, the technician will notify the RPT, who will perform a release survey in accordance with CABRERA procedure OP-004.

- If the item satisfies the criteria for release, as stated in OP-004, remove the item to a holding area for disposal and document results. When prepared for disposal, ensure compliance with the provisions of CABRERA procedures AP-014 and AP-013.
- If the item remains contaminated, attempt a second decontamination.
- If the item continues to be contaminated, attempt a third decontamination only at the direction of the RSO or duly authorized representative.

7.4.2 If an item cannot be effectively or economically decontaminated, the SRSL may direct the CABRERA work crew to volume-reduce (reduce to component parts) the equipment, material, or tools as much as possible. If the item is expendable, the individual parts may be surveyed and released in accordance with step 7.4.1.

7.4.3 If an item is volume-reduced to its component parts and decontamination is not feasible, and the item is not needed, the item parts will be considered radioactive waste. Radioactive waste is to be segregated into similar material for shipment purposes by the direction of the PM. The SRSL will direct the segregation of radioactive waste into the following categories:

- Steels, hard metals
- Wood

- Fiber products
- Paper
- Rubber
- Cloth (duct tape is considered a cloth)
- Aluminum, soft metals (brass)
- Glass
- Questionable items (e.g. light bulbs pipe with lead solder, electronic component parts) which could be considered mixed or hazardous waste.
- Other categories, if applicable.

7.4.4 After all decontamination operations have been completed, an RPT will perform a release survey of the decontamination area and de-post the area in accordance with CABRERA procedures OP-001 and OP-019.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- AP-006, *Respiratory Protection Program*, Cabrera Services Inc., Operating Procedure
- AP-012, *Radiation Work Permits*, Cabrera Services Inc., Operating Procedure
- AP-013, *Packaging Radioactive Material*, Cabrera Services Inc., Operating Procedure
- AP-014, *Classifying Radioactive Waste*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-004, *Unconditional Release of Material from Radiological Control Areas*, Cabrera Services Inc., Operating Procedure
- OP-019, *Radiological Posting*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-021, *Operation of Alpha-Beta Sample Counting Instrumentation*, Cabrera Services Inc., Operating Procedure
- OP-023, *Operation of Micro-R Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

The records generated by the use of this procedure are documented in accordance with the provisions of referenced CABRERA procedures. No new records are created.

10.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

Radiation Safety Procedure

For

Radiological Posting

OP-019

Revision 0

Reviewed By: ______________________ Date: 1/24/00
David Watters, Radiological Safety Engineer

Approved By: ______________________ Date: 1/24/00
Steven Masciulli CHP CSP, Radiation Safety Officer

Approved By: ______________________ Date: 1/24/00
Henry Siegrist CHP, P.E., Corporate Health Physicist

1.0 PURPOSE

This procedure provides the methods Cabrera Services, Inc. (CABRERA) uses to control radioactive materials. Adherence to this procedure will provide reasonable assurance that personnel will remain free of contamination, contamination will not spread beyond the designated contamination area, and personnel exposures will be maintained As Low As Reasonably Achievable (ALARA).

2.0 APPLICABILITY

This procedure will be used by CABRERA personnel to control and contain radioactive materials. The following are types of controls methods that will be employed:

- Posting requirements for radioactive materials.
- Establishing and posting radiation areas.
- Establishing and posting contaminated areas.
- Establishing and posting airborne radioactivity areas.

3.0 PRECAUTIONS, LIMITATION, AND REQUIREMENTS

3.1 Precautions

3.1.1 If a HPT is unable to perform this procedure due to errors, extenuating circumstances, or for any reason, the HPT shall immediately stop and notify the RSO.

3.2 Limitation

None

3.3 Requirements

None

4.0 REFERENCES

• 10 CFR 20, Subpart F	Surveys and Monitoring
• 10 CFR 20.2103	Records of Surveys
• RSP	Radiation Safety Program
• AP-001	Record Retention
• AP-010	Personal Protective Equipment
• AP-015	Radioactive Materials Brokering

- OP-020 Operation of Contamination Survey Instrument
- OP-021 Alpha-Beta Sample Counting Instrument
- OP-022 Operation of Ionization Chambers
- OP-023 Operation of Micro-R Survey Meters

5.0 DEFINITIONS AND ABBREVIATIONS

5.1 Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

5.2 Contamination Survey – A survey technique to determine fixed and removable radioactive contamination on components and facilities.

5.3 Radiation Survey – is defined as an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

5.4 ALARA – (acronym for "as low as is reasonably achievable") An approach to radiation exposure control to maintain personnel radiation exposures as far below the federal limit as technical, economical and practical considerations permit.

5.5 Radioactive Materials – Materials containing or capable of emitting alpha particles, beta particles, gamma rays, X-rays, neutrons and/or other ionizing radiations.

5.6 Airborne Radioactivity Area – A room, enclosure or area in which radioactive material is dispersed in the form of dusts, fumes, mists, vapors, or gases and the concentration of the of the dispersed radioactive materials in excess of:

5.6.1 The derived air concentrations (DAC's) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

5.6.2 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 percent of the annual limit on intake (ALI) or 12 DAC-hours.

6.0 EQUIPMENT

None Required

7.0 RESPONSIBILITIES

7.1 Project Manager (PM) – the PM is responsible for ensuring that personnel assigned the task of establishing and posting restricted areas are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

7.2 Radiation safety Officer (RSO) – The RSO is responsible for monitoring compliance with this procedure and training personnel in establishing and posting restricted areas. The RSO can also assist in the interpretation of the results obtained during surveys.

7.3 Radiological Field Supervisor (RFS) – During field assignments, the RFS is responsible for ensuring that this procedure is implemented. When the RSO is not on site, the RFS will act as the RSO's duly authorized representative for radiological issues.

7.4 Health Physics Technicians (HPT) – The HPT establishing and posting restricted areas are responsible for knowing and complying with this procedure.

8.0 INSTRUCTIONS

8.1 Posting Requirements for Radioactive Materials

8.1.1 Any area or room in which there is used or stored an amount of licensed material exceeding 10 times of the quantity of such material specified in Appendix C, Title 10 Part 20 of the Code of Federal Regulations shall be posted with a sign or signs "Caution Radioactive Materials Area" or "Danger, Radioactive Materials".

8.1.2 When posting a room as required in step one, a sign should be placed on each entrance door to the room. If the area to be posted is not a room, the area containing the license material shall be bounded by a yellow and magenta/black rope or ribbon securely fastened to stanchions, posts or other durable devices and signs shall be displayed in all accessible directions.

8.1.3 Any container, which contains licensed material in quantities equal to or greater that the quantities listed in Appendix C, Title 10 Part 20 of the Code of Federal Regulation shall be posted with a sign or label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIALS" OR "DANGER, RADIOACTIVE MATERIALS".

8.1.4 When posting a container as required by step three, the label should also state the radionuclide present in the container, the activity in the container, the date at which the activity was determined, the radiation levels emanating from the unshielded radioactive source, and the levels from the container holding the radioactive source. The label shall also state the mass enrichment if different from natural enrichment and the kind of material (encapsulated source, liquid, powder. etc.).

8.1.5 Posting of containers is not required if the containers are in transport and packages and labeled in accordance with the regulations of the Department of Transportation. (Title 49 Parts 172 and 173 of the Code of Federal Regulations). Containers, which are awaiting shipment at a facility, are subject to posting requirements as specified in 8.1.1

8.2 Establishing and Posting Radiation Areas

8.2.1 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 cm from the source of from any surface that the radiation penetrates shall be identified and posted with a sign "CAUTION RADIATION AREA".

8.2.2 A Micro-R Meter or other calibrated dose rate meter is used to identify the boundary location of the 5 mrem/hr dose rate.

8.2.3 If an entire room or most of the room is at or above the 5 mrem/hr level, a sign should be placed on each entrance door to the room. If the area to be posted is not a room, the area at or above the 5 mrem/hr level shall be bounded by a yellow and magenta/black rope or ribbon securely fastened to stanchions, posts or other durable device and signs shall be displayed in all accessible directions.

8.2.4 An exemption to this posting requirement is allowed in areas or rooms containing radioactive materials for periods less than 8 hours, if each of the conditions is met:

8.2.4.1 The materials are constantly attended to during these periods by an individual who takes the precautions necessary to prevent the exposure to radiation or radioactive materials in excess of the limits specified in the RSP; and

8.2.4.2 The area or room subject to the licensee's control. For example, the area around the truck loading radioactive waste does not require posting if the above conditions are met.

8.2.5 If the dose rates above 100 mrem/hr are encountered, control access to the area and contact the RSO or duly authorized representative for posting instructions.

8.3 Establishing and Posting Contaminated Areas

8.3.1 A restricted area that has fixed and removable radioactive materials in the form of dusts, particulates or sorbed contaminants which are above the limits specified in the RSP shall be identified and posted with a "CONTAMINATED AREA" sign.

8.3.2 Contamination levels are determined using procedure OP-001 (Radiological Surveys) and the results of the survey measurements compared to the contamination limits specified in the RSP.

8.3.3 If an entire room or most of the room is above the contamination criteria, a sign should be placed on the entrance door to the room. If the area to be posted is not a room, the above area contamination criteria shall be bounded by a yellow and magenta/black rope or ribbon securely fastened to stanchions, posts or other durable device and signs displayed in all accessible directions.

8.3.3.1 A single entry point shall be established to access the contaminated area. A step-off pad is placed at the entry point, which provides a defined boundary between contaminated and restricted areas.

8.3.3.2 Receptacles for protective clothing and waste materials shall be placed just inside the entry point to collect protective clothing from personnel exiting the area.

8.3.3.3 If work activities in the work areas are likely to generate significant dusts containing radioactive materials, the area should be enclosed within a containment to prevent the spread of contamination beyond the identified contaminated area.

8.4 Establishing and Posting Airborne Radioactivity Areas

8.4.1 CABRERA's policy is to minimize (and protect, if practical) the amount of radioactive materials taken into a workers body. In order to accomplish this, Airborne Radioactivity Areas are posted at 10% DAC, as specified in Table 1, Column 3 of Appendix B of 10 CFR 20. Maintaining the airborne activity below these limits will eliminate any posting requirements.

8.4.2 To verify that these limits are not exceeded, an air sample is taken during each work activity, which could create an airborne radioactivity hazard. The results of these samples are compared with the above limits to verify the limits are not exceeded. If these limits are exceeded, immediately contact the RSO or duly authorized representative.

8.4.3 A room, enclosure or area shall be posted with a "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA" if radioactive material is dispersed in the form of fumes, dusts, mists, vapors, or gases and the contamination of the dispersed radioactive materials is in excess of:

8.4.3.1 The derived air concentration (DAC) specified n Table 1, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

8.4.3.2 Concentration 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 percent of the annual limit on intake (ALI) or 12 DAC-hours.

8.4.4 If a room, enclosure or area requires posting as specified in 8.4.3, immediately stop work activities and contact the RSO or duly authorized representative for instructions.

9.0 QUALITY ASSURANCE/RECORDS

9.1 Quality Assurance

9.1.1 Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

9.2 Records

9.2.1 Record any radioactive materials posting made in the project logbook. Include the date, location, and all information posted.

9.2.2 Record the date and the location of any radiation areas established in the project logbook. Include a sketch of the area and radiation area boundary on survey forms.

9.2.3 Record the date and location of any contaminated areas established in the project logbook. Include a sketch of the area and contaminated area boundary on survey forms.

9.2.4 Record the date and location of any airborne radioactivity areas established in the project logbook. Include a sketch of the area on survey forms. Indicate time and date of any notifications required by this procedure.

9.2.5 Radiological survey records, routine survey schedules, and tracking forms are generated during the performance of this procedure.

9.2.6 Documented information shall be legibly written in ink.

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

9.2.8 The HPT performing the posting shall ensure that this procedure is the most current and approved revision.

9.2.9 The HPT performing the posting shall review Forms and any other applicable forms for accuracy and completeness.

9.2.10 Entries on Forms and any other pertinent forms must be dated and initialed by the HPT performing the posting to be valid.

9.2.11 The RSO or duly authorized representative shall review any applicable completed forms. The review shall be for accuracy and completeness.

10.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

OPERATION OF CONTAMINATION SURVEY METERS

OP-020

REVISION 1.0

Reviewed by:

4/112/13

David Wunsch, Quality Assurance Manager — Date

Approved by:

Henry Siegrist

Henry Siegrist, CHP, PE, Radiation Safety Officer — 4/12/2013 Date

1.0 PURPOSE

This procedure provides the methods for Cabrera Services Inc. (CABRERA) to use when operating alpha/beta survey meters in performing contamination surveys. Adherence to this procedure will provide a reasonable assurance that the surveys performed have reproducible results.

2.0 APPLICABILITY

This procedure will be used by CABRERA personnel to measure fixed and removable alpha and/or beta/gamma emitting radioactive material on facility surfaces, equipment, waste packages, personnel, personnel protective clothing, etc.

3.0 DEFINITIONS

3.1 Restricted Area – An area containing radioactive material(s) to which access is controlled, by the licensee, to protect individuals from exposure to ionizing radiation.

3.2 Alpha/Beta Contamination Survey – A survey technique used to determine fixed and removable alpha/beta contamination.

3.3 Acceptance Range – A range of values that describe an acceptable daily instrument source check result.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Ensure that thin Mylar or mica windows on the probe face are protected from punctures, during survey operations.

4.1.2 In the case of the 44-110 tritium windowless meter, very fragile anode wires are behind the screen. **Note:** Do not allow objects to pass beyond the protective wire screen as damage to the detector can occur.

4.1.3 If any instrument inconsistencies are observed (e.g., unusually high or low background readings, source checks outside the acceptable range, etc.), remove the instrument from use, label it "OUT OF SERVICE" and report the condition to the Radiation Safety Officer (RSO), Site Radiation Safety Lead (SRSL), or a duly authorized representative.

4.2 Limitations

Typical operating temperature ranges for detectors are -20 to 50 degrees Celsius (°C) [-4 to 122 degrees Fahrenheit (°F)].

4.3 Requirements

4.3.1 Calibration sources must be traceable to the National Institutes of Science and Technology.

4.3.2 A battery check, general observation of instrument condition, high voltage check, and source response check will be performed each day before instrument use. An end of daily work activities final verification of instrument operability may also be provided, as required by site work plans.

4.3.3 Survey instrument calibrations will be performed by a calibration facility licensed by the Nuclear Regulatory Commission or an Agreement State.

4.3.4 Instruments used to perform routine surveys will be used in accordance with the applicable CABRERA administrative and operational procedures. Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments.

4.3.5 Prior to field mobilization, project SRSL and identified radiological leads will review approved work plans to ensure identified survey equipment is appropriate. Where practical, equipment familiarization with expected ranges to be used, typical efficiency of detection, and templates to be used in the field with the particular instrument are desired.

4.3.6 Personnel performing the survey will ensure that this procedure is the most current and approved revision.

4.3.7 Personnel performing the survey will review QC records to ensure that the instrument passed the source-check prior to use.

4.3.8 The RSO or their duly authorized representative will review any applicable completed forms and templates for accuracy and completeness.

4.3.9 All entries documented on pertinent forms must be dated and initialed by personnel performing the survey to be valid.

5.0 EQUIPMENT

5.1 Equipment counting efficiencies should be determined by qualified CABRERA personnel to verify efficiencies of calibrated instruments prior to use. Routine survey equipment includes, but is not limited to:

5.1.1 Alpha Surveys – Ludlum Model 43-5 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.1.2 Beta/Gamma Surveys – Ludlum Model 44-9 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.2 Proportional meters may be advantageous for use in situations where the suspected contamination type is unknown or the contamination contains mixed alpha and beta/gamma components. Alpha and beta/gamma contamination can be detected simultaneously with proportional meters. Proportional meters that may be used for a contamination survey include, but are not limited to:

5.2.1 Hand-held meters – Ludlum Model 43-93 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.2 Gas proportional floor meters – Ludlum Model 43-37 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.3 Radionuclide-specific meters – Includes meters such as a tritium contamination meter: Ludlum Model 44-110 probe coupled with a Ludlum Model 2221 meter or equivalent meter/probe combination.

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

6.0 RESPONSIBILITIES

6.1 <u>Project Manager</u> (PM) – Ensuring that personnel assigned the task of operating contamination survey meters know and understand this procedure, are adequately trained, and have access to a current copy.

6.2 <u>Radiation Safety Officer</u> (RSO) – Verifying that personnel comply with this procedure and are trained in the use of the contamination survey meters described in this procedure.

6.3 <u>Site Radiation Safety Lead</u> (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented and will review approved work plans to ensure identified survey equipment is appropriate. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 <u>Radiation Protection Technician</u> (RPT) – The RPT operating contamination survey meters is responsible for knowing, understanding, and complying with this procedure and may be required to review approved work plans to ensure identified survey equipment is appropriate.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Select the contamination survey meter and probe to be used in the survey.

7.1.2 Before each use, perform the following checks:

- Verify the probe/meter has a current calibration label.
- Visually inspect the probe/meter for physical damage or defects.
- Position the meter switch to “BAT” and check to see that the needle falls within the “Bat Test” checkband.
    - If the needle falls below the “Bat Test” checkband, install new battery(ies).
    - If the needle still falls outside the “Bat Test” checkband after the installation of new batteries, tag the instrument “OUT OF SERVICE” and notify the RSO or their duly authorized representative.
- Check alpha detectors for light leaks by pointing the Mylar window of the detector towards a light source (preferably sunlight) and observing for a change in the meter indication.

7.1.3 Remove and tag the instrument “OUT OF SERVICE” if it fails any of the criteria in steps 7.1.1 and 7.1.2 and notify the RSO or their duly authorized representative.

Note: Any defects, damages, or other physical abnormalities require that the instrument be removed from service and the RSO or their duly authorized representative be notified.

7.2 Initial Preparations

7.2.1 Assure that the necessary daily quality control (QC) checks have been performed prior to instrument use.

7.2.2 Obtain the necessary forms, smears, and protective clothing that will be used during the survey. This information can be obtained from the Radiation Work Permit (RWP) or the SRSL.

7.2.3 Position the meter fast/slow (“F/S”) switch to “S” as appropriate.

7.2.4 Position the meter switch to the appropriate range scale.

7.2.5 Ensure that the QC acceptance range has been calculated utilizing CABRERA count rate templates. Current templates can be obtained from the RSO and may be found in the CCDR.

7.3 Daily QC Check

7.3.1 Ensure both the source and detector are in documented, reproducible positions which will be used each time this check is performed.

7.3.2 Allow the instrument reading to stabilize (approximately 30 seconds) and place the QC source on its designated position, near the detector, and record the value on the QC template.

7.3.3 Compare the reading to the acceptance range and response check criteria on the count rate QC template. If the response reading falls outside of the acceptance range, tag the instrument “OUT OF SERVICE” and notify the RSO or their duly authorized representative.

7.4 Contamination Survey Techniques

CAUTION*:* The window area of the detectors is covered with either a very thin layer of aluminized Mylar or mica. In the case of the tritium windowless detector, small anode wires are present behind the protective screen. Windows and fragile anode wires can be easily punctured or broken when surveying areas that have protruding fragments. Ensure that care is used and that such potentially damaging fragments are removed, prior to performing surveys, or avoided.

Note: To maintain the calibrated detection efficiency, the detector must be held at the appropriate height when surveying, which is determined during calibration. For example, if a beta probe’s efficiency was calculated at ½ inch from the calibration source, the detector must be held at ½ inch from the surface being surveyed to maintain calibrated detection efficiency.

Avoid contacting the detector probe to the area being surveyed. This potentially could contaminate the probe.

7.4.1 Initially, verify the instrument selector switch is in the x0.1 position or on the lowest scale. Scale settings may change during surveys.

7.4.2 For a stationary reading, place the detector over the area to be measured and allow the meter to stabilize. Record the average meter indication in either counts per minute (cpm) or total counts recorded on the ratemeter, in a set time interval, on the radiological survey form/template.

7.4.3 For a scan survey, move the detector slowly over the surface, at the rate described in the site work plan and record data, as described by the plan.

7.5 Final Verification

If required by the site work plan, upon completion of work activities, repeat steps 7.1.1 and 7.1.2 as a final verification that the instrument is working properly.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-009, *Use and Control of Radioactive Sources*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

Results will be documented electronically in the “Alpha Beta Counting and Smear Worksheet” and Smear and/or Static worksheets should be printed out and filed along with the radiological Survey Form in Attachment B of OP-001. All records, including electronic records, must be managed in accordance with OP-187.

10.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

ALPHA-BETA COUNTING INSTRUMENTATION

OP-021

REVISION 1.0

Reviewed by:

David Wunsch, Quality Assurance Manager — 4/12/13 Date

Approved by:

Henry Siegrist

Henry Siegrist, CHP, PE, Radiation Safety Officer — 4/12/2013 Date

1.0 PURPOSE

This procedure provides instruction on the operation and setup of an alpha/beta sample counter. Adherence to this procedure will provide a reasonable assurance that the surveys performed have reproducible results.

2.0 APPLICABILITY

This procedure will be used by Cabrera Services Inc., (CABRERA) personnel operating an alpha/beta sample counter during surveys. Types of surveys that may use an alpha/beta sample counter are:

- Smear surveys performed to determine the removal of alpha and beta contamination on facility surfaces, equipment, waste, source packages, etc.
- Air sample surveys performed in a worker's breathing zone, a work area, or around the perimeter of a work site to determine alpha and beta air concentrations.

3.0 DEFINITIONS

3.1 Restricted Area – An area to which access is controlled to protect individuals against undue risks from exposure to radiation and radioactive materials.

3.2 Smear Sample Survey – A technique using a two-inch diameter filter paper to determine removable contamination of alpha and/or beta emitting radioactive material over a 100 cm^2 area.

3.3 Air Sample Survey – A technique where particulates are collected, from a known volume of air drawn through a filter paper, and the concentrations of airborne alpha and beta activity, associated with the particulates, are determined by sample counting.

3.4 Chi-Square Test – A statistical test used to evaluate the operation of a sample counter by determining how data fit a series of counts to a Poisson distribution.

3.5 Daily Calibration Check – A determination of alpha and beta sample counting efficiency by counting radioactive standards that are traceable to the National Institutes of Science and Technology.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

If any instrument inconsistencies are observed (e.g., unusually high or low background counts, source checks outside the tolerance range), remove the instrument from use and report the condition to the Site Radiation Safety Lead (SRSL) or other duly authorized representative.

4.2 Limitations

This instrumentation should be set up for use in a low background area, as determined by the SRSL or other duly authorized representative.

4.3 Requirements

4.3.1 Calibration sources will be traceable to the National Institutes of Science and Technology (NIST).

4.3.2 Survey instrument calibrations will be performed by a calibration facility licensed by the Nuclear Regulatory Commission or Agreement State.

4.3.3 A battery or power source check, general observation of instrument condition, background check, and source check will be performed each day before instrument use. A second daily quality check that includes all of the above can be performed at the end of daily work activities, if determined to be necessary on a project site.

4.3.4 The alpha/beta sample counter will be checked for proper calibration daily with a NIST-traceable source, when in use.

4.3.5 Chi-Square tests will be verified and noted as currently valid, when performed.

4.3.6 The Radiation Protection Technician (RPT) will ensure that the attachment forms are the most current and approved revisions.

4.3.7 The RPT will review completed forms for accuracy and completeness; all entries must be dated and initialed, by the RPT, to be valid.

4.3.8 The RSO or their duly authorized representative will review any applicable, completed forms for accuracy and completeness.

5.0 EQUIPMENT

Ludlum Model 2929 sample counter, or equivalent, coupled to a Ludlum Model 43-10-1 alpha/beta scintillation detector with sample tray. Equivalent instruments, based on project need, can be utilized (i.e. Ludlum Model 3030, Canberra Tennelec).

6.0 RESPONSIBILITIES

6.1 Project Manager (PM) – Ensuring that personnel assigned the task of operating alpha/beta sample counters know and understand this procedure, are adequately trained in its use, and have easy access to a copy.

6.2 Radiation Safety Officer (RSO) – Verifying that personnel comply with this procedure and are trained in the use of alpha/beta sample counters described in this procedure.

6.3 Site Radiation Safety Lead (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 Radiation Protection Technician (RPT) – The RPTs, using alpha/beta sample counters, are responsible for knowing and complying with this procedure.

6.5 CABRERA personnel – Individuals performing work with an alpha/beta counter will know and understand the requirements set forth in the current and approved version of this procedure.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Before each use, perform the following checks:

- Verify that the instrument has a current calibration label.
- Visually inspect the instrument for physical damage and defects.
- Verify that the high voltage and high voltage potentiometer settings agree with the calibration sheet.

7.1.2 Remove and tag the instrument "OUT OF SERVICE" if it fails any of the above criteria and notify the SRSL or the duly authorized representative.

Note: Any defects, damages or other physical abnormalities require that the instrument be removed from service and the SRSL, or other duly authorized representative, be notified.

7.2 Chi-Square Test

Note: The Chi-Square Test is not always required, but is a good verification check on the instrument operability and count setup routines, at the beginning of a project. A Chi-Square Test is only required whenever significant changes have been made to the equipment, such as a detector tube (Model 43-10-1) change out and subsequent recalibration or decontamination of the equipment. Contact the SRSL for guidance.

7.2.1 Set up the instrument in a low background area.

7.2.2 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust if necessary.

7.2.3 Set the time multiplier switch to "x1".

7.2.4 Set the instrument-preset timer to one (1) minute.

7.2.5 Insert the alpha calibration standard into center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a one minute count.

7.2.6 Upon completion of the count, record digital counts appearing in the alpha display in the “Xi” column on the Chi-Square Data Sheet (Attachment A).

Note: Approved electronic templates may be used in place of this form as long as the equivalent information is provided as described in this procedure.

7.2.7 Repeat counting sequence, ensuring that the count source is removed and repositioned within the count holder, thus ensuring count position variability consistent with actual use counting. No instrument settings can be changed during this count sequence. Continue until a total of 20 counts have been taken and recorded in the “Xi” column on the Chi-Square Data Sheet (Attachment A).

7.2.8 Add the 20 counts recorded in the “Xi” column and record in the “Sum” column. Then divide by 20 to obtain the mean number of counts (Xm) and record on the line “Xm. “

7.2.9 Calculate the individual count “Xi” difference from the mean (Xm) value and record in the “(Xi-Xm)” column the Chi-Square Data Sheet for all 20 values.

7.2.10 Calculate (Xi-Xm)2, sum the “(Xi-Xm)2 ” column, and record on the Chi-Square Data Sheet.

7.2.11 Calculate the value of Chi- Square using the following formula:

$$X^2 = \frac{\sum (X_i - X_m)^2}{X_m}$$

7.2.12 The value of Chi-Square should be between 8.91 and 32.8 (represents a probability between 0.025 and 0.975). Record this value at “X2.“ If the Chi-Square value falls outside this range, contact the SRSL or other duly authorized representative for further instructions.

7.2.13 Sign and date the Daily Calibration Check form (Attachment B) and forward the results to the SRSL or other duly authorized representative for review. Keep an electronic copy in the project files.

7.3 Initial Quality Control Check

7.3.1 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust slowly, if necessary.

7.3.2 Set time multiplier switch to “x1.”

7.3.3 Set the instrument-preset timer to the pre-determined background count time set by the SRSL. Counter MDAs need to be setup for 50% of the release limit for the given isotope.

7.3.4 Record the source type to be used and corresponding serial number on the proper line indicated on the Daily Calibration Check form. Use separate rows of the form for each source efficiency to be calculated.

Note: Approved electronic templates may be used in place of this form as long as the equivalent information is provided, as described in this procedure.

7.3.5 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a background count.

7.3.6 Record the background count rate in the cell labeled “Bkg Count Time” on the Daily Calibration Check form.

7.3.7 Repeat the counting sequence until a total of 10 counts have been taken and recorded in the “Bkgd” row on the Daily Calibration Check form. Calculate the average of the 10 counts and the standard deviation (σ) for the average count.

7.3.8 Reset the instrument-preset timer to the pre-determined source count time set by the SRSL.

7.3.9 Remove the blank sample and insert the alpha or beta calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a source count.

Note: Be sure to turn the source approximately 90 degrees with every count as this will give a wider range since not all sources are uniform in nature.

7.3.10 Record the source count rate in the columns labeled “Source #1 Count Time” and “Source #2 Count Time,” respectively, on the Daily Calibration Check form

7.3.11 Repeat the counting sequence until a total of 10 counts have been taken and recorded for both alpha and beta check sources in the “Source #1” and “Source #2” rows on the Daily Calibration Check form. Calculate the average of the 10 counts for each source and (σ) for the average counts.

7.3.12 Remove calibration standards and place in source holders.

7.3.13 Initial and date the Daily Calibration Check form and forward the results to the SRSL, or other duly authorized representative, for review.

7.3.14 Record all data electronically in an alpha/beta counting spreadsheet and keep in project files. All records, including electronic records, must be managed in accordance with OP-187.

7.4 Daily Calibration Check

7.4.1 Ensure the high voltage potentiometer is positioned according to the posted instrument label. Adjust slowly, if necessary.

7.4.2 Set time multiplier switch to “x1”.

7.4.3 Set the instrument-preset timer to the pre-determined background count time, set by the SRSL.

7.4.4 Record the source type to be used and corresponding serial number on the proper line indicated on the Daily Calibration Check form. Use separate rows of the form, for each source efficiency, to be calculated.

7.4.5 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a background count.

7.4.6 Calculate and record the background total counts and count rate in the columns labeled “Bkgd” and “Bkg Count Time” respectively on the Daily Calibration Check form. The background count rate in CPM (counts per minute) can be calculated as follows:

$$CPM = \frac{Total\,Counts}{Total\,Time}$$

7.4.7 Remove the blank sample and insert the alpha or beta calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the “COUNT” button to obtain a source count.

7.4.8 Upon completion of the measurement, calculate and record the total counts and count rate in the columns labeled “Total Counts” and “CPM” respectively, under ‘Source’ information on the Daily Calibration Check form. The count rate (CPM) can be calculated as listed in Step 7.4.6.

7.4.9 Calculate Net Source CPM, as below, and record on the Daily Calibration Check form under “Net CPM.”

$$Net\ Source\ CPM = CPM - BKG\ CPM$$

Note: Obtain activity (DPM) value from the source certification paperwork. Decay correct activity, if needed.

7.4.10 Use the source disintegration per minute (DPM) to calculate the 4 pi efficiency, as shown below, and check against calibrated efficiency. This data can be recorded in the electronic template.

$$\%\ Efficiency = \frac{Net\ Source\ CPM}{DPM} * 100$$

7.4.11 To calculate the efficiency, for the next source, remove the current source standard and insert a new source standard, then repeat steps 7.4.1 through 7.4.10, as necessary.

7.4.12 Remove calibration standards and place in source holders.

7.4.13 Generate an excel control chart tracking the daily efficiencies and notify the SRSL or duly authorized representative if any point falls outside of 2σ variance.

Note: For the first day on the control chart, use five data points to begin the trend line.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- AP-005, *ALARA*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- U.S. Nuclear Regulatory Commission, Consolidated Guidance About Material Licenses, *Vol.11 - Program-Specific Guidance About Licenses of Broad Scope*, NUREG-1556, (1999).

9.0 REQUIRED RECORDS

The following records must be maintained whether paper or electronic:

- Chi-Square Data Sheet (when applicable)
- Daily Calibration Check
- Excel calibration records

10.0 ATTACHMENTS

Attachment A – Chi-Square Data Sheet

Attachment B – Daily Calibration Check

Attachment A

Chi-Square Data Sheet

Chi-Square Data Sheet

Date:________Instrument:__________________Serial Number:___________ X^2________

Alpha Source No./Activity:________________Beta Source No./Activity:__________________

Count Number	X_i	(X_i-X_m)	$(X_i-X_m)^2$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Sum		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
X_m		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\

Prepared By: ____ Date: _________________
Print/Sign

Reviewed By: ____ Date: _________________
Print/Sign

Attachment B

Daily Calibration Check

Daily Calibration Check

Make	Model	S/N	Probe	S/N	Cal Date
Bkg Count Time	Source #1 Count Time	Source #2 Count Time	Source #1 ID	Source #2 ID	Cal Due Date

Date(s)										
Intial QC's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Init.**
Bkgd											
Source #1											
Source #2											

Daily QC's

Date	Bkgd	Source #1 ( ) α/β/γ	Source #2 ( ) α/β/γ	Battery OK?	Comments	Init.
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		
				Yes / No		

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

PERSONNEL FRISKING AND DECONTAMINATION

OP-243

Revision 2.0

Reviewed by:

David Wunsch

David Wunsch, Quality Assurance Manager

4/12/13

Date

Approved by:

Scott Hay

Scott Hay, Principal Health Physicist

4/11/2013

Date

1.0 PURPOSE

The purpose of this procedure is to provide the steps necessary to properly perform personnel frisking and decontamination, and to provide Cabrera Services Inc. (CABRERA) personnel with requirements for contamination control and decontamination implements.

2.0 APPLICABILITY

The protocols presented here apply to personnel frisking and decontamination. This procedure provides the requirements and proper techniques to be adhered to while performing personnel frisking and decontamination from clothing, skin and/or wounds. Adherence to this procedure will provide adequate contamination controls while maintaining CABRERA'S goals for control of radiation exposure As Low As Reasonably Achievable.

3.0 DEFINITIONS

3.1 Radiological Survey – 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.

3.2 Contamination Survey – A survey used to determine fixed and removable radioactive contamination on personnel, components and structures.

3.3 As Low As Reasonably Achievable (ALARA) – An approach to maintaining exposures to radiation as far below the federal limit as technical, economical and practical considerations permit.

3.4 Bioassay – A direct measurement of radioactive material in the body using In-vitro and In-vivo techniques.

3.5 In-vitro – An examination of discrete samples of tissue or fluids outside the body (i.e., urine and hair samples).

3.6 In-vivo – An examination of the individuals body tissues as a whole without taking discrete samples (i.e., whole body counter).

3.7 Internal Dose Assessment – An evaluation process involving the dose, at which human tissues are subjected to radiations from radionuclides, that has entered the body via inhalation, ingestion, injection or other routes. This can be measured via air sampler data or bioassay.

3.8 Frisking – A process of monitoring for radioactive contamination using handheld instrumentation on personnel or their clothing performed before exiting a known or potentially contaminated area.

3.9 Decontamination – The removal of unwanted radioactive material from personnel, clothing, equipment, or other materials.

3.10 Low level radioactive waste – A broad category of material that has become contaminated with radioactive material, but does not belong in the categories of: “high-level” waste; uranium mill residues or tailings; transuranic material; naturally-occurring radioactive material; or, material produced in an accelerator.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Ensure that all necessary steps are taken to limit the further spread of contamination to work areas, personnel, equipment, and materials.

4.1.2 Ensure that instruments are used and maintained in accordance with operating procedures or manufacturer’s recommendations, and are in current calibration.

4.1.3 Ensure that all survey instruments are inspected for serviceability and checked against check sources each day they are in use, to verify they are in proper working condition.

4.1.4 Ensure that all radiation surveys and reports are to be reviewed by the Site Radiation Safety Lead (SRSL), or duly authorized representative, for accuracy and completeness.

4.2 Limitations

4.2.1 Only Health Physicists, Radiation Protection Technicians, or authorized personnel and qualified medical personnel are permitted to decontaminate personnel with skin contamination.

4.2.2 Contaminated wounds of any kind must be decontaminated under the supervision of the SRSL or duly authorized representative.

4.3 Requirements

4.3.1 Emergency medical care must be administered immediately for injuries affected by radioactive materials. Medical treatment of injuries will take precedence over radiological considerations.

4.3.2 Personnel skin contamination events must be reported to the Corporate Health Physicist (Corporate HP) and a duly authorized representative (e.g. SRSL) to determine whether a skin dose assessment must be performed. An evaluation is required to accurately assess the need for medical action when personnel contamination exceeds background by 1,000 disintegrations/minute (dpm) alpha or 5000 dpm beta-gamma.

4.3.3 Internal dose assessment may be required by the Corporate HP under the following circumstances:

- Nasal or mouth smears exceeding 20 dpm alpha, or 1,000 dpm beta-gamma, above background.

- Any detectable radioactivity above background on nasal or mouth smears, and if the skin or clothing contamination exceeds 1,000 dpm alpha or 5,000 dpm beta-gamma.
- Facial contamination exceeds 1,000 dpm alpha or 5,000 dpm beta-gamma, above background.

4.3.4 An in-vivo and/or in-vitro examination may be required, at the discretion of the Corporate HP, if the internal dosimetry evaluation exceeds 100 millirem (mrem) Committed Effective Dose Equivalent (CEDE).

4.3.5 When in-vitro examinations are required as a result of an incident, the Corporate HP will be immediately be notified and the affected personnel will be given a bioassay kit and continue supplying samples until directed to stop by the Corporate HP or duly authorized representative.

4.3.6 If in-vivo bioassay (via whole body counter) is required, the affected personnel will be transported directly to the nearest whole body counter facility, as soon as possible, after the incident. Results of this evaluation will be forwarded to the Corporate HP immediately for review and analysis.

5.0 EQUIPMENT

- Latex or equivalent gloves.
- Tape with strong adhesive for decontamination (e.g., duct tape).
- Ratemeter with alpha/beta sensitive detector (Ludlum model 43-89/93 or equivalent).
- Ratemeter with beta/gamma sensitive detector (Ludlum model 44-9 Geiger-Mueller [GM] or equivalent).
- Smears and/or large area wipes (Masslinn).
- Nasal smears or Q-tips for facial contamination.
- Mild detergent (e.g., baby shampoo or equivalent).

6.0 RESPONSIBILITIES

6.1 Corporate Health Physicist (Corporate HP) – Responsible for identifying radiation control areas and frisking station locations for a project, evaluating frisking results when contamination has been identified, performing an internal dose assessment and calculating the CEDE, determining the need for in vivo and in vitro bioassay, determining when medical attention for radiation exposure is required, assigning the total dose associated with exposure to contamination, determining the source of contamination, and ensuring similar exposures are reduced or eliminated.

6.2 Project Manager (PM) – Responsible for ensuring that the assigned personnel know and understand this procedure and have access to a current copy.

6.3 Radiation Safety Officer (RSO) – The RSO is responsible for verifying that personnel comply with this procedure and are trained in the use of personnel frisking and decontamination.

6.4 Site Radiation Safety Lead (SRSL) – Responsible for training personnel on this procedure, establishing frisking stations and radiation control area boundaries designated by the Corporate HP, monitoring compliance ensuring its proper implementation, reviewing instrument logs to ensure proper operation of equipment, performing or overseeing decontamination of personnel, investigating potential sources of contamination and preventing additional exposures or spread of contamination..

6.5 Field Supervisor – Responsible for ensuring daily implementation of this procedure. When the SRSL is not on-site the Field Supervisor will act as the authorized representative for radiological issues.

6.6 Radiation Protection Technician (RPT) – Responsible for knowing, understanding, and complying with this procedure.

7.0 PROCEDURE

7.1 The Corporate HP will identify radiation control area boundaries and locations of frisking stations at all access points based on the project requirements.

7.2 The Corporate HP will identify frisking requirements based on the radionuclides of concern, expected activity levels, expected chemical and physical form of contamination, and activities to be performed. The default frisking requirements are total body frisk for alpha/beta and beta/gamma contamination. Alternative frisking requirements may include less than total body frisk (e.g., hands and feet only) or nuclide-specific screening (e.g., alpha/beta only or beta/gamma only).

7.3 All personnel exiting a radiation control area are required to frisk for contamination. CABRERA-trained radiation workers are allowed to self-perform frisking. All other personnel will be frisked by a CABRERA-trained RCT.

7.4 In case of a medical emergency the SRSL will issue a stop work order and have all non-emergency personnel exit the area. If the injured person can be safely moved, move them out of the contaminated area. If the injured person cannot be moved, the SRSL will escort emergency personnel to the injured person and assist with contamination control during the emergency.

7.5 Frisking is performed by positioning the detector approximately one centimeter (1 cm) above the skin surface and slowly moving the detector until the entire area to be frisked has been covered. The detector should move at a rate of approximately one detector width per second. Listen to the audio output of the detector during frisking. If an increase in the count rate is detected, hold the detector stationary for at least 30 seconds to determine if there is an area of contamination at that location. A total body frisk should take at least 3 minutes.

7.6 Areas of concern during frisking include areas that are most likely to come into contact with radiation during work activities such as hands, feet, knees, elbows, and the seat of the pants. Areas with the highest potential for exposure are also of interest, such as the mouth, nose, and face.

7.7 Contamination may be removed from personnel clothing by patting the **affected area with tape and resurveying to determine if additional** decontamination is necessary. If contamination cannot be reduced to levels below the applicable levels and ALARA, the clothing will be removed from service for disposal as low-level radioactive waste.

7.8 If personnel require skin decontamination, they will be decontaminated by health physics personnel and/or qualified medical personnel. The following are protocols for performing skin decontamination.

7.8.1 Medical treatment of severe injuries will take precedence over radiological considerations.

7.8.2 Emergency medical care should be administered immediately for injuries affected by radioactive materials.

7.8.3 Personnel skin contamination must be reported to the Corporate HP if levels exceed those stated in Section 4.3. The Corporate HP will determine if a skin dose assessment must be performed.

7.8.4 The SRSL and Corporate HP will provide medical personnel with any necessary radiological support regarding radiological contamination control and monitoring of the patient, medical staff, and medical facilities.

7.8.5 The treatment of radiologically contaminated injuries should include the following:

- Treatment of contaminated wounds by medically qualified individuals,
- Monitoring of wounds, bandages, and medical instruments and equipment for contamination, and
- Radionuclide identification.

7.8.6 Contaminated wounds, of any kind, will be decontaminated under the guidance of the SRSL or Corporate HP. Severe wounds will be decontaminated by medical personnel with health physics personnel providing guidance and support.

7.8.7 Survey the affected area and record the types and initial levels of contamination on the Personnel and Clothing Contamination Report (Attachment A). If possible, remove particles of contamination with tape and save the particles for evaluation. The SRSL will prepare a report documenting the number, type, and locations of measurements and the results of the measurements. This report will be maintained in the employee's radiation exposure file.

7.8.8 Attempt localized washing with warm water and soap while ensuring that contamination is not spread to uncontaminated parts of the body.

7.8.9 Resurvey the affected area to determine if the contamination has been reduced to levels below the applicable levels and ALARA.

7.8.10 If contamination persists, decontamination attempts and resurveys may be repeated multiple times but should stop if these methods are ineffective or skin irritation occurs.

7.8.11 If the area cannot be decontaminated sufficiently with soap and water, the area may be covered (e.g. with plastic or by wearing latex gloves) to allow contamination to be removed through perspiration.

7.8.12 Depending on the levels of contamination encountered, an internal dosimetry evaluation (AP-008, *Dosimetry Program*) and/or bioassay (AP-007, *Bioassay Program*) may be required. See Section 4.3 for specific details.

7.9 The SRSL will interview all personnel with contamination on skin or clothes exceeding the limits listed in Section 4.3.3 and attempt to identify the source of the contamination. Common sources of contamination on personnel include unexpected radiological conditions in the work area, damaged or non-functioning personal protective equipment (PPE, such as ripped gloves), and improper work technique.

7.9.1 If unexpected radiological conditions are encountered the SRSL will suspend work in that area or on that task. The Corporate HP will review the available information and make recommendations to adjust PPE requirements or modify the tasks being performed to minimize the chance for contamination of personnel and equipment, and control the potential spread of contamination.

7.9.2 If PPE is damaged the SRSL and Corporate HP will review the current PPE requirements and make necessary changes to the PPE requirement. If PPE is non-functioning the damaged equipment will be replaced. All similar PPE will be inspected and replaced if necessary.

7.9.3 If personnel are performing a task improperly the SRSL will restrict that person from access to radiological control areas and tasks involving radioactivity. The person will be instructed in the proper method for performing tasks in a radiological control area to minimize exposure to radiation and control the spread of contamination. The SRSL will observe the person performing the necessary tasks in an uncontaminated area to evaluate the effectiveness of the training. The person will not be re-instated for work in radiation control areas without written approval from the Corporate HP.

7.9.4 If the source of contamination is not identified the SRSL will notify all personnel working in the area that contamination was observed and initiate additional radiological monitoring (e.g., static measurements, smears, air monitoring as required) during the next shift to identify the source of contamination.

7.10 The Corporate HP will document the results of the contamination investigation in a letter report describing the levels of contamination observed, the sources of contamination identified including measurements performed, and documenting any corrective actions implemented to prevent additional contamination of personnel and control the spread of contamination.

8.0 REFERENCES

- AP-005, *ALARA*, Cabrera Services Inc., Operating Procedure
- AP-007, *Bioassay Program*, Cabrera Services Inc., Operating Procedure
- AP-008, *Dosimetry Program*, Cabrera Services Inc., Operating Procedure
- AP-011, *Emergency Response*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-020, *Operation of Contamination Survey Meters*, Cabrera Services Inc., Operating Procedure
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

- Personnel and Clothing Contamination Report (Attachment A).
- All instrument logs containing inspections for serviceability, checks against check sources and calibration data as specified in OP-020.
- Letter report describing any observed contamination and documenting all investigations and corrective actions implemented to prevent additional contamination of personnel and control the spread of contamination.

10.0 ATTACHMENTS

Attachment A – Personnel and Clothing Contamination Report

Attachment A

Personnel and Clothing Contamination Report

PERSONNEL AND CLOTHING CONTAMINATION REPORT
(Page 1 of 2)

Contaminated Individuals Name:	Date:	Time:	RWP/Task #:
Project Name & Number:	Approx. surface area of contamination (cm^2):		Technician/Supervisor:
Approximate length of time that individual remained contaminated, including decontamination attempts:	**Type of Contamination:** ☐ Localized ☐ Discrete Particle ☐ Distributed		

Individual was wearing:

☐ Street Clothes ☐ Full Protective Clothing ☐ Lab Coat ☐ Scrubs

Probable Reason for Contamination (see attachment 1):

☐ Poor Work Practices ☐ Inadequate HP Controls ☐ Inadequate Protective Clothing

☐ Failure of Protective Clothing ☐ Contaminated PCs ☐ Perspiration Through PCs

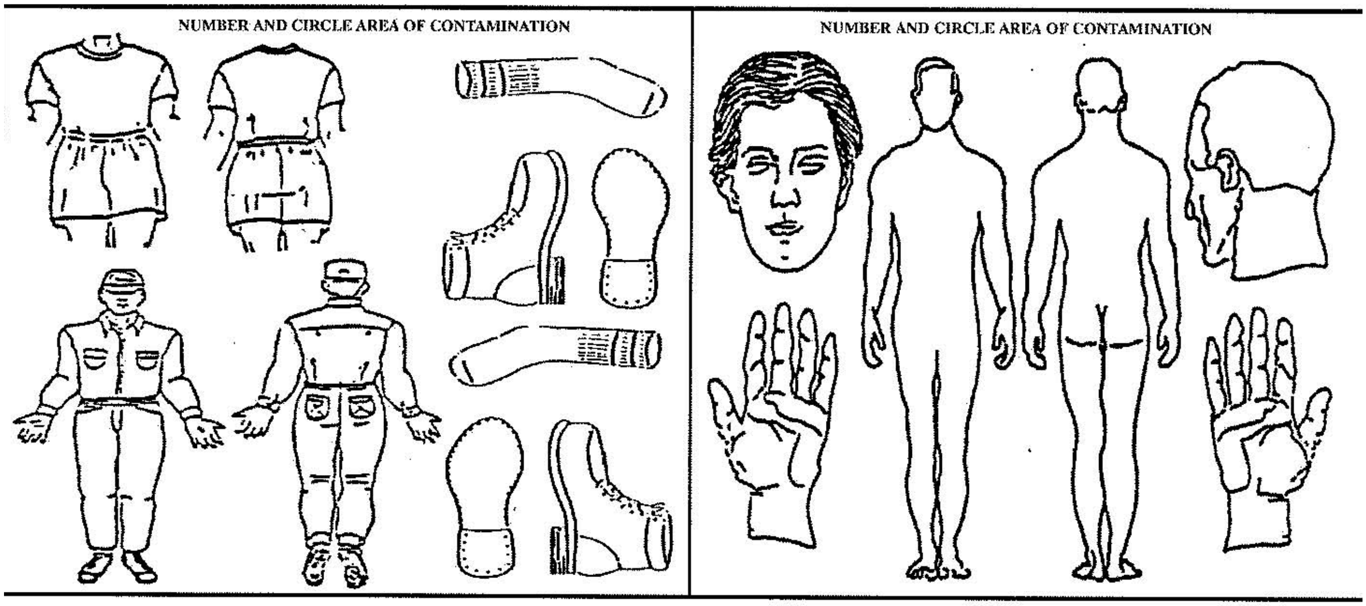
☐ Planned Contamination ☐ Accidental ☐ Spread From Adjacent Work Area

Contamination

Comments:
Acton Taken:

PERSONNEL AND CLOTHING CONTAMINATION REPORT
(Page 2 of 2)

☐ CLOTHING CONTAMINATION CONTAMINATION ☐ SKIN



If a discrete particle is on clothing, provide survey through clothing, if possible.

Location No (mark on diagram)	Counts per Minute (cpm)	1st Decontamination		2nd Decontamination		3rd Decontamination	
		Method	Results (cpm)	Method	Results (cpm)	Method	Results (cpm)

Instrument Type:	Serial No:	Cal Due Date:	Efficiency:	Background (cpm):
Instrument Type:	Serial No:	Cal Due Date:	Efficiency:	Background (cpm):

Disposition of clothing: ______________________________

____

____

Surveyed by: ______________________________
Print Sign Date Released

Reviewed by: ______________________________
Print Sign Date

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OP-500

Occupational Health & Safety
Management System

Effective Date
October 2013
Revision 4

Prepared By: ______________________
Sean Liddy, CSP
Occupational Health & Safety Manager

Approved By: ______________________
Alan Solow, CHP
Chief Executive Officer

Cabrera Services, Inc.
473 Silver Lane
East Hartford, Connecticut 06118

TABLE OF CONTENTS

1.0 SCOPE, PURPOSE, & APPLICATION

Cabrera Services Inc. (Cabrera) is a leading provider of environmental remediation services (radiological and chemical) for government and commercial clients. Cabrera believes that the safety and health of its employees is a critical element to business success and growth. Cabrera demonstrates its commitment to this fundamental responsibility by embracing Health, Safety and Enviornmental (HS&E) best practices as a Core Value.

This Occupational Health & Safety Management System (OHSMS), is based on proven management principles and practices and consists of an organized framework that is continually monitored, and periodically reviewed, in response to changing internal and external factors. The processes establish the minimum requirements for management involvement, responding to health, safety and environmental incidents, monitoring health and safety performance, and communicating with staff regarding their occupational health and safety obligations. It is meant to supplement the standards set by Cabrera's clients, state and federal regulatory agencies.

This Safety Management System is based on the four-step problem solving process of "Plan-Do-Check-Act" methodology which incorporates five major operational components:

Plan: HS&E Management will establish the objectives and processes necessary to deliver results in accordance with the OHSMS.

Do: Cabrera Operations management provides the resources, including human and financial, for implementing an effective OHSMS.

Check: HS&E management will monitor and measure processes against health, safety and environmental policies, objectives, legal and other requirements, and report the results.

Act: Cabrera Operations management and HS&E management will take actions to continually improve the OHSMS and its performance.

Through implementation of this OHSMS, Cabrera has established a uniform, systematic and cost-effective approach to administrating health, safety and environmental issues and concerns associated with Cabrera personnel and services. The OHSMS has been structured to align itself with the key elements of ANSI Z10 (American National Standards Institute), OHSAS 18001 (Occupational Health and Safety Assessment Series), ISO 14001 (the International Standard for Environmental Management Systems), and Regulatory Agency Requirements.

All Cabrera employees are responsible for maintaining compliance with the OHSMS and associcated safe Operating Procedures (OPs). Subject to the scope of a contract, elements of this OHSMS may be applied to subcontractors and equipment suppliers to maintain an adequate level of awareness, control and cooperation with Cabrera and our clients' needs.

Where there is potential for regulatory action against Cabrera or any of its employees or subcontractors, employees must notify Cabrera's Senior Management immediately.

2.0 TERMS AND DEFINITIONS

Acceptable Risk: A risk that has been reduced to a level that can be tolerated or effectively managed by the organization.

Audit: Systematic examination to determine whether activities and related results conform to established Cabrera policies and whether such policies have been implemented and are being effectively followed.

Compliance: Meeting statutory/regulatory requirements.

Conformance: Meeting the requirements of the Occupational Health and Safety Management System.

Contractor: A company or organization that performs on-site activities that are, or will be, governed by a contract between the client (not Cabrera) and that organization. In some cases, the contractor may also have the responsibility as the Prime Contractor, Construction Manager, Constructor, or other entity responsible for HS&E on-site.

Corrective Action: Action to eliminate the cause of a detected deviation from established policies and procedures.

Control Measures: Precautions and arrangements taken to eliminate or reduce hazards.

Emergency: An unplanned situation or event requiring the involvement of public emergency services or regulatory authorities.

Employee: A person who is employed by Cabrera or a contractor, to the organization, when that person is under the day-to-day direction and control of Cabrera.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from Cabrera's activities, products, or services.

Hazard: Any situation, condition or thing that may be dangerous to the health or safety of workers or could pose a risk of an accident or injury.

Hazard Assessment: A process by which workplace hazards are identified and evaluated. Existing and potential hazards are identified through inspections and/or during the proposal or planning stage of a project or task.

Health, Safety (HS&E): Health (Protection from occupational contaminants and diseases). Safety (Protection from unacceptable risk of harm). Environment (Protection from adverse impacts to the environment from Cabrera operations).

Occupational Health & Safety (OH&S) Manager: Supports operations, within Cabrera, that assist management personnel in controlling conditions and factors that affect the well-being of employees.

Health Safety & Environemtnal Performance: Measurable results of the OHSMS related to the organization's control of safety and health risks, and environmental impacts based on its policies and objectives.

Health Safety & Environment Policy Statement: Overall intentions and direction of an organization related to its OHSMS as formally expressed by Senior Management.

Incident: A work-related event which is unplanned, potentially harmful or damaging, and which may (1) result in personal injury, environmental impact, or loss; (2) may impact the reputation of Cabrera or its clients; or (3) may result in an investigation by a regulatory agency or an insurer.

Near Miss: A near miss or risk is the identified *potential* for an incident to occur, but which produces no visible injury or damage.

Non-conformance: Any deviation from work standards, practices, procedures, regulations, management system performance, etc., that could either directly or indirectly lead to injury or illness, property damage, damage to the workplace environment, or a combination of these.

Objectives: In terms of HS&E performance, goals that an organization or individual set out to achieve.

Occupational Health & Safety Management System (OHSMS): A set of interrelated elements that establish and/or support occupational health and safety policy and objectives, and mechanisms to achieve those objectives in order to continually improve occupational health and safety.

Personal Protective Equipment (PPE): Equipment or clothing worn by a person for protection from health or safety hazards associated with conditions at a work site.

Process: A series of actions, changes, or functions that bring about an end result.

Regulatory Agency: With respect to this document, a government agency with authority and jurisdiction over safety, health and/or environmental laws and regulations.

Regulatory Inspection: An inspection completed by a regulatory agency.

Risk: Combination of the likelihood and severity of the consequence(s) of a specified hazardous event.

Risk Assessment: Overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable.

Safety Inspections: Workplace, office or site inspections of work practices and controls as they apply to project or program specific HS&E requirements.

Senior Management: Officers of Cabrera with a title of Director or above who are expressly authorized to make management decisions for Cabrera.

Significant: In this context, used to denote those HS&E aspects, in relative terms, that warrant action by Senior Management.

Site: Any location where Cabrera employees perform work for Cabrera, whether or not owned by Cabrera, including, without limitation: offices, buildings, plant facilities, project sites or work sites.

Stakeholders: Individuals such as employees, client, suppliers, investors, and the public with a vested interest in the organization's achievements.

Stop Work Orders: A directive to cease work on a project, work site or in an office.

Subcontractors: A company or organization providing on-site activities that are or will be governed by a contractual arrangement between Cabrera (or its subsidiaries) and said company/organization involving hours worked by non-Cabrera employees and not directly controlled or supervised by Cabrera employees. This excludes office-based contract services (e.g. janitorial, copy machine, etc.) delivery/pickup services performed by mail, motor/rail/air freight carriers, and vendor vehicles. Subcontracted services include Subconsultant Services and Independent Contractors.

Supervisor or Project Manager: Management personnel who represent Cabrera at any office, project or worksite and who are responsible for overseeing all aspects of the work performed and maintaining compliance with HS&E Policy and Procedures.

Target: A target is a detailed performance requirement derived from a goal or objective.

Temporary Employee: Individuals hired on a temporary basis to perform a limited task under the direction of a Cabrera employee. All temporary employees must provide proof of workers' compensation coverage.

3.0 MANAGEMENT LEADERSHIP AND EMPLOYEE PARTICIPATION

3.1 Management Leadership

Effective protection from occupational hazards takes leadership and a commitment from senior management. Management leadership provides the motivating force and the resources for organizing and controlling activities. The Senior Management at Cabrera regards worker safety and health as a fundamental (Core) value of the organization.

Senior Management will be visible in the implementation of the OHSMS, through leading by example, being knowledgeable of the contents of the OHSMS, being involved in the Safety & Quality Council (SQC, Section 5.16) meetings on a regular basis, and being accessible to employees. Leadership will be provided by assigning and communicating responsibility, authority and resources to responsible parties and holding those parties accountable. In addition, they will ensure that employees are encouraged to report hazards, symptoms, injuries and illnesses, so that prompt corrective actions can be implemented.

3.2 Health Safety & Environment Policy Statement

A policy statement which outlines Cabrera's commitment to HS&E has been developed and signed by Cabrera's President and CEO. This policy has been communicated to all employees and is posted at each permanent and temporary office (project) site. An electronic version of this policy is also available on Cabrera's intranet.

This policy will be formally reviewed, on an annual basis, as part of the Management Review process. Interim changes may be made if substantial changes occur in legislation, organization and/or other business drivers.

3.3 Roles and Responsibilities

Cabrera is committed to establishing an organizational structure that defines roles, responsibility, authority and accountability necessary to effectively manage the HS&E function and to define and provide the resources needed to implement and sustain the OHSMS.

Primary responsibility for HS&E performance belongs to operational management. Technical assistance, hands on support, guidance, and monitoring are provided to Operations by the OH&S Manager. The roles and responsibilities assigned to personnel for a project site are defined within the site-specific planning documents prepared for each project.

3.4 Employee Participation

Employee involvement provides the means through which workers develop and express their own commitment to safety and health, for both themselves and their fellow workers. All Cabrera employees, especially field staff, are the persons with the greatest potential for contact with health and safety hazards and have a vested interest in effective protection measures.

Employees are encouraged to offer their ideas for continuous improvement of the OHSMS and are more likely to support and use processes to which they have input.

Employee participation in the Safety & Quality Council (SQC) and other group discussions/meetings about the safety system will allow management leadership to better understand employee's needs, and work with the OH&S Manager to make the appropriate changes to the HS&E Manual.

Employee participation will also be measured through compliance with the following:

- Training
- Fixing hazards within their control
- Providing co-workers feedback on risks and hazard elimination
- Performing hazard analysis and preparing safe work practices or implementing controls prior to participating in new/different activities; and
- Prompt reporting of all unsafe conditions with potential to present an unacceptable risk of harm.

Additional goals and objectives, to further encourage employee participation, may be established by Senior Management and incorporated into annual performance reviews.

3.5 HS&E Guiding Principles

Cabrera's Senior Management has developed "HS&E Guiding Principles" to help employees understand and implement Cabrera's HS&E Policy and achieve the HS&E Core Values.

The HS&E Guiding Principles are:

- **Compliance** - We will comply with all relevant and applicable rules and regulations pertaining to HS&E issues, as well as those voluntary requirements to which we subscribe.
- **Leadership** - Management will be directly involved in the OHSMS. All supervisors will lead by example and through appropriate decision-making.
- **Involvemen**t - All employees will be encouraged to provide continual feedback on the effectiveness of our existing processes and to provide recommendations for the development of new ones that can advance our OHSMS.
- **Risk Management -** We will only undertake activities that we have evaluated thoroughly from an HS&E risk standpoint. Where risks are identified, we will develop and implement appropriate controls to reduce the possibility of injuring people, damaging property, or impairing the environment**.**
- **Resources** - We will provide the necessary human, financial and material resources to implement, maintain and monitor the Cabrera OHSMS.
- **Training** - We will provide thorough and effective training programs to employees. Our management teams will evaluate the training needs for all projects and only assign competent personnel.
- **Work With Others** - We will assess the competencies and capabilities of our contractors, suppliers, vendors and partners prior to selecting them to perform work on our behalf. We will also monitor their implementation of

HS&E processes during all phases of their activities.

- **Performance** - We will establish short- and long-term performance targets relative to HS&E and regularly report our progress toward these goals to our employees and other stakeholders.
- **Assessment** - We will routinely assess our processes at the corporate, business unit and individual project levels to enable continual improvement.
- **Reporting** - Every employee is expected to report any occupational injury, illness, environmental release, near-miss incident and property damage incident in a timely, open and thorough manner. Information gained from this reporting will be communicated throughout the organization to enhance our ability to prevent future incidents.
- **Sustainability** - We will promote environmental sustainability through the efficient use of energy, conservation of natural resources, and prevention of pollution through reuse, recycling, and reduction whenever practical throughout our company.
- **Industry Leadership** - We will work with clients, partners, suppliers, competitors and regulators to raise the HS&E standards of our industry.

4.0 PLANNING

4.1 Project Review Process

Cabrera has established a detailed Project Review Process that plans and delivers projects while effectively controlling risk. This review process requires significant involvement from various levels of the organization and departments and is comprised of both initial and on-going reviews conducted throughout the lifecycle of a project. A discussion of this process follows:

4.1.1 Business Development: The OH&S Manager participates in key regional marketing meetings, and coordinates with regional market segment managers to provide guidance on key HS&E issues associated with specific client needs and company pursuits. In this way HS&E-related issues can be adequately incorporated into proposals, subcontractor agreements and equipment supplier purchases upon the receipt of a request for proposal (RFP).

4.1.2 Project Risk Assessment: Projects that have the potential for a specific risk (e.g. working with hazardous materials, project safety responsibilities for non-Cabrera employees) require senior management review, input, and approval. All projects are developed, planned and executed by Program/Project Managers with Senior Management input. This process is supported by the Cabrera OH&S Manager for issues involving safety, health and/or environmental risks. Once a project is approved by Senior Management, the Program/Project Manager can instruct his/her team to proceed with the project planning documents.

4.1.3 Project Specific Hazard Analysis and Planning: Every Cabrera project with work outside of an office setting must have, at a minimum, a hazard analysis in place that effectively deals with known or anticipated hazards and provides for emergency response and evacuation, as needed.

Every worksite requires a hazard assessment which identifies and classifies existing and potential hazards and identifies controls required to mitigate identified hazards. This is called an Activity Hazard Analysis (AHA).

In addition, high risk activities, complex projects, or regulated sites must have a Site-Specific Safety & Health Plan (SSHP) reviewed and approved by the Program/Project Manager and, as appropriate, the OH&S Manager prior to the start of activities. All site employees involved in field work must read and acknowledge compliance with the SSHP and AHAs as required for their designated tasks, prior to performing work.

4.1.4 Subcontractors Hazard Analysis and Planning: Subcontractors are responsible for generating their own project-specific hazard analysis that addresses their specific HS&E issues. Subcontractors are solely responsible for evaluating the hazards and potential hazards to their employees and shall adhere to their own hazard analysis. However, subcontractors shall be required, at a minimum, to follow all HS&E requirements established in the Cabrera project-specific hazard analysis.

4.1.5 Contractors Hazard Analysis and Planning: Prior to the start of site activities, Program/Project Managers are responsible for coordinating with other project site contractors to minimize the potential for conflicting plan elements. Cabrera's project hazard analysis (and appropriate planning documents) will be distributed to other site contractors, when theire is a potential for overlap of work activities.

4.1.6 Continuous Risk Management: Projects that present a significant risk or impact to Cabrera may require monthly management reviews for the life of the project. The OH&S Manager will participate in this process and routinely review and evaluate project-specific risks and the effectiveness of the implemented control strategies through the project-specific safety plan, HS&E audits, incident reviews and additional HS&E data generated by the project.

4.2 Access to Applicable Codes, Regulations and Standards

Cabrera is committed to remaining current with, and maintaining access to, relevant national, state, provincial and local environmental, occupational health and safety laws, legislation and regulations and other requirements. In addition to regulations, many of our services require access to, and knowledge of, consensus standards established by many non-governmental agencies.

Management procedures provide a practical means of identification and access to current legislation and information on proposed legislation. Information is communicated internally to provide an awareness of legal obligations. Responsibility and authorities are defined to achieve and maintain statutory and regulatory compliance.

4.3 Client Requirements

Many of Cabrera's clients have additional HS&E requirements specific to their needs and operations that must be addressed. In order to comply with those requirements, Cabrera may develop client-specific manuals, programs, procedures, training and/or documentation to effectively implement and manage these special requirements. Identification of client HS&E requirements occurs during the project risk assessment phase and project teams are responsible for complying with client HS&E requirements where they exceed Cabrera standards.

4.4 Objectives and Targets

HS&E objectives and targets are established for all relevant functions and are compatible with Cabrera's overall business plan. Implementation of the objectives and targets are coordinated within the Cabrera management processes that define responsibility and timeframes for completion.

At a corporate level, Cabrera will establish performance targets using numerous indicators, such as:

- Regulatory citations and Notices of Violation (NOV),
- Recordable Injury Rate (RIR),
- Experience Modification Rate (EMR),
- Lost time incidents, and
- Days away from work.

At the operations level, Cabrera will establish targets using the performance indicators and activity objectives listed above, and in addition:

- Project management reviews, and
- Staff interviews.

At the employee level, Cabrera will establish targets using performance indicators and activity objectives, such as:

- training needs assessment,
- HS&E training compliance, and
- Observation and Near Miss reporting.

5.0 IMPLEMENTATION AND OPERATION

5.1 Risk Assessment and Determining Controls

Cabrera is committed to managing services and activities that pose a potential risk to our employees' safety and health or impact the environment. Thorough risk assessments will be conducted prior to starting any project through the preparation of the required planning documents, by the project teams, using the most relevant, current, and applicable data known about the site, with the OH&S Manager input on technical guidance regarding controls.

These documents must be reviewed and approved by both the responsible Program/Project Manager and the OH&S Manager.

5.2 Hierarchy of Controls

The OHSMS evaluates, manages and controls potential risks through the following safety hierarchy:

- Recognition
- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

The SSHP and/or AHA prepared for the overall project Scope of Work will outline the hazards and the controls to be implemented in an effort to eliminate, or reduce the potential for incident, in accordance with the hierarchy above.

5.3 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions. Whenever any employee determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. This shall be immediately binding on all affected Cabrera employees and subcontractors.

Upon issuing the stop work order, the employee shall consult with the appropriate management staff and supervisors to implement corrective actions. Resumption of safe operations is the primary objective and the OH&S Manager should be consulted to ensure workplace conditions meet acceptable safety standards. Every employee has the ability to STOP WORK if they feel unsafe, or uncertain, of any aspect of work, as it relates to safety.

5.4 Management of Change

Hazard controls are outlined in the HS&E planning documents to verify that the HS&E aspects of operations are managed appropriately and serve to mitigate the risk of harming personnel, property, and the environment. However, at the time of execution, conditions may have unexpectedly changed, requiring the use of new/different tools, equipment, or procedures. When conditions change, or are altered from the prescribed plans, employees must be cognizant of this, and stop work to reassess the hazards posed by such changes.

Consultation with the Program/Project manager and the OH&S Manager will be conducted, when necessary, to ensure the appropriate controls are prescribed and planning documents revised/amended to accommodate the necessary change. Any changes should be discussed during the review of the documents with affected staff during daily safety meetings.

5.5 Safe Operating Procedures

Cabrera will establish and maintain a series of Safe Operating Procedures which guide operations in the safe work practices and safe job procedures during their daily functions.

OHSMS safe Operating Procedures, or the 500 series Operating Procedures (OPs) are considered administrative controls and are an integral part of the OHSMS. The Ops describe how operations are to be carried out, including responsibility, authority, planning, communications, work programs and methods. They are written for operations to maintain ongoing compliance with the OHSMS.

Forms and Documents: Forms and documents essential to the OHSMS are carefully generated, managed and catalogued electronically as part of the individual OPs. They demonstrate compliance with HS&E Policy, OPs, legal and other requirements. Some examples of forms and documents include:

- HS&E Audit Reports
- Incident Investigation Reports
- Injury/Illness Records
- Medical Surveillance Records
- HS&E Training Records
- Respirator Fit Testing Records
- Exposure Monitoring Results

5.6 Procurement

Upon purchase of any product or material to be used on a project site, a Safety Data Sheet (SDS, or Material Safety Data Sheet - MSDS) must be obtained and evaluated. Through the hazard analysis process, the safety and health risks associated with all purchased products, raw materials, and other related services will be evaluated and recommended controls included into the hazard analysis for the particular task or project.

5.7 Subcontractors

Expectations for HS&E performance are communicated to subcontractors and equipment suppliers, mainly through the obligations set forth in our subcontract agreements with such parties. Subcontractors shall be evaluated for their overall safety performance, for a period of no less than three years prior experience, in an effort to make a determination of their ability to actively contribute to a safe working environment while under contract to Cabrera.

Cabrera considers each subcontractor to be an expert in all aspects of the work operations for which they are tasked to provide, and each subcontractor is responsible for compliance with the regulatory requirements that pertain to those services. Each subcontractor is expected to perform its operations in accordance with its own unique safety policies and procedures, in order to ensure that hazards associated with the performance of the work activities are properly controlled.

Subcontractors and suppliers involved with field work are provided with copies of the project hazard assessment for their projects. In addition to this, Cabrera may, at its discretion, supply guidance notes to subcontractors and equipment suppliers to aid compliance with this OHSMS. However, this general guidance does not relieve the subcontractors and suppliers from their primary responsibility for performing services and providing materials in a way that does not create HS&E risks.

5.8 Emergency Preparedness and Response

Each office and project site is to have a written site-specific emergency action plan which identifies potential emergency situations, alarm systems, external emergency response agencies, shut-down procedures, location of emergency equipment, personal protective equipment, how to obtain medical treatment, personal decontamination, accountability of personnel, and temporary sheltering of employees.

Some project operations may also require Cabrera employees to perform an actual response to an emergency situation, in which case more extensive emergency response training and equipment are provided. Emergency action plans for office locations are evaluated annually and are reviewed prior to the start of all project site operations.

The Cabrera Senior Management team will coordinate appropriate actions and communications in order to minimize the impact of a pandemic, property loss, or other catastrophic event on staff health and business operations.

5.9 Modified Duty

Cabrera supports a Modified Duty process for all of its employees.

A Modified Duty process is designed to return injured employees to the workplace, as quickly as possible, by providing modified duties or meaningful alternative work for the injured employee. This is maintained until such time as the employee can function in, and return to, their regular duties.

5.10 Medical Surveillance and Information

Employees who are assigned specific tasks working in proximity to hazardous waste, materials or substances will be required to enroll in Cabrera's Medical Surveillance Process based on regulatory, client, and internal requirements.

Employees have the right to accept or deny enrollment into this process, provided it was not a condition of their employment. An employee choosing not to participate in the process may be restricted from working in certain locations or on certain projects requiring medical surveillance.

5.11 Personal Protective Equipment

Cabrera will provide the personal protective equipment (PPE) where and when it is required by federal or state legislation, workplace hazards, and/or site specific rules of the contractor or client. Cabrera employees must wear all required PPE and are responsible for the inspection, care, and maintenance of PPE assigned to them.

Employees must immediately correct or report any problems, damage or loss of this equipment. Supervisors must verify that employees have been trained, and know how to use the appropriate PPE for each job and work site.

5.12 Training

All Cabrera employees shall receive training on Cabrera's HS&E Policy and safe Operating Procedures for their job assignments, as well as complying with applicable regulations, codes, and standards upon intial hire, and at a frequency determined within the individual Operating Procedures for the subject matter, or overall training program. In particular, employees shall be trained to recognize, evaluate and manage the risks associated with their current position. Employees shall receive training in:

- Compliance with applicable HS&E regulations and Cabrera's specific requirements,
- Fulfilling HS&E responsibilities, and
- Understanding how their actions can influence HS&E performance.

Cabrera provides the necessary HS&E training for all employees to safely perform their work and employees will be assessed for their job specific training by their supervisors. Employees and their supervisor must annually review the common work tasks that are listed in the HS&E Training Needs Assessment to determine the tasks the employee will be required to perform and request enrollment into the appropriate safety training program. Employees must not perform tasks without completing the appropriate training.

Cabrera will provide training to meet HS&E requirements and track the completed training to confirm that staff are adequately trained for the duties they are required to perform. Different levels of training will be provided to employees based on the functions of their job duties, and will include both ***awareness level*** and ***performance-based level*****s** of training, where applicable. Training will be conducted through one or more of the following means:

- Formal and informal instruction,

- On-the-job training, and
- Attendance at technical and professional seminars and conferences.

Cabrera defines competently trained staff as those that have the ability, through the combination of education and experience, to apply knowledge and skill to achieve the intended results of the OHSMS. Cabrera will ensure that only competently trained staff will be assigned to critical functions such as Site Safety & Health Officers (SSHOs) and other task-specific safety supervisory roles.

5.13 Project Site Orientation

Cabrera employees assigned to a project site receive an initial Project Site Orientation that introduces the employee to the site, client-specific requirements, and the project hazard assessment. Additionally, specific hazards of the project may be explained as well as the resources dedicated to mitigate the hazards.

5.14 Project/Employee Safety Meetings

Cabrera employees performing work at a project site are required to participate in routine safety meetings in accordance with the project hazard assessment. A sign-off sheet recording the date, subject(s) covered, presenter and names of attendees is required to be generated after each project safety meeting. Office employees are also required to participate in routine employee safety meetings, as appropriate.

5.15 Communications

Cabrera will maintain effective communications relevant to HS&E both internally and externally, and we will solicit and encourage input from employees and other interested parties. Cabrera's OH&S Manager will communicate with employees to keep them informed, share lessons learned, hear about concerns, keep safety at the forefront of day-to-day operations and inspire a culture of safety within Cabrera.

Communication bulletins as listed below will be issued by or from the Senior Management, local safety committee or OH&S management, as appropriate, and for the greatest impact. Leaders will be expected to regularly communicate to their teams about safety.

- **Internal Communications:** Internal communications are established between management levels to maintain awareness and understanding of HS&E Policy, safe Operating Procedures and to provide a pathway for feedback of operational experience and HS&E performance. Internal HS&E communications will be maintained through direct, electronic and written media. Communications will be coordinated through the OH&S Manager and, as appropriate and necessary, corporate communications. Communications relevant to HS&E will include, but not be limited to: Lessons Learned, Safety Awareness, Incident Investigations, and revised and/or new HS&E Procedures.
- **Employee Participation:** Cabrera employees are provided the opportunity to participate and have frequent and open HS&E communications at all levels of the organization, as previously discussed in Section 3.4. Employees are to

be asked for their input at projects, meetings and during training sessions. Employees will have the option to anonymously communicate any HS&E concern.

- **External Communications – Stakeholders**: While sharing of information is very common amongst various contractors, and ultimately encouraged, some level of due diligence should be exercised prior to passing along information from external parties. Communications related to HS&E received from stakeholders should be forwarded to Cabrera's OH&S Manager for recording, directing and response generation, if deemed necessary.

5.16 Safety & Quality Council

Cabrera and the Occupational Health and Safety Act in many jurisdictions require that a health and safety committee is established to encourage the active participation of employees in the prevention of incidents and the promotion of health and safety activities in the workplace. As such, Cabrera has established the corporate Safety & Quality Council to outline and discuss topics relevant to the implementation, performance, and improvement of the OHSMS.

The Safety & Quality Council is an independently chartered group working to disseminate information, assist in the implementation of best practices, and raise individual awareness with both safety and quality, helping to achieve the overall goal of a corporate safety culture. Employee participation in the council helps to assist with education and dissemination of the OHSMS throughout the organization.

5.17 Document Control

Cabrera will verify that documentation associated with the OHSMS is under effective management control, and document formats used are approved by the OH&S Manager prior to issuance. The prefix OP will designate a safety, health, or environmental document that relates to an aspect of the OHSMS.

HS&E safe Operating Procedures shall identify documents required to be controlled and define authorization, generation, availability, approval, updating and storage of such documents. In addition, HS&E documents shall be controlled in accordance with Cabrera's Records Retention Policy and Quality Management System.

6.0 EVALUATION AND CORRECTIVE ACTION

The following section describes the processes that Cabrera utilizes to continually check and assess the effectiveness of the OHSMS.

6.1 Monitoring, Measurement & Assessment

HS&E performance data is collected, reviewed and assessed to monitor conformance with HS&E Policy, safe Operating Procedures, objectives and targets, and to confirm legal compliance.

Cabrera has established methods to measure and monitor OHSMS performance and effectiveness on a regular basis. OHSMS performance is measured through a set of metrics of lagging and leading indicators. Examples of some of these indicators include the following:

Lagging Indicators (follows an event, indicating failure to prevent injury/illness)

- Work-related injuries and illnesses
- Lost time cases
- Incidents
- Workers' compensation costs
- Regulatory inspections and citations

Leading Indicators (precedes an event, indicating positive efforts towards preventing injury/illness)

- Exposure monitoring
- Completed Task Hazard Analyses
- Completed Project Review
- Completed office or site inspections
- Internal & External HS&E audits
- Near miss and safety observations reporting and investigation
- Completed Training Needs Assessment
- HS&E Training completed

The OH&S Manager will identify trends and generate reports for both leading and lagging indicators. These reports will be distributed to the appropriate operations management levels for review and consideration for distribution.

6.2 Incident Reporting

All work-related injuries, illnesses, and near-miss situations, including environmental impacts, vehicular incidents, instances of permit non-compliance, or citation by a regulatory agency must be immediately, verbally reported by the employee, or their designee, to their Supervisor and Project Manager.

The Supervisor and/or Project Manager shall immediately notify the Cabrera OH&S Manager, and the incident reporting procedures and any required incident investigation process will immediately ensue. Notification proceses will include the appropriate Senior Manager (Director Level) and include notification to Executive Management, including the CEO.

6.3 Incident Investigation

Investigation results will attempt to identify the systemic root causes and result in the development of corrective actions aimed at preventing a reoccurrence of the incident. Management must ensure corrective actions are completed in a timely manner, and complete the required internal and external reports.

The Cabrera Program/Project manager must initiate an incident investigation, invite the appropriate participants to the investigation proceedings, and coordinate an investigation review call. The OH&S Manager will be a participant in all Incident Investigations. Notification to, and inclusion of Executive leadership, including the CEO, will included in theis process.

An incident investigation may also require attendance by any or all of the following Cabrera employees: Senior Management, a designated member of the Safety & Quality Council (or local HS&E Representative), or by the Supervisor of the staff who was involved in the incident.

6.4 Internal Audits

As part of the OHSMS, Cabrera has established procedures to continually monitor and measure the effectiveness of HS&E Policy and Safe Operating Procedures, and determine when action is needed to improve upon the Objectives and Targets used to establish performance expectations.

Audits are an essential independent check on the effectiveness of the OHSMS. Formal and informal audits are performed at Cabrera offices, sites and projects on a regular basis. Audits are performed to certify the organization’s conformance with HS&E Policy, safe Operating Procedures, Objectives and Targets and effective functioning of the OHSMS.

6.5 Management Audits

The Program/Project Manager is responsible for conducting regular and ongoing inspections and surveillance of active projects under their respective purview. Corrective and preventative actions shall be immediately taken for any identified deficiencies. The OH&S Manager conducts inpections and audits of offices, sites and projects.

The results of audits are communicated to Cabrera Senior Management, Program/Project managers and supervisors to confirm areas of non-conformance and to facilitate the implementation of corrective actions.

6.6 Inspections

Inspections are an integral part of the OHSMS. They are used to identify and recommend controls for existing and potential hazards in the workplace. Every office will coordinate office inspections, on a regular basis or more frequently if required by local legislation.

Project supervisors must conduct, at a minimum, formal monthly safety inspections on active project sites, carry out ongoing informal visual inspections and correct any identified deficiencies in their assigned work areas.

6.7 Preventive and Corrective Action

The OHSMS includes procedures to identify and control several types of non-conformance. Responsibility and authorities are defined for taking preventative action to control potential non-conformance and for initiating and completing corrective actions to eliminate the causes of non-conformance.

The OH&S Manager will work with supervisors and managers to identify and implement preventive and corrective actions on HS&E-related issues, including changes to practices and procedures. Priority for the allocation of resources is related to the magnitude of the non-conformance and the need for mitigation.

6.8 Feedback to the Planning Process

An essential component to the continual improvement of the OHSMS is the feedback to Senior Management and the OH&S Manager with regards to the planning and document preparation processes. This communication loop is encouraged in several different ways, including direct communication with Senior Management and the OH&S Manager, anonymous comment cards, and the Observation & Near Miss reporting process. Feedback received from employees will be responded to either in writing, or verbally, with the identified party, where applicable.

7.0 MANAGEMENT REVIEW

7.1 Management Review Process

An annual Management Review is conducted to evaluate the performance results of the OHSMS and to approve Objectives and Targets for the next fiscal year. The meeting is chaired and attended by Senior Management, Corporate OH&S Manager and key Program/Project Management staff.

The Corporate OH&S Manager generates and presents a summary report of the OHSMS performance results for the fiscal year. Senior Management reviews data to determine continuing suitability, adequacy and effectiveness, provide input, and come to consensus on any corrective actions.

7.2 Management Review Outcomes and Follow-up

The Management Review may consider all relevant HS&E issues to determine the need for change and continuous improvement. Any changes to HS&E Policy, safe Operating Procedures, Objectives or Targets may arise due to circumstances, including:

- New or developing concerns of clients and stakeholders,
- New or revised statutory/regulatory requirements, or
- Availability of improved technology to address HS&E risk.

Additional Management Reviews may be held at any time if special circumstances arise. For example, major restructuring of operations or management responsibilities, new processes that introduce significantly new HS&E risks, major external concerns from stakeholders, or statutory/regulatory obligations.

8.0 APPENDICES

8.1 OHSMS (safe) Operating Procedures

500 Series – OHSMS Manual Management
OP-501- Organizational Roles & Responsibilities
OP-502- OHSMS Assessment & Auditing
510 Series – HS&E Essentials
OP-511- Safe Work Standards
OP-512- Incident, Near Miss & Observation Reporting
OP-513- Incident Investigations
OP-514- HS&E Training
OP 515 – Emergency Management Planning
OP 516 – Fire Protection
OP-517- Hazardous Materials Communication
OP 518 - Housekeeping
OP-519- Manual Lifting
OP-520- Driver and Vehicle Safety
530 Series - Medical Management
OP-531- First Aid & Medical Services
OP-532- Medical Surveillance
OP-533- Modified Duty
OP-534- Drug Free Workplace
540 Series - Office
OP-541- Office Safety
OP-542- Ergonomics
550 Series - Project Management
OP-551- Project Planning
OP-552- Subcontractors
OP-553- Site Safety & Health Officer
OP-554- Competent Persons
OP-555- Safety Meetings
OP-556- Project Safety Inspections
OP-557- Regulatory Inspections
560 Series - Field (Basics)
OP-561- Personal Protective Equipment
OP-562- Respiratory Protection
OP-563- Heat Stress Prevention
OP-564- Cold Stress Prevention
OP-565- Hearing Conservation
OP-566- Hand and Power Tools
OP-567- Electrical Safety
OP-568- Ladder Safety
OP-569- Working Alone
OP-570- Spill Response,
580 Series – Field (Specifics)
OP-581- Radiation Safety – Refer to OP 000 Series, Radiation Protection Procedures
OP-582- Confined Spaces
OP-583- Excavation and Trenching

OP-584- Heavy Equipment Operations
OP-585- Fall Protection
OP-586- Traffic Safety
OP-587- Water Operations
OP-588- Drilling and Boring
OP-589- Utility Clearance and Isolation
OP-590- Elevated Work Platforms
OP-591- Scaffolding
OP-592- Forklifts
OP-593- Hazardous Energy Control
OP-594- Hot Work Operations
OP-595- Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO)
OP-596- Hazardous Materials (HzM) & Dangerous Goods (DG) Shipping

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

INCIDENT, NEAR MISS & OBSERVATION REPORTING

OP-512

Revision 1

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

11-18-13
Date

Approved by:

Alan Solow
Chief Executive Officer

11/18/2013
Date

1.0 PURPOSE

To document and report all Health Safety & Environmental (HS&E) incidents in a timely and accurate manner, allowing Cabrera Services Inc. (Cabrera) to gather appropriate lessons learned from incidents and ensure that information for regulatory reports is generated and/or filed, as required for compliance.

2.0 APPLICABILITY

This procedure applies to all Cabrera employees and operations.

3.0 DEFINITIONS

3.1 Health Safety & Environmental (HS&E) Incidents - The following events or situations, as applied to Cabrera employees and/or Cabrera-controlled operations, are considered HS&E Incidents:

- Any injury to or illness (including pain and soreness) of an employee, that could be potentially work related or become aggravated by the work environment. This includes Cabrera subcontractors, temporary employees or third party contractors, performing work under the control of a Cabrera operation.
- Fire, explosion, or flash that is not an intended result of a remediation process, laboratory procedure, or other planned event.
- Any accidents involving company-owned, rented, or leased vehicles (including personal vehicles used for company business).
- Any failure to obtain a government permit or consent when required (including failure to obtain revisions before an existing permit or consent expires).
- Any breach of a numeric limit attached to a governmental permit or consent.
- Any failure to perform the obligations of a non-numeric requirement contained in a government permit or consent.
- Any notice of violation or notice of non-compliance received from a regulatory authority with enforcement powers.
- Property damage resulting from any Cabrera or subcontractor activity.
- Unexpected release or imminent release of a hazardous material.
- Unexpected chemical exposures to workers or the public.

- A safety, health or environmental complaint from the public regarding Cabrera activities that could result in adverse public media interest concerning Cabrera.

- Any inspection by a federal, provincial, or local safety, health, & environmental enforcement agency conducted for reasons of enforcement.

3.2 Serious HS&E Incident - Any HS&E Incident that meets/involves the following:

- Any amputation.

- Hospitalization for treatment (admission).

- Absence from work for more than 30 calendar days due to a work-related injury or illness.

- Any single event resulting in more than one employee requiring medical treatment.

- Any Health & Safety or environmental-related Consent Agreement/Order/Lawsuit or enforcement action seeking more than $10,000 in damages or alleging criminal activity.

- Any spill or release of a hazardous material that is reportable to a government agency.

- Any Notices of Violation.

3.3 Near-Miss Incidents - Defined as an incident having the potential to cause injury, health effects, environmental impairment, or property damage as described in the above categories – but did not. For example:

- A crane drops its load during a lift – and nobody is hurt, no equipment is damaged.

- During a drilling operation, preclearance of the borehole reveals a previously unmarked underground utility line.

- Employee involved in motor vehicle incident in which there is no injury or damage to vehicle, or others.

- Unsafe condition that could have caused an incident if not corrected.

3.4 Observation – Observations are Near Misses that originate from a third party in which Cabrera is not directly contracted (Client or subcontractor relationship) or are conditions/behaviors observed by employees regarding safety. Observations may be positive (noting proactive measures/controls) or constructive (areas in need of improvement) in nature. These are referred to as At-Risk Conditions or At-Risk Behaviors.

If an employee observes others working in an unsafe condition, it is the responsibility of the employee to temporarily Stop Work and discuss the situation with the affected parties. Unsafe behaviors or conditions should be discussed in a constructive manner and corrective actions implemented before work resumes Examples of Observations are as follows:

- Cabrera employee observes and Incident or Near Miss of a third party contractor at a project site.
- Awareness of an equipment recall or incident that occurs at another similar worksite.
- Cabrera employee observes co-worker or subcontractor reviewing AHA prior to initiating new task (Positive Observation).
- Cabrera employee observes co-worker or subcontractor initiating proactive safety measures to prevent potential harm to personnel or environment (Positive Observation).
- Cabrera employee observes co-worker or subcontractor performing work in unsafe manner (At-Risk Condition or At-Risk Behavior) where there is perceived potential harm to employees, by-standards, or environment (Constructive Observation).

3.5 Lesson Learned - A learning experience originating from and Incident or near-miss that the affected group (i.e. project team, office staff, etc.) believes could have wide-ranging impacts throughout the organization.

3.6 Fatality – For the purposes of this procedure, the loss of life of any Cabrera employee, subcontractor personnel, client personnel or member of the general public that can be perceived to be related to work performed or controlled by Cabrera.

3.7 General Liability - Incidents where Cabrera could potentially be held financially responsible or legally accountable for damages as a result of an incident.

3.8 First Aid - Specific medical treatment defined to include the following:

- Using nonprescription medication at nonprescription strength.
- Administering tetanus immunizations.
- Cleaning, flushing or soaking wounds on the surface of the skin.

- Providing wound coverings such as bandages, Band-Aids™, gauze pads, etc.; or using butterfly bandages or Steri-Strips™.
- Administering hot or cold therapy.
- Providing any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc.
- Temporary immobilization while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.).
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister.
- Providing eye patches.
- Removing foreign bodies from the eye using only irrigation or a cotton swab.
- Providing finger guards.
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means.
- Administering massages.
- Drinking of fluids for cooling or re-hydration.

3.9 Recordable Injury - Medical treatment beyond First Aid.

3.10 Lost Time Days - The total number of days the injured person accumulates before returning back to regular duties.

3.11 Lost Time Injury or Disease - A work-related injury or disease that has caused a worker to be absent from his or her regular work following the day that the injury or awareness of the disease occurred.

3.12 Restricted (Modified) Work - When an injury is medically treated, but the person is not able to return to regular duties, restricted duties are assigned based on the limitations of the injured person's ability to perform them (documentation may be required per regulatory requirements).

3.13 Restricted Work Days - The total number of work days the injured person accumulates before being able to return to regular duties.

3.14 Incident Report - Form used to document incidents. The form must be completed within 24 hours after an incident.

3.15 <u>WC Carrier</u> - Workers Compensation Insurance Carrier.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 All incidents, regardless of type or severity, shall be reported to the on-site supervisor immediately.

4.2 All incidents, regardless of type or severity, shall be reported to the OH&S Manager, by the supervisor, as soon as possible but no later than the end of the current work shift.

4.3 Completed Incident Reports shall be submitted to the OH&S Manager within 24 hours.

4.4 Fatalities and serious HS&E incidents shall be reported to the OH&S Manager as soon as reasonably possible but no more than two hours after the incident.

4.5 Where there is potential for criminal, civil or regulatory action against Cabrera or any of its employees or subcontractors, Senior Management shall be contacted prior to any external communication, correspondence, or meeting concerning any incident, governmental investigation, or environment impact.

5.0 EQUIPMENT

There is no equipment associated with this procedure.

6.0 RESPONSIBILITIES

6.1 <u>Employees</u> - Each employee involved in an HS&E incident will:

- Notify his/her supervisor immediately that an incident (including a near-miss) has occurred, the circumstances involved, the nature and extent of the injuries/illness, and whether medical treatment may be required.
- Except for emergency situations, affected employees are required to discuss their injury/illness status with their supervisor and OH&S Manager or Site Safety and Health Officer (SSHO) prior to obtaining medical treatment.
- Assist supervisor in completing appropriate reporting and investigation forms. If issues are raised regarding the content prepared in the Incident Report, contact the OH&S Manager for guidance.

6.2 <u>Supervisors</u> - In an incident involving an employee, supervisors will:

- Use the appropriate local emergency phone numbers listed in the site specific safety and health plan and seek immediate medical care for the employee.

- Address any immediate corrective actions needed. Consult with the OH&S Manager if guidance is required.
- Call the OH&S Manager as soon as the situation is stabilized, but not later than the end of the current work shift.
- Complete the applicable forms (Cabrera Incident Report and applicable project/client specific forms) and email to appropriate Senior Manager (Director Level) and OH&S Manager within 24 hours of the incident.
- Notify the appropriate lead manager (i.e., manager responsible for personnel involved).
- As appropriate, initiate an Incident Investigation and Review per the requirements of OP-514, Incident Investigation and Review.
- Completion of any external reporting requirements (e.g., U.S. Coast Guard CG-3865 or EM 3394).
- Report all fatalities and/or serious HS&E incidents to the appropriate Senior Manager and OH&S Manager, as soon as reasonably possible, but no more than 2 hours after the incident.

6.3 Occupational Health & Safety (OH&S) Manager

- Coordinate with the appropriate staff for completion of an Incident Report.
- Upon notification of an incident, contact the supervisor to discuss the incident as well as short-term and long-term corrective actions.
- Engage the Cabrera Corporate Medical Provider for non-urgent medical guidance, if needed.
- Notify appropriate Senior Manager of the incident as soon as reasonably possible, but no more than two hours after the incident.
- As appropriate, initiate or assist an Incident Investigation and Review.

6.4 Incident Reporting Support Staff (e.g., Site Safety & Health Officer)

- Assist Supervisor to inform appropriate personnel that have not already been notified of incidents.

- Coordinate with OH&S Manager, or designee, for management of medical support.

7.0 PROCEDURE

Note: The following procedure is outlined in Attachment A, Incident Reporting Flowchart.

7.1 Initial Incident Response:

- Take control of the scene (get everyone's attention and cooperation).
- Provide first aid and/or call for emergency services.
- Control secondary incidents (e.g., ensure hazards are removed or controlled; issue a stop work order, if required).
- Identify and preserve evidence. In the event of a critical injury, the incident scene must be preserved for the potential site visit of a representative from the applicable government agency (**Note**: if you are unsure, err on the side of caution and leave the site intact).
- Report the incident to the immediate supervisor for implementing stop work orders or immediate corrective action, as required.
- The Supervisor calls the OH&S Manager to initiate internal reporting and obtain guidance, as necessary. If a manager or supervisor is not available, any Cabrera employee can make the call.
- The Supervisor completes the applicable reporting forms.

7.2 Fatality or Serious Health Safety & Environmental (HS&E) Incident Notification:

Any fatality or serious HS&E incident is to be directly reported as soon as practical (i.e., as soon as the site is secure and appropriate local emergency response is coordinated), but in no case more than two hours after the incident, to the OH&S Manager, and the appropriate Senior Manager (Director Level) as soon as reasonably possible, but no more than two hours after the incident.

Note: Voicemails and/or emails alone are not adequate to meet this requirement.

7.3 Hazardous Material Spill/Release, Permit Condition Notification:

Any HS&E incident involving release of a hazardous material/substance or breach of a numeric or non-numeric permit/consent limit is to be reported using a direct communication method (face-to-face or phone call) as soon as possible, but not later than the end of the work-shift, to the OH&S Manager and appropriate Senior Manager (Director Level). Responsibility for this reporting belongs to the cognizant Program/Project manager.

7.4 Internal Reporting Procedures:

- The call (from the scene of the incident, if possible) to the OH&S Manager initiates the reporting procedures.
- For observations or near miss, a Near Miss/Observation Report needs to be completed within 24 hours and forwarded to the OH&S Manager.
- The employee involved in an incident shall complete the Incident Report with their supervisor within 24 hours following the incident.
- If the employee is unable to complete the report because of the severity of the injuries, the supervisor, in conjunction with another employee who witnessed the incident, should complete the report.
- If the employee is not comfortable submitting the report to their immediate supervisor or manager, they are encouraged to submit it to the OH&S Manager directly.

The Supervisor will contact the OH&S Manager to:

- Confirm that on-site corrective actions were implemented.
- Determine the need for HR involvement (for medical aid incidents, WC reporting, and modified work cases).
- Determine the need for review by Senior Management (Director Level or above).
- Identify and complete any other external reporting requirements (client specific), and;

The OH&S Manager must:

- Initiate an internal or external investigation of the incident, as necessary (Senior Management may request/oversee an external investigation).
- Review and sign the Incident Report. If no investigation is required, identify corrective actions that can be implemented within the Occupational Health & Safety Management System (OHSMS) (e.g., safe work practices, equipment, training, safety bulletins, policies or procedures) to safeguard against a recurrence of the incident.

7.5 External Reporting Procedures:

The manager signing the Incident Report, in conjunction with the OH&S Manager, will determine what (if any) external reporting obligations must be met. For example:

- Client Specific – HS&E requirements will vary for different clients and, therefore, client reporting will be handled on an individual basis by the manager(s) involved.

- Worker's Compensation – Human Resources (HR) will be responsible for working with the appropriate manager if the employee is off work for any length of time, if a modified work routine will be created for the individual, or if there are any long-term implications from the accident.

  State requirements vary for different types of incidents. The OH&S Manager, in conjunction with the WC carrier, will ensure that appropriate State reporting has been completed, as applicable.

- For property damage with possible liability to the company, reporting will be completed and sent to the general liability insurance carrier.

- Fatalities or hospitalization of three or more employees must be called into the Occupational Safety & Health Administration (OSHA) within eight hours.

State or Its OH&S Governing Agency:

Reporting requirements, for an employer (Cabrera or representative) to the state (or its labor governing body), may vary slightly between jurisdictions throughout North America. Therefore, the following instructions can only be used as rough guidelines for determining whether or not a call should be made to the governing body:

- If a fatality or permanent injury is incurred;

- If the accident/incident involved a major structural failure or collapse of a building, bridge, tower, crane, hoist, temporary construction support system or excavation; or

- If the accident/incident involved the release of a hazardous substance above the Reportable Quantity.

Environmental Governing Agency:

Reporting requirements may vary between jurisdictions when an employer (Cabrera management/representative) reports to the jurisdictional governing body for chemical releases, damage to the environment or spill reporting.

Therefore, you must refer to the applicable jurisdictional legislation for the *de minimus* quantities to report based on the type of product spilled or released.

8.0 REFERENCES

None.

9.0 REQUIRED RECORDS

Incident Reports and supporting documentation are maintained in a secure file by the OH&S Manager and project staff.

The completed report and supporting documents relating to occupational injury and accidents must be retained for up to 30 years, depending on the classification of incident.

10.0 ATTACHMENTS

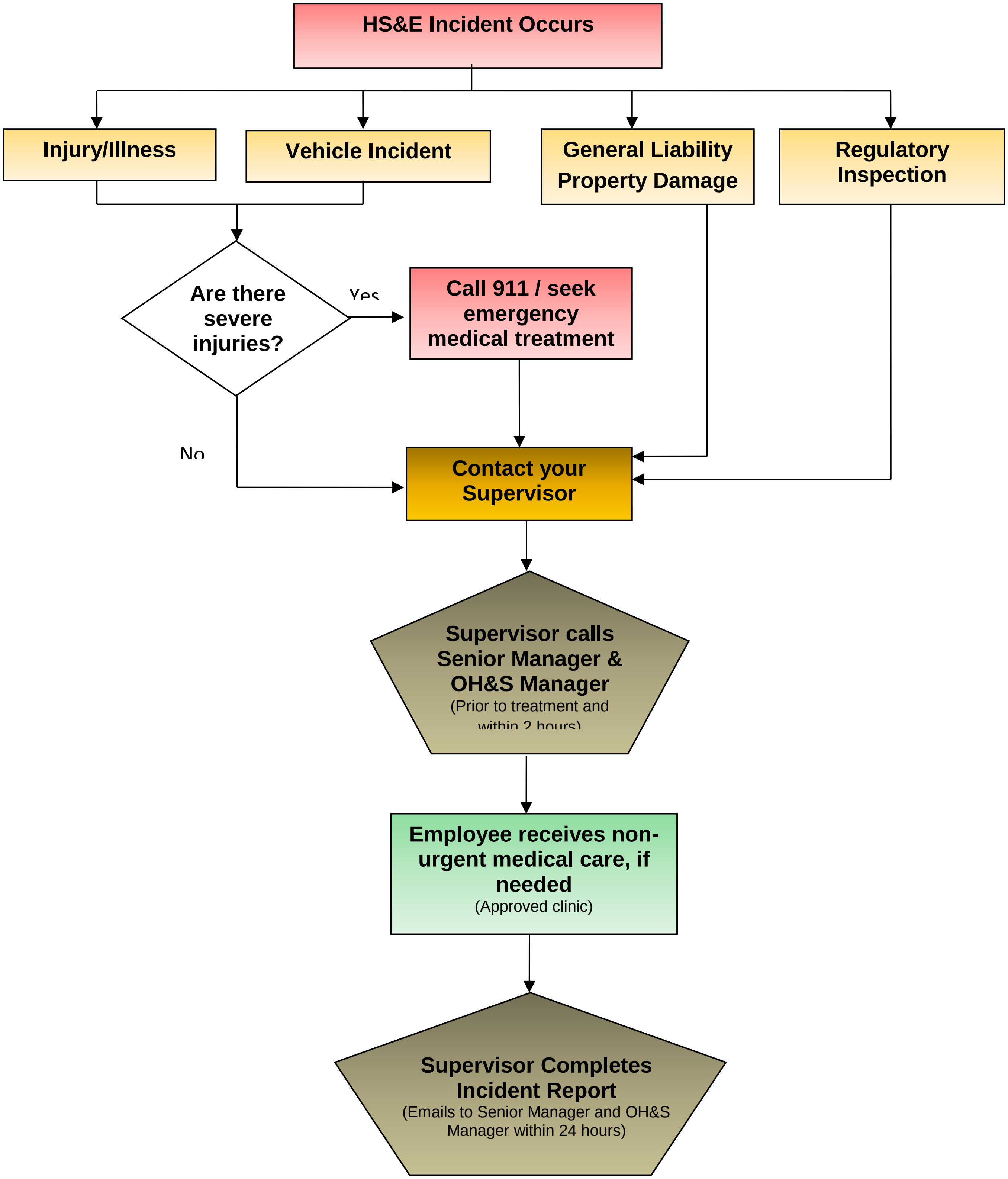
Attachment A – Incident Reporting Flowchart

Attachment B – Incident Report

Attachment C - Near Miss/Observation Report

Attachment A
Incident Reporting Flowchart

Incident Reporting Flowchart



Attachment B
Incident Report

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

1. EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY.
2. REPORT THE INCIDENT TO THE APPROPRIATE SENIOR MANAGER AND OH&S MANAGER WITHIN 2 HOURS.
3. COMPLETE FORM AND SUBMIT WITHIN ONE 24 HOURS FOLLOWING THE OCCURRENCE OF THE INCIDENT.

I. LOCATION INFORMATION

INCIDENT ADDRESS/LOCATION:	DATE:
	TIME:
CLIENT NAME:	PROJECT NAME:
SUPERVISOR (FIELD):	REPORT COMPLETED BY:

II. DESCRIPTION OF INCIDENT

TYPE OF OCCURRENCE: ☐ INJURY/ILLNESS (SEC III) ☐ MOTOR VEHICLE INCIDENT (COMPLETE SUPPLEMENT) ☐ PROPERTY DAMAGE (SEC IV)
☐ ENV DAMAGE/SPILL (SEC IV) ☐ REGULATORY INSPECTION/NOV/CITATION (SEC V)
☐ OTHER BE SPECIFIC

DESCRIPTION OF EVENT:

WHAT, WHEN, WHERE, WHY, HOW? ATTACHED NOTES/DIAGRAMS AS REQUIRED AND LIST ANY MACHINERY OR EQUIPMENT INVOLVED

WERE THERE ANY WITNESSES OR OTHER PERSONS INVOLVED: ☐ YES ☐ NO

IF YES, PLEASE PROVIDE NAMES AND CONTACT INFORMATION

III. PERSONAL INJURY (COMPLETE FOR INJURY/ILLNESS ONLY)

EMPLOYEE NAME:	EMPLOYEE NUMBER:
WORK PHONE:	CELL PHONE:
EMPLOYEE STATUS ☐ FULL TIME ☐ PART TIME ☐ TEMP AGENCY ☐ SUBCONTACTOR ☐ THIRD PARTY	HOME OFFICE ADDRESS:
JOB TITLE/HIRE DATE:	Date Reported to Supervisor:

TYPE OF INJURY: ☐ FIRST AID (TREATED ON-SITE) ☐ MEDICAL AID (TREATED BY PROFESSIONAL) ☐ FATALITY

DESCRIBE THE INJURY AND BODY PART AFFECTED: *BE SPECIFIC (I.E. RIGHT HAND, INDEX FINGER, BELOW FIRST JOINT)*

WAS A DOCTOR OR HOSPITAL VISITED? ☐ YES ☐ NO	IF YES, WHEN:
FIRST AID/MEDICAL TREATMENT RECEIVED:	FIRST AIDER/DOCTOR/HOSPITAL NAME:
PROVIDER ADDRESS:	PHONE NUMBER:

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

IV. PROPERTY DAMAGE OR ENVIRONMENTAL RELEASE

TYPE OF DAMAGE: ☐ Cabrera PROPERTY ☐ SUBCONTRACTOR PROPERTY ☐ MAJOR STRUCTURAL FAILURE
☐ MOTOR VEHICLE (REFER TO MVI SUPPLEMENT FOR GREATER DETAIL) ☐ ENVIRONMENTAL RELEASE ☐ OTHER:

DESCRIBE THE SPECIFIC DAMAGE:

RANK THE SEVERITY OF THE DAMAGE: ☐ MINOR ☐ SERIOUS ☐ MAJOR

WHERE CAN THE PROPERTY BE SEEN?

PROPERTY OWNER NAME:	**CONTACT INFORMATION:**

IS THERE ANY POTENTIAL FOR CIVIL, CRIMINAL OR REGULATORY LIABILITY AGAINST Cabrera? ☐ **YES** ☐ **NO**
IF YES, DISCUSS WITH SENIOR MANAGEMENT AND OH&S MANAGER.

INDICATE WHO HAS BEEN NOTIFIED OF THE EVENT (E.G., OWNER/OPERATOR, STATE (US) OR GOVERNING BODY OF LABOUR, ETC?

V. REGULATORY INSPECTION/NOV/CITATION

TYPE OF EVENT: ☐ INSPECTION ☐ NOV ☐ CITATION

DESCRIBE EVENT: ***BE SPECIFIC***

FINDINGS NOTED AT SITE ☐ **YES** ☐ **NO**	**IF YES, WHAT:**
NAME OF REGULATORY AGENCY	**FOLLOW UP SCHEDULED:**
CONTACT PERSON:	**PHONE NUMBER:**

VI. REVIEW AND ACCEPTANCE

EMPLOYEE COMMENTS:

EMPLOYEE NAME AND PHONE	**SIGNATURE AND DATE**

SUPERVISOR COMMENTS:

SUPERVISOR NAME AND PHONE	**SIGNATURE AND DATE**

MANAGER COMMENTS:

MANAGER NAME AND PHONE	**SIGNATURE AND DATE**

FOR OH&S MANAGER USE ONLY:

NAME AND SIGNATURE:	**DATE:**

RECORDABILITY DETERMINATION ☐ FIRST AID ☐ RECORDABLE ☐ RECORDABILITY UNDETERMINED ☐ NON WORK
☐ PROPERTY DAMAGE ☐ GENERAL LIABILITY ☐ VANDALISM

COMMENTS:

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

MOTOR VEHICLE INCIDENT (MVI) SUPPLEMENT		
REMEMBER: **STAY CALM. TAKE PICTURES OF INCIDENT SCENE (LICENSE PLATE, DAMAGES, ETC)** Do not admit liability, agree to pay for any damage or sign any document except as required by law.		
ADMINISTRATIVE		
VEHICLE TYPE: ☐ **FLEET** ☐ **RENTAL** ☐ **PERSONAL**	**JOB ACTIVITY AT TIME OF MVI:**	
DATE OF MVI: **TIME OF MVI:**	**LOCATION OF MVI:**	
MANAGER:	**NUMBER OF VEHICLES INVOLVED:**	
DRIVER INFORMATION		
DRIVER:	**PASSENGERS:**	**PASSENGERS:**
DRIVER'S LICENSE:	**STATE ISSUED:**	**EXPIRATION DATE:**
INJURIES TO DRIVER:		
INJURIES TO PASSENGERS:		
VEHICLE INFORMATION		
YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #:	**LICENSE PLATE #:**	**REGISTRATION #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
COMMERCIAL MOTOR VEHICLE :	**I F RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:**	
RANK THE SEVERITY OF THE DAMAGE TO THE VEHICLE:	☐ 0 - $500 ☐ $500 - $1000	☐ $1000 - $4000 ☐ >$4000
DESCRIPTION OF DAMAGE TO THE BODY OF THE VEHICLE:		
OTHER DRIVER/VEHICLE INFORMATION		
YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #	**LICENSE PLATE #:**	**REGISTRATION #:**
DRIVER'S NAME:	**CONTACT INFO:**	**LICENSE #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
IF RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:		
DESCRIPTION OF DAMAGE TO THE BODY OF THE OTHER VEHICLE:		
INCIDENT DESCRIPTION		
EXACT LOCATION OF MVI (HIGHWAY, INTERSECTION, EXACT ADDRESS, ETC.)**?**		
OTHER PROPERTY DAMAGED:		
DESCRIBE THE EVENTS LEADING UP TO AND THE INCIDENT (REPORT FACTS ONLY: SPEED OF VEHICLES, DIRECTION TRAVELLING, WEATHER CONDITIONS, ETC. DO NOT GIVE OPINIONS REGARDING CAUSE OF INCIDENT OR LOSS.)**:**		
DID THE POLICE ATTEND THE SCENE: ☐ **YES** ☐ **NO**	**CITATION ISSUED:** ☐ **YES** ☐ **NO**	**TO WHO:**
POLICE :	**CONTACT INFO:**	
SUBMIT THIS MVI SUPPLEMENT WITH A COMPLETED INCIDENT REPORT TO THE APPROPRIATE MANAGER		

Attachment C
Near Miss/Observation Report

OP 512 - Near Miss/Observation Report

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Use this form to report Near Misses and Observation (Field or Office)
Identification of such assists in development of proactive approaches to avoiding potential future incidents.

LOCATION INFORMATION	
REPORT COMPLETED BY:	**SUPERVISOR:**
ADDRESS/LOCATION:	**DATE:**
	TIME:
CLIENT NAME:	**PROJECT NAME:**
DESCRIPTION OF NEAR MISS OR OBSERVATION	
DESCRIPTION OF EVENT:	
NEAR MISS POTENTIAL OUTCOME: ☐ INJURY/ILLNESS ☐ PROPERTY DAMAGE ☐ ENV DAMAGE/SPILL ☐ REGULATORY INSPECTION/NOV/CITATION ☐ OTHER BE SPECIFIC	
POTENTIAL SEVERITY: ☐ **MINOR** ☐ **SERIOUS** ☐ **FATAL**	
OBSERVATION TYPE: ☐ POSITIVE ☐ AT RISK CONDITION ☐ AT RISK BEHAVIOUR ☐ OTHER	
POTENTIAL CAUSES	
IMMEDIATE CAUSES: ☐ PROCEDURES NOT FOLLOWED ☐ USE OF TOOLS OR EQUIPMENT & VEHICLES ☐ USE OF PROTECTIVE MEASURES ☐ PROTECTIVE SYSTEMS ☐ ENVIRONMENT/LAYOUT ☐ INATTENTION/LACK OF AWARENESS ☐ WORK EXPOSURE TO	
SYSTEM CAUSES: ☐ WORK RULES/PROCEDURES ☐ TOOLS AND EQUIPMENT ☐ WORK PLANNING ☐ ENGINEERING/DESIGN ☐ PURCHASING, MATERIAL HANDLING/CONTROLS ☐ CONTRACTOR SELECTION ☐ PHYSICAL CAPACITY/CONDITION ☐ MENTAL STATE ☐ SKILL LEVEL ☐ TRAINING/KNOWLEDGE ☐ MGMT/SUPER/EMPLOYEE LEADERSHIP ☐ COMMUNICATION ☐ OTHER	
CORRECTIVE ACTION(S)	
WERE CORRECTIVE ACTIONS IMMEDIATELY IMPLEMENTED? ☐ **YES** ☐ **NO**	
CORRECTIVE ACTION: ☐ CHANGE IN PROCEDURE ☐ NEW STOP WORK TRIGGER IDENTIFIED ☐ NEW TOOL/EQUIPMENT ☐ DIFFERENT/NEW PPE ☐ IMPROVED PLANNING ☐ IMPROVED HOUSEKEEPING ☐ ADDITIONAL/PROPER PERSONNEL ☐ ADDITIONAL TRAINING/SKILLS ☐ MODIFIED WORK BEHAVIOUR ☐ OTHER	
ARE LONG-TERM CORRECTIVE ACTIONS REQUIRED? ☐ **YES** ☐ **NO**	
DESCRIBE:	
FOR OH&S MANAGER USE ONLY:	
ADDITIONAL CORRECTIVE ACTIONS (IF NECESSARY):	
CONFIRMATION: ☐ REPORTING EMPLOYEE ☐ SUPERVISOR AND/OR MANAGER	
NAME AND SIGNATURE:	**DATE:**

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

HEAT STRESS

OP-563

Revision 1
October 2013

Prepared/Reviewed by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

This operating procedure (OP) establishes the methods to help employees recognize the symptoms of heat stress-related illnesses and recommends controls to take appropriate corrective actions.

2.0 APPLICABILITY

This procedure applies to all Cabrera employees and operations.

3.0 DEFINITIONS

3.1 Acclimated - Workers who have physiologically adapted to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures with minimal stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

3.2 Chemical Protective Clothing (CPC) - Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the worker with potentially hazardous materials in the workplace. Such materials include:

- Tyvek coveralls (all types)
- Polyvinyl chloride (PVC) coveralls
- Rain suits

3.3 Unacclimated - Workers who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

3.4 Heat Cramps - A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

3.5 Heat Exhaustion - A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

3.6 Heat Rash - A heat-induced condition characterized by a red, bumpy rash with severe itching.

3.7 Heat Stress - The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

3.8 Heat Stroke - The most serious form of heat stress, which involves a profound disturbance of the body's heat regulating mechanism.

3.9 Sunburn - Is caused by unprotected exposure to ultraviolet light that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling. This condition if not addressed may cause more severe problems.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

Employees working in extreme heat or sun for extended periods of time away from a shelter or vehicle must not work alone.

Employees shall not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the American Conference of Government Industrial Hygienist (ACGIH) Standard.

Clothing corrections shall be applied in accordance with the heat stress and strain section of the ACGIH Standard.

5.0 EQUIPMENT

Supplies used in support of this OP may include the following items:

- Sunblock (min 30 SPF)
- Wide-brimmed hard hats
- Shade tents
- Drinking water
- Water coolers
- Air conditioned vehicle or office

6.0 RESPONSIBILITIES

6.1 Project Managers responsibilities:

Evaluate the need for heat stress prevention measures and incorporate as appropriate into the Site Safety & Health Plan (SSHP).

Implement heat stress prevention measures, as applicable, at each work site.

Develop/coordinate a work-rest schedule, as applicable.

Ensure heat stress hazard assessments/evaluations were completed for the planned activities.

Assign personnel that are physically capable of performing the assigned tasks.

Ensure that personnel are properly trained in the recognition of heat stress-related symptoms.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide heat stress awareness training.

Assist project teams that are developing the appropriate work-rest schedules.

Conduct/support incident investigations related to potential heat stress-related illnesses.

6.3 Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned employees.

Ensure that employees have been trained on the recognition of heat stress-related illness.

Ensure that adequate supplies of appropriate fluids are readily available to employees.

Ensure that a proper rest area is made available. This may include the use of portable tents to provide temporary shade.

Conduct heat stress monitoring, as applicable.

Implement a work-rest schedule.

Ensure that first aid measures are implemented if heat stress symptoms are identified.

Ensure that personnel are physically capable of performing the assigned tasks and are not in physically compromised conditions.

Report all suspected heat stress-related illnesses.

6.4 Employees' responsibilities:

Observe each other for the early symptoms of heat stress-related illnesses.

Maintain an adequate intake of available fluids.

Be familiar with heat stress hazards, predisposing factors, and preventative measures.

Report to work in a properly vested and hydrated condition.

Report all suspected heat stress-related illnesses to the SSHO and/or FSM.

7.0 PROCEDURE

7.1 Controls

If employees are, or may be exposed to heat stress, the Field Site Manager (FSM) or designee (SSHO) shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of workers, and;
- Develop and implement a heat stress exposure control plan.

The project team shall implement engineering controls (e.g., shelters, shading, cooling devises, etc.) to reduce the exposure of employees to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

If engineering controls are not practicable, the supervisor shall reduce the exposure of workers to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

The supervisor shall provide and maintain an adequate supply of cool, potable water close to the work area for the use of a heat exposed worker.

If an employee shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant, if available, or by a physician.

Heat stress can be a significant field site hazard, especially for workers wearing CPC. The workforce will gradually work up to a full workload under potentially stressful conditions to allow for proper acclimation.

Site personnel shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Workers must be encouraged to immediately report any heat stress that they may experience or observe in fellow workers. Supervisors must use such information to adjust the work-rest schedule to accommodate such problems.

Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow workers to loosen or remove protective clothing, and sufficient seating should be available for all personnel. During breaks, workers must be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

7.2 Symptoms and Treatment

Workers who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin), shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

Anyone exhibiting symptoms of heat stroke (red, dry skin, or unconsciousness) must be taken immediately to the nearest medical facility, taking steps to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

Severe heat stress (heat stroke) is a life-threatening condition that must be treated by a competent medical authority.

Heat Stress-related Illness Symptoms

There are three stages of heat-related illness:

1. Heat Cramps

First stage of heat-related illness

- Heat cramps are painful muscle cramps caused by over-exertion in extreme heat
- Muscle spasms, and
- Pain in the hands, feet, and abdomen

2. Heat Exhaustion

Heat exhaustion is the second stage. Symptoms include:

- Cool, moist, pale, flushed or red skin
- Heavy (profuse) sweating
- Headache
- Nausea or vomiting
- Dizziness, fainting

- Exhaustion
- Mood changes (irritable, or confused/can't think straight)
- Pale, cool, moist skin

3. Heat Stroke

Heat stroke is the third and final stage.

Heat exhaustion can sometimes lead to heat stroke, which is more severe and can be fatal. Heat stroke requires emergency treatment. Heat stroke happens when you stop sweating and your body temperature continues to rise, above 102^{o}F (38.9 ^{o}C) often to 105^{o}F (40.5^{o}C) and above. Symptoms of heat stroke include:

- Vomiting
- A decreased alertness level or complete loss of consciousness
- High body temperature (sometimes as high as 105^{o}F (40.5^{o}C))
- Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry
- Rapid, weak pulse
- Rapid, shallow breathing
- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong rapid pulse
- Coma

<u>Recommended Treatment for Heat Stress-related Illnesses</u>

Heat Cramps Treatment:

- Apply manual pressure to cramped muscles gently stretching the cramped muscle(s) and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary.

- Take more frequent breaks and drink more water
- Move victim to a cool place, shaded if possible
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated

Heat Exhaustion Treatment:

- Movet out of the sun to a cool, shaded (if possible) location and drink lots of water, a little at a time
- Remove or loosen tight clothing and elevate feet
- If you are nauseated or dizzy, lie down
- Administer drinks of cool water and fan to cool
- Seek medical attention immediately

Heat Stroke Treatment, or if a person's temperature exceeds 102^{o}F (38.9 ^{o}C):

- Call for immediate medical help and then try to lower the temperature as quickly as possible
- Apply cool (not cold) water the person's whole body using a wet sheet if possible then fan the person
- Stop cooling if the person's temperature appears to come down; be careful not to overcool
- Do not give aspirin or acetaminophen to reduce the temperature
- Treat as a true medical emergency Seek medical help immediately
- Reduce body temperature quickly
- If available, use cold packs under arms, neck, and ankles
- Protect from injury during any convulsion
- Ensure that the person's airway is open
- Transfer to a medical facility immediately

7.3 Prevention

All staff working in extreme heat or sun should understand the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- If you experience heat exhaustion or heat stroke you must immediately seek shelter and water
- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently
- Try to schedule work for the coolest part of the day, early morning and evening
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun
- Avoid sudden changes of temperature; air out a hot vehicle before getting into it
- If you take diuretics, ask your doctor about taking a lower dose during hot weather
- On a normal day, drink 8 to 10 8-ounce glasses of water per day. Continue to drink even more if you are working or exercising in hot weather.
- Avoid caffeine and alcohol as they increase dehydration

7.4 Personal Protective Equipment

Wear a hat and light-colored, loose-fitting clothing to reflect the sun.

Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).

Wear sunglasses with UV protection.

Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

7.5 Establishment of Work Rest Schedules

The prevention of heat stress is best performed through supervisor observation of employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow workers to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks must be determined by the work supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the workers (e.g., acclimated/not), and personal protective clothing being used.

Cabrera permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

1. Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred, if a WBGT meter is available.

2. Adjusted Temperature Method: This method should be used only if WBGT data is not available.

Either procedure will provide the work supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

WBGT Work-Rest Schedule Guidelines

Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing CPC. Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

WBGT readings are compared directly with the values the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1 - Non-CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	85°F (29.4°C)	81°F (27.2°C)	78°F (25.6°C)	
75% Work – 25% Rest	86°F (30°C)	83°F (28.3°C)	81°F (27.2°C)	
50% Work – 50% Rest	88°F (31.1°C)	85°F (29.4°C)	83°F (28.3°C)	81°F (27.2°C)
25% Work – 75% Rest	90°F (32.2°C)	87°F (30.6°C)	86°F (30°C)	85°F (29.4°C)

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

Table 2 - CPC Activities WBGT Chart

Work-Rest Regimen	WBGT			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
Continuous Work	74°F (23.3°C)	70°F (21.1°C)	67°F (19.4°C)	
75% Work – 25% Rest	75°F (23.9°C)	72°F (22.2°C)	70°F (21.1°C)	
50% Work – 50% Rest	77°F (25°C)	74°F (23.3°C)	72°F (22.2°C)	70°F (21.1°C)
25% Work – 75% Rest	79°F (26.1°C)	76°F (24.4°C)	75°F (23.9°C)	74°F (23.3°C)

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

Adjusted Temperature Work-Rest Schedule Guidelines

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

Table 3 - Temperature Adjustment Factors

Time of Day	
Before daily temperature peak*	+2°F (+1.11°C)
10 am – 2 pm (peak sunshine)	+2°F (+1.11°C)
Sunshine	
No clouds	+1°F (+0.56°C)
Partly Cloudy (3/8 – 5/8 cloud cover)	-3°F (-1.67°C)
Mostly Cloudy (5/8 – 7/8 cloud cover)	-5°F (-2.78°C)
Cloudy (>7/8 cloud cover)	-7°F (-3.89°C)
Indoor or nighttime work	-7°F (-3.89°C)
Wind (*ignore if indoors or wearing CPC*)	
Gusts greater than 5 miles per hour at least once per minute	-1°F (-0.56°C)
Gusts greater than 10 miles per hour at least once per minute	+2°F (+1.11°C)
Sustained greater than 5 miles per hour	-3°F (-1.67°C)
Sustained greater than 10 miles per hour	-5°F (-2.78°C)
Humidity (*ignore if wearing CPC*)	
Relative Humidity greater than 90%	+5°F (+2.78°C)
Relative Humidity greater than 80%	+2°F (+1.11°C)
Relative Humidity less than 50%	-4°F (-2.23°C)
Chemical Protective Clothing (CPC)	
Modified Level D (coveralls, no respirator)	+5°F (+2.78°C)
Level C (coveralls w/o hood, full-face respirator)	+8°F (+4.45°C)
Level C (coveralls with hood, full-face respirator)	+10°F (+5°C)
Level B with airline system	+9°F (+5.56°C)
Level B with SCBA	+9°F (+5.56°C) and right one column**
Level A	+14°F (+7.78°C) and right one column[2]
Other	Specified in the HASP
Miscellaneous	
Unacclimated work force	+5°F (+2.78°C)
Partially acclimated work force	+2°F (+1.11°C)
Working in shade	-3°F (-1.67°C)
Breaks taken in air conditioned space	-3°F (-1.67°C)

*This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak, ignore.

**Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.

Table 4 - Work-Rest Schedule Based on Adjusted Temperature

Work-Rest Regimen	Adjusted Temperature			
	Light Work	Moderate Work	Heavy Work	Very Heavy Work
No specified requirements	< 80°F (22.67°C)	< 75 (23.88°C)	< 70 (21.11°C)	< 65 (18.33°C)
15 minute break every 90 minutes of work	80°F – 90°F (22.67°C) - (32.22°C)	75 – 85 (23.88°C) - (29.44°C)	70 – 80 (21.11°C) - (22.67°C)	65 – 75 (37.77°C) - (23.88°C)
15 minute break every 60 minutes of work	>90 – 100 (32.22°C) - (37.77°C)	> 85 – 95 (23.88°C) - (35°C)	>80 – 85 (22.67°C) - (23.88°C)	>75 – 80 (23.88°C) - (22.67°C)
15 minute break every 45 minutes of work	>100 – 110 (37.77°C) - (43.33°C)	>95 – 100 (35°C) - (37.77°C)	>85 – 90 (23.88°C) - (32.22°C)	>80 – 85 (22.67°C) - (23.88°C)
15 minute break every 30 minutes of work	>110 – 115 (43.33°C) - (46.11°C)	>100 – 105 (37.77°C) – (40.55°C)	>90 – 95 (32.22°C) - (35°C)	>85 – 90 (23.88°C) - (32.22°C)
15 minute break every 15 minutes of work	>115 – 120 (46.11°C) - (48.88°C)	>105 – 110 (40.55°C) - (43.33°C)	>95 -100 (35°C) - (37.77°C)	>90 – 95 (32.22°C) - (35°C)
Stop Work	**>120** (48.88°C)	**>110** (43.33°C)	**>100** (37.77°C)	**>95** (35°C)

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.

7.6 Work-Rest Schedule Practices

Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.

Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 oz. per hour during the work shift; fluid replacement at frequent intervals is most effective.

The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.

If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.

Additional salt is usually not needed and salt tablets should not be taken.

Replacement fluids should be cool, but not cold.

Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.

Dry clothing or towels should be made available to minimize chills when taking breaks.

Manual labor will not be performed during breaks, other than paperwork or similar light tasks.

Other controls that may be used include:

- Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm)
- Erecting a cover or partition to shade the work area
- Wearing cooling devices such as vortex tubes or cooling vests beneath protective garments. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

7.7 Evaluating the Work-Rest Schedule's Effectiveness

Once a work-rest schedule is established, the work supervisor must continually evaluate its effectiveness through observation of workers for signs/symptoms of heart stress. Measurement of each worker's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate, and is accomplished as follows:

- At the start of the workday each worker's baseline pulse rate (in beats per minute – bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by four or an automated pulse count device may be utilized
- Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria
- Each worker's maximum heart rate at the start of any break should be less than [180 minus worker's age] bpm. If this value is exceeded for any worker, the duration of the following work period will be decreased by at least 10 minutes.
- At the end of each work period all workers' heart rates must have returned to within +10% of the baseline pulse rate. If any worker's pulse rate exceeds this value, the break period will be extended for at least 5 minutes, at the end of which pulse rates will be re-measured and the end of-break criteria again applied.

Use a clinical thermometer or similar device to measure the oral/ear temperature at the beginning (before drinking liquids) and end of each break period and apply the following criteria:

- If the oral temperature exceeds 99.6^{o}F, shorten the next work cycle by one-third without changing the rest period
- If the oral temperature still exceeds 99.6^{o}F (36.6^{o}C) at the beginning of the next rest period, shorten the following work cycle by one-third

Use of an automated or similar blood pressure device will be used to assess each employee's blood pressure at the beginning and at the end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an employee is outside of 90/60 to 150/90, then the employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be re-measured and the end-of-break criteria again applied

All physiological monitoring of heat stress will be documented using the attached Heat Stress Monitoring Log.

7.8 Training

Project staff and their supervisors that may be exposed to the hazard will be oriented to the hazard and the controls prior to work commencing.

Those personnel potentially exposed to heat stress will receive training including, but not limited to:

- Sources of heat stress, influence of personal protective clothing, and importance of acclimatization
- How the body accommodates heat
- Recognition of heat-related illness symptoms
- Preventative/corrective measures
- Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress
- All employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress

- First aid procedures for heat stress-related illnesses

8.0 REFERENCES

- 29 CFR 1910. 132, General Requirements
- OSHA Technical Manual (OTM), Section 3, Chapter 4, Heat Stress
- ACGIH's 2002 Threshold Limit Values for Chemical Substances and Physical Agents
- OP 512, Incident Reporting

9.0 REQUIRED RECORDS

- Heat Stress Monitoring Logs will be kept with project files.

10.0 ATTACHMENTS

Attachment A – Heat Stress Monitoring Log

Attachment A
Heat Stress Monitoring Log

OP 563 - Heat Stress

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Heat Stress Monitoring Log

The purpose of this form is to track entry into hot zones wearing chemically protective clothing and monitor employees for heat stress-related illness. It is the responsibility of the foreman or supervisor-in-charge to ensure that each person entering the hot zone completes the required information. Vital signs must be taken by a competent person.

Project Name:			**Foreman/Supervisor:**							**Work/Rest Schedule[1]:**			IN *(min)*		OUT *(min)*	
Date:	**Water Provided[2]**		**Acclimated[3]**		**Initial Vitals[4]**	**Vital Signs and Time In/Out[5]**										
Employee Name	**Yes**	**No**	**Yes**	**No**	**Vitals**	**In**	**Out**	**Vitals**	**In**	**Out**	**Vitals**	**In**	**Out**	**Vitals**	**In**	**Out**
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		
					P			P			P			P		
	☐	☐	☐	☐	BP			BP			BP			BP		
					Temp			Temp			Temp			Temp		

1. Section 7.5 provides specific details on how to develop a work-rest schedule.
2. Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
3. A worker is "acclimated" if he/she has worked in a hot environment for at least 7 to 10 consecutive days. If a worker is acclimated, check "Yes." If a worker is not acclimated, check "No" and reduce the "Min In" by 50 percent for that employee until the 7- to 10-day period is reached.
4. "Vitals" refers to employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work operations in the hot zone. Each time the employee exits the hot zone, vitals must be taken and evaluated for heat stress criteria. Section 7.7 provides specific instructions for taking and evaluating employee vital signs.
5. Body temperature vital signs will be recorded in °F.

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

HAND & POWER TOOLS

OP-566

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

This operating procedure (OP) establishes requirements for manually-operated hand and power tools and equipment use, handling and storage.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

None.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

The use of Fixed Blade Open Knives (FBOKs) is prohibited. FOBKs are tools that have an exposed, prominent, sharp-edged blade that is fixed or can be locked into a fixed position. Examples of FOBKs include pocket knives, multi- tool or Leatherman©, hunting knives, sheetrock knives, and standard utility knives.

If an Activity Hazard Analysis (AHA) shows that a FOBK is the safest and most appropriate tool for a specific task then a FOBK can be used if the Occupational Health & Safety (OH&S) Manager agrees with the determination and gives approval by signing the AHA. Hazards associated with the use of a FOBK should be included in the hazard analysis and the person completing the task must have knowledge of the proper use of the FOBK to prevent injury to self and others.

No employee shall use any hand tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

Employees who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and splashing objects, or to harmful dusts, fumes, mists, vapors, or gases must be provided with the appropriate personal protective equipment (PPE) to prevent unnecessary exposure and/or injury .

All tools will be used in accordance with manufacturer’s specifications.

5.0 EQUIPMENT

Hand and power tools used during field operations.

6.0 RESPONSIBILITIES

6.1 Project Managers and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Each Manager/Supervisor must ensure that all aspects of this procedure are followed and adhered to on all projects sites and locations.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees' responsibilities:

Employees shall not work with any tool that they are not familiar with without first obtaining training associated with that equipment. In addition, employees must follow the manufacturer's guidance and/or recommendations for its use. It is recommended that modifications to the equipment not be performed without first consulting the OH&S Manager and/or FSM/SSHO and the manufacturer.

7.0 PROCEDURE

7.1 Basic Safety Rules

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and use the appropriate PPE..
- All electrical connections for hand and power tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors).
- When a temporary power source is used,a ground-fault circuit interrupter should be used.
- Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools. If unsure about eye, head and face protection, contact the OH&S.
- Screens or other protective measures must be set up to protect nearby

workers and others from being struck by flying fragments around chippers, riveting guns, staplers, air drills or similar equipment. The site safety officer will establish safe work zones as necessary.

- Compressed air guns should never be pointed toward anyone.
- A chip guard must be used when compressed air is used for cleaning.
- Use of heavy jackhammers can cause fatigue and strains. Heavy rubber grips reduce these effects by providing a secure handhold.
- Workers operating jackhammers must wear safety glasses and safety shoes that protect them against injury if the jackhammer slips or falls. A face shield also should be used. If unsure about eye, head and face protection, contact the OH&S.
- Noise hazard associated with pneumatic tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

7.2 Hazard Prevention Sharp Objects

Employees, when using saw blades, knives, or other tools, should direct the tools away from aisle areas and away from other employees working in close proximity. Tools should always be used in a safe manner.

Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones. A dull blade will require more force to cut, increasing the likelihood of slipping.

Safe cutting tools (tools with covered to retractable blades) should be used for cutting materials (FBOKs are prohibited). There are a variety of tools that provide safe and effective cutting and some are specially designed for a particular task or material; therefore, it may be necessary to possess a few different types of cutting tools to complete a task. The safety cutting tools should be maintained and inspected prior to use as with any other hand tool. Comply with the manufacturer’s instructions for proper use and safe storage. Proper PPE (hand, face and eye protection) should be worn at all times during use. Contact the OH&S Manager for assistance in purchasing the right tool for the task.

Always keep body parts (i.e., fingers) away from the cut line, and ensure that the material being cut is on a sturdy surface (vise, tailgate, etc.) and not against a body part (i.e. cutting rope against your leg). Always pull the knife; never push the knife (the blade may break, and the momentum could cause the body to come into contact with broken blade). Pre-plan the cut path, and be sure the path is away from the body in the event the blade moves from the desired cutting path.

Cracked or otherwise damaged saw blades must be removed from service.

Wrenches must not be used when jaws are sprung to the point that slippage occurs.

Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads.

The wooden handles of tools must not be splintered.

Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

7.3 Hazard Prevention of Power tools

Precautions

Never carry a tool by the cord or hose.

Never yank the cord or the hose to disconnect it from the receptacle.

Keep cords and hoses away from heat, oil, and sharp edges.

Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.

Keep all people not involved with the work at a safe distance from the work area.

Secure work with clamps or a vise, freeing both hands to operate the tool.

Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.

Maintain tools with care; keep them sharp and clean for best performance.

Follow instructions in the user's manual for lubricating and changing accessories.

Be sure to keep good footing and maintain good balance when operating power tools.

Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.

Inspect all cords and connector before using.

Remove all damaged portable electric tools from use and tag them: “Do Not Use.”

Use GFCI protected receptacles or cord adapters during use of power tools.

Guards

The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded.

Machine guards, as appropriate, must be provided to protect the operator and others from the following:

- Point of operation
- In-running nip points
- Rotating parts
- Flying chips and sparks

Safety guards must never be removed when a tool is being used. Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards.

An upper guard must cover the entire blade of the saw.

A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

7.4 Operating Controls and Switches

The following hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released: drills; tappers; fastener drivers; horizontal, vertical, and angle grinders with wheels more than 2 inches (5.08 centimeters) in diameter; disc sanders with discs greater than inches (5.08 centimeters); belt sanders; reciprocating saws; saber saws, scroll saws, and jigsaws with blade shanks greater than 1/4-inch (0.63 centimeters) wide; and other similar tools.

These tools also may be equipped with a “lock-on” control, if it allows the worker to also shut off the control in a single motion using the same finger or fingers.

The following hand-held power tools must be equipped with either a positive "on-off" control switch, a constant pressure switch, or a "lock-on" control:

- Disc sanders with discs 2 inches (5.08 centimeters) or less in diameter
- Grinders with wheels 2 inches (5.08 centimeters) or less in diameter
- Platen sanders, routers, planers, laminate trimmers, nibblers, shears, and scroll saws; and jigsaws, saber and scroll saws with blade shanks a nominal 1/4-inch (6.35 millimeters) or less in diameter.

It is recommended that the constant-pressure control switch be regarded as the preferred device.

Other hand-held power tools such as circular saws having a blade diameter greater than 2 inches (5.08 centimeters), chain saws, and percussion tools with no means of holding accessories securely must be equipped with a constant-pressure switch.

7.5 Electrical Shock Caution

Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.

An electric shock also can cause the user to fall off a ladder or other elevated work surface and be injured due to the fall.

To protect the user from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer.

Three-wire cords contain two current carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.

The third prong must never be removed from the plug.

Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

It is recommended that a GFCI protected outlet or cord adapter is used.

7.6 Electric Tools General Practice

Operate electric tools within their design limitations as specified by the manufactor.

Use gloves and appropriate safety footwear when using electric tools.

Store electric tools in a dry place when not in use.

Inspect cords and plugs daily before use.

Do not use electric tools in damp or wet locations unless they are approved for that purpose.

Keep work areas well lighted when operating electric tools. Ensure that cords from electric tools do not present a tripping hazard and are kept up/out of damp/wet locations.

In the construction industry, employees who use electric tools must be protected by ground-fault circuit interrupters or an assured equipment-grounding conductor program.

7.7 Pneumatic Tools (powered by compressed air)

There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected.

A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.

If an air hose is more than 1/2-inch (12.7 millimeters) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

In general, the same precautions should be taken with an air hose that are recommended for electric cords, because the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards.

When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa - kilopascal), must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

7.8 Liquid Fuel Tools (operated with gasoline)

The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

Before refilling a fuel-powered tool tank, the user must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors.

When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.

Noise hazards associated with gasoline engines must be mitigated by proper hearing protection.. Ear Plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.

Fire extinguishers must also be available in the area.

7.9 Hydraulic Power Tools (fluid run)

The fluid used in hydraulic power tools must be an approved fire resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

The manufacturer’s recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded. Also, the manufacturer’s load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

To set up a jack, make certain of the following:

- The base of the jack rests on a firm, level surface;
- The jack is correctly centered;
- The jack head bears against a level surface; and
- The lift force is applied evenly.

Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:

- For jacks used continuously or intermittently at one site—inspected at least once every 6 months;
- For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and
- For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

7.10 Training

Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool.

7.11 Personal Protective Equipment

Lockout devices (padlocks, multiple lock hasps, tags), gloves appropriate to the task, safety-toed boots, as required, hard hats and eye & face protection, as required.

7.12 Inspections

All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used. Every broken or defective tool must be tagged or identified as such. Tagged tools will be returned to your supervisor for repair or replacement. Tagged tools will be immediately removed from service.

All tools must be inspected to manufacture's specifications according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly.

8.0 REFERENCES

- 29 CFR 1926, Subpart I, Tools, Hand and Power
- 29 CFR 1910, Subpart P , Hand and Portable Powered Tools and Other Hand-Held Equipment
- OP 567, Electrical Safety

9.0 REQUIRED RECORDS

None.

10.0 ATTACHMENTS

None.

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

ELECTRICAL SAFETY

OP-567

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

This operating procedure (OP) establishes the requirements to minimize and control electrical hazards in the workplace.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Circuit Protective Device - A load-rated switch, circuit breaker, or other device specifically designed as a disconnecting means for opening, reversing, or closing of live circuits.

3.2 Energized Electrical Equipment - Electrically connected to or having a source of voltage.

3.3 Ground Fault Circuit Interrupter (GFCI) - An electrical device that protects the users of all devices connected to it from electrical shock. The GFCI is part of the circuit or device in use and continuously measures the current in that circuit. If a leakage of current is detected, as in the case of an electrical short circuit, the circuit is opened at the GFCI and current cannot flow beyond the GFCI.

3.4 Hazardous Atmospheres - Areas that contain or may contain explosive or flammable atmospheres require specific electrical precautions. The United States Occupational Health & Safety Administration (OSHA) regulates the use of electrical devices in explosive atmospheres according to National Electrical Code criteria and classifications for hazardous atmospheres.

3.5 Portable Electric Equipment - Cord-and plug-connected equipment and extension cords.

3.6 Qualified Persons - Individuals who have specific and documented training to avoid the hazards of working on or near energized electrical equipment and have been specifically permitted to work on or near exposed energized and parts.

3.7 Shock Hazard - A dangerous situation associated with the possible release of energy caused by contact or approach to live parts.

3.8 Unqualified Persons - Individuals with little or no training to avoid the hazards of energized electrical parts or equipment.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

As a general rule, employees should not work on exposed, energized systems with a potential greater than 50 volts. This work should be subcontracted to a qualified licensed electrician (Qualified Person).

Electrical outlets utilized to supply power for electrical equipment during field operations shall be of the three-wire grounding type. Whenever possible, they should be tested for correct polarity and adequacy of the ground with a circuit analyzer. If it is determined that the outlet is incorrectly wired or inadequately grounded, it should not be used.

GFCI devices will be in place between the equipment and power source for all temporary circuits unless protected by an assured equipment grounding program as defined in this procedure

5.0 EQUIPMENT

Only tools and testing or protective equipment approved by ANSI/ASTM for the relevant voltage rating will be used when working on energized electrical systems. All tools and testing or protective equipment will be visually inspected prior to use to confirm that the protection systems associated with the tool or equipment are not damaged or impaired and that diagnostic meters and tools are configured properly. Any tool or testing or protective equipment suspected of being compromised will be immediately taken out of service and will be tagged for disposal.

6.0 RESPONSIBILITIES

6.1 <u>Project Managers and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities</u>:

Determining if potential exposure to electrical hazards exist for the project.

The Manager or Supervisor will determine the appropriate safe guards to be put in place to protect employees.

6.2 <u>Occupational Health & Safety (OH&S) Manager responsibilities</u>:

Provide technical guidance and support as to this procedure.

6.3 <u>Employees' responsibilities</u>:

Employees will stop work if workers, other than Qualified Persons, are exposed to live electrical systems at unknown voltages or potentials greater than 50 volts.

Employees shall not open electrical panels unless they are a Qualified Person.

7.0 PROCEDURE

7.1 General Requirements for Use of Electricity

Personnel who meet the requirements of a Qualified Person and have been specifically designated as such in the project health and safety plan may set up temporary circuits up to 240 volts. Maintenance or installation of circuits over 240 volts will require professionally trained personnel (i.e. professional electricians).

All electrical panels, lines, equipment, and facilities are to be considered energized unless confirmation that they are de-energized can be obtained from a Qualified Person or electrician.

All work on de-energized systems will be performed using established Hazardous Energy Control procedures. Lockout devices will be used to prevent the operation/energizing of equipment or circuits during maintenance or other work. Tagout devices will be used only where it is not feasible to use a lockout device.

Insulated tools and electrical handling equipment shall be inspected prior to use to confirm that their protective properties are not damaged. Damaged equipment will be tagged “DAMAGED” and removed from service.

7.2 Distribution System Setup

Only qualified personnel shall perform electrical wiring or connections.

Under no circumstances shall electrical lines be routed through doorways, hatches, windows, or other openings where lines could be crimped, bent, or cut.

Electric lines crossing work areas, personnel, or vehicular traffic areas shall be either fastened securely overhead (at a height that provides safe clearance for work operations), or protected by a cover capable of withstanding the imposed loads without creating a trip hazard.

Circuit breakers shall be labeled to indicate their use.

All circuit breaker panels shall be kept covered when not in use.

A fuse puller shall be used to remove cartridge fuses where one or more energized circuits are present.

All live parts of electrical equipment operating at 50 volts or more shall be properly guarded against accidental contact, which includes:

- Limit access to the equipment to qualified employees only.

- Unqualified Persons shall remain at least one meter (three feet) from exposed, energized systems managed by the Qualified Person(s). This distance shall be three meters (10 feet) for systems with a potential greater than 240 volts.
- Label using the proper accident prevention sign, stating DANGER as well as the voltage of the equipment
- Provide a conductor of the amp rating of not less than the rating of the circuit breaker or fuses protecting that circuit
- Confirm that a bare conductor or earth return is not used for any temporary circuit
- Confirm that all electrical wiring is protected from physical damage by covering and by not placing it in a location where it can be crimped or cut, etc

7.3 Extension Cord Use

Extension cords and electrical connections on handheld and other power tools will be inspected prior to use for cuts, kinks, frayed wires, etc. If any deficiency is noted, the equipment will be tagged “DAMAGED” and removed from service. Manufacturer-installed insulated electrical cords will not be repaired or spliced.

Extension cords are to be kept clean, free of kinks, and protected from oil, hot or sharp surfaces, and chemicals. Extension cords are not to be placed across aisles, through doors, through holes in a wall, or in areas where the cord may be damaged or create a tripping hazard. Extension cords will be appropriate for the specific task and environment.

Extension cord sets for use in field operations should be of the three-wire grounding type and should be designed for hard or extra-hard use. This type of cord will typically utilize insulated wires within an outer insulated sleeve. Examples of such cord include the type marked S, ST, SO, STO, SJ, SJO, or SJTO. Molded wire (flat) cord sets should not be used in field situations. The cord will minimally be rated for the intended current (e.g., heavy duty extension cords are often available in both 15 and 20 amp versions).

Use of extension cords is allowed only for temporary installations not to exceed 90 days (e.g., decorations).

Extension cords shall be provided with a plug cap that is either molded to the cord or equipped with a cord clamp to prevent strain on the terminal screws.

Extension cords shall not be fastened with staples or otherwise hung in a manner that could damage the outer jacket or insulation.

Extension cords shall be inspected prior to each use to confirm that there is no damage or defects. Defective cords shall not be used.

Extension cords used with grounding-type equipment (e.g., three-prong plug) shall contain a grounding-type conductor (have three plugs to accept the ground plug). If an adapter is used to accommodate a three-wire cord to a two-hole receptacle, the adapter wire will be attached to a known ground. The third prong shall never be removed from the plug.

Electrical cords shall not be removed from a receptacle by pulling on the cord line.

Employees' hands shall not be wet when plugging and unplugging cord and plug connected equipment and extension cords. The outlet box for portable extension cords for outdoor use shall be weatherproof and shall be maintained in good condition.

Ground fault circuit interrupters shall be used for all nonpermanent wiring needed for construction purposes or when working in wet or moist areas or onboard ships.

Extension cords used in potentially wet locations shall be approved for use in those locations by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation (e.g., F.M., UL, etc.).

Grounding-type equipment (e.g., three-prong plugs) shall not be modified to mate to incompatible outlets (e.g., cut off grounding prong to fit two prong outlets).

7.4 Portable Electrical Equipment

Double-insulated, portable, industrial-type electrical tools meeting the requirements of the National Electrical Code (NEC) are authorized for use (ground wire not required). Where this type of tool is used, the equipment will be distinctly marked.

Portable electrical tools not provided with special insulating or grounding protection are not for use in damp, wet, or otherwise conductive locations (e.g., by persons standing on the ground or on metal floors).

All portable electrical appliances and equipment with non-current-carrying metal parts to which personnel may be exposed shall be grounded by a continuous conductor of adequate capacity from the device to a grounded receptacle. The SSHO shall resolve any question of whether or not a particular appliance should be grounded.

Manufacturer-installed guards shall not be tampered with, modified, or removed. These guards will be in place and utilized during operation of equipment.

The dimension of the working space in the direction of access to energized parts in switchboards, control panels, fused switches, circuit breakers, panel boards, motor controllers, and similar equipment that requires examination, adjustment, servicing, or maintenance while energized shall not be less than 36 inches deep and 30 inches wide or the width of the equipment, whichever is greater.

Portable electrical equipment shall be handled in a manner that will not cause physical damage to the equipment.

Portable electrical equipment shall not be carried by the cord.

Cords shall not be used to raise or lower equipment.

Disconnect portable electric equipment when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.

Portable electric equipment used in potentially wet locations shall be approved for use in those locations by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation (e.g., F.M., UL, etc.).

Portable electric equipment and extension cords used in areas exposed to gases, fumes, vapors, liquids, or other agents having a deteriorating effect shall be approved for use in those locations.

Portable electric equipment used in areas in which hazardous concentrations of flammable gases or vapors exist shall be approved for use in those locations.

After a circuit is de-energized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized.

7.5 Temporary Lights/Task Lights

A temporary light shall not be suspended by the cord unless the cord and light are designed for suspension.

Temporary lights shall be equipped with bulb protectors unless they are installed at least 7 or more feet overhead.

7.6 Ground Fault Protection

OSHA standard 1926.404(b)(1) requires “ground fault protection” on construction sites. The standard allows two different approaches to providing the required protection for employees from electrical ground faults. Either GFCIs are to be used with temporary receptacles, or an “assured equipment grounding conductor program” is to be established in which plug-connected electrical equipment, extension cords, and temporary receptacles are tested on a periodic basis.

<u>Ground Fault Circuit Interrupters</u>

A GFCI is an electrical device that is designed to prevent electrocution from electrical leakage. It is designed to measure the difference in amperage between the “hot” wire and the “neutral” wire in a circuit. Under ideal conditions, the amperage should be the same in both wires. If there is electrical leakage (a ground-fault), the amperages will be different. If the difference is more than a predetermined amount, the GFCI “trips” and stops the flow of electricity.

GFCIs may trip from many causes:

- Electrical leakage in the tool from internal defects
- Electrical leakage in the extension cord from damaged insulation or from normal leakage in long runs of cords
- Moisture in the air or cords lying in water or on moist dirt
- Too many tools on one GFCI circuit
- Electromagnetic interference from two-way radios or from power transmission lines
- Faulty wiring of the GFCI into the circuit
- Defective GFCI

Any such tripping will require the problem to be corrected before the protected circuit can be re-set.

All 120-volt, single phase, 15 and 20 ampere temporary receptacles shall be protected with “approved” GFCIs. “Approved” means listed by Underwriters Laboratories.

There are several types of GFCIs.

1. A combination circuit breaker and GFCI that is installed in place of the ordinary circuit breaker

2. A receptacle containing a built-in GFCI

3. A portable GFCI that plugs into a receptacle and allows the extension cord or tool to be plugged into the GFCI

4. A portable unit containing several GFCI protected receptacles

GFCIs contain a test button and a reset button. Each GFCI needs to be tested prior to use and on a periodic basis depending upon the manufacturer's recommendations (at a minimum monthly).

Assured Equipment Grounding Conductor Program

If an assured equipment grounding conductor program is to be used instead of GFCIs to provide ground fault protection, the program shall be governed by the following requirements.

Temporary receptacles shall be electrically grounded in accordance with the temporary wiring requirements of the NEC.

Extension cords shall be three-wire cords containing an equipment grounding conductor (ground wire).

Electrical equipment that is plugged into a receptacle or extension cord (portable electrical tools, bench grinders, electric heaters, etc.) shall have a ground wire properly attached to the non-current-carrying metal parts of the equipment. (Double-insulated tools have no ground wire and are therefore exempt from these testing and recording requirements but still need to be inspected for defects.)

The Field Site Manager and/or Supervisor are required to designate one or more competent persons (SSHO) to administer this testing and recording program.

Periodic testing of all plug connected equipment, all extension cords, and all temporary receptacles is to be conducted at the following times:

- Before a new item (equipment, cord, or receptacle) is put into use

- After any repairs to the item

- After any incident in which the item may have been damaged.

- Within 3 months of the last test. (An exception is allowed in the Standard in which extension cords, and temporary receptacles, which are fixed in place and are not exposed to damage, may be tested every 6 months.)

The purpose of the test is to determine the following:

- Temporary Receptacles—to be sure that the receptacle is grounded
- Extension Cords—to be sure that the ground wire is connected to the proper terminal at each end and that the ground wire is continuous throughout the length of the cord
- Plug Connected Equipment—to be sure that the ground wire is connected to the proper terminal and to the non-current carrying metal parts of the equipment and that the ground wire is continuous from the equipment to the plug

The tests may be conducted using the following instruments:

- A receptacle tester may be used to test receptacles and to test extension cords when plugged into a receptacle
- A continuity tester, or a volt-ohm meter, may be used to test equipment and to test extension cords when not plugged into a receptacle

Records must be kept to show which items have passed the test and when the test was conducted. These records may be either written inspection logs, combined with a color coding system using colored tape attached to the item, or some other effective means of identification of the inspected device/cord.

Color coding shall be used in the following manner:

- After a plug-connected piece of equipment or an extension cord has passed the test, colored tape is to be placed around the cord near the plug. After a temporary receptacle has passed the test, colored tape is to be placed on the cover plate.
- Any set of colors may be used, with the exception of black, or silver. Use the following colors for the test periods.
    - January, February, March White
    - April, May, June Green
    - July, August, September Red
    - October, November, December Orange

The tests administered every three months are to begin on the first working day of each quarter. Testing and color coding are to be continued until all items covered by this program have been tested. The test administered every six months, for those receptacles and extension cords needing only semi-annual testing, are to be color coded using the quarterly color current at the time of the semi-annual test.

A visual inspection of plug-connected equipment, extension cords, and temporary receptacles is to be made by the user before each use. The purpose of the visual inspection is to look for damage or defects that could affect the safe use of the item. (Exception: extension cords and temporary receptacles that are fixed in place and not exposed to damage are not required to be given a daily visual inspection, but it is a good idea to do the daily visual inspection anyway.)

Equipment, cords, or receptacles showing damage or defects that could affect its safe operation are not to be used. This applies not only to the visual inspection before each use but also applies to any evidence of damage observed any time during use. Damaged items are to be taken out of service and are not to be used until properly repaired and retested.

Equipment covered by this program is not to be used until the equipment has been tested and color coded according to the requirements of this program.

A copy of this program is to be kept at the worksite.

7.7 Personal Protective Equipment/Work Practices

Nonconductive hardhats shall be worn when there is danger of head injury from electric shock or burns due to exposure to energized parts.

Jewelry shall not be worn when working around or with energized parts.

Insulated tools shall be used to work with energized parts. Tools that have insulation that might be damaged (e.g., rubber handles) shall be inspected prior to each use to confirm the insulation is not damaged.

Eye protection with side shields shall be worn when working with energized parts.

Rubber mats, non-conductive shields, or protective barriers shall be used as needed to protect employees from electrical hazards.

Appropriate insulating gloves shall be worn to pick up or unplug connections that are in highly conductive areas, such as in water.

Do not plug in or unplug electric equipment with wet hands.

8.0 REFERENCES

- 29 CFR 1926, Subpart K, Electrical
    - 1926.404(b)(1), Ground Fault Protection
- 29 CFR 1910, Subpart S, Electrical
    - 1910.303, General
- National Fire Protection Association (NFPA) 70, National Electric Code, 70E, Standard for Electrical Safety in the Workplace.

9.0 REQUIRED RECORDS

If using the assured grounding program, the designated Competent Person for project site (SSHO or designee) shall maintain all inspection records with the project files.

10.0 ATTACHMENTS

None.

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

EXCAVATION & TRENCHING

OP-583

Revision 1
October 2013

Prepared by:

12-19-2013

Sean Liddy, CSP
Occupational Health & Safety Manager

Date

Approved by:

12/19/2013

Alan Solow, CHP
Chief Executive Officer

Date

1.0 PURPOSE

This operating procedure (OP) establishes the minimum requirements for evaluating of excavation and trenching operations to provide for proper protective systems for employee protection.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Benching (Benching system) - A series of horizontal levels or steps, usually with vertical or near vertical surfaces between levels to protect employee from cave-ins and slumping soil material.

3.2 Cave-in (collapse) - The separation of a mass of soil or rock material from the side of an excavation or the loss of soil from beneath a trench shield or support system due to sudden movement of material into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure, immobilize or incapacitate a person.

3.3 Competent person – A person, who by way of training, knowledge, and/or experience, is capable of classifying or “typing” the soils and who is also capable of identifying existing and predictable hazards in excavation/trenching work areas. This person has the authority to establish best management practices and controls and to take prompt corrective measures to eliminate potential hazards. The person must also be familiar with the requirements in the regulation.

3.4 Excavation - A manmade cut, cavity, trench, pit or depression in an earth surface formed by earth removal. Examples include trenches, tunnels, shafts, caissons and open cut holes.

3.5 Faces (or sides) - The vertical or inclined earth surfaces formed as a result of excavation work.

3.6 Failure - A structural member’s integrity and supportive capabilities is compromised, causing a breakage, displacement, or permanent deformation.

3.7 Hazardous Atmosphere - An atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful may cause death, illness, or injury.

3.8 Protective Systems - Devices or methods used to protectemployees from cave-ins or a collapse or falling material while working in an excavation.

Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection such as a trench box.

3.9 Ramp - An inclined walking or working surface that is used to gain access to one point from another in the excavation and is constructed from earth or from structurally suitable materials such as steel or wood. A ramp is typically placed at a gentle slope, less than a 10 percent grade.

3.10 Registered Professional Engineer - An engineer who can authorize any state of work by his professional designation. However, a professional engineer is deemed to be a “registered professional engineer” within the meaning of this standard when approving designs for “manufactured protective systems” or “tabulated data” to be used in interstate commerce.

3.11 Shield (Shield system) - A structure that is able to withstand the forces imposed on it by a cave-in or slumping soil material and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre manufactured or job-built. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

3.12 Shoring (Shoring system) - A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and that is designed to prevent cave-ins.

3.13 Sloping (Sloping system) - An alternative to shoring is trench sloping. This means that the trench walls are cut back to decrease the possibility of cave-ins. The angle of incline required to prevent a cave-in varies with such factors as soil type, environmental conditions of exposure, and application of surcharge loads.

3.14 Stable rock - A natural solid mineral material that is indurated but not lithified and can be excavated with vertical side wall; unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against cave-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

3.15 Support system - A structure such as underpinning, bracing, or shoring that provides support to an adjacent structure, underground installation, or the sides of an excavation.

3.16 Trench - An open narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is often not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet

(4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered a trench.

3.17 Trench Box - A trench box is a unit of shoring that is an engineered shoring system capable of protecting workers in case of cave-in of trench walls. The space between the trench wall and the trench box must be backfilled.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

Because of their inherent dangers, entry into trenches and excavations shall not be performed if there are means other than entry to perform the work. Where entry into trenches and excavations is necessary, strict adherence to the procedures specified below is extremely important and mandatory. Whenever there are questions regarding the safety of trench or excavation entry, contact shall be made with the Competent Person or the Occupational Health and Safety (OH&S) Manager.

No one shall enter any trench or excavation until the walls have been adequately cut back or otherwise stabilized with temporary protective structures. A trench or excavation may be entered if it is shallower than the legal minimums and the surrounding soil has been deemed stable by the competent person.

Excavation work must be undertaken with care. Excavations should be inspected daily and when conditions change in accordance with local, tate and/or federal regulations.

5.0 EQUIPMENT

Refer to Section 3.

6.0 RESPONSIBILITIES

6.1 Project Managers and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Implementation of this procedure for supervised employees.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees' responsibilities:

Apply appropriate precautions and work practices in their use of ladders, ramps and other structures while working in and around excavations. Bring any concerns to the competent person and OH&S Manager for discussion immediately.

6.4 Competent Person responsibilities:

A competent person must be present during all work that involves entry by Cabrera personnel into trenches or excavations greater than 5 feet/1.5m in depth (as above).

For the purpose of this OP, a competent person is defined as an individual, who by education or experience, is capable of evaluating the hazards associated with trench or excavation collapse and is capable of classifying soils. The competent person for the project will be indicated in the Activity Hazard Analysis (AHA) for the project.

The competent person:

- Determines the maximum allowable slope for the walls of the trench or excavation

  Classifies or types the soil in and surrounding the trench or excavation in accordance with the requirements specified in the legislation (e.g., CFR 1926 subpart P, Appendix A Soil Classification) prior to determining that a maximum allowable slope, other than 34° with the horizontal, is selected.

- Inspects the excavation or trench on a daily basis and when conditions change to assess the potential for employees to be exposed to the hazards of the trench or excavation..sts.

7.0 PROCEDURE

7.1 Underground and Overhead Utilities

Prior to beginning any excavation work at a site, the location of all underground and overhead utilities shall be identified. Work locations will be carefully planned to avoid any potential for inadvertent contact with them. Call Before You Dig, Dig Safe or other underground utility locator will be notified as is necessary and required by State and local regulations.

Locate underground utilities and expose (when possible) prior to excavating. Flag, paint or otherwise demarcate the locations and orientations of underground utilities not exposed so as to avoid during earthwork.

Identify any overhead power lines and de-energize (when possible) or protect / avoid by other appropriate means.

7.2 Excavation Requirements

Soil conditions, wall slope, or shoring must be identified and designed by a professional engineer or Competent Person to meet the federal, state, provincial, territorial regulations.

Excavated (spoil) material shall be kept at least 1.0 meter (3.2 feet) from the edge of the excavation, or further if local regulations are more stringent.

If the walls of an excavation or trench are not sloped or cutback, barriers must be placed around the perimeter. The barrier must be at least 1.1 meters (3.6 feet) in height.

Workers must be protected whenever shoring is being installed or removed.

If water is controlled or prevented from accumulating by the use of water removal (dewatering) equipment, the water removal equipment and operations shall be monitored regularly to ensure proper operation.

If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require regular inspections. Groundwater that is removed (dewatered) from the excavation shall be controlled / managed in accordance with the contract documents and all applicable local, state and federal regulations / guidelines.

All excavations must be secured at the end of the day with a protective covering (metal plate, etc) or other appropriate barriers to prevent the public from falling into the open excavation.

Backfill trenches as soon as is reasonably possible after work is complete.

7.3 Sloping or Shoring Protection Requirements

A Professional Engineer or qualified soils professional can properly assess the need for and the type of shoring required for specific applications. Shoring may not be needed in all cases, but failure to recognize the need for shoring can be catastrophic.

Exceptions. Each individual in an excavation shall be protected from cave-ins and trench collapse by an adequate protective system except when:

- Excavations are made entirely in stable rock
- Excavations are less than 5 feet (and as above) in depth and an examination of the excavation by a competent person reveals no indication of a potential cave-in

The depth of the excavation is to be measured at its greatest vertical dimension. Be aware that crouching or kneeling in a trench that is greater than 3 feet in depth may still pose significant hazard for the employee involved. The three means for supporting trench walls are sloping, shoring, and trench boxes.

The protective system may include sloping the excavation walls, shoring the excavation walls, or installing a shielding system. The protective system chosen must have the capacity to resist, without failure, all expected loads that would be applied to the system.

In the case when an excavation is deeper than 20 feet (6.0 m), a professional engineer experienced in civil work must approve and sign on all protective systems.

Trenches must be protected from cave-ins or loss of ground prior to workers entering the trench when the following conditions apply:

- The trench is greater than 3’11” (1.2 m) in depth (however, even if the trench is less than 1.2 meters deep the potential for a cave-in exists, and appropriate controls must be implemented prior to entry to ensure the trench is safe)
- A worker is required to enter the trench
- A worker is required to be closer to a trench wall than the height of the trench wall; and
- If an excavation may affect the stability of an adjacent building or structure, precautions must be taken to prevent damage to the structure. The precautions shall be specified in writing by a professional engineer.

7.4 Use of Sloping as a Means of Protection

Sloping of the excavation or trench walls is the preferred, and typically simplest means of protecting employees who must enter trenches or excavations which are greater than 5 feet (1.5 m) in depth or where there is danger of collapse.

The trench or excavation walls may be sloped back so that the ratio of the horizontal distance to the vertical rise (H:V ratio) of the sloped wall is at least 1½:1 (i.e., equivalent to an angle with the horizontal of 34° or less).

In many cases, determining the maximum allowable slope may allow the use of a steeper slope, which will result in a narrower excavation. However, determination of soil classification is complicated and requires that the competent person be familiar with the manual and visual tests. Since incorrect soil classification may result in the use of a steeper, and potentially unsafe, slope, it is recommended that an angle of 34° (or less) with the horizontal typically be selected.

7.5 Use of Shoring or Shielding as a Means of Protection

Where sloping the walls of the trench or excavation is unfeasible (e.g., when there are dimensional constraints or adjacent structures), the use of shoring or a shield systems (e.g., trench boxes) may be necessary.

Factors that affect the selected method of shoring include:

- Soil Structure and Strength: Trench walls, at first glance, may appear to have strength, particularly if rock is encountered. Fractures in the rock can develop because of construction and soil strength may fail when subjected to undercutting or high-energy impacts. Irregular slopes on stratified soils that appear stable can fail if lower materials do not have adequate strength.

- Soil Moisture Content: Soil may be moist even though the weather has been dry. Care must be taken and shoring provided if the soil appears to be moist.

- Weather and Humidity: These can have a significant impact on shoring requirements. Frozen stable soil may collapse if warm mild weather persists. Percolation of water into the soil can increase the load on the shoring due to the increased weight and mobility of saturated soils. Frozen ground does not preclude the need to install shoring unless the freezing process is designed and approved by a Professional Engineer.

- Soil Stress: Stress can originate from many sources. Heavy machinery passing close to the shoring creates vibrations that decrease the soil strength and can result in shoring failure. Stationary equipment at the edges of the excavation can transmit loads and additional stresses to the shoring.

- Trench Depth and Width: These directly influence the choice of materials and the spacing of support bracing. The shoring requirements of a wide and deep trench differ substantially from those of a narrower trench.

- Erosion Time: If excavations are to be left open for extended periods, shoring materials may have to be increased.

7.6 Working Around the Trench/Excavation

While workers are in a trench, an aboveground observer must be present to warn of earth movements and to advise equipment operators of the presence and location of those in the trench so as to avoid vibrating equipment near trenches or excavations.

If there is a danger of a worker or equipment falling into an excavation, or whenever the edge is not clearly visible, the observer must identify the trench or excavation perimeter with visual markers (e.g., barricade tape, wooden railings, stop logs, etc). If the trench or excavation is 4 ft (1.2 m) or greater in depth, the visual barrier must be a minimum of 6 ft (1.8 m) from the edge.

Personnel must notify workers of the excavation through flagging, marking, safeguards, or other appropriate and effective means. Safety meetings should address any excavation concerns and issues.

Where employees or equipment are required or permitted to cross over excavations, walkways or bridges over excavations must have a minimum clear width of 20 inches (0.6 meters), be fitted with standard guard rails and extend a minimum of 24 inches (0.6 meters) past the surface edge of the trench. If vehicle crossings over excavations are required, they must be designed by and installed under the direction of a registered professional engineer.

Precautions must be taken to isolate loose rocks or other slumping materials that may slide, roll, or fall into the trench and onto workers..

While operating heavy equipment in the work area, the equipment operator shall maintain communication with a designated signal person through either direct voice contact or approved standard hand signals.

When mobile equipment is operated adjacent to an excavation or when such equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs shall be used. If possible, the grade should be away from the excavation.

All site personnel should maintain a safe distance and remain clear of the swing of operating excavation equipment.

Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped to provide adequate protection for the operator during loading and unloading operations.

Personnel that operate or work in the vicinity of heavy equipment shall wear all required safety equipment, including a high visibility vest (Class 2 or 3).

All materials such as pipe, rebar, etc., shall be kept out of traffic lanes and access ways. Materials and equipment shall be stored in a designated storage or laydown area so as not to disrupt work operations or endanger personnel at any time.

A flagman with roadwork, signs, cones, and high-level warning signs shall be provided when it is necessary to control normal vehicular traffic due to vehicles, such as end-dumps, entering, or leaving the site.

7.7 Working Within the Trench/Excavation

Employees shall not work in excavations in which there is accumulated water or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

A stairway, ladder, ramp, or other safe means of egress shall be located in excavations or trenches that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees. Ladders should extend at least 3 feet (0.75m) above the trench top.

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design and shall be constructed in accordance with the contract documents and/or system design.

Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement. Structural members used for ramps and runways shall be of uniform thickness. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

7.8 Hazardous Atmospheres

Confined spaces may exist in excavations where there is limited access or egress and in which a hazardous gas, vapor, dust, or fume or an oxygen deficient atmosphere may occur.

To prevent exposure to harmful levels of atmospheric contaminants, entry into trenches and excavations greater than 5 feet/1.5m in depth in which a hazardous atmosphere exists, or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, must be performed in accordance with the requirements specified in OP 582, Confined Spaces.

Adequate precautions, such as mechanical ventilation or appropriate respiratory protection shall be taken prior to entry into trenches and excavations in which the oxygen concentration is less than 19.5 percent or the concentration of flammable gases or vapors is in excess of 10 percent of the lower explosive limit (LEL).

When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to confirm that the atmosphere remains safe. Atmospheric testing will be conducted in the anticipated breathing zone of the work area to determine oxygen content, combustible gas, and toxic gases and vapors, if applicable. Downwind sample points and atmospheric sampling may be required to assess any potential off-site migration of airborne contaminants.

Appropriate respiratory protection shall be donned prior to entry into any trench or excavation in which airborne levels of toxic substances are present at concentrations in excess of their Threshold Limit Value (TLV) or Permissible Exposure Limit (PEL).

If a confined space is identified, emergency rescue procedures will be in place in accordance with OP 582, Confined Spaces.

7.9 Stability of Adjacent Structures

Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

- The excavation is in stable rock; or

- A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

- A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

In addition, sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

7.10 Inspections

Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift and when site conditions. Inspections shall also be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

7.11 Personal Protective Equipment (PPE)

Minimum PPE requirements include:

- Hard hats
- Safety glasses with side shields
- Steel-toed boots
- Reflective vest
- Respiratory equipment, as required

7.12 Special Excavation Entry Permit Required for California

In California, for the construction of trenches or excavations that are 5 feet/1.5 m or deeper and into which a person is required to descend, an additional permit must be obtained from Cal/OSHA.

8.0 REFERENCES

- 29 CFR 1926, Subpart P, Excavations

9.0 REQUIRED RECORDS

- Completed Daily Excavation Checklist will be kept with project files (must be retained for +1 year).

10.0 ATTACHMENTS

Attachment A – Excavation Inspection Form

Attachment A

Excavation Inspection Form

OP 583 - Excavation & Trenching

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Excavation Inspection Form

Designated Competent Person must inspect/document excavation prior to beginning work, after a rain event, and as needed throughout the shift.

Project Name:	**Project Number:**	**Project Location:**
Date:	**Inspection Completed By:**	

Excavation Information:

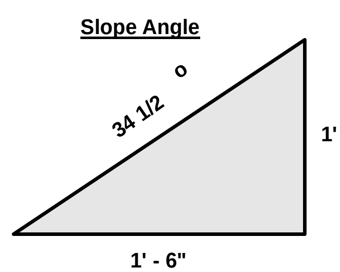
Soil Type:	**Excavation Depth**:	**Excavation Width:**
Type of Protective System Used:		

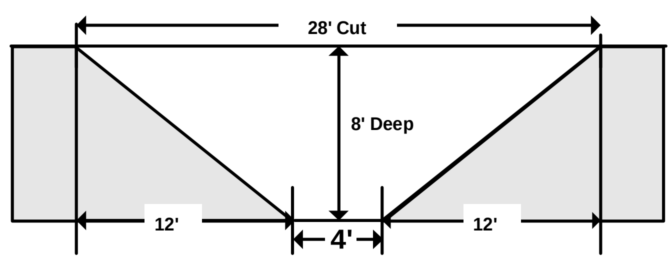
1. General Information:	**Yes**	**No**	**N/A**
A. Is excavation less than five feet in depth?	☐	☐	☐
B. Is there a potential for a cave-in? ***IF YES, excavation must be sloped, shored, or shielded.**	☐	☐	☐
C. Is excavation deeper than 5 feet? *** IF YES, excavation must be sloped, shored, or shielded.**	☐	☐	☐
D. Is sloping used as your protective system?	☐	☐	☐
E. 1- Manual & 1- Visual Method utilized to determine Soil Classification as A-B-C (select one: Y=A, N=B, N/A=C)	☐	☐	☐

Manual Test Method Used: ☐ Plasticity ☐ Dry Strength ☐ Thumb Penetration ☐ Dry Testing ☐ Pocket Penetrometer

Visual Characteristics: ☐ Cemented ☐ Cohesive ☐ Dry ☐ Fissured ☐ Granular ☐ Layered ☐ Moist ☐ Plastic ☐ Saturated ☐ Submerged ☐ Surface cracking ☐ Undercut

Slope information to keep in mind:





Example of a Simple 34-degree Slope commonly used around the site for cave-in protection.

2. Surface Conditions	**Yes**	**No**	**N/A**
A. Surface encumbrances removed or supported.	☐	☐	☐
B. Individuals protected from loose rock/soil that may pose a hazard by falling/rolling into excavation.	☐	☐	☐
C. Hard hats, safety-toed boots, and safety glasses worn by all individuals.	☐	☐	☐
D. High visible vest (Class 2 or 3) worn by all individuals. Vest required around heavy equipment.	☐	☐	☐
E. Spoils, materials, and equipment set back at least 3 feet from the edge of the excavation.	☐	☐	☐
F. Adequate barriers provided at all excavations, wells, pits, shafts, etc.	☐	☐	☐
G. Individuals are required to stand away from vehicles being loaded or unloaded.	☐	☐	☐
H. Warning system established and utilized when mobile equipment is operating near the edge of the excavation	☐	☐	☐

(e.g., barricade tape, signalpersons, stop logs, etc).			
I. Individuals prohibited from going under suspended loads.	☐	☐	☐
3. Utilities	**Yes**	**No**	**N/A**
A. Location of utilities marked.	☐	☐	☐
B. Prior to the use of equipment, underground utilities have been located by hand digging and exposed.	☐	☐	☐
C. Underground utilities are protected, supported, or removed when excavation is open.	☐	☐	☐
4. Means of Access and Egress:	**Yes**	**No**	**N/A**
A. Travel distance to means of egress no greater than 25 feet in excavations 4 feet or more in depth.	☐	☐	☐
B. Straight ladders used in excavations extend at least 3 feet above the edge of the trench.	☐	☐	☐
C. Ramps being used for employee access have been designed by the competent person.	☐	☐	☐
D. All individuals are protected from cave-ins when entering or exiting the excavation.	☐	☐	☐
5. Wet Conditions:	**Yes**	**No**	**N/A**
A. Precautions have been taken to protect individuals from the accumulation of water.	☐	☐	☐
B. Water removal equipment monitored by a competent person.	☐	☐	☐
C. Surface water or runoff is diverted or controlled to prevent accumulation in the excavation.	☐	☐	☐
D. Inspections have been made after every rainstorm or other hazard-increasing occurrence (freeze/thaw, local demolition, rerouting of traffic, etc).	☐	☐	☐
6. Hazardous Atmosphere:	**Yes**	**No**	**N/A**
A. Are there exposed sewer or natural gas lines in excavation?	☐	☐	☐
B. Is excavation near a landfill, or are hazardous substances being stored close to the excavation?	☐	☐	☐
If you answered YES to A or B, then treat the excavation as a confined space. **OP 582 *Confined Spaces***			
C. All individuals will contact the Fire/Rescue Group at prior to entry and in case of emergencies.			
7. Support Systems:	**Yes**	**No**	**N/A**
System Manufacturer:	System Type:		
A. Tabulated Data for system on-site?	☐	☐	☐
B. Materials/equipment for support systems selected based on soil analysis, trench depth, and expected loads.	☐	☐	☐
C. Materials/equipment used for protective systems have been inspected and are in good condition.	☐	☐	☐
D. Protective systems installed without exposing all individuals to the hazards of cave-ins, collapses, or the threat of being struck by materials or equipment.	☐	☐	☐
E. Members of support system are securely fastened to prevent failure.	☐	☐	☐
F. Support systems are provided to ensure stability of adjacent structures (buildings, roadways, sidewalks, etc.)	☐	☐	☐
G. Excavations below the level of the base of a footing have been approved by a registered PE.	☐	☐	☐
H. Removal of support systems progresses from the bottom (members released slowly to note indication of possible failure).	☐	☐	☐
I. Backfilling progresses with the removal of support system.	☐	☐	☐
J. Material excavated to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.	☐	☐	☐

K. A shield system has been placed to prevent lateral movement.	☐	☐	☐
M. All individuals are prohibited from remaining in the shield system during vertical movement.	☐	☐	☐
8. Training:	**Yes**	**No**	**N/A**
A. All individuals have had Excavation Safety Awareness Training.	☐	☐	☐

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

HEAVY EQUIPMENT OPERATIONS

OP-584

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

This operating procedure (OP) establishes the safe working requirements for working with and in the vicinity of heavy equipment.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Heavy equipment - All excavating equipment including scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and other similar equipment.

3.2 Operator - Any qualified and/or licensed person who operates the controls while the heavy equipment in is motion or the engine is running

3.3 Ground personnel/workers - Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc.

The following outlines the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities. Confirm all equipment (i.e., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath aboveground utilities.

- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers (Dig Safe, Call Before You Dig, etc.) for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc.

- Observe and understand all color-coded ground markings for the presence of buried utilities. If working near marked out utilities or in areas where utilities are assumed to exist but have not been marked out, contact the project manager or site health and safety officer for direction if uncomfortable; it is better to be safe than sorry.

5.0 EQUIPMENT

Refer to Section 3.

6.0 RESPONSIBILITIES

6.1 Project Managers (PM) and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Implementation of this procedure for supervised employees.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees' responsibilities:

Apply appropriate precautions and work practices when working with, or in close proximity to, heavy equipment. Contact the PM, SSHO or field site manager for direction / clarification if unsure or unclear regarding work tasks in the vicinity of buried and overhead utilities.

6.4 Competent Person responsibilities:

A competent person must be present during all work that involves heavy equipment operations by Cabrera personnel or selected subcontractor.

For the purpose of this OP, a competent person is defined as an individual, who by education or experience, is capable of evaluating the hazards associated with heavy equipment operations and is capable of taking corrective actions to control the hazards. The competent person for the project will be indicated in the Activity Hazard Analysis (AHA) for the project.

The competent person:

- Is knowledgeable in the safe operation of the selected/designate piece of heavy equipment
- Possesses the skill level to safely operate the heavy equipment in the manner prescribed for the equipment, and the environment in which it is operating.
- Will inspect the equipment on a daily basis to ensure safe operation.
- Informs all ground personnel of appropriate precautions when working with/around the heavy equipment and when operating in close proximity to buried and/or overhead utilities and other hazards.

7.0 PROCEDURE

For work under Cabrera control, PMs are responsible for ensuring all equipment is in good working order and all equipment operators are qualified on the piece of machinery they are assigned. If the equipment and operator have been subcontracted and there are concerns regarding the equipment and/or the operator, the PM will first discuss with the operator to resolve any concerns. If the PM does not resolve those concerns satisfactorily with the operator, he/she will contact the operator's supervisor to resolve.

The operator will confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.

The operator of mobile equipment is the only worker permitted to ride the equipment unless the equipment is a worker transportation vehicle.

A person will not operate heavy equipment unless the person has received adequate instruction and training in the safe use of the equipment, has demonstrated to a qualified supervisor or instructor competency in operating the equipment. The operator will provide documentation indicating he/she maintains the proper license to operate the equipment and will not operate the equipment until such license is obtained and provided to Cabrera.

The operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment.

7.1 Prior to work commencing

All heavy equipment will be regularly inspected pre-shift and then regularly as required with the details of the inspection recorded using the attached Heavy Equipment Inspection form or in a log book.

The operator will report defects and conditions affecting the safe operation of the equipment to the supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.

Exposed moving parts on equipment which are a hazard to the operator or to other workers will be guarded and if a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

An approved Underwriter's Laboratories (UL) 4A40BC fire extinguisher shall be present on all mobile equipment.

Inform the operators of the equipment that employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, equipment has the 'right of way'. Stay in visual contact with the operator as is necessary to work safely.

Where the operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

Where the operator of \heavy equipment cannot directly or by mirror or other effective device, see immediately behind the machine, an automatic audible warning device (alarm) will be utilized to provide safe movement. The alarm will activate whenever the equipment controls are positioned to move the equipment in reverse, and if practicable and should be audible above the ambient noise level.

7.2 Inspection and Maintenance

Maintenance records will be maintained on the site or project for equipment.

Servicing, maintenance and repair of heavy equipment will not be done when the equipment is operating, unless continued operation is essential to the process and a safe means is provided.

Prior to use, all heavy equipment shall be inspected. Inspections and any repairs will be documented. Inspections and/or repair reports will be available for review upon request. . Operators shall not operate heavy equipment that has not been inspected and cleared for use. All machinery and mechanized equipment will be certified to be in safe operating condition by a competent individual prior to on-site operation (typically by rental company). Certifications shall be renewed annually or when maintenance and/or repairs are made to make the equipment safe to operate.

All heavy equipment shall be inspected in accordance with the manufacturer's recommendations.. All defects shall be reported to the site supervisor/manager immediately. Inspection records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use the Heavy Equipment Inspection Form (attached).

Defective heavy equipment shall be immediately taken out of service until repaired and recertified for safe usage.

7.3 Fueling and batteries

A well-ventilated area shall be used for refueling.

Only the type and quality of fuel recommended by the engine manufacturer shall be used.

Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

No one shall spill fuel on hot surfaces. Any spillage shall be cleaned before starting an engine.

Spilled fuel shall be contained and cleaned with cotton rags or cloths; do not use wool or metallic cloth. Consult the site-specific spill response plan to contain and remediation of spills. At a minimum, absorbent material should be applied to contain/mitigate spills.

Open flames, lighted smoking materials, or sparking equipment shall remain well away from the fueling area.

Heaters in carrier cabs shall be turned off when refueling.

Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.

The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.

Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent buildup of a static charge.

Cell phones and other electronic devices are not allowed in the refueling area during refueling operations.

Batteries shall be serviced in a ventilated area while wearing appropriate PPE.

When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first.

When installing a battery, the battery shall be connected ground post last.

When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water. Absorbent material shall, at a minimum, be applied to contain any spill (Refer site-specific spill response plan).

Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention sought immediately.

To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around battery by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least 25 feet away from battery-charging stations.

7.4 Safe Operation (Operator)

The operator of heavy equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment.

The operator of heavy equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement such as by setting the parking brake, placing the transmission in the manufacturer's specified park position, and by chocking wheels where necessary.

The operator will maintain the cab, floor and deck of mobile equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

If mobile equipment has seat belts required by law or manufacturer’s specifications, the operator and any passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

Do not wear loose clothing where there is a danger of entanglement in rotating equipment.

Maintain a distance of 10 feet between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, the area will be barricaded or guarded to prevent access.

Vibration from moving traffic or mobile equipment can cause excavations or spoil piles to become unstable. Be aware of the risk and keep clear.

All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

All heavy equipment shall be operated at safe speeds.

Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

When feasible, operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

Slow down and sound horn when approaching a blind curve or intersection. Flagmen equipped with 2-way radio communications may be required to adequately control traffic.

Operators shall remain in cab while heavy equipment is being loaded.

Equipment shall be shut down prior to and during fueling. Do not smoke or use electrical devices while fueling. Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

Turn off heavy equipment, place gear in park (or leave in gear) and set parking brake prior to leaving vehicle unattended. Buckets and blades are to be placed on the ground and with hydraulic gears in neutral. Heavy equipment parked on slopes shall have the wheels chocked.

Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

Never exit heavy equipment while it is in motion.

Passengers shall only ride in heavy equipment designed for occupancy of passengers.

Never ride on the outside of a piece of heavy equipment (e.g., tailgates, buckets, steps, etc.).

Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

Equipment left unattended at night adjacent to traveled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (or the regulatory requirement for the work location) to the active roadway.

Pneumatic-tired earthmoving haulage equipment, with a maximum speed exceeding 15 miles per hour, shall be equipped with fenders on all wheels. Support vehicles with flashing lights, signage made be required when moving heavy equipment for one job site to another.

Lift trucks shall have the rated capacity clearly posted on the vehicle. These ratings will not be exceeded.

Steering or spinner knobs shall not be attached to steering wheels.

High lift rider industrial trucks shall be equipped with overhead guards.

When ascending or descending grades in excess of 5%, loaded trucks shall be driven with the load upgrade.

All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.

All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.

All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

7.5 Safe Operation (Ground Personnel)

A supervisor will not knowingly operate or permit a non-authorized or licensed worker to operate mobile equipment which could create an undue hazard to the health or safety of any person.

When approaching or crossing the intended path of travel of heavy equipment, establish eye contact with the operator of the mobile equipment first to and confirm that it is safe to proceed.

Have vehicle headlights on at all times when driving in the area.

Park motor vehicles off the haul roads, or away from the work areas. Site vehicles will be parked in a designated parking location away from heavy equipment.

Do not enter the swing area of machines such as cranes, or excavators, without first making eye contact with the operator, and receiving permission to do so.

Stay out of the blind areas around heavy equipment and never assume that the equipment operators have seen or are aware of your presence.

Do not wear loose clothing where there is a danger of entanglement in rotating equipment.

Vibration from moving traffic or mobile equipment can cause excavations or spoil piles to become unstable. Be aware of the risk and keep clear.

Stay on the uphill side of equipment while operating near steep slopes, shoulders, ditches, cuts, or excavations.

7.6 Communication

Communication between site supervisors/managers, heavy equipment operators, and other site personnel is a key method of preventing serious injury or death during heavy equipment operations.

The following outlines the communication requirements during heavy equipment operations:

- Site supervisors/managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site and within close proximity to heavy equipment operations.
- Site supervisors/managers shall inform all ground personnel before changes are made in the locations of designated work areas
- Prior to work initiating onsite the site supervisor/manager will confirm that all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel
- Personnel working around heavy equipment operations will maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.
- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (i.e., backup alarms) that can be heard distinctly, over equipment and other background noise. Reverse signaling lights and alarms shall always be in working order
- When feasible, two-way radios shall be used to verify the locations of nearby ground personnel

- When an operator cannot adequately survey the working or traveling zone, a guide shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may also be used to highlight these signals.

7.7 Ground Personnel

Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

The following outlines the clearance requirements during heavy equipment operations:

- Ground personnel shall always yield to heavy equipment
- Ground personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment. Recommended minimum safe distance is 50 feet plus the maximum swing radius of the piece of equipment being used.
- A job-specific hazard analysis (AHA) that identifies any special precautions shall be completed and communicated to all site personnel
- Site supervisors/managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of these designated areas. Designated areas shall include boundaries and travel routes for heavy equipment. Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
- When feasible, site supervisors/managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers, etc.) around designated areas and confirm that unauthorized ground personnel do not enter such areas
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear
- Ground personnel shall never stand between two pieces of heavy equipment or other objects (i.e., steel support beams, trees, buildings, etc.)
- Ground personnel shall never stand directly below heavy equipment

located on higher ground

- If working near heavy equipment, ground personnel shall stay out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment
- Personnel shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment
- Personnel shall not talk on a cell phone while standing or walking on a roadway or other mobile equipment path.

At a minimum, all ground personnel and operators outside of heavy equipment shall wear the following:

- High visibility, reflective (Class 2 or 3) safety vest that is visible from all angles and made of fluorescent material and orange, white, or yellow reflective material (confirm that vest is not faded or covered with outer garments, dirt, etc.)
- Retro-reflective striping for arms and legs (night work)
- American National Standards Institute (ANSI) approved hard hat
- ANSI approved safety glasses with side shields
- ANSI approved work boots (unless project requirements are more stringent)
- ANSI approved hearing protection as needed
- Appropriate work clothes (i.e., full length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).

7.8 Training

The operator or other qualified supervisor will provide all on-site personnel with an orientation to the heavy equipment and its associated hazards and controls.

Only designated, qualified (licensed if required) personnel shall operate heavy equipment.

Operators shall have all appropriate local, state, or federal licenses or training to operate a designated piece of heavy equipment.

Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by a Cabrera operator in which case a practical evaluation is needed. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

8.0 REFERENCES

- 29 CFR 1926 Subpart O, Motor Vehicles, Mechanized Equipment & Marine Operations
- 29 CFR 1926 Subpart W, Rollover Protective Structures

9.0 REQUIRED RECORDS

- Completed Heavy Equipment Inspection Forms will be kept with project files.

10.0 ATTACHMENTS

Attachment A – Heavy Equipment Inspection Form

Attachment A

Heavy Equipment Inspection Form

OP 584 - Heavy Equipment Operations

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Heavy Equipment Inspection Form

Competent Person must inspect/document equipment when it is put into service, using this form. Equipment must be inspected prior to each use by the operator.

Project Name:	**Project Number:**	**Project Location:**
Operator:	**Make/Model:**	

Week of:	**Monday**			**Tuesday**			**Wednesday**			**Thursday**			**Friday**		
Hour meter reading:															
Check the following as appropriate	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**
1. Operator qualified	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Overhead guard (ROPS)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Horn	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Lights	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Parking brake	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Service brakes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Steering	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Engine Oil level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Hydraulic oil level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Radiator fluid level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Major fluid leaks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Windows/Wipers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Backup alarm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Tires (visual)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Seat belts	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Fuel leaks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Fire extinguisher	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Fuel lines secure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Electrical lines	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Exhaust components	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

SAT – Satisfactory, UNSAT – Unsatisfactory, N/A – Not Applicable
Comments/Remarks:

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

FALL PROTECTION

OP-585

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

This operating procedure (OP) establishes fall prevention and protection requirements for employees who perform work at heights of 6 feet (1.8 m) or more above ground or other work surfaces.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Anchor Point - A secure point of attachment for lifelines or lanyards, usually a building structural component, crane, or other support capable of holding a 5,400 pound static load.

3.2 Base Surface - The area immediately beneath an elevated structure or surface (ground, walking surface, floor, etc.). Used synonymously here with “grade.”

3.3 Body Harness (Class III) - A tight fitting harness designed to fit the torso and spread the shock associated with arresting a fall over the entire torso area. Harnesses typically have connecting D rings at chest level in the front and the back for attaching a lanyard.

3.4 Climbing Protection System - A type of fall protection used while working from long ladders, poles, and towers. The climbing protection system incorporates a permanently installed rail or cable that runs the length of the ladder. The climber's harness is attached to the rail or cable by a sliding device or sleeve that allows climbing freedom but locks the instant a fall is sensed.

3.5 Deceleration Device - A mechanism, such as a rope grab, rip-stitch lanyard, specially woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards, etc., that serves to dissipate a substantial amount of energy during a fall arrest or to otherwise limit the energy imposed on an employee during fall arrest.

3.6 Fall Prevention - Any structure (e.g., a ladder cage or guardrail), fence, or barrier that will prevent falls while working from heights. A safety belt and short lanyard is also considered a type of fall prevention.

3.7 Fall Protection - A personal lifeline system (e.g., harness and lanyard), deceleration device, and fixed anchor points or climbing protection system (e.g., permanent ladder rails) that limit falls to less than 6 feet (1.8m).

3.8 Free Climbing - Climbing on a structure such as a ladder, tower, or chimney that is not equipped with guardrails, walls, a cage, or other type of structural fall prevention. Free climbing generally requires the use of a fall protection system.

3.9 Grade - (see Base Surface).

3.10 Lanyard - A line connecting a safety harness or safety belt to a safety line or structure. When used with a safety belt, the lanyard must be short enough to prevent the employee from approaching the fall hazard.

3.11 Personal Lifeline System - A type of fall protection that is comprised of a body support (i.e., a safety belt or body harness) and a lanyard that is attached to an anchorage point or a safety line.

3.12 Personal fall arrest system - A system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, and full-body harness and may include a lanyard, deceleration device, or static line.

3.13 Safety Belt (Class I) - A belt worn around the waist that when attached to an anchor point with a lanyard prevents a worker from approaching a fall hazard. Safety belts should not be used other than as a restraint device without the prior approval of the Project Manager and the Occupational Health and Safety (OH&S) Manager.

3.14 Safety Line - A rope or cable secured to one or more anchor points to which lanyards may be attached to limit fall distance.

3.15 Standard Railing - Railing provided to enclose open-sided work platforms and consisting of a top rail, intermediate rail, and posts. The top rail has a vertical height of 42 inches above the platform surface and the intermediate rail is approximately halfway between the top rail and the platform surface.

3.16 Work at Heights - Any work/job/task to be performed above the normal walking/working surface that necessitates the use of some form of fall protection as determined by the applicable governing rules and regulations. In the absence of applicable rules and/or regulations governing this type of work in a particular jurisdiction, the default requirement shall be 6 feet (1.8 meters).

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

All fall arrest equipment must bear a manufactures label and confirmation of annual inspection.

All workers must visually inspect fall arrest equipment prior to each use.

Use all Personal Protective Equipment (PPE) in accordance with manufacturers' specifications.

Do not attempt to repair or modify equipment yourself.

If there are any concerns regarding unacceptable risks while working at an elevated work station, the work shall not be initiated until such concerns have been address by the site health and safety officer and/or the OH&S Manager. Alternatives to climbing (elevators, aerial lifts, etc.) shall be used when practical.

Any fall arrest components which have been involved in a fall must be tagged out and removed from service.

5.0 EQUIPMENT

Refer to Section 3.

6.0 RESPONSIBILITIES

6.1 Project Managers and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Responsible for implementing the requirements of this procedure, ensuring that work done at elevations is done safely and that the proper precautions are taken. The Field Site Manager’s responsibilities include;

- Assuring that all personnel who perform work at heights are familiar with and understand this procedure
- Designating a competent person to monitor the safety of other employees and ensure that the safety monitor complies with the following requirements:
  - Assure that all personnel are apprised of any site specific hazards prior to performing work more than 6 feet (1.8 m) above grade
  - Assure that required PPE and/or personal lifeline systems are available on site as necessary

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees’ responsibilities:

Apply appropriate controls and safe work practices in their use of fall protection.

6.4 Competent Person responsibilities:

A competent person must be present during all work that involves Cabrera personnel working at heights more than 6 feet (1.8 m) above grade.

For the purpose of this OP, a competent person is defined as an individual, who by education or experience, is capable of evaluating the hazards associated with working at heights. The competent person for the project will be indicated in the Activity Hazard Analysis (AHA) for the project.

The competent person will:

- Recognize fall hazards
- Warn employees if they are unaware of a fall hazard or are acting in an unsafe manner
- Ensure fall protection equipment is properly inspected and maintained
- Provide site specific fall protection training to employees

7.0 PROCEDURE

7.1 General Requirements

Each worksite and all activities shall be evaluated prior to the start of the job to identify the hazards of falling from any elevation. The results of this evaluation shall be described in either a Site Specific Safety and Health Plan (SSHP) or site-specific fall protection program. The evaluation shall identify the areas/activities requiring fall protection, the manner in which fall protection will be accomplished, a listing of qualified individuals for fall protection and a roster of personnel authorized to utilize specific fall protection equipment. As part of this evaluation, all applicable requirements of 29 CFR 1926 Subpart M shall be addressed.

- Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems (refer to 29 CFR 1926.501(b)(1)).
- Every open sided floor or platform (walk ways, scaffolding, stairs, etc) 4 feet or more above above adjacent floor or ground level shall be guarded by a standard railing on all open sides except where there is entrance to a ramp, stairway, or fixed ladder. The railing shall be provided with a toeboard wherever, beneath the open sides (refer to 29 CFR 1910.23(c)(1)).
- All elevated work, regardless of the height, shall incorporate job planning to anticipate and mitigate the consequences of a fall. Job planning should include rescue after a fall.

- First consideration shall be given to the elimination of fall hazards. If a fall hazard cannot be practically eliminated, second consideration shall be implementing effective permanent or temporary means of fall prevention.

- Before using any equipment, pipelines, or trusses for elevated work, it must be determined by the project manager if they are suitable for climbing or walking. Not all pipelines, trusses, and hanger systems are designed to support individuals doing elevated work. For example, walking on pipelines may cause flanges to leak, damage insulation, damage tracing or deform piping.

- Weather must be a safety consideration whenever outdoor elevated work is to be done. The weather hazard must be addressed prior to and during the work.

- When fall protection is required, a personal fall arrest system must be utilized that complies with 29 CFR 1926.502(d) (full body harness with a fall arrest system)

The following are specific situations/work areas that require fall protection:

- Aerial life devices: Personnel operating or working from an aerial lift platforms shall wear fall protection equipment with the lanyard attached to a designated anchor point. When exiting or entering an aerial lift device at elevated heights, the use of continuous fall protection is required.

- Elevated work stations: Working from elevated work stations of 4 feet or greater and not protected by fall prevention shall utilize fall protection (refer to 29 CFR 1910.23(c)(1)).

- Scaffold erection/disassembly: Personnel engaged in scaffold erection or disassembly shall use fall protection. These options include, but are not limited to, vertical and self-retracting lanyard lifeline attachments to associated structures and horizontal lifeline attachments when guardrails are not installed. Scaffolds shall be adequately secured if they are used as an anchorage point. Braces and/or couplers of scaffolds shall not be used as anchorage points.

- Ladders:

    - Portable: When working from a portable ladder and the work requires the use of both hands, fall protection shall be used whenever working at 6 feet or above, as measured from the ladder base to the bottom of the employee's feet unless a Safe Operating Procedure for the job is approved by the Project

Manager.

- o Fixed: Any fixed ladder 20 feet in height or greater must be equipped with a cage or fall arrest device. For fixed ladders less than 20 feet in height, ladder climbing devices shall be utilized whenever available, and are the preferred method of ladder travel. Personnel are allowed to climb or descend a fixed ladder less than 20 feet in height without fall protection or a cage only where if both hands are free for climbing.

- Crane suspended platforms: Personnel working from or riding in any crane-suspended platform shall wear fall protection with a lanyard attached to the boom or basket. Work platforms shall not be used in winds in excess of 15 miles per hour or during electrical, snow, ice, and/or sleet storms, or other adverse weather conditions which could affect the safety of personnel.

- Designed access ways: Personnel using designed access ways (cab accesses, crane accesses, trucks, railcars, etc.) may climb or descend the access way using a minimum of three points of contact (hands and feet).

- Working on a flat roof or low-pitched roof (<9.5 degree slope): Personnel working within 6 feet of any unprotected roof edge or opening (i.e. not protected by a guardrail, or a parapet of at least 39 inches in height) are required to use fall protection. When working more than 15 feet from an unprotected roof edge/opening a warning line system shall be erected that is not less than 15 feet from the edge, unless some other means of fall prevention is in use. A safety observer is not an acceptable fall prevention system.

- Working on a sloped roof: Personnel working on any sloped roof, other than low pitched roofs (<9.5 degree slope) shall use fall protection at all times.

- Trucks, railcars, and large equipment: Personnel working on top of trucks, railcars, and large equipment shall use fall prevention or protection systems.

7.2 Fall Protection Plan

Where the risk of a fall exists, a fall protection plan must be developed for the project or site by a qualified and competent person. The plan must:

- Identify specific fall protection needs and systems prior to the start of the project

- Confirm that the worker is trained appropriately for the fall protection plan
- Identify fall hazards on an ongoing basis and review fall protection equipment needs
- Hold a pre-job meeting to address and discuss the fall protection system requirements. This includes any training or review of equipment usage. Provide updated meetings as necessary to address any changes in site conditions that would affect fall protection system requirements.
- Consider the procedures and tracking for assembly, maintenance, inspection, and disassembly of equipment
- Confirm that there will be adequate anchor points available at each location where fall protection systems are used
- Control or restrict access below or around the personnel working at elevation.
- Confirm the use of barricades, caution tape, and signs identify restricted areas

Fall protection systems can be either:

1. A fall RESTRAINT system (physically stops a worker from getting too close to a fall hazard), or
2. A fall ARREST system (stops a fall already occurring and limits arresting forces to 800 kilo newtons or less)

Guardrails are the preferred fall RESTRAINT system; however, if guardrails are not feasible, staff shall be adequately protected by at least one of the following methods:

- Positioning Device Systems
- Personal Fall Protection Equipment

7.3 Guardrails

Where possible, guardrails must be installed:

- along the open edges of roofs, platforms, and floors
- on formwork, scaffolds, and other work surfaces

- openings in floors and roofs; and
- where ever workers are exposed to the risk of falling

All guardrails—especially wooden guardrails—must be inspected regularly.

When guardrail systems are used, they shall meet the requirements given in 29 CFR 1926.502(b).

The top edge of the guard rail shall be from 39 inches to 45 inches above the walking/working surface. Midrails, screen, or mesh shall be installed unless there is a wall or parapet wall at least 21 inches high outside of the guardrail.

Guardrails shall be constructed to withstand a lateral or downward vertical force of 200 pounds without failure. Midrails, screen, mesh, or equivalent shall be constructed to withstand a lateral or downward vertical force of 150 pounds without failure. Guardrails constructed in accord with Appendix B to Subpart M of 29 CFR 1926, shall be considered adequate.

7.4 Protection From Falling Objects

Toeboards used as falling object protection shall be erected along the edge of the overhead working level for a distance sufficient to protect employees below. Toeboards shall be capable of withstanding a 50-pound force outward or downward at any point Toeboards shall be at least 3½ inches in height, and the gap between the working surface and bottom of the toeboard shall not be greater than ¼ inch. Toeboards shall be solid, or have openings less than 1 inch in greatest dimension. Where tools, material, or equipment exceed the height of the toeboard, paneling or screening shall be added to protect employees below.

Guardrail systems used as falling object protection shall have openings small enough to prevent passage of potential falling objects. Falling object protection during overhand bricklaying work shall comply with 29 CFR 1926.502(j)(6).

Canopies when used as falling object protection shall be strong enough to prevent collapse, and to prevent penetration by any objects which may fall onto the canopy.

7.5 Floor, Roof, and Other Walking/Working Surfaces

Covers in roadways, and vehicular aisles shall be capable of supporting at least twice the maximum axle load of the largest vehicle expected to cross over the cover.

All other covers shall be capable of supporting at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

All covers shall be secured when installed so as to prevent accidental displacement by the wind, equipment, or employees.

All covers shall be color-coded, or marked with the word "Hole" or "Cover" to provide warning of the hazard. (This does not apply to cast manhole covers or steel grates used on streets or roadways.)

7.6 Positioning Device Systems

If fall protection normally provided by walls, floors, guardrails, scaffolds, and cages is absent during work at height, personal lifeline, or positioning device systems, must be used. Personal lifeline systems typically consist of a body support (i.e., a safety belt or harness), an attached lanyard, and an anchorage point.

These systems shall be constructed in such a manner that allows employees to access (reach) the leading edge, but prohibits them from falling. Lifeline and lanyard are adjusted to let you travel only so far. When you get close to the open edge of a floor or roof, the system holds you back. Positioning devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kN), whichever is greater.

Locking type snaphooks designed and used to prevent disengagement of the snaphook by the contact of the snaphook keeper by the connected member shall be used on these systems. Any equipment used for fall protection systems must meet the applicable American National Standards Institute (ANSI) and American Society for Testing and Materials (ASTM) requirements for that equipment.

7.7 Personal Fall Protection Equipment

A fall-arrest system consists of a full body harness, lanyard with shock absorber or retractable lifeline, and the anchorage point to which the lanyard is attached. Any fall arrest components which have been involved in a fall must be removed from service and destroyed (unable to reuse).

All Fall Arrest Equipment must be formally inspected and certified annually according to the manufacturer’s specifications.

Full Body Harness

A Class III safety harness, often referred to as a body harness or parachute harness, is a belt system designed to spread shock load over the torso (shoulders, thighs, and seat area). It must be used during free climbing or working above 6 feet (1.8 m).

Connectors shall be drop-forged, pressed or formed steel, or made of equivalent materials. Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.

D-rings and snaphooks shall have a minimum tensile strength of 5,000 pounds. D-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or taking permanent damage.

Snaphooks shall be the locking type, and designed and used to prevent disengagement of the keeper by the connected components.

Safety belts (Class 1) are no longer approved for personal fall arrest systems (PFAS). Only a full body harness may be used for this purpose.

Lanyard

A lanyard is a short, flexible rope or strap webbing that connects a worker's safety harness to an anchorage point. Lanyards cannot exceed 6 feet (1.8 m) in length. Length should be selected to allow appropriate freedom of movement while limiting the fall to as short a distance as possible.

A shock-absorbing lanyard is designed to absorb a portion of the shock as the lanyard becomes taut during a fall and should be used in all applications when possible.

Do not wrap the lanyards and/or rope around beams, girders, pipes, etc. The safety lines and lanyards must be protected from cuts, wear, and abrasions.

Lanyards should be replaced at the first sign of wear and after they have been subjected to a fall.

Retractable Lifelines

Retractable lifelines contain a cable wound around a drum with a spring that removes slack from the line and an inertial latching device that stops a sudden decent. The device is attached to an anchor point. This system allows a freedom of motion for the worker but stops a fall very rapidly.

Anchorage Point

The anchorage point is the position on an independent structure to which the lanyard is attached. It should be capable of supporting a minimum 5,000-pound static load per employee. Fall-arrest loads can be high, depending on the height of the fall and the weight of the person.

To limit the fall distance, lanyards should be attached to an anchorage point at or over the head.

7.8 Use of Personal Fall Protection Equipment

Personal fall protection systems shall limit the maximum arresting force on an employee to 1,800 pounds when using a body harness; limit free fall distance to 6 feet (4 feet in California) (where this maximum distance will not cause the employee to contact any lower level); limit deceleration distance to 3.5 feet; and be able to withstand twice the potential impact energy of an employee falling 6 feet or the maximum free fall distance permitted by the system.

Fall protection must be maintained 100% of the time when working from heights. In order to achieve this, two (or a double) lanyard must be used, and a minimum of one lanyard must be attached to an acceptable anchorage point at all times during use.

As an example, for climbing purposes, the worker attaches the first lanyard to an anchorage point (e.g., ladder rung or tower brace) above his/her head and climbs until the anchorage point is at slightly below waist height. At that point, the worker attaches the second lanyard to an anchorage point over his/her head, detaches the first lanyard, and repeats the process. By using this method, the worker is always attached during the climb, resulting in 100% fall protection.

Personal fall-arrest systems shall not be attached to guardrail systems.

Body harnesses and components shall not be used to hoist material or equipment.

7.9 Equipment Inspection and Maintenance

All equipment must be inspected prior to use, daily as required. Visually inspect all restraint components before each use for wear, damage, or deterioration. Defective components are removed from use and tagged out to prevent others from using them.

Thorough, annual inspections of fall protection equipment must be performed, documented using the attached harness and lanyard inspection forms (Attachments A & B), and initialed on the equipment tags.

<u>Inspection</u>

Inspect all equipment visually before each use and periodically thereafter. The frequency of subsequent checks should be contingent upon the conditions where used. If defective conditions are found as described below, remove the item from service immediately, and get it properly repaired or replaced.

Damaged items should be destroyed and removed from service. If conditions are found that are not included below, remove the item from service and contact safety engineer, distributor, OH&S Manager, or manufacturer for advice.

Webbing - Beginning at one end, bend a portion of the harness (6 to 8 inches) into a U-shape between your hands to reveal worn, cut, frayed, burnt, or damaged fibers. Check both sides of the harness and all straps along the entire length.

Buckle and D-ring attachment - Carefully check the buckles and D-rings attached to the webbing for excessive wear, cut, or torn fibers.

D-rings - Check for rough or sharp edges, corrosion, burrs, cracks, dents, or distortions.

Tongue buckle - Check for rough or sharp edges, corrosion, burrs, cracks, dents, or distortions. Buckle tongues should be free of distortion, move easily back and forth, and overlap the buckle frame. The frame roller should rotate freely.

Friction buckle - Check for rough or sharp edges, corrosion, burrs, cracks, dents, or distortions. All portions of the buckle should be straight.

Sliding bar buckle - Check for rough or sharp edges, corrosion, burrs, cracks, dents, or distortion. Sliding bar should move freely within the frame; ridges should be complete and not smooth. Carefully check the ends of the bar for distortion.

Grommets - Check for rough or sharp edges, corrosion, burrs, cracks, dents, or distortion. Grommets must be tight.

Labels - The manufacturer's labels should be on each piece of equipment and easily read. If missing, remove from service and contact purchasing, or distribution.

Rope - Rope lanyards should be inspected by bending the rope into a U-shape between the hands and untwisting the rope slightly to check the inside fibers as well. This helps to reveal frayed, worn, cut, broken, burnt, or damaged fibers. Check all sides of each strand along the entire length of the lanyard.

Locking-type snap hooks - All snap hooks must operate smoothly, and open and close completely. Check snap hook body for sharp edges, burrs, distortion, cracks, corroded, or pitted surfaces. Rivets should be checked for cracks, broken, or bent or otherwise damaged conditions. Gate and double-locking gate keepers should be free from distortion, bending, and seat properly against the snap hook nose and body. The gate keeper spring should be sufficient to completely and firmly close the snap hooks should freely rotate into the locked position when released.

Lanyard - If any part of the danger label is showing or if there is any broken stitching, remove from service.

Anchorage points inspection - Check all identified anchorage points for corrosion and adherence to minimum sizes and conditions.

Maintenance and Cleaning

Cleaning - Nylon or polyester; if lanyards or harnesses need to be cleaned, they may be wiped down with a wet sponge, then washed with a soapy sponge using a brisk back-and-forth motion. Rinse completely with clear water and hang up to air dry avoiding exposure to high heat, steam, or long durations of sunlight.

Storage - Lanyards or harnesses should be hung up or placed loosely (in a container) in a clean, dry area free from exposure to harmful fumes or corrosive agents.

7.10 Training

Prior to using personal fall protection equipment, staff must be trained in Fall Protection and must be provided detailed instructions on the inspection and use of the equipment and all on-site work procedures.

Training required for employees working at height is identified below. At a minimum, the training will include instructions on the following functions:

- Work on scaffolds erected by others
- Wear and use personal fall arrest systems (refer to PPE procedure)
- Work on and/or operate Aerial Lift devices
- Work on and/or utilize fixed and portable ladders
- Work on roofs (where applicable)
- Work around unprotected walking/working surfaces such as unfinished mezzanines, etc.

People Requirements: Only properly trained personnel shall be permitted to perform Work at Height tasks.

Workers weighing above 300 pounds (lbs) must consult a qualified fall protection engineer who can review the circumstances and establish procedures to control the free fall and/or provide additional equipment that will confirm that the energy absorber will not bottom out.

8.0 REFERENCES

- 29 CFR 1926 Subpart M
- 29 CFR 1910 Subpart F

9.0 REQUIRED RECORDS

- Completed Harness and Lanyard Inspection Forms will be kept with project files.

10.0 ATTACHMENTS

Attachment A – Harness Inspection Form

Attachment B – Lanyard Inspection Form

Attachment A
Harness Inspection Form

OP 585 - Fall Protection

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Harness Inspection Form

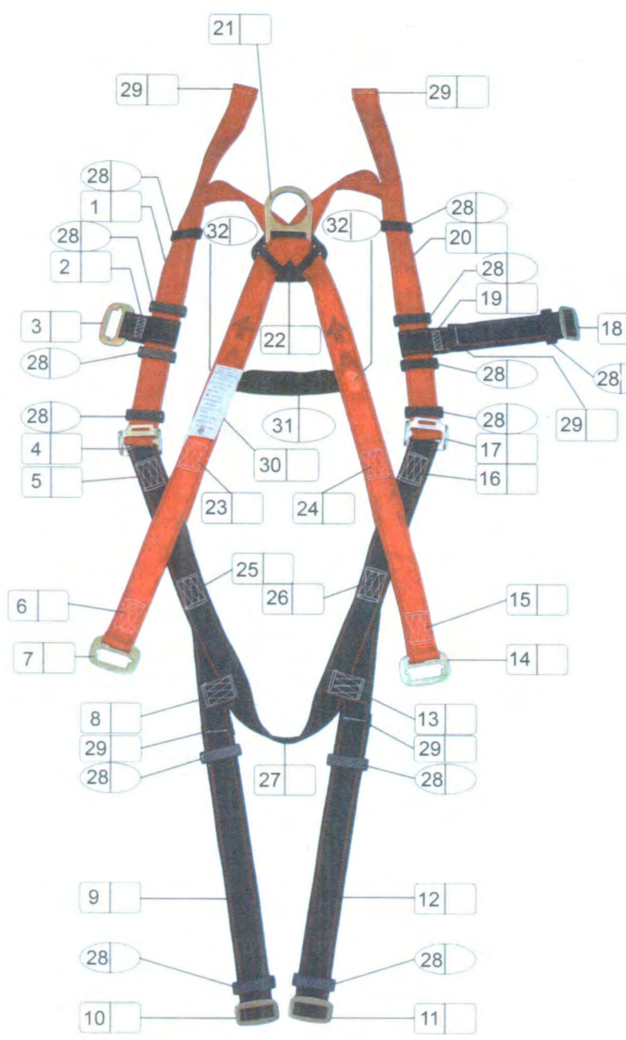
Designated Competent Person must inspect/document before initial use, and annually thereafter. The inspection must also be dated on the equipment tag. Defective equipment shall be removed from service and destroyed.

Project Name:	**Project Number:**	**Project Location:**
Date:	**Inspection Completed By:**	

Harness Information:

Harness Manufacturer:	**Manufacture Date:**
Serial Number:	**Harness Class:**

Inspection



	Description	Pass	Fail
1	Left Shoulder Webbing		
2	Stitching		
3	Mating Buckle		
4	Adjusting Buckle		
5	Stitching		
6	Stitching		
7	Mating Buckle		
8	Stitching		
9	Left Leg Webbing		
10	Mating Buckle		
11	Mating Buckle		
12	Right leg webbing		
13	Stitching		
14	Mating Buckle		
15	Stitching		
16	Stitching		
17	Adjusting Buckle		
18	Mating Buckle		
19	Stitching		
20	Right shoulder webbing		
21	Dorsal D Ring		
22	D-ring back pad		
23	Stitching		
24	Stitching		
25	Stitching		
26	Stitching		
27	Sub-pelvic strap		
28	Belt keepers		
29	Stitching – end pattern		
30	Product label		
31	Back Strap		
32	Stitching – back strap		
	Load Indicators		

Comments:

Attachment B

Lanyard Inspection Form

OP 585 - Fall Protection	CABRERA SERVICES RADIOLOGICAL · ENGINEERING · REMEDIATION

Lanyard Inspection Form

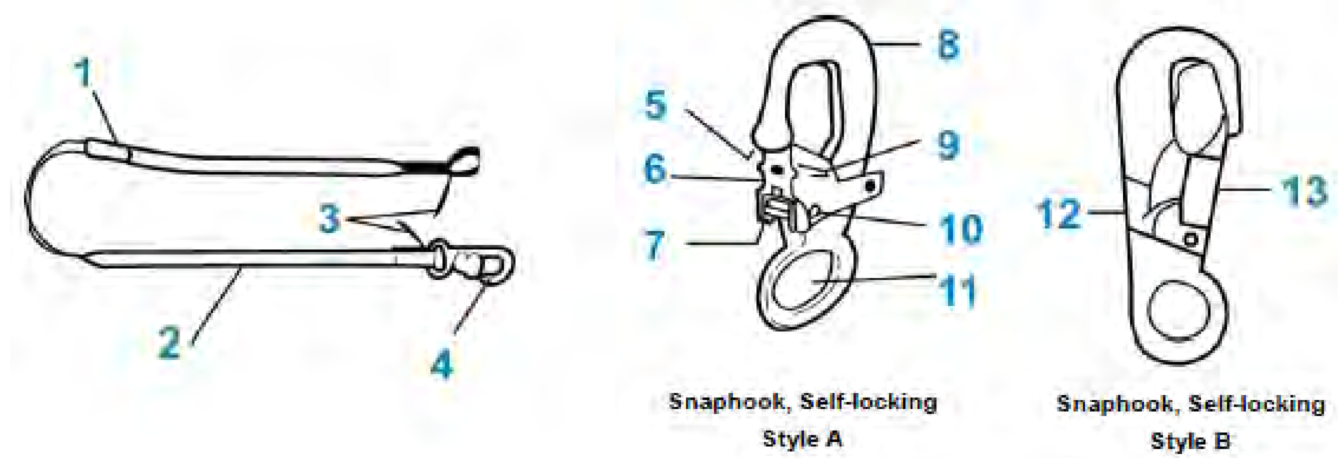
Designated Competent Person must inspect/document before initial use, and annually thereafter. The inspection must also be dated on the equipment tag. Defective equipment shall be removed from service and destroyed.

Project Name:	**Project Number:**	**Project Location:**
Date:	**Inspection Completed By:**	

Lanyard Information:

Lanyard Manufacturer:	**Manufacture Date:**
Serial Number:	**Lanyard Type:**

Inspection



	Description	Pass	Fail
1	Flag Indicator	☐	☐
2	Outside Core Webbing	☐	☐
	Core	☐	☐
3	Wear Pads	☐	☐
	Labelling Tags	☐	☐
	Stitching	☐	☐
4	Snaphooks (self-locking)	☐	☐
5	Hook nose	☐	☐
6	Gate (keeper)	☐	☐
7	Lock	☐	☐
8	Hook Body	☐	☐
9	Spring (inside gate)	☐	☐
10	Hinge	☐	☐
11	Eye	☐	☐
12	Lock	☐	☐
13	Gate	☐	☐

Comments:

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

UTILITY CLEARANCE & ISOLATION

OP-589

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

12-19-2013
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

12/19/2013
Date

1.0 PURPOSE

The purpose of this Operating Procedure (OP) is to establish requirements necessary to ensure that underground installations are properly identified before ground disturbing work commences and to outline requirements to be observed where overhead power lines are present on a job site.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Underground Utilities - All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

3.2 Ground Disturbance (GD) - Any indentation, interruption, intrusion, excavation, construction, or any other activity on the earth's surface and results in the penetration of the ground.

3.3 Overhead utility lines include:

- Overhead power lines
- Structural cable supports
- Guide wires
- Cable television / communication lines

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

When contacted by equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc.

The following outline the requirements while performing operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (i.e., boom, towers) is lowered prior to moving underneath of aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any intrusive operation. Contact the local utility service providers for

clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc. Contractor performing the actual work has the ultimate responsibility for this.

5.0 EQUIPMENT

Refer to Section 3.

6.0 RESPONSIBILITIES

6.1 Project Managers (PM) and Field Site Manager (FSM) or designee (Site Safety & Health Officer – SSHO) responsibilities:

Ensure that all work, including the identification, location, and access to all underground and overhead utilities, is planned and performed in accordance with contract specifications and safety requirements.

Plan for associated work and avoidance of contacting utilities shall be part of the project safety planning in the Site Safety & Health Plan (SSHP).

Verify that all steps have been taken to identify existing underground and overhead utilities in the area to be disturbed.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees' responsibilities:

Apply appropriate precautions and work practices when working with, or within close proximity to utilities.

7.0 PROCEDURE

7.1 Underground Utility Lines

To avoid injury from electrical and other utilities on site, utility lines shall be located and marked prior to conducting any drilling or digging on site. If available, refer to site drawings or client interviews for information pertaining to utilities on site. Proper utility clearances must be obtained, and copies of all dig tickets (from all applicable agencies), maintained on-site prior to the commencement of any intrusive operations.

Types of underground lines:

- Gas line

- Potable water line
- Raw water line
- Sewer line
- Power line
- Cable television/communication/fiber optic line
- Cathodic protection lines
- Grounding cable
- Process piping/flow line

7.2 Surface Markings

Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than two inches.

If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

<u>Uniform Color-Coding</u>

To control hazards associated with coming in contact with such installations, the American Public Works Association's (APWA) guidelines for the uniform identification of underground installations has been adopted. The colors and corresponding installation type are as follows unless otherwise contract-specified:

- Red: Electric Power Lines, Cables, Conduit, and Lighting Cables
- Yellow: Gas, Oil, Stream, Petroleum, or Gaseous Materials
- Orange: Communication, Alarm or Signal Lines, Cables, or Conduit
- Green: Sewers and Drain Lines

- Purple: Non-potable Water
- Pink: Temporary Survey Markings
- White: Proposed Ground Disturbance area

7.3 Identification of Installations

Extreme caution shall always be exercised when attempting to locate underground utilities. The location of utilities can be in some cases not be consistent with site drawings or plans, as indicated by the placement of surface signage, or as described by personnel. Coordination and planning of the job shall be required with the client or site owner.

<u>One Call System</u>

The One Call System Directory or equivalent shall be used as the first step to prepare for ground disturbing work. The One-Call system (811) provides a listing of public utilities that may be present in the proposed work area and will be marked accordingly. In order to give line operators sufficient time to respond to a request to locate, a minimum waiting period of 72 business hours is required prior to beginning work.

<u>Private Utility Clearances</u>

Privately owned utilities on a project site are not part of the One Call System. Examples include power to light poles/fixtures and storm water and potable water lines. As such, a third party, independent verification contractor, should be obtained to assist in marking out the privately owned underground utilities.

As-built drawings (if available) should be obtained from the property owner or client to help facilitate marking out privately owned utilities. Most private utility clearance companies will utilize a combination of Ground Penetrating Radar (GPR) or electromagnetic locating equipment to identify the locations of the utilities.

Department of Defense (DOD) facilities and sites (or similar), may require base/location specific dig permits to be obtained prior to starting ground disturbing work. The PM is responsible for verifying the need to obtain these permits prior to commencing intrusive work.

<u>Visual Verification</u>

Even after dig tickets and private clearances/permits have been obtained, the potential still exists to encounter undocumented utilities during intrusive activities. Prior to commencing operations, the designated competent person(s) for the task, along with the SSHO, should attempt to visually identify the presence of such previously undocumented infrastructure. Several potential indicators are as follows:

- Look for warning signs where pipelines cross roads or water courses.
- Look for manholes and other surface obstructions. If possible, open manhole and attempt to identify orientation of lines entering/exiting.
- Look for cut lines, wells, tanks, or valves that may indicate the presence of pipelines.
- Look for ground settling from previous work.
- Talk to nearby landowners and residents.
- Look for vegetation appearing “different” from the surrounding vegetation (e.g., greener, taller, shorter, or more brown than surrounding vegetation).

<u>Soft Dig Techniques</u>

Where a line placement and depth is known or suspected and where there is potential for contact, soft dig techniques (hand digging or air knifing/vacuum extraction) shall be used. Additionally, all underground utilities within 5 feet (1.6 m) of a planned disturbance, or within the distance required by the owner of the utility, will be exposed via soft dig techniques before operating any mechanized equipment.

When utilizing soft dig techniques, proceed with caution, as hand tools may still damage utilities (shovels, picks, digging bars).

Once the underground installation has been identified, proper surface markings shall be made in accordance with the American Public Works Association (APWA) guidelines or as contract-specified. Document the exact location in a field log book, and include measurements from adjacent structures, adequate enough to allow you to relocate if necessary.

In summary, typical utility identification/isolation process for underground utilities is as follows:

- Obtain One Call Ticket
- Obtain private utility mark-out or base/location permit
- Perform visual identification/location in field
- Hand clear or air knife within 5 feet of utility mark-outs

- Proceed with ground disturbing activities using spotter.

7.4 During ground disturbance:

Various forms of underground utility lines or pipes may be encountered during deployments to field sites. Damaged utilities, in particular, can present other hazards including asbestos, explosion, electric shock, scalding, etc. The presence of damaged utilities at any work location shall be immediately brought to the attention of the Field Site Manager or SSHO.

Guidance will be provided on the appropriate action to be taken, which could include suspension of work until the responsible utility agency and/or owner is contacted and the hazard is either isolated or eliminated.

All underground installations shall be considered “live” and “operational” until the owner, client, or utility authority isolates any hazardous energy or deactivates the system and can demonstrate that condition.

If an underground utility is struck, stop the work immediately and notify the Project Manager and OH&S Manager. Notification will also be required to the owner or client responsible for the facility or site at which the work is occurring. The owner or client shall be informed of the location of the contact and the type of damage that resulted.

If the utility is a pipeline, the company (client) shall immediately notify the required agencies and regulatory bodies of the location of the contact and the type of damage that resulted.

7.5 Overhead Utility Lines

An appropriate distance must be kept between equipment and overhead utility lines, especially overhead power lines (Refer to table for Minimum Safe Work Distances from Overhead Power Lines). Operation of heavy equipment and cranes in areas with overhead power lines represents a significant hazard to all personnel on the job site. Accidental contact with an energized line or arcing between a high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment.

Although maintaining a safe distance from all energized lines is the preferred means for control of this hazard, site conditions may not always accommodate this. If work will (or may) occur within 50 feet of any energized line, the procedures outlined below will be observed.

Overhead power lines will be identified on each job site before the work commences. For each identified line, the PM/FSM must determine whether it is energized (and the operating voltage for energized lines), and whether work activities will require use of heavy equipment (excavators, loaders, cranes, etc.) within 50 feet (15.25 meters) of the line. Unless verified, it will be assumed that all lines are energized.

Contact with the utility (power line) owner shall be completed before commencement of operations, and/or before equipment is operated within 50 feet (15.25 meters) of an energized overhead power line. The purpose of this contact is to:

- Determine the voltage of the power line, and
- Establish the appropriate safe limit of approach distance as identified by regulations.

Safe working distance is the minimum distance that must be maintained between any energized electrical line and any part of the operating equipment to maintain adequate safety margins and is based on the line voltage of the power line. The table below lists the line voltages in kilovolts and the Minimum Safe Work Distance as required in the United States. The following safe working distance criteria will be applied for all Cabrera operations:

Minimum Safe Work Distances from Overhead Power Lines

Line Voltage (Kilovolts)	Minimum Safe Working Distance
0 – 50	10 feet
>50 – 200	15 feet
>200 – 350	20 feet
>350 – 500	25 feet
>500 – 750	35 feet
>750 – 1,000	45 feet

- Source: American National Standards Institute, Publication B30.5.

Field Site Managers or designee (SSHO) will notify equipment operators and employees of the presence of overhead lines before work commences.

Employees must not place material under or beside an overhead power line if doing so reduces the safe clearance to less than the safe limit of approach distances.

To maintain minimum safe clearances:

- Install warning devices and signs (hang a sign from and mark all guide wires to warn traffic of low clearance; provide warning signage for all overhead services).
- Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearances for the line voltage.
- Position signs or other devices to determine the “Danger Zone.”
- Inform all on-site staff with the on-site clearances required.
- Beware of atmospheric conditions, such as temperature, humidity, and wind, which may require more stringent safety procedures.

Under no circumstances will any object pass closer than 10 feet (3 meters) to any energized, electrical line.

7.6 Acceptable Safety Procedures for Overhead Utilities

When any work task does not allow the minimum safe working distance to be maintained at all times, an alternate means of protection must be identified and approved by the OH&S Manager. In order of preference, acceptable procedures are:

- De-energize the power line(s)/lockout by local utility authorities
- Install insulated sleeves on power lines
- Assign line spotters to assist the equipment operator

<u>De-energize Power Lines</u>

Elimination of electrical power provides the most acceptable means of ensuring safety of personnel. While temporary site power lines are under the control of the site manager (and can be de-energized locally), electrical distribution and transmission lines can be de-energized only by the owner of the line (generally the local electrical utility). Therefore, de-energizing a line requires advance coordination with the line owner; generally, at least one week advance notice should be provided.

<u>Install Insulating Sleeves</u>

Insulating sleeves can be placed over power lines to provide a contact and arcing barrier if work must occur closer to the power lines than the accepted safe work distance. Although not as desirable as line de-energizing, the use of these sleeves can provide an acceptable alternative where electrical lines are required to remain in service.

As with de-energizing of distribution and transmission lines, placement of insulating sleeves can be performed only by the line owner. This requires advance coordination with the line owner; generally, at least one week advance notice should be provided. To install the sleeves, representatives of the line owner will require access to the job site.

Assign Line Spotters

A line spotter is a person located at ground level who is assigned to observe equipment operations, with the specific duty of assisting the equipment operator to ensure that no part of the equipment gets too close to an energized, unprotected electrical line.

Personnel assigned to act as line spotters must meet the following requirements:

- While acting as a line spotter, no other duties may be performed (e.g., the line spotter cannot also act as the load spotter during lifting operations).
- The spotter will have a radio or other direct means of communicating with the equipment operator at all times.
- The spotter will be positioned at a right angle to the equipment operator's line of sight to maximize the sight angles between personnel.
- Under no circumstances will any portion of a piece of equipment pass closer than 10 feet to any energized electrical line.

Additional Safety Measures

The following additional safety measures can be implemented as needed when working around energized power lines:

- Provide equipment with proximity warning devices. These provide an audible alarm if any part of the equipment gets too close to a line.
- Install ground safety stops. These prevent vehicles from accidentally entering hazardous areas.
- Equip cranes with a boom-cage guard. This prevents the boom from becoming energized if an electrical line is contacted.
- Utilize insulated links and polypropylene tag lines. These prevent the transmission of electricity to loads or tag line handlers if an electrical line is contacted.

NOTE: These additional safeguards are intended as supplemental protection. Use of these measures is not permissible as a substitute for maintaining the safe working distance or implementation of the procedures herein.

7.7 Overhead Utility Incidents

If an electrical power line is hit or an electrical arc occurs:

- All ground personnel must evacuate IMMEDIATELY to a distance of at least 50 feet (15.25 meters). DO NOT attempt to rescue any injured person until the line has been de-energized.
- The operator should remain in the cab until the line can be de-energized and should carefully try to extricate the equipment from the power line. This may not be possible where melting of insulator material or metal has occurred.
- If the operator must evacuate while the line is still energized (because of fire or other life-threatening condition) he/she should jump clear of the equipment (making sure to avoid touching the equipment and the ground simultaneously), and land upright and with both feet together. Once on the ground, proceed in a direct line away from the equipment using a short, shuffling gait (feet touching, sliding each foot no more than 1 foot forward at a time) to minimize shock hazard from electrical energy being transmitted through the ground.
- Contact the line owner to report the line contact and request that the line be de-energized immediately.
- Once the line has been confirmed to be de-energized, the operator can safely evacuate the cab and rescue can commence for any injured personnel.
- Contact the PM and OH&S Manager immediately to report the incident and implement any instructions provided.

8.0 REFERENCES

- American Public Works Association, Excavator's Damage Prevention Guide and One-Call System Directory International 1990-1991, Utility Location and Coordination Committee
- 29 CFR 1926 Subpart: CC, Cranes & Derricks in Construction, Parts 1407 through 1411, Power line safety
- American National Standards Institute, Publication B30.5

9.0 REQUIRED RECORDS

- All utility clearance tickets, and site specific dig permits, will be kept with project files.

10.0 ATTACHMENTS

None.

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

ELEVATED WORK PLATFORMS

OP-590

Revision 1
October 2013

Prepared by:

Sean Liddy, CSP
Occupational Health & Safety Manager

3-7-14
Date

Approved by:

Alan Solow, CHP
Chief Executive Officer

March 7, 2014
Date

1.0 PURPOSE

The purpose of this Operating Procedure (OP) is to establish the requirements necessary to ensure safe operation and use of elevated work platforms and aerial lift equipment.

2.0 APPLICABILITY

This procedure applies to all Cabrera Services Inc. (Cabrera) employees and operations.

3.0 DEFINITIONS

3.1 Elevating Work Platform (EWP) - Includes aerial lifts, scissor lifts, articulating boom lifts, truck platforms, and crane-suspended personnel platforms.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

No person shall operate an elevated work platform until they have received adequate training, in accordance with manufacturer's specification.

The elevated work platform must be equipped with ground level controls so that in the event of an emergency where there is no operator in the basket/bucket, the personnel lift can be operated safely from ground level. Personnel on the ground must be trained to operate the lift in an emergency situation.

5.0 EQUIPMENT

Refer to Section 3.

6.0 RESPONSIBILITIES

6.1 Project Managers and Field Site Manager or designee (Site Safety & Health Officer – SSHO) responsibilities:

Project site management is responsible to see that sound principles of safety, training, inspection, maintenance, and operation consistent with all resource data available from the manufacturer, governing or regulatory authority is provided to the operator and users.

The Supervisor has direct control over the use and operation of elevating work platforms. The Supervisor and the assigned operating personnel have the responsibility for proactive, safe employee behavior. Decisions about the use and operation of a EWP shall be made with due consideration that the equipment will be carrying personnel whose safety is dependent on those decisions.

6.2 Occupational Health & Safety (OH&S) Manager responsibilities:

Provide technical guidance and support as to this procedure.

6.3 Employees' (including Operators) responsibilities:

It is the operator's responsibility to implement safe work practices provided by project management, supervision or the task leader supplemented by good judgment, safe control, and caution whenever evaluating personnel in a platform, bucket, or basket. The safety of all personnel in the EWP is dependent on safe use and operation by the operator.

All employees engaged in project field activities involving EWPs shall follow these procedures.

7.0 PROCEDURE

7.1 General Equipment Requirements

All aerial lifts shall be operated and maintained in accordance with manufacturer's specifications.

All aerial lifts must be certified by the manufacturer to meet requirements of the American National Standards Institute (ANSI) standard applicable to the device:

- For truck-mounted boom or scissor lifts – ANSI Standard 92.2.
- For manually propelled boom or scissor lifts – ANSI Standard 92.3.
- For self-propelled boom lifts – ANSI Standard 92.5.
- For self-propelled scissor lifts – ANSI Standard 92.6.

Lift controls on extendable and articulating boom platforms shall be clearly identified as to function.

Aerial lifts designed as personnel carriers shall have both work platform (primary) and lift mount (secondary) controls. Primary controls shall be within easy reach of the operator. Secondary controls shall be capable of overriding the upper controls. All controls shall be plainly marked to identify their function.

7.2 Personal Protective Equipment (PPE)

Fall Protection – All employees on EWPs shall wear and use a full body harness, fall arrest device, and lanyard and be secured to the manufacturer's provided anchorage point at all times. Employees shall not secure themselves to a handrail or work structure. Fall protection will consist of:

- A Full Body Harness, meeting the requirements of ANSI/CSA, Class A, suitably sized for the body mass and shape of the worker.

- A shock absorbing lanyard meeting the regulatory requirements and suitably sized for the body mass and shape of the worker. The lanyard should be as short as possible to allow the user to perform his/her work while anchored to the designated anchor point on the elevated work platform.

7.3 Operator Training

EWP operators shall be trained and certified by an approved source (e.g., vendor / equipment rental company or a competent operator). Documentation of training shall be maintained including the source, date, persons trained and outline of information.

A demonstration shall accompany any operator training to verify that the prospective operator possesses the actual skills to operate the specific type of EWP. Instruction in the use and operation of the EWP will include typical observation and check of the Work Zone for proper marking, foreign objects, uneven or rough surfaces, and signal staff if required.

Staff using Personal Fall Protection Equipment must be trained in Working at Heights and must be trained in the proper inspection, use, and care of the harness and lanyard that will be used in accordance with this procedure.

7.4 Equipment Inspection

Records of all inspections and maintenance on EWP shall be maintained by the project.

- Pre-Operational Check - The EWP Inspection Form (Attachment A) shall be completed prior to each day of operation. The form will be submitted to the supervisor or task leader with explanation of any noticed defects.

  Note: Any problems or malfunctions that affect safe operation of the equipment shall be repaired prior to the use of the EWP.

- Periodic Inspection – Project management shall ensure that complete inspections scheduled in accordance with the manufacturer's recommendations are performed on the EWP. Periodic inspections shall be performed by the dealer or qualified mechanic familiar with such equipment designated by project management.

- Post Incident Inspection – An inspection shall be conducted before continuing the operation of an EWP following any incident where the EWP has obvious or suspected operational damage. This post incident inspection must be supported by communications to the dealer or manufacturer of the equipment requesting any additional specific inspection, maintenance checks or repairs.

- Maintenance/Repairs – All maintenance and repairs shall be made by a qualified person in conformance with the manufacturer's recommendations and specifications. EWP shall be immediately removed from service until repaired and their use discontinued any time there are problems or malfunctions that affect safe operation of the EWP.

7.5 Equipment Operation

The operator of the EWP equipment shall review the work to be performed with the assigned staff including the work task(s), work zone set up, client requirements, any hazards, equipment controls, safety equipment, fall prevention, emergency response plan and coordination of the operation before undertaking the work.

The operator must make decisions about the use and operation of the EWP with due consideration that his/her own safety as well as the safety of other personnel on the platform is dependent on those decisions.

During operation, the EWP shall be used in accordance with project requirements, manufacturer operation specifications and the following guidelines:

- Conduct a work area hazard evaluation prior to initiating any elevated platform work. Plan work accordingly.

- The work area below EWP must be clear or barricaded from unauthorized person’s entry (e.g., project personnel, pedestrians, traffic) in case something is dropped from work platform.

- On public highways and roadways, a safe work zone must be established in compliance with appropriate local, state, provincial and federal requirements. In rail systems and airports, a safety work area shall be similarly established in conformance with client requirements and applicable standards.

- The EWP must be operated on a surface within the limits specified by the manufacturer.

- Lift controls shall be tested each day prior to use to determine that they are in safe working condition. Controls shall be plainly marked as to their function.

- Outriggers, stabilizers, extendible axles or other stability enhancing means are used as required by the manufacturer.

- Guardrails must be in a safe condition and access gate(s) or openings are closed per manufacturer's instructions.

- The load and its distribution on the platform and any platform extension(s) are in accordance with the manufacturer's rated capacity for that specific configuration. Never exceed manufacturer's rated load limits.

- Personnel must stand firmly on the platform floor, and shall not sit or climb on the edge of the basket or use planks, ladders or other objects to gain a work position or as a climbing device.

Fall Protection – Each person in the platform must wear a full body harness and be secured to the manufacturer provided anchorage point at all times.

Adequate clearance from overhead obstructions must be maintained.

- Safe operating distances are maintained from all potentially energized (exposed or insulated) power lines and parts including temporary construction power lines/cord sets. (OP 589, Utility Clearance & Isolation).

- Safe distances are maintained from all potential hazards where a client's moving equipment may be in transit and come in contact with an EWP or its parts. All client procedures, approval, permits and accompaniments shall be secured prior to operating an EWP.

- Should an EWP become snagged or caught on a structure preventing normal operation/motion, personnel should be removed from the platform before attempting to free the platform using ground controls.

Articulating boom and extendable boom platforms shall have both upper (platform level) and lower (ground level) controls. Lower controls shall override upper controls, but shall not be operated unless permission has been obtained from the employee in the lift, except in the case of an emergency.

Never attempt to operate an EWP from below (ground controls) when it is already in use, except in an emergency situation. Ground controls may only be used for emergency purposes, and when the lift platform/bucket is empty.

No more than two people shall be in an EWP at any one time without approval of the Supervisor. Under no circumstances shall more than two people be allowed in the EWP if the manufacturer prohibits such a practice.

- Only essential materials and tools required to perform the work from the lift are stored in the platform and fit completely inside, taking into account total weight involved and the maximum load capacity of the equipment.

When operating from a barge, ensure that the EWP is positively secured to the barge deck by using tie down lines and appropriate anchorage points. Anchorage needs to ensure that wheels remain firm on the barge deck. Use four-point tie down or equivalent method. Never secure to anything loosely lying on the barge deck.

Never use the EWP for hoisting, towing or pulling.

Never place heavy objects on hand rails or come in contact with objects that could damage railings or platform.

Immediately report any problems or equipment malfunctions occurring during operation to the Supervisor or task leader.

Do not continue to operate an EWP if unsafe conditions occur during operations.

Never alter, disconnect or disable interlocks or other safety devices that would allow operation in violation of the manufacturer's specifications.

Ensure care is taken to prevent entanglement in ropes, wires, cables, etc. Retract and lower the EWP to its lowest possible position before attempting to move. Ensure that the path of intended movement is clear of debris and personnel. Use a spotter attendant in congested or hazardous areas. Equipment movement speed shall be limited to surface and safe condition in accordance with the manufacturer's recommendations.

Shut engine off during refueling and fuel only in well-ventilated areas free of other flammable/combustible materials.

7.6 Emergency Response

In the rare instance where personnel fall while attached to an EWP, it is essential that they be rescued promptly.

The Site-Specific Safety & Health Plan (SSHP) must include detailed instructions for the immediate recognition and prompt rescue of a fallen worker. In urban centers or in industrial settings where trained rescue specialists have confirmed their availability and capability to affect a prompt rescue, the plan may simply include instructions for summoning the designated rescue team. In remote locations where it is not possible to summon rescue specialists to extract the fallen worker within 20 minutes of the fall occurrence, a rescue team must either be mobilized and on standby at the site or accompanying employees must be trained and equipped to effect a prompt rescue in accordance with the plan.

The rescuers who will implement the rescue plan must be properly trained in the applicable rescue techniques and must have the rescue equipment readily available.

After the fall, immediately assess the condition of the casualty. If the casualty appears to be seriously injured or unconscious, summon emergency medical responders to the site before initiating the rescue so that they will be en-route during the rescue.

After a fall, if there is a person left in the basket/bucket who is competent to operate the controls, he/she shall carefully and slowly maneuver the basket/bucket to move the casualty until suspended over a safe area (ground or bridge deck). Take great care that the casualty does not become entangled or snagged by any structures that are adjacent to the movement.

After a fall, if there is no person left in the basket/bucket who is competent to operate the controls, the designated person on the ground will switch control to ground level and will carefully maneuver the basket/bucket to move the casualty until suspended over a safe area (ground or bridge deck). Take great care that the casualty does not become entangled or snagged by any structures that are adjacent to the movement.

Operate the lift to lower the casualty to the safe area. If the casualty is injured, unconscious, or unable to stand, call other available personnel to assist laying the casualty down as the lift is lowered. If there are no other personnel available, swing the lift as needed, after the persons feet touch the ground, while carefully lowering the person into a lying position.

Once the casualty is on the ground, deck or other safe platform, and there is no tension in the lanyard, immediately reassess the condition of the casualty and begin first aid if needed.

In all cases, whether the casualty appears to be injured or not, evacuate him or her to the nearest medical facility for medical examination and treatment of any trauma or circulatory problems.

Contact the PM and OH&S Manager to initiate the Incident Reporting process.

8.0 REFERENCES

- 29 CFR 1926.453, Aerial Lifts
- 29 CFR 1926, Subpart M, Fall Protection
- 29 CFR 1910, Subpart F - Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms

9.0 REQUIRED RECORDS

- EWP Inspection Forms will be kept with project files.

10.0 ATTACHMENTS

Attachment A – EWP Inspection Form

Attachment A
EWP Inspection Form

OP 590, Elevated Work Platforms

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

EWP Inspection Form

EWP Operator must inspect/document equipment daily, using this form.

Project Name:	**Project Number:**	**Date:**
Operator:	**Make/Model:**	

Inspection

EWP Inspection	**Satisfactory**	**Unsatisfactory**	**N/A**
General appearance (hood, paint, undercarriage)	☐	☐	☐
Tires (adequate tread)	☐	☐	☐
Batteries (tie-downs in place, corroded, leaking)	☐	☐	☐
Hydraulic Oil Levels	☐	☐	☐
Engine Oil Levels	☐	☐	☐
Coolant Levels	☐	☐	☐
Structural Arms (welds and paint condition)	☐	☐	☐
Chain properly lubricated	☐	☐	☐
Outriggers deployed and stable	☐	☐	☐
Basket in sound condition (toe boards, flooring)	☐	☐	☐
Guardrails intact, swing gate functional	☐	☐	☐
Controls properly marked/labelled and functional	☐	☐	☐
Ground controls (emergency override) functional	☐	☐	☐
Motion Alarm functional	☐	☐	☐
Fire Extinguisher (min 5 lbs B:C)	☐	☐	☐
Operators manual present	☐	☐	☐
Utilities			
Safe distance from overhead lines (min 10 feet)	☐	☐	☐
Work Area			
Work zone demarcated and barriers erected	☐	☐	☐
Non-essential personnel behind barriers	☐	☐	☐
Area clear of obstructions, holes, uneven surfaces	☐	☐	☐
Travel routes clear and demarcated	☐	☐	☐
Overhead obstructions marked	☐	☐	☐
Personal Protective Equipment			
Fall protection (harness and lanyard) available and in use	☐	☐	☐
Anchorage points intact	☐	☐	☐

Comments:

Attachment B
Activity Hazard Analysis

OP 551 - Project Planning

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Activity Hazard Analysis – 1.0

Activity/Work Task: Mobilization/Demobilization	Overall Risk Assessment Code (RAC) (Use highest code): **L**
Project Location: University of California, Berkeley Richmond Field Station	
Contract Number: 15-1003.00	
Date Prepared: 9/4/2014	
Prepared by (Name/Title): Greg Bright / Project Manager	
Reviewed by: Sean Liddy, CSP	
Competent Person (if applicable):	

Risk Assessment Code (RAC) Matrix

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Notes: (Field Notes, Review Comments, etc.)
The following outlines minimum requirements per accordance with the approved SHSP for the project site. Subcontractors are responsible for performing tasks in accordance with the minimum requirements established for the site and in accordance with their own HS&E policies and procedures. Subcontractors shall review and supplement the AHA with company specific HS&E guidance. Modifications or changes to the AHA should be forwarded to the PM/SSHO and reviewed by all project staff prior to performing the task.

Personal Protective Equipment (PPE):

☒ Hard Hat ☒ Safety Glasses ☐ Ear Muffs ☒ Long Pants/Sleeves ☐ Inner Glove ☐ Fall Protection ☐ Wide Brim Hat
☐ Leather Glove ☐ Safety Goggles ☒ Ear Plugs ☐ Coveralls (coated) ☐ Outer Glove ☐ Cooling Vest ☐ Half/Full Face Respirator
☐ Kevlar Glove ☒ Safety Toe Boots ☒ Traffic Vest ☐ Flame Resistant Clothing ☐ Face Shield ☐ Welding PPE ☐ Cartridge/Filter Type:

Other PPE: Level D PPE, use hearing protection if noise levels exceed 85decibels.

Safety Equipment:

☒ First Aid Kit ☐ Eyewash Station ☐ Eyewash Bottles ☒ Fire Extinguisher (A-B-C) ☐ Pop-up Shade ☒ Sunscreen ☒ Drinking Water
☐ Air Horn ☐ Trekking Poles ☐ Insect Repellent ☐ Wheel Chocks ☐ Cargo Net ☐ Stretch First Safety First

Other Safety Equipment:

Monitoring Procedures and Action Levels (Refer to Section 5.0 of SHSP):

☐ PID (10.6eV) ☐ PID (11.7eV) ☐ Multi-Rae (PID+O2, H2S, CO, LEL) ☐ PDR (Respirable Dust) ☐ PDM (Total Dust) ☐ Radiological Meter ☐ Personal Air Pump

Chemicals of Concern (COC): None.

Job Steps	Hazards	Controls	RAC
Pre-trip Planning	Traffic delays, weather	-Plan your route, research construction delays, weather impacts	L
Complete Vehicle Inspection	Unserviceable vehicles	-Inspect vehicle for deficiencies, report and correct prior to use. Complete vehicle inspection log each day prior to use.	L
Safety Equipment	Unsecured driver, passenger, or gear and equipment	-Always use seatbelts while vehicle is in motion, lock doors. Always secure the load with a cargo net or rope. Secure all loose equipment in cab.	L

Job Steps	Hazards	Controls	RAC
Backing	Blind spots; unseen objects	-Always use a spotter when backing, check mirrors and over shoulder Back into parking spaces upon arrival, whenever possible. When preparing to move or back vehicles, walk around the vehicle 360 degrees before entering vehicle to identify any new conditions or obstructions. Use a spotter when backing whenever possible. Determine and agree upon hand signals (between spotter and driver) before attempting to back vehicle. Check the rear-view and side mirrors prior to backing (Note: All vehicles, other than automobiles, must have small convex mirrors attached to the side mirrors.) Back slowly in areas of obstructed vision. Anticipate others who may be backing out into your pathway and adjust accordingly.	L
Driving	Rough road surface (potholes), sleepiness, Blind corners, reduced visibility due to dust, fog, snow, rain. Mobile devices Crossing Rail road tracks Steep inclines/declines, narrow windy roads	-Keep eyes moving, use mirrors, follow posted signs, avoid distractions -Aim high in steering, -Maintain 15 sec eye lead time -Leave yourself an out, maintain cushion around vehicle Get the big picture; -Avoid being boxed in, adjust speed to traffic, focus on driving, -Refrain from emotional discussions/NO CELL PHONE. -When approaching a blind corner slow down to 10 mph at least 250 feet from the corner, proceed around the corner at no greater than 10 mph. -During periods of reduced visibility, reduce speeds, pull over and stop until visibility improves, and increase following distance during periods of decreased visibility. - Hand held phone use prohibited. No texting. Car on, phone off. - Stop, look, and listen before crossing railroad tracks. Be aware that multiple tracks may have more than one train using them, and the trains may be traveling in opposite directions. Look for direction from track spotter (if present).	L
Parking	Collision, injury to others, possible grass or brush fire from hot vehicle parts (catalytic converter) in contact with dry vegetation.	-Park away from other cars, set brake, park on level terrain, use wheel chocks and turn wheels if parked on sloped terrain. -Park only in cleared areas or where vegetation beneath vehicle is less than 6 inches tall.	L
Backing	Collision with stationary objects, backing into ditch	-Get out and look around vehicle before backing, use a spotter. -When parking, pull through or back in when possible.	L
Driving larger trucks/vans	Blind spots; unseen objects; longer stopping, distance; wider turning radius	-Driver should be familiar with the vehicle they are driving set sideview mirrors to r-reduce blind spots	L
Heavy equipment operations adjacent to and on site roadways	Collisions with heavy equipment, heavy equipment backing out into roadway from side roads or work areas along the roadways.	-Know the increased turning radius of the vehicle vs. a small compact	L
Heavy equipment cutting roads or clearing vegetation adjacent to roadways or at locations above roadways.	Falling rocks/debris	-Slow speeds when approaching heavy equipment activities along or adjacent to roads. -Stop and make contact with operator or spotter to ensure it is safe to pass. -Pass only when given permission by the operator or spotter.	L

Additional Safety Considerations

1. All employees must receive site specific safety orientation prior to beginning work on the project site. Site specific orientation and review of SHSP required prior to commencement of site work.
2. No Chemical Hazards anticipated during these project activities.
3. Use caution around delivery trucks and stay clear if not involved in spotting operation. Use one person to communicate with driver via hand signals to avoid unnecessary confusion. Watch for overhead utilities. Wear high visibility vest or shirt at all times.
4. Maintain eye contact with equipment operator during stone installation and use proper hand signals. Do not approach running equipment unless eye contact is made, and acknowledgment is received from operator.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed or the truck. It can cause property damage or serious injuries to others or yourself by falling-off from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible.
7. Keep clear area around work area, maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
8. Avoid the use of chains for lifting. If necessary, ensure chain is equipped with annual load rating cert and proper hooks being used. For synthetic slings, ensure red warning line is not showing and item is in good condition. For wire ropes, inspect for broken wires (6 in a lay, 3 in a strand).
9. Keep line of site with co-worker and ensure regular verbal contact. If out of the line of site, ensure radio or cell phone contact is established and maintained.

Contact Information

Cabrera Contacts			Project Contacts	
Contact Name	**Title**	**Number**	**Contact Name**	**Number**
Greg Bright	Deputy Project Manager	C: 781-264-4445 O: 508-315-6246	Karl Hans, Project Manager	510-643-9574
Tony Mason	PM/Senior HP	C: 435-655-1009	Carolyn Mac Kenzie, Radiation Safety Officer	510-643-7976
Sean Liddy	OH&S Manager	C:443-553-1403 O:410-982-0726		
			Emergency Contacts	
			Police Department (local)	911 or (510) 620-6655
			Fire Department (local)	911 or (510) 307-8031
			Kaiser Permanente, Richmond Hospital (nearest hospital)	(510) 307-1566/ (510) 307-1555
			Non-work related emergency	911

Equipment to be Used	Inspection Requirements	Training Requirements
Utility Vehicles	Daily Preventative Maintenance Checks	Vehicle & Driver Safety Awareness Familiarity with the vehicle being operated.
Communications Equipment	Daily communications Checks	Familiarity with the equipment. Knowledge of Emergency Response Procedures.
Hand Tools	Inspect hand tools for serviceability	Use hand tools for their intended purposes. Familiarity with the equipment.
		<u>Other Training:</u> -Evacuation, Emergency Response & Notification Procedures IAW SHSP/AHA. -Safe work practices and precautions IAW SHSP/AHA. -OSHA qualifications and training as required IAW SHSP/AHA.

Acknowledgement			
All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site. By signing this form, Cabrera employees agree that: • I have read this Activity Hazard Analysis and I understand the requirements of the AHA. • I will conduct work at this site in accordance with the requirements of the AHA. By signing this form, subcontractors and visitors agree that: • I have read and understood the potential hazards associated with the site. • I have read this Activity Hazard Analysis and I understand the requirements of the AHA. • I will conduct work at this site in accordance with the requirements of the AHA. • I will ensure compliance with my company's policies on health and safety.			
Name (Print)	**Date**	**Company**	**Signature**

Activity Hazard Analysis

Activity/Work Task: Pre-Excavation Surveys	Overall Risk Assessment Code (RAC) (Use highest code): **L**
Project Location: University of California, Berkeley Richmond Field Station	
Contract Number: 15-1003.00	
Date Prepared: 9/8/2014	
Prepared by (Name/Title): Greg Bright / Project Manager	
Reviewed by: Sean Liddy, CSP	
Competent Person (if applicable):	

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Notes: (Field Notes, Review Comments, etc.)
The following outlines minimum requirements per accordance with the approved SHSP for the project site. Subcontractors are responsible for performing tasks in accordance with the minimum requirements established for the site and in accordance with their own HS&E policies and procedures. Subcontractors shall review and supplement the AHA with company specific HS&E guidance. Modifications or changes to the AHA should be forwarded to the PM/SSHO and reviewed by all project staff prior to performing the task.

Personal Protective Equipment (PPE):

☒ Hard Hat ☒ Safety Glasses ☐ Ear Muffs ☒ Long Pants/Sleeves ☐ Inner Glove ☐ Fall Protection ☐ Wide Brim Hat
☐ Leather Glove ☐ Safety Goggles ☐ Ear Plugs ☐ Coveralls (coated) ☐ Outer Glove ☐ Cooling Vest ☐ Half/Full Face Respirator
☐ Kevlar Glove ☒ Safety Toe Boots ☒ Traffic Vest ☐ Flame Resistant Clothing ☐ Face Shield ☐ Welding PPE ☐ Cartridge/Filter Type:
Other PPE: Level D PPE

Safety Equipment:

☒ First Aid Kit ☐ Eyewash Station ☒ Eyewash Bottles ☒ Fire Extinguisher (A-B-C) ☐ Pop-up Shade ☒ Sunscreen ☒ Drinking Water
☐ Air Horn ☐ Trekking Poles ☒ Insect Repellent ☐ Wheel Chocks ☐ Cargo Net ☐ Stretch First Safety First
Other Safety Equipment:

Monitoring Procedures and Action Levels (Refer to Section 5.0 of SHSP):

☐ PID (10.6eV) ☐ PID (11.7eV) ☐ Multi-Rae (PID+O2, H2S, CO, LEL) ☐ PDR (Respirable Dust) ☐ PDM (Total Dust) ☐ Radiological Meter ☐ Personal Air Pump
Chemicals of Concern (COC): None. Non-intrusive operation.

Job Steps	Hazards	Controls	RAC
Site walk/survey to perform inspections and collect geophysical measurements and data	Twisting ankles/feet due to surface/subsurface obstructions. Biologic hazards such as insects, poison ivy, spiders, and snakes.	Inspect area before driving and/or walking. Identify possible hazards such as holes, obstructions protruding from the ground, or debris that may be scattered on the ground. Contact site manager immediately and do not proceed if any conditions are observed that could make driving/walk in the area unsafe and that cannot be fixed with the equipment or personnel onsite. Check immediate area for potential hazards such as poison ivy, spiders, wasps, snakes, etc. Use bug repellent, sunscreen, and snake gaiters/trekking pole as necessary.	L

Job Steps	Hazards	Controls	RAC
	Injuries caused by improper lifting techniques. Trips/Falls Vehicular Traffic Loose/falling rocks, land/rock slides Potential punctures, cuts or scrapes from debris	Use proper bending/lifting techniques by bending and lifting with legs and not with back. Avoid lifting >50 lbs without assistance or mechanical means. Keep loads close to body and avoid twisting. Lift with legs, not back. Watch footing and observe ground surface for breaks in elevation, uneven surfaces, loose debris, or other obstructions to cause improper footing. Do not jump or step down from elevated areas without ensuring solid/flat ground surface present. Wear high visibility work vest when working. Watch for moving vehicles. Avoid walking on road and stay out of travel lanes. Watch for loose, disturbed earth and balanced rocks, make sure to stay clear of these areas. Do not work on unstable/steep grades and do not work or stand directly underneath areas where falling rocks may be likely. Be observant for tripping hazards, holes, stickups, vines, old fence lines. Wear rubber over boots with steel foot inserts to protect against punctures from debris in dirt/mud. Use caution and avoid areas of thick/heavy mud where inadequate footing or debris may be present.	L
Secure equipment in vehicle	Damage to equipment/tools and/or accidents with loose objects. Pinch points. Communications	Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed or the truck. It can cause property damage or serious injuries to others or yourself by falling-off from vehicle. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible. Maintain contact with site workers and advise of location of survey, and status. Confirm when complete prior to departure.	L

Additional Safety Considerations

1. Be aware of equipment being used in work zones and maintain adequate safe distances (50 ft plus max mast height). Make eye contact with equipment operators and receive confirmation prior to approaching.
2. Ensure all personnel have read and acknowledged the AHA. The AHA may be revised daily based on daily de-brief of work activities.
3. Keep line of site with co-worker and ensure regular verbal contact. If out of the line of site, ensure radio or cell phone contact is established and maintained.
4. Wear sunscreen and wide brim hat to avoid sun exposure.

Equipment to be Used	Inspection Requirements	Training Requirements
Utility Vehicles, including trucks	Daily Preventative Maintenance Checks	Vehicle & Driver Safety Awareness Familiarity with the vehicle being operated.
Communications Equipment	Daily communications Checks	Familiarity with the equipment. Knowledge of Emergency Response Procedures.

Equipment to be Used	Inspection Requirements	Training Requirements
PPE – steel toed boots, hard hat, safety glasses, high visibility vest, snake gaiters	Daily inspection prior to use	To be used in accordance with manufacturer's specifications and operator's manual
Hand/Power Tools	Inspect hand tools for serviceability	Use hand tools for their intended purposes. Use gas powered tools only for intended purposes. Review manufactures instructions. Familiarity with the equipment.
		Other Training: -Evacuation, Emergency Response & Notification Procedures IAW SHSP and AHA. -Safe work practices and precautions IAW SHSP and AHA. -OSHA qualifications and training as required IAW SHSP and AHA.

Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, CABRERA employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.
- I will ensure compliance with my company's policies on health and safety.

Name (Print)	Date	Company	Signature

OP 551 - Project Planning

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Activity Hazard Analysis

Activity/Work Task: Excavation, Test pitting

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Project Location: University of California, Berkeley Richmond Field Station

Contract Number: 15-1003.00

Date Prepared: 9/5/2014

Prepared by (Name/Title): Greg Bright / Project Manager

Reviewed by: Sean Liddy, CSP

Competent Person (if applicable):
Operator for heavy equipment operations.
Field engineer for excavation.

Notes: (Field Notes, Review Comments, etc.)
The following outlines minimum requirements per accordance with the approved SHSP for the project site. Subcontractors are responsible for performing tasks in accordance with the minimum requirements established for the site and in accordance with their own HS&E policies and procedures. Subcontractors shall review and supplement the AHA with company specific HS&E guidance. Modifications or changes to the AHA should be forwarded to the PM/SSHO and reviewed by all project staff prior to performing the task.

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Personal Protective Equipment (PPE):

☒ Hard Hat ☒ Safety Glasses ☐ Ear Muffs ☒ Long Pants/Sleeves ☒ Inner Glove ☐ Fall Protection ☐ Wide Brim Hat
☒ Leather Glove ☐ Safety Goggles ☐ Ear Plugs ☒ Coveralls (Tyvek) ☒ Outer Glove ☐ Cooling Vest ☐ Half/Full Face Respirator
☐ Kevlar Glove ☒ Safety Toe Boots ☒ Traffic Vest ☐ Flame Resistant Clothing ☐ Face Shield ☐ Welding PPE ☐ Cartridge/Filter Type:

Other PPE: Use modified Level D PPE to avoid dermal contact with potentially impacted soils and groundwater. Use ear plugs if noise exceeds 85 decibels.

Safety Equipment:

☒ First Aid Kit ☐ Eyewash Station ☒ Eyewash Bottles ☒ Fire Extinguisher (A-B-C) ☒ Pop-up Shade ☒ Sunscreen ☒ Drinking Water
☐ Air Horn ☐ Trekking Poles ☒ Insect Repellent ☐ Wheel Chocks ☐ Cargo Net ☐ Stretch First Safety First

Other Safety Equipment:

Monitoring Procedures and Action Levels (Refer to Section 5.0 of SHSP):

☒ PID (10.6eV) ☐ PID (11.7eV) ☒ Multi-Rae (PID+O2, H2S, CO, LEL) ☒ PDR (Respirable Dust) ☒ PDM (Total Dust) ☒ Radiological Meter ☒ Personal Air Pump

Chemicals of Concern (COC): Radiological (unknown radionuclides of concern), Heavy Metals (lead, arsenic, cadmium, chromium, mercury, nickel, thallium, zinc), PCBs, pesticides, low level VOCs. Monitor for dust, VOC and radiological COCs per accordance with SHSP and AMP at direction of SSHO/SRSO.

Job Steps	Hazards	Controls	RAC
Utility Locate call, Review site drawings. Mark known subsurface lines	Overhead or underground utilities that can be encountered during excavation activities causing injury to personnel and/or damage to equipment and property	-Obtain all necessary utility clearance permits and maintain copies at site. Use site drawings to assist with utility location. Clearly mark and refresh lines/markings as needed. Hand dig or air knife within 5-feet of suspected lines to positively ID and avoid. -Ensure minimum safe distances from overhead utilities. STOP Unmarked lines suspected, or observed evidence of potential presence.	L

Job Steps	Hazards	Controls	RAC
Stage tools and equipment	-Slips, trips, and uneven surfaces -Cuts/laceration hazards from sharp edges of tools. -Unsafe Equipment. -Biological Hazards	-Inspect equipment to assure that all operational and safety systems are functional. -Keep work area clear of surface encumbrances -Use leather gloves and avoid sharp metal and protruding objects. -Operator must perform thorough inspection of equipment and note any missing/damaged components. Ensure motion alarms are functional (at proper audible levels), horn functional, mirrors and windows intact (no cracking). -Be aware of potential presence of poisonous plants (ivy/oak). Avoid contact. Wear long-sleeve shirts/trousers or Tyvek® coveralls to avoid skin contact with plants or other skin irritants. Immediately notify the SSHO if you suspect you contacted. STOP Defective equipment or safety systems	L
Establish EZ and install perimeter controls (Perimeter protection and sediment & erosion control devices)	-Exposure to COCs	-Barriers such as fences and ropes will be put in place to limit the access to Controlled and Restricted Areas as specified in the SHSP. Use Class 2 or 3 perimeter protection with stop logs and clear distances to maintain safe distances with equipment and trucks. -Avoid contact with contaminated materials. Wear Modified Level D PPE. - RPTs will perform radiological surveillance. COC surveillance will include: 1. Personnel working in Restricted Areas may be issued Lapel Samplers (also called Breathing Zone (BZ) Air Samplers). 2. General Area Air Monitors may be used to sample work areas for dust, VOC, H2S, and radiological concerns. 3. Perimeter Air Monitors may be used to sample Control Area boundary locations. 4. Real-time dust monitoring may be used to sample boundary areas.	L
	-Slips, trips, and uneven surfaces -Cuts/laceration hazards from sharp edges of tools/equipment -Crush hazards on fingeres/hands during fence install	-Keep work area clear of surface encumbrances. Be aware of vines and other natural debris on ground surface, including holes and tree stumps. -Use leather gloves and avoid sharp metal and protruding objects. -Use dedicated fence post driver. Avoid over exertion. Do not place hands near post while someone is driving with hammer. Use extension rod to hold.	L
Excavation of soils (test-pitting) Hand dig around subsurface lines	-Excavation/trench side walls can collapse. -Heavy equipment hazards from pinch points on equipment, swinging arms of backhoes, and moving. -Noise Building wall cracks, bulges or breaks. -Underground and overhead utilities -Fall into excavation/trench by personnel and/or equipment -Hand tool use during fence install, and manual digging.	-If sloughing of sides is observed, ensure proper sloping/shoring of excavation. Assume Class C soils to start. Place spoils at least 2-3 ft back from edge of trench. CP must inspect daily and after each rain event. Shoring systems to be installed per engineered design. Exposed edges properly sloped and/or benched. -All unessential personnel stay back 50 feet plus max swing radius of equipment. Do not stand between equipment and other fixed objects. -Use hearing protection while working adjacent to heavy equipment. -Use hand signals, keep clear of moving equipment, ensure eye contact with operator prior to approaching. -Unsure utility locations in facility are clearly demarcated and verified with CP and/or engineer prior to intrusive work. -Excavation edges must be properly demarcated with orange fencing at sufficient distance from edge (≥ 6 ft where possible) and curb stops if equipment is operating adjacent (Minimum Class 2 or 3 perimeter protection). -Inspect hand tools and ensure in proper operating condition. Remove defective tools from use.	M

Job Steps	Hazards	Controls	RAC
Excavation (cont.)	Trench collapse	-Competent person for excavation has inspected and documented the excavation conditions prior to the start of work (daily) and ensures trench box assembled per engineered drawing. Exposed edges properly sloped/benched. -Appropriate means of egress used to enter/exit from excavation STOP Exposing subsurface lines or structures not previously identified. Excavation fills with water or product. Adjacent road or structure cracks, bulges or breaks.	**M**
Dust suppression	Exposure to COCs via dust generation during excavation	-Control dust by maintaining equipment operation rates and by applying water (spray/fogger). -Personnel shall stay out of dust and work from upwind when possible. -Perform dust and rad monitoring per accordance with SHSP/WP and per SSHO/SRSO to verify dust control is effective. -Read and follow SDS for each chemical used. Do not use any chemical that you have not been trained to safely use. Wear proper PPE. Properly label all containers.	**L**
Excavation (cont.) Water accumulation in the excavation	-Stability -Dust (with potential COCs)	-Pump out water to expose bottom of excavation. Designated CP to inspect and document conditions. -Use dust suppression as necessary to avoid airborne dust in work zone. STOP Inability to control water level.	**M**
Use of pumps and generators	-COC exposure -Electrical Hazards -Fire Hazards -Sprains/Strains during lifting	- Wear proper PPE (modified D) and avoid splashing water. - All extension cords should be inspected daily. Use GFCI protected outlets. Ensure grounding plug intact. Keep connections and cord out of water. Dry hands prior to connecting/disconnecting. -Turn equipment off and let cool prior to refueling. Ensure fire extinguisher present. -Use proper lifting techniques and mechanical assistance where necessary. Wear gloves.	**M**
Decontamination of equipment from EZ	-Off-Site spread of Contamination	-Heavy equipment shall use dedicated site entrance/exit. -Excavator will be decontaminated (dry brush techniques) and scanned (verified clean) prior to departure from the EZ.	**L**
Back fill excavation	-Heavy equipment hazards from pinch points on equipment, swinging arms of backhoes, and moving. -Rigging hazards -Sprains/stains from manual lifting and use of compaction equipment. Noise	-All workers except the excavator operator shall remain outside the swing radius of the equipment. Workers shall not approach the excavator unless the bucket is on the ground and the operator signals that it is OK to approach. -Use proper rigging for lifting compaction equipment into/out of excavation. -Use mechanical assistance whenever possible. Use proper lifting techniques. Use remote control on compaction roller and do not stand directly adjacent to machine. -Hard Hat, Safety Glasses or Goggles, Leather Gloves, Hearing Protection	**M**
Police area and remove all tools and equipment	-Sprains/Strains from lifting -Hand tool use	-Use proper lifting techniques and mechanical assistance -Inspect hand tools and ensure in proper operating condition. Remove defective tools from use.	**L**

Additional Safety Considerations	
1.	Air monitoring procedures to be used to ensure controls effective in prevention of exposure and off-site migration of COCs from work area.
2.	Use one person to communicate with driver via hand signals to avoid unnecessary confusion. Watch for overhead utilities.
3.	Maintain eye contact with equipment operator and use proper hand signals. Do not approach running equipment unless eye contact is made, and acknowledgment is received from operator. Unessential personnel must stay back 50-feet plus maximum swing radius of equipment.
4.	Keep clear area around work area, maintain good housekeeping practices.
5.	When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
6.	Avoid the use of chains for lifting. If necessary, ensure chain is equipped with annual load rating cert and proper hooks being used. For synthetic slings, ensure red warning line is not showing and item is in good condition. For wire ropes, inspect for broken wires (6 in a lay, 3 in a strand).

Equipment to be Used	Inspection Requirements	Training Requirements
Utility Vehicles	Daily Preventative Maintenance Checks	Vehicle & Driver Safety Awareness Familiarity with the vehicle being operated.
Excavator	Daily Preventative Maintenance Checks	Certified heavy equipment operator Familiarity with the equipment being operated.
Sodium iodide gamma detector with rate-meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual
Alpha-Beta-detector with rate-meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual
Dose rate meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual
Hand Tools	Inspect hand tools for serviceability	Use hand tools for their intended purposes. Familiarity with the equipment.
		Other Training: -Evacuation, Emergency Response & Notification Procedures IAW SHSP. -Safe work practices and precautions IAW SHSP. -OSHA qualifications and training as required IAW SHSP.

Acknowledgement			
All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site. By signing this form, CABRERA employees agree that: • I have read this Activity Hazard Analysis and I understand the requirements of the AHA. • I will conduct work at this site in accordance with the requirements of the AHA. By signing this form, subcontractors and visitors agree that: • I have read and understood the potential hazards associated with the site. • I have read this Activity Hazard Analysis and I understand the requirements of the AHA. • I will conduct work at this site in accordance with the requirements of the AHA. • I will ensure compliance with my company's policies on health and safety.			
Name (Print)	**Date**	**Company**	**Signature**

Activity Hazard Analysis

Activity/Work Task: Aerial Lift Use	Overall Risk Assessment Code (RAC) (Use highest code): **M**
Project Location: University of California, Berkeley Richmond Field Station	
Contract Number: 15-1003.00	
Date Prepared: 9/5/2014	
Prepared by (Name/Title): Greg Bright/Project Manager	
Reviewed by: Sean Liddy, CSP	
Competent Person (if applicable): Aerial Lift Operator: TBD	

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Notes: (Field Notes, Review Comments, etc.)
The following outlines minimum requirements per accordance with the approved SHSP for the project site. Subcontractors are responsible for performing tasks in accordance with the minimum requirements established for the site and in accordance with their own HS&E policies and procedures. Subcontractors shall review and supplement the AHA with company specific HS&E guidance. Modifications or changes to the AHA should be forwarded to the PM/SSHO and reviewed by all project staff prior to performing the task.

Personal Protective Equipment (PPE):

☒ Hard Hat ☒ Safety Glasses ☐ Ear Muffs ☒ Long Pants/Sleeves ☒ Inner Glove ☒ Fall Protection ☐ Wide Brim Hat
☒ Leather Glove ☐ Safety Goggles ☒ Ear Plugs ☒ Coveralls (Tyvek) ☒ Outer Glove ☐ Cooling Vest ☐ Half/Full Face Respirator
☐ Kevlar Glove ☒ Safety Toe Boots ☒ Traffic Vest ☐ Flame Resistant Clothing ☐ Face Shield ☐ Welding PPE ☐ Cartridge/Filter Type:

Other PPE: Use modified Level D PPE to avoid dermal contact with potentially impacted soils and groundwater. Use of 100% fall protection when on lift.

Safety Equipment:

☒ First Aid Kit ☐ Eyewash Station ☒ Eyewash Bottles ☒ Fire Extinguisher (A-B-C) ☒ Pop-up Shade ☒ Sunscreen ☒ Drinking Water
☐ Air Horn ☐ Trekking Poles ☐ Insect Repellent ☐ Wheel Chocks ☐ Cargo Net ☐ Stretch First Safety First

Other Safety Equipment:

Monitoring Procedures and Action Levels (Refer to Section 5.0 of SHSP):

☒ PID (10.6eV) ☐ PID (11.7eV) ☒ Multi-Rae (PID+O2, H2S, CO, LEL) ☒ PDR (Respirable Dust) ☒ PDM (Total Dust) ☒ Radiological Meter ☒ Personal Air Pump

Chemicals of Concern (COC): Radiological (unknown radionuclides of concern), Heavy Metals (lead, arsenic, cadmium, chromium, mercury, nickel, thallium, zinc), PCBs, pesticides, low level VOCs. Monitor for dust, VOC and radiological COCs per accordance with SHSP and AMP at direction of SSHO/SRSL.

Job Steps	Hazards	Controls	RAC
Operator Qualification	Inexperienced or unqualified operator for specified equipment	• Verify the operator has had sufficient experience in the complete operation of the selected equipment. • Verify the operator has a full understanding of the limitations and specifications of the selected equipment and is familiar with all controls and operating parameters. • Verify operator properly trained on fall protection requirements STOP Operator is unfamiliar with the equipment and is not sufficiently trained to operate.	L

Job Steps	Hazards	Controls	RAC
Inspect equipment	Battery conduits not in full contact Pneumatic tires not inflated properly Structural damage on lift arm or other components.	• Visually inspect equipment for any abnormalities, such as leaking oil, missing bolts, tire pressure, rust, or non-properly connected terminals • Utilize manufacturers operations checklist • Complete EWP Inspection Form STOP Vehicle requires maintenance or repair	L
Entering lift	Slips, trips, and falls	• Open door to lift • Maintain three points of contact with the lift at all times while entering the lift • Fasten body harness lanyard to proper safety equipment latch points. Attaching or belting off to an adjacent structure while working from the bucket truck is not permitted. • Always stand firmly on the floor of the basket and shall not sit or climb on the edge of the basket or use a ladder or other device for a work position. STOP Door to lift does not open No latch points for lanyard No lanyard	L
Mobilizing/Demobilizing equipment at each location	Lift tip-over Collision with objects	• Fully retract lift and maintain close to ground before moving in order to reduce lift tip hazard while in motion • Review planned route of travel. Watch for overhead utilities and surface encumbrances. STOP No clear route can be established	M
Raising lift	Lift tip-over Contact with objects while extending lift	• Be sure lift support feet/wheels has firm/level contact with ground • Be sure the lift is balanced before extending lift • If equipped, deploy outriggers before extending • Use of the lift in the close proximity to electric power lines will not be permitted until contact has been made with the electric utility regarding de-energizing of the power line. • Use of the lift will be discontinued during electrical storms when threat of lightning is present. • Carefully raise lift and watch for overhead pipes/structures that may cause pinch or strike hazard to personnel in basket. STOP Lift cannot be balanced or have firm contact with ground	M
Changing location of lift	Lift tip-over Falling	• Always lower the lift to its full down and lock position prior to moving from one location to another. • Always ensure the intended path is clear of all obstacles and surface encumbrances • Always use a spotter • Maintain safe distance from edge of excavation with lift. As depth of excavation proceeds, additional set-back will be required to accommodate sidewall loading from lift weight. Close coordination with excavation CP required. STOP Blocked pathway No spotter available Evidence of sloughing of sidewalls or cracking of ground surface adjacent to excavation.	M

Job Steps	Hazards	Controls	RAC
Conduct inspection/work	Lift tip-over Falling Overloading lift Lowering monitoring devices into excavation	• Keep both feet flat and in contact with platform at all times. DO NOT climb on rails • Raise platform to sample location so that no stretching of the body is needed • Remain balanced at all times to reduce lift tipping hazard • Be aware of maximum capacity and do not exceed load ratings from manufacturer • Slowly lower monitoring equipment to bottom of excavation using rope/cable. Wear leather work gloves and do not overextend over edge of basket/railing. • While in lift, visually inspect surrounding surface area of ground and sidewalls of excavation for signs of potential failure (sloughing or cracking). STOP Lift not large enough to reach sample location. Evidence of sloughing of sidewalls or cracking of ground surface adjacent to excavation.	M
Lowering lift	Crushing of nearby objects	• Before retracting lift, be sure to check that no objects have moved in the path of the lift arms while lift was extended STOP Objects in the path of lift retraction	L

Additional Safety Considerations

- 100% Fall Protection required at all times when on lift.
- Do not tie off to adjacent structures.
- Use ground spotter when possible to assist with clearance of obstacles/tools.
- Rope off ground area to prevent unauthorized personnel from entering into work area.
- Coordinate with CP to ensure excavation is safe to approach.

Equipment to be Used	Inspection Requirements	Training Requirements
Utility Vehicles	Daily Preventative Maintenance Checks	Vehicle & Driver Safety Awareness Familiarity with the vehicle being operated.
Aerial Lift (Elevated Work Platform)	Daily Preventative Maintenance Checks EWP Inspection Form	Authorized Lift Operator Familiarity with the equipment being operated.
Fall Protection Equipment (Harness and Lanyards)	Daily Inspections	Competent Person for fall protection Familiarity with harness and lanyard.
Communications Equipment	Daily communications Checks	Familiarity with the equipment. Knowledge of Emergency Response Procedures.
Hand Tools	Inspect hand tools for serviceability	Use hand tools for their intended purposes. Familiarity with the equipment.
Sodium iodide gamma detector with rate-meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual
Alpha-Beta-detector with rate-meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual
Dose rate meter	Daily functional test prior to use	Qualified Radiological Protection Technician To be used in accordance with manufacturer's specifications and operator's manual

Equipment to be Used	Inspection Requirements	Training Requirements
		Other Training: -Evacuation, Emergency Response & Notification Procedures IAW SHSP/AHA. -Safe work practices and precautions IAW SHSP/AHA. -OSHA qualifications and training as required IAW SHSP/AHA.

Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, CABRERA employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

Name (Print)	Date	Company	Signature

Attachment C
H&S Forms

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

1. EMPLOYEE MUST REPORT ALL INCIDENTS TO THEIR SUPERVISOR IMMEDIATELY.
2. REPORT THE INCIDENT TO THE APPROPRIATE SENIOR MANAGER AND OH&S MANAGER WITHIN 2 HOURS.
3. COMPLETE FORM AND SUBMIT WITHIN ONE 24 HOURS FOLLOWING THE OCCURRENCE OF THE INCIDENT.

I. LOCATION INFORMATION

INCIDENT ADDRESS/LOCATION:	DATE:
	TIME:
CLIENT NAME:	PROJECT NAME:
SUPERVISOR (FIELD):	REPORT COMPLETED BY:

II. DESCRIPTION OF INCIDENT

TYPE OF OCCURRENCE: ☐ INJURY/ILLNESS (SEC III) ☐ MOTOR VEHICLE INCIDENT (COMPLETE SUPPLEMENT) ☐ PROPERTY DAMAGE (SEC IV)
☐ ENV DAMAGE/SPILL (SEC IV) ☐ REGULATORY INSPECTION/NOV/CITATION (SEC V)
☐ OTHER BE SPECIFIC

DESCRIPTION OF EVENT:

WHAT, WHEN, WHERE, WHY, HOW? ATTACHED NOTES/DIAGRAMS AS REQUIRED AND LIST ANY MACHINERY OR EQUIPMENT INVOLVED

WERE THERE ANY WITNESSES OR OTHER PERSONS INVOLVED: ☐ YES ☐ NO

IF YES, PLEASE PROVIDE NAMES AND CONTACT INFORMATION

III. PERSONAL INJURY (COMPLETE FOR INJURY/ILLNESS ONLY)

EMPLOYEE NAME:	EMPLOYEE NUMBER:
WORK PHONE:	CELL PHONE:
EMPLOYEE STATUS ☐ FULL TIME ☐ PART TIME ☐ TEMP AGENCY ☐ SUBCONTACTOR ☐ THIRD PARTY	HOME OFFICE ADDRESS:
JOB TITLE/HIRE DATE:	Date Reported to Supervisor:

TYPE OF INJURY: ☐ FIRST AID (TREATED ON-SITE) ☐ MEDICAL AID (TREATED BY PROFESSIONAL) ☐ FATALITY

DESCRIBE THE INJURY AND BODY PART AFFECTED: *BE SPECIFIC (I.E. RIGHT HAND, INDEX FINGER, BELOW FIRST JOINT)*

WAS A DOCTOR OR HOSPITAL VISITED? ☐ YES ☐ NO	IF YES, WHEN:
FIRST AID/MEDICAL TREATMENT RECEIVED:	FIRST AIDER/DOCTOR/HOSPITAL NAME:
PROVIDER ADDRESS:	PHONE NUMBER:

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

IV. PROPERTY DAMAGE OR ENVIRONMENTAL RELEASE

TYPE OF DAMAGE: ☐ Cabrera PROPERTY ☐ SUBCONTRACTOR PROPERTY ☐ MAJOR STRUCTURAL FAILURE
☐ MOTOR VEHICLE (REFER TO MVI SUPPLEMENT FOR GREATER DETAIL) ☐ ENVIRONMENTAL RELEASE ☐ OTHER:

DESCRIBE THE SPECIFIC DAMAGE:

RANK THE SEVERITY OF THE DAMAGE: ☐ MINOR ☐ SERIOUS ☐ MAJOR

WHERE CAN THE PROPERTY BE SEEN?

PROPERTY OWNER NAME:	**CONTACT INFORMATION:**

IS THERE ANY POTENTIAL FOR CIVIL, CRIMINAL OR REGULATORY LIABILITY AGAINST Cabrera? ☐ **YES** ☐ **NO**
IF YES, DISCUSS WITH SENIOR MANAGEMENT AND OH&S MANAGER.

INDICATE WHO HAS BEEN NOTIFIED OF THE EVENT (E.G., OWNER/OPERATOR, STATE (US) OR GOVERNING BODY OF LABOUR, ETC?

V. REGULATORY INSPECTION/NOV/CITATION

TYPE OF EVENT: ☐ INSPECTION ☐ NOV ☐ CITATION

DESCRIBE EVENT: ***BE SPECIFIC***

FINDINGS NOTED AT SITE ☐ **YES** ☐ **NO**	**IF YES, WHAT:**
NAME OF REGULATORY AGENCY	**FOLLOW UP SCHEDULED:**
CONTACT PERSON:	**PHONE NUMBER:**

VI. REVIEW AND ACCEPTANCE

EMPLOYEE COMMENTS:

EMPLOYEE NAME AND PHONE	**SIGNATURE AND DATE**

SUPERVISOR COMMENTS:

SUPERVISOR NAME AND PHONE	**SIGNATURE AND DATE**

MANAGER COMMENTS:

MANAGER NAME AND PHONE	**SIGNATURE AND DATE**

FOR OH&S MANAGER USE ONLY:

NAME AND SIGNATURE:	**DATE:**

RECORDABILITY DETERMINATION ☐ FIRST AID ☐ RECORDABLE ☐ RECORDABILITY UNDETERMINED ☐ NON WORK
☐ PROPERTY DAMAGE ☐ GENERAL LIABILITY ☐ VANDALISM

COMMENTS:

OP 512 - INCIDENT REPORT

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

MOTOR VEHICLE INCIDENT (MVI) SUPPLEMENT

REMEMBER: **STAY CALM. TAKE PICTURES OF INCIDENT SCENE (LICENSE PLATE, DAMAGES, ETC)**
Do not admit liability, agree to pay for any damage or sign any document except as required by law.

ADMINISTRATIVE

VEHICLE TYPE: ☐ FLEET ☐ RENTAL ☐ PERSONAL	**JOB ACTIVITY AT TIME OF MVI:**
DATE OF MVI: **TIME OF MVI:**	**LOCATION OF MVI:**
MANAGER:	**NUMBER OF VEHICLES INVOLVED:**

DRIVER INFORMATION

DRIVER:	**PASSENGERS:**	**PASSENGERS:**
DRIVER'S LICENSE:	**STATE ISSUED:**	**EXPIRATION DATE:**
INJURIES TO DRIVER:		
INJURIES TO PASSENGERS:		

VEHICLE INFORMATION

YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #:	**LICENSE PLATE #:**	**REGISTRATION #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
COMMERCIAL MOTOR VEHICLE :	**I F RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:**	
RANK THE SEVERITY OF THE DAMAGE TO THE VEHICLE:	☐ 0 - $500 ☐ $500 - $1000	☐ $1000 - $4000 ☐ >$4000
DESCRIPTION OF DAMAGE TO THE BODY OF THE VEHICLE:		

OTHER DRIVER/VEHICLE INFORMATION

YEAR:	**MAKE:**	**MODEL:**
SERIAL/VIN #	**LICENSE PLATE #:**	**REGISTRATION #:**
DRIVER'S NAME:	**CONTACT INFO:**	**LICENSE #:**
OWNER:	**INSURANCE COMPANY:**	**POLICY #:**
IF RENTED OR PERSONAL, CONTACT INFORMATION OF OWNER:		
DESCRIPTION OF DAMAGE TO THE BODY OF THE OTHER VEHICLE:		

INCIDENT DESCRIPTION

EXACT LOCATION OF MVI (HIGHWAY, INTERSECTION, EXACT ADDRESS, ETC.)**?**	
OTHER PROPERTY DAMAGED:	
DESCRIBE THE EVENTS LEADING UP TO AND THE INCIDENT (REPORT FACTS ONLY: SPEED OF VEHICLES, DIRECTION TRAVELLING, WEATHER CONDITIONS, ETC. DO NOT GIVE OPINIONS REGARDING CAUSE OF INCIDENT OR LOSS.)**:**	
DID THE POLICE ATTEND THE SCENE: ☐ YES ☐ NO **CITATION ISSUED:** ☐ YES ☐ NO **TO WHO:**	
POLICE :	**CONTACT INFO:**

SUBMIT THIS MVI SUPPLEMENT WITH A COMPLETED INCIDENT REPORT TO THE APPROPRIATE MANAGER

Incident Reporting Flowchart

OP 512, Near Miss/Observation Report

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Use this form to report Near Misses and Observation (Field or Office)
Identification of such assists in development of proactive approaches to avoiding potential future incidents.

LOCATION INFORMATION

REPORT COMPLETED BY:	**SUPERVISOR:**
ADDRESS/LOCATION:	**DATE:**
	TIME:
CLIENT NAME:	**PROJECT NAME:**

DESCRIPTION OF NEAR MISS OR OBSERVATION

DESCRIPTION OF EVENT:

NEAR MISS POTENTIAL OUTCOME: ☐ INJURY/ILLNESS ☐ PROPERTY DAMAGE ☐ ENV DAMAGE/SPILL ☐ REGULATORY INSPECTION/NOV/CITATION ☐ OTHER BE SPECIFIC

POTENTIAL SEVERITY: ☐ **MINOR** ☐ **SERIOUS** ☐ **FATAL**

OBSERVATION TYPE: ☐ POSITIVE ☐ AT RISK CONDITION ☐ AT RISK BEHAVIOUR ☐ OTHER

POTENTIAL CAUSES

IMMEDIATE CAUSES: ☐ PROCEDURES NOT FOLLOWED ☐ USE OF TOOLS OR EQUIPMENT & VEHICLES ☐ USE OF PROTECTIVE MEASURES ☐ PROTECTIVE SYSTEMS ☐ ENVIRONMENT/LAYOUT ☐ INATTENTION/LACK OF AWARENESS ☐ WORK EXPOSURE TO

SYSTEM CAUSES: ☐ WORK RULES/PROCEDURES ☐ TOOLS AND EQUIPMENT ☐ WORK PLANNING ☐ ENGINEERING/DESIGN ☐ PURCHASING, MATERIAL HANDLING/CONTROLS ☐ CONTRACTOR SELECTION ☐ PHYSICAL CAPACITY/CONDITION ☐ MENTAL STATE ☐ SKILL LEVEL ☐ TRAINING/KNOWLEDGE ☐ MGMT/SUPER/EMPLOYEE LEADERSHIP ☐ COMMUNICATION ☐ OTHER

CORRECTIVE ACTION(S)

WERE CORRECTIVE ACTIONS IMMEDIATELY IMPLEMENTED? ☐ **YES** ☐ **NO**

CORRECTIVE ACTION: ☐ CHANGE IN PROCEDURE ☐ NEW STOP WORK TRIGGER IDENTIFIED ☐ NEW TOOL/EQUIPMENT ☐ DIFFERENT/NEW PPE ☐ IMPROVED PLANNING ☐ IMPROVED HOUSEKEEPING ☐ ADDITIONAL/PROPER PERSONNEL ☐ ADDITIONAL TRAINING/SKILLS ☐ MODIFIED WORK BEHAVIOUR ☐ OTHER

ARE LONG-TERM CORRECTIVE ACTIONS REQUIRED? ☐ **YES** ☐ **NO**

DESCRIBE:

FOR OH&S MANAGER USE ONLY:

ADDITIONAL CORRECTIVE ACTIONS (IF NECESSARY):

CONFIRMATION: ☐ REPORTING EMPLOYEE ☐ SUPERVISOR AND/OR MANAGER

NAME AND SIGNATURE:	**DATE:**

OP 555 - Safety Meetings

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

SAFETY MEETING FORM

SIX QUESTIONS FOR SUCCESS – Take two minutes to think through and answer these questions:

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

If you and your team aren't prepared to do the assigned work, STOP WORK, and take time to properly prepare.

Project Information

This sign-in log documents the topics of the safety meeting and individual attendance. Personnel who perform work operations onsite are required to attend and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the selected topics as applicable to the Project in the comment box (ex. Name of AHA reviewed).

PROJECT NAME & LOCATION

PROJECT NO.	**DATE/TIME**	**WEATHER CONDITIONS**

Topic

Discussion – check one

Today's Scope of Work (All tasks)	☐ yes	☐ n/a	Access / Egress / Slips, Trips, & Falls	☐ yes	☐ n/a
Schedule / New Work / Scope Changes	☐ yes	☐ n/a	Smoking, Eating, & Drinking	☐ yes	☐ n/a
Reviewed Procedures, AHA, etc.	☐ yes	☐ n/a	Washroom / Facilities Location	☐ yes	☐ n/a
Emergency Action Plan & Procedures	☐ yes	☐ n/a	Heat/Cold Stress	☐ yes	☐ n/a
Communications Protocol	☐ yes	☐ n/a	Exclusion Areas Barricades / Cones	☐ yes	☐ n/a
Required PPE	☐ yes	☐ n/a	Required Permits, Passes, Keys, etc.	☐ yes	☐ n/a
Required Monitoring / Instruments	☐ yes	☐ n/a	Decon Procedures / IDW Mgmt.	☐ yes	☐ n/a
Site Control / Work Zones / Security	☐ yes	☐ n/a	Eqpmt. Inspections/Safety Checklists	☐ yes	☐ n/a

OTHER/COMMENTS:

Safety Meeting Attendees

Print Name	**Signature**
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

Safety Meeting Leader

______________________	______________________
Name of Meeting Leader	**Signature**

OP 556 - Project Safety Inspections

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Project Safety Inspection Report

Project Name:		**Inspection Date:**	
Project Number:		**Inspector/SSHO:**	
Project Manager:		**Client:**	

Site Safety Plan	**YES**	**NO**	**NA**
1. Is a site safety plan posted on site or accessible to all employees?	☐	☐	☐
2. Have potential hazards been described to employees on site?	☐	☐	☐
3. Are manufacturer safety data sheets available for review by employees on site?	☐	☐	☐
4. Is there a designated SSHO on site?	☐	☐	☐
5. Are employees aware and knowledgeable of the results of potential exposures?	☐	☐	☐
Site Posters	**YES**	**NO**	**NA**
Are the following documents posted in a prominent and accessible area?			
6. Cabrera Safety Policy and Guiding Principles	☐	☐	☐
7. OSHA Job Safety and Health Protection (or state-OSHA equivalent)	☐	☐	☐
8. Equal Employment Opportunity	☐	☐	☐
Medical and First Aid	**YES**	**NO**	**NA**
9. Are first aid kits accessible and identified?	☐	☐	☐
10. Are emergency eye wash and safety showers available?	☐	☐	☐
11. Are daily logs for first aid present and up to date?	☐	☐	☐
12. Are first aid kits inspected weekly?	☐	☐	☐
Site Set Up	**YES**	**NO**	**NA**
13. Are work zones clearly defined?	☐	☐	☐
14. Are support trailers located to minimize exposure from a potential release?	☐	☐	☐
15. Is general housekeeping up to Cabrera standards?	☐	☐	☐
Personal Protective Equipment	**YES**	**NO**	**NA**
16. Have levels of personal protection been established?	☐	☐	☐
17. Do all employees know their level of protection?	☐	☐	☐
18. Are respirators used, decontaminated, inspected, and stored according to standard procedures?	☐	☐	☐
19. Have employees been fit-tested?	☐	☐	☐
20. Is defective personal protective equipment tagged?	☐	☐	☐
21. Does compressed breathing air meet CGA grade "D" minimum?	☐	☐	☐
22. Are there sufficient quantities of safety equipment and repair parts?	☐	☐	☐
Fire Prevention	**YES**	**NO**	**NA**
23. Is smoking prohibited in flammable storage areas?	☐	☐	☐
24. Are fire lanes established and maintained (where applicable?)	☐	☐	☐
25. Are flammable dispensing systems grounded and bonded?	☐	☐	☐
26. Are proper receptacles available for storage of flammables?	☐	☐	☐
27. Has the local fire department been contacted to inform of work ops?	☐	☐	☐
Welding and Cutting	**YES**	**NO**	**NA**
28. Are fire extinguishers present at welding and cutting operations?	☐	☐	☐
29. Are confined spaces, such as, tanks, pipelines, and trenches, tested prior to cutting and welding operations?	☐	☐	☐
30. Are hot work permits available?	☐	☐	☐
31. Are proper helmets, aprons & gloves available for welding/cutting ops?	☐	☐	☐
32. Are welding and machines properly grounded?	☐	☐	☐
33. Are oxygen and fuel gas cylinders stored a minimum of 20 feet apart?	☐	☐	☐
34. Are only trained personnel permitted to operate welding/cutting equipment?	☐	☐	☐
Hand And Power Tools	**YES**	**NO**	**NA**
35. Are defective hand and power tools tagged and taken out of service?	☐	☐	☐
36. Is eye protection available and used when operating power tools?	☐	☐	☐
37. Are guards and safety devices in place on power tools?	☐	☐	☐
38. Are power tools inspected before each use?	☐	☐	☐
39. Are non-sparking tools available?	☐	☐	☐

OP 556 - Project Safety Inspections

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Project Safety Inspection Report

Motor Vehicles	YES	NO	NA
40. Are vehicles inspected before each use?	☐	☐	☐
41. Are personnel licensed for the equipment they operate?	☐	☐	☐
42. Are unsafe vehicles tagged and reported to supervision?	☐	☐	☐
43. Are vehicles shut down before fueling?	☐	☐	☐
44. When backing vehicles, are spotters provided (when necessary)?	☐	☐	☐
Emergency Plans	**YES**	**NO**	**NA**
45. Are emergency telephone numbers posted?	☐	☐	☐
46. Have emergency escape routes been designated?	☐	☐	☐
47. Are employees familiar with site-specific emergency signals?	☐	☐	☐
Materials Handling	**YES**	**NO**	**NA**
48. Are materials stacked and stored as to prevent sliding or collapsing?	☐	☐	☐
49. Are flammables and combustibles stored in non-smoking areas?	☐	☐	☐
50. Is machinery braced when personnel are performing maintenance?	☐	☐	☐
51. Are tripping hazards labeled?	☐	☐	☐
52. Are semi-trailers chocked?	☐	☐	☐
53. Are fixed jacks used under semi-trailers?	☐	☐	☐
54. Are riders prohibited on materials handling equipment?	☐	☐	☐
55. Are cranes inspected as prescribed and logged?	☐	☐	☐
56. Are OSHA-approved manlifts provided for the lifting of personnel?	☐	☐	☐
57. Are all containers labeled as to contents?	☐	☐	☐
58. Are flammable liquids stored in approved safety cans?	☐	☐	☐
Hazardous Waste/Environmental Compliance	**YES**	**NO**	**NA**
59. Are hazardous wastes stored in DOT approved containers?	☐	☐	☐
60. Is hazardous waste stored in a secure area?	☐	☐	☐
61. Are hazardous waste containers labeled and dated?	☐	☐	☐
62. Are waste container dates outdated?	☐	☐	☐
63. Is a contingency plan on file?	☐	☐	☐

64. Is there a preparedness and prevention plan in effect?	☐	☐	☐
65. Are warning signs posted where required?	☐	☐	☐
66. Have the project's environmental hazards been assessed?	☐	☐	☐
67. Has a reg. permit needs assessment been completed for the project?	☐	☐	☐
Fire Protection	**YES**	**NO**	**NA**
68. Has a fire warning system been established?	☐	☐	☐
69. Do employees know the location and use of all fire extinguishers?	☐	☐	☐
70. Are fire extinguishers marked and inspected weekly?	☐	☐	☐
71. Are combustible materials segregated from open flames?	☐	☐	☐
Electrical	**YES**	**NO**	**NA**
72. Are warning signs exhibited on high voltage equipment (>250 V)?	☐	☐	☐
73. Is electrical equipment and wiring properly guarded?	☐	☐	☐
74. Are electrical lines, extension cords, and cables guarded and maintained in good condition?	☐	☐	☐
75. Are extension cords kept out of wet areas?	☐	☐	☐
76. Is damaged electrical equipment tagged and taken out of service?			
77. Have underground electrical lines been identified by proper authorities?	☐	☐	☐
78. Has a positive lock-out system been established by the project electrician?	☐	☐	☐
Slings And Chains	**YES**	**NO**	**NA**
79. Are damaged slings, chains, and rigging tagged and taken out of service?	☐	☐	☐
80. Are slings inspected before each use?	☐	☐	☐
81. Are slings padded or protected from sharp comers?	☐	☐	☐
82. Do employees keep clear of suspended loads?	☐	☐	☐
Compressed Gas Cylinders	**YES**	**NO**	**NA**
83. Are breathing air cylinders charged only to prescribed pressures?	☐	☐	☐
84. Are like cylinders segregated in well ventilated areas?	☐	☐	☐

OP 556 - Project Safety Inspections

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Project Safety Inspection Report

85. Is smoking prohibited in cylinder storage areas?	☐	☐	☐
86. Are cylinders stored secure and upright?	☐	☐	☐
87. Are cylinders protected from snow, rain, etc.?	☐	☐	☐
88. Are cylinder caps in place before cylinders are moved?	☐	☐	☐
89. Are fuel, gas, and O2 cylinders stored a min. of 20 feet apart?	☐	☐	☐
Ladders and Scaffolding	**YES**	**NO**	**NA**
90. Are ladders/scaffolds placed on a flat, firm surface?	☐	☐	☐
91. Are ladders/scaffolds planks free of mud, ice, grease, etc.?	☐	☐	☐
92. Are ladders/scaffolding inspected before each use?	☐	☐	☐
93. Are defective ladders or scaffold parts taken out of service?	☐	☐	☐
94. Does scaffold height exceed 4 times the width or base dimension?	☐	☐	☐
95. Does scaffold planking overlap a minimum of 12 inches?	☐	☐	☐
96. Does scaffold planking extend over end supports 6" to 18"?	☐	☐	☐
Walking and Working Surfaces	**YES**	**NO**	**NA**
97. Are access ways, stairways, ramps, and ladders clean of ice, md, snow or debris?	☐	☐	☐
98. Do ladders exceed maximum lengths?	☐	☐	☐
99. Are ladders used in passageways, doors, or driveways?	☐	☐	☐
100. Are broken or damaged ladders tagged and taken out of service?	☐	☐	☐
101. Are metal ladders prohibited in electrical service?	☐	☐	☐
102. Are stairways and floor openings guarded?	☐	☐	☐
103. Are safety feet installed on straight and extension ladders?	☐	☐	☐
104. Is general housekeeping up to Cabrera standards?	☐	☐	☐
105. Are support trailers accessible for emergency vehicles?	☐	☐	☐
106. Is the site properly secured during and after work hours?	☐	☐	☐
Heavy Equipment	**YES**	**NO**	**NA**
107. Is heavy equipment inspected as recommended by the manufacturer?	☐	☐	☐
108. Is defective heavy equipment tagged and taken out of service?	☐	☐	☐
109. Are project roads and structures inspected for load capacities and proper clearances?	☐	☐	☐
110. Is heavy equipment shut down for fueling and maintenance?	☐	☐	☐

Excavation	**YES**	**NO**	**NA**
111. Are the sides of excavations sloped or shored to properly?	☐	☐	☐
112. Are guardrails or fences placed around excavations, near pedestrian or vehicle thoroughfares?	☐	☐	☐
113. Prior to opening excavations, are utilities located and marked?	☐	☐	☐
114. Are ladders used in trenches over 4 feet deep (when entered)?	☐	☐	☐
115. Is material excavated placed a minimum of 3 ft from the trench?	☐	☐	☐
Confined Spaces	**YES**	**NO**	**NA**
116. Have employees scheduled to be part of the confined space entry team been trained to the level of their responsibilities?	☐	☐	☐
117. Are confined space permits available on project site?	☐	☐	☐
118. Is a confined space entry procedure on the project site?	☐	☐	☐
Personnel Decontamination	**YES**	**NO**	**NA**
119. Are decontamination stations set up in the site contamination reduction zone(s)?	☐	☐	☐
120. Are waste receptacles available for contaminated clothing / PPE?	☐	☐	☐
121. Are steps taken to contain liquids used for decontamination?	☐	☐	☐
122. Have decontamination steps and procedures been covered by the site supervisor or acting site safety officer?	☐	☐	☐
123. Are personnel using utility knives or FOBKs to doff PPE?	☐	☐	☐
124. Is all personal protective equipment and respiratory equipment being cleaned on a daily basis (when applicable)?	☐	☐	☐

Inspection Summary

Comments:

I have reviewed this inspection checklist with the safety inspector/SSHO, fully understand the recommendations and will make every attempt to immediately implement the appropriate corrective actions:

______________________________ ______________

Project/Field Site Manager Date

OP 583 - Excavation & Trenching

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Excavation Inspection Form

Designated Competent Person must inspect/document excavation prior to beginning work, after a rain event, and as needed throughout the shift.

Project Name:	**Project Number:**	**Project Location:**

Date:	**Inspection Completed By:**

Excavation Information:

Soil Type:	**Excavation Depth**:	**Excavation Width:**

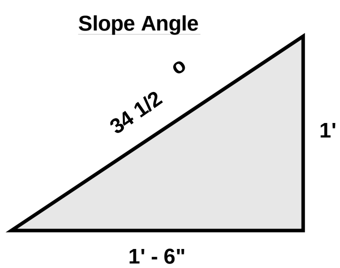
Type of Protective System Used:

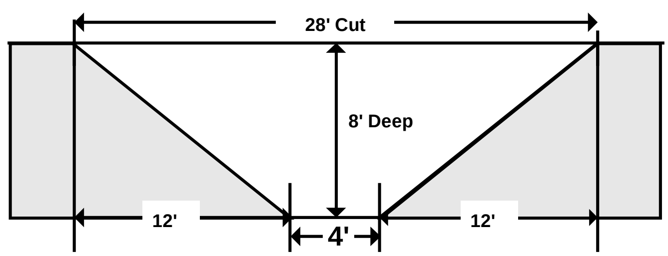
1. General Information:	**Yes**	**No**	**N/A**
A. Is excavation less than five feet in depth?	☐	☐	☐
B. Is there a potential for a cave-in? ***IF YES, excavation must be sloped, shored, or shielded.**	☐	☐	☐
C. Is excavation deeper than 5 feet? *** IF YES, excavation must be sloped, shored, or shielded.**	☐	☐	☐
D. Is sloping used as your protective system?	☐	☐	☐
E. 1- Manual & 1- Visual Method utilized to determine Soil Classification as A-B-C (select one: Y=A, N=B, N/A=C)	☐	☐	☐

Manual Test Method Used: ☐ Plasticity ☐ Dry Strength ☐ Thumb Penetration ☐ Dry Testing ☐ Pocket Penetrometer

Visual Characteristics: ☐ Cemented ☐ Cohesive ☐ Dry ☐ Fissured ☐ Granular ☐ Layered ☐ Moist ☐ Plastic ☐ Saturated ☐ Submerged ☐ Surface cracking ☐ Undercut

Slope information to keep in mind:





Example of a Simple 34-degree Slope commonly used around the site for cave-in protection.

2. Surface Conditions	**Yes**	**No**	**N/A**
A. Surface encumbrances removed or supported.	☐	☐	☐
B. Individuals protected from loose rock/soil that may pose a hazard by falling/rolling into excavation.	☐	☐	☐
C. Hard hats, safety-toed boots, and safety glasses worn by all individuals.	☐	☐	☐
D. High visible vest (Class 2 or 3) worn by all individuals. Vest required around heavy equipment.	☐	☐	☐
E. Spoils, materials, and equipment set back at least 3 feet from the edge of the excavation.	☐	☐	☐
F. Adequate barriers provided at all excavations, wells, pits, shafts, etc.	☐	☐	☐
G. Individuals are required to stand away from vehicles being loaded or unloaded.	☐	☐	☐
H. Warning system established and utilized when mobile equipment is operating near the edge of the excavation (e.g., barricade tape, signalpersons, stop logs, etc).	☐	☐	☐
I. Individuals prohibited from going under suspended loads.	☐	☐	☐

3. Utilities	Yes	No	N/A
A. Location of utilities marked.	☐	☐	☐
B. Prior to the use of equipment, underground utilities have been located by hand digging and exposed.	☐	☐	☐
C. Underground utilities are protected, supported, or removed when excavation is open.	☐	☐	☐
4. Means of Access and Egress:	**Yes**	**No**	**N/A**
A. Travel distance to means of egress no greater than 25 feet in excavations 4 feet or more in depth.	☐	☐	☐
B. Straight ladders used in excavations extend at least 3 feet above the edge of the trench.	☐	☐	☐
C. Ramps being used for employee access have been designed by the competent person.	☐	☐	☐
D. All individuals are protected from cave-ins when entering or exiting the excavation.	☐	☐	☐
5. Wet Conditions:	**Yes**	**No**	**N/A**
A. Precautions have been taken to protect individuals from the accumulation of water.	☐	☐	☐
B. Water removal equipment monitored by a competent person.	☐	☐	☐
C. Surface water or runoff is diverted or controlled to prevent accumulation in the excavation.	☐	☐	☐
D. Inspections have been made after every rainstorm or other hazard-increasing occurrence (freeze/thaw, local demolition, rerouting of traffic, etc).	☐	☐	☐
6. Hazardous Atmosphere:	**Yes**	**No**	**N/A**
A. Are there exposed sewer or natural gas lines in excavation?	☐	☐	☐
B. Is excavation near a landfill, or are hazardous substances being stored close to the excavation?	☐	☐	☐
If you answered YES to A or B, then treat the excavation as a confined space. **OP 582 *Confined Spaces***			
C. All individuals will contact the Fire/Rescue Group at prior to entry and in case of emergencies.			
7. Support Systems:	**Yes**	**No**	**N/A**
System Manufacturer:	System Type:		
A. Tabulated Data for system on-site?	☐	☐	☐
B. Materials/equipment for support systems selected based on soil analysis, trench depth, and expected loads.	☐	☐	☐
C. Materials/equipment used for protective systems have been inspected and are in good condition.	☐	☐	☐
D. Protective systems installed without exposing all individuals to the hazards of cave-ins, collapses, or the threat of being struck by materials or equipment.	☐	☐	☐
E. Members of support system are securely fastened to prevent failure.	☐	☐	☐
F. Support systems are provided to ensure stability of adjacent structures (buildings, roadways, sidewalks, etc.)	☐	☐	☐
G. Excavations below the level of the base of a footing have been approved by a registered PE.	☐	☐	☐
H. Removal of support systems progresses from the bottom (members released slowly to note indication of possible failure).	☐	☐	☐
I. Backfilling progresses with the removal of support system.	☐	☐	☐
J. Material excavated to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.	☐	☐	☐
K. A shield system has been placed to prevent lateral movement.	☐	☐	☐
M. All individuals are prohibited from remaining in the shield system during vertical movement.	☐	☐	☐
8. Training:	**Yes**	**No**	**N/A**
A. All individuals have had Excavation Safety Awareness Training.	☐	☐	☐

OP 584 - Heavy Equipment Operations

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

Heavy Equipment Inspection Form

Competent Person must inspect/document equipment when it is put into service, using this form. Equipment must be inspected prior to each use by the operator.

Project Name:	Project Number:	Project Location:
Operator:	**Make/Model:**	

Week of:	Monday			Tuesday			Wednesday			Thursday			Friday		
Hour meter reading:															
Check the following as appropriate	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**	**SAT**	**UNSAT**	**N/A**
1. Operator qualified	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Overhead guard (ROPS)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Horn	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Lights	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Parking brake	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Service brakes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Steering	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8. Oil level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Hydraulic oil level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Radiator fluid level	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. Major fluid leaks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Windows	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Backup alarm	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
14. Tires (visual)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. Seat belts	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
16. Fuel leaks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
17. Fire extinguisher	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
18. Fuel lines secure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
19. Electrical lines	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
20. Exhaust components	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments/Remarks:

OP 590 - Elevated Work Platforms

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

EWP Inspection Form

EWP Operator must inspect/document equipment daily, using this form.

Project Name:	**Project Number:**	**Date:**
Operator:	**Make/Model:**	

Inspection

EWP Inspection	**Satisfactory**	**Unsatisfactory**	**N/A**
General appearance (hood, paint, undercarriage)	☐	☐	☐
Tires (adequate tread)	☐	☐	☐
Batteries (tie-downs in place, corroded, leaking)	☐	☐	☐
Hydraulic Oil Levels	☐	☐	☐
Engine Oil Levels	☐	☐	☐
Coolant Levels	☐	☐	☐
Structural Arms (welds and paint condition)	☐	☐	☐
Chain properly lubricated	☐	☐	☐
Outriggers deployed and stable	☐	☐	☐
Basket in sound condition (toe boards, flooring)	☐	☐	☐
Guardrails intact, swing gate functional	☐	☐	☐
Controls properly marked/labelled and functional	☐	☐	☐
Ground controls (emergency override) functional	☐	☐	☐
Motion Alarm functional	☐	☐	☐
Fire Extinguisher (min 5 lbs B:C)	☐	☐	☐
Operators manual present	☐	☐	☐
Utilities			
Safe distance from overhead lines (min 10 feet)	☐	☐	☐
Work Area			
Work zone demarcated and barriers erected	☐	☐	☐
Non-essential personnel behind barriers	☐	☐	☐
Area clear of obstructions, holes, uneven surfaces	☐	☐	☐
Travel routes clear and demarcated	☐	☐	☐
Overhead obstructions marked	☐	☐	☐
Personal Protective Equipment			
Fall protection (harness and lanyard) available and in use	☐	☐	☐
Anchorage points intact	☐	☐	☐

Comments:

Attachment D
Material Safety Data Sheets

HNU SYSTEMS INC -- ISOBUTYLENE SPAN GAS, SEE SUPP DATA -- 6665-01-214-8247
==================== Product Identification ====================

Product ID:ISOBUTYLENE SPAN GAS, SEE SUPP DATA
MSDS Date:12/08/1987
FSC:6665
NIIN:01-214-8247
MSDS Number: BJDVR
=== Responsible Party ===
Company Name:HNU SYSTEMS INC
Address:160 CHARLEMONT ST
City:NEWTON HIGHLANDS
State:MA
ZIP:02161
Country:US
Info Phone Num:617/964-6690
Emergency Phone Num:800/841-4357
CAGE:57631
=== Contractor Identification ===
Company Name:HNU SYSTEMS INC
Address:160 CHARLEMONT ST
Box:City:NEWTON HIGHLANDS
State:MA
ZIP:02161
Country:US
Phone:617/964-6690
CAGE:57631

============= Composition/Information on Ingredients =============

Ingred Name:ISOBUTYLENE
CAS:115-11-7
RTECS #:UD0890000
Fraction by Wt: 0.01%

==================== Hazards Identification ====================

LD50 LC50 Mixture:NONE SPECIFIED BY MANUFACTURER.
Routes of Entry: Inhalation:YES Skin:NO Ingestion:NO
Reports of Carcinogenicity:NTP:NO IARC:NO OSHA:NO
Health Hazards Acute and Chronic:ISOBUTYLENE IS A SIMPLE ASPHYXIANT;
MODERATE CONCENTRATION IN AIR CAUSE UNCONSCIOUSNESS. CONTACT
W/LIQUID CAUSES FROSTBITE.
Explanation of Carcinogenicity:NOT RELEVANT
Effects of Overexposure:SEE HEALTH HAZARDS.
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

====================== First Aid Measures ======================

First Aid:IF BREATHED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS
DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED, GIVE
ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET; GET MEDICAL
ATTENTION.

==================== Fire Fighting Measures ====================

Flash Point Method:CC
Flash Point:-76 C OR -105 F
Lower Limits:1.8%
Upper Limits:9.6%
Extinguishing Media:CO2 OR DRY CHEMICAL
Fire Fighting Procedures:STOP FLOW OF ISOBUTYLENE IF POSSIBLE. USE
WATER SPRAY TO COOL SURROUNDING CONTAINERS.
Unusual Fire/Explosion Hazard:ISOBUTYLENE IS HEAVIER THAN AIR MAY
TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION. SHOULD FLAME BE
EXTINGUISHED AND FLOW OF GAS CONTINUE SEE SUPP DATA.

================== Accidental Release Measures ==================

Spill Release Procedures:NONE SPECIFIED BY MANUFACTURER.
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

====================== Handling and Storage ======================

Handling and Storage Precautions:STORE AWAY FROM HEAT AND PROTECT
CYLINDERS FROM PHYSICAL DAMAGE.
Other Precautions:DO NOT PUNCTURE CYLINDER.

============= Exposure Controls/Personal Protection =============

Respiratory Protection:POSITIVE PRESSURE AIR LINE OR SCBA FOR EMERGENCY
USE.
Ventilation:HOOD W/FORCED VENTILATION TO PREVENT ACCUMULATION ABOVE
LEL.
Protective Gloves:PLASTIC OR RUBBER.
Eye Protection:SAFETY GOGGLES OR GLASSES.
Other Protective Equipment:SAFETY SHOES, SAFETY SHOWER, EYEWASH
FOUNTAIN.
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
MFR PART NO, TRADE NAME:CALIBRATION GAS 101- 350-N, DC102573.EXPLO
HAZ:INCREASE VENTILATION TO PREVENT FORMATION OF FLAMMABLE MIXTURE
IN LOW AREAS/POCKETS. NOTE:DATA GIVEN FOR PURE ISOBUTLENE. CYLINDE
R OF HNU SPAN GAS/ISOBUTYLENE CALIBRATION GAS CONTAINS 100 PPM IN
ZERO AIR OR 0.01% ISOBUTYLENE IN AIR.

================== Physical/Chemical Properties ==================

Boiling Pt:B.P. Text:19.6F,-6.9C
Melt/Freeze Pt:M.P/F.P Text:-221F,-140C
Vapor Pres:@20C 24SIG
Vapor Density:1.95
Spec Gravity:0.59
Solubility in Water:UNAVAILABLE
Appearance and Odor:CLEAR UNPLEASANT ODOR SIMILAR TO COAL GAS

================= Stability and Reactivity Data =================

Stability Indicator/Materials to Avoid:YES
OXIDIZERS.

Stability Condition to Avoid:NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomposition Products:NONE

==================== Disposal Considerations ====================

Waste Disposal Methods:DISPOSAL MUST BE I/A/W FED, STATE AND LOCAL REGULATIONS.

Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever, expressly or implied, warrants this information to be accurate and disclaims all liability for its use. Any person utilizing this document should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation.

MSDS Number: **N3659** * * * * * *Effective Date:* ***11/02/01*** * * * * * *Supercedes:* ***10/15/99***

NITRIC ACID 1.0 N AND 2.0 N VOLUMETRIC SOLUTIONS

1. Product Identification

Synonyms: Azotic acid solution; nitric acid 6.3%; nitric acid 1.0 N volumetric solution; nitric acid 2.0 N volumetric solution; nitric acid 12.6%
CAS No.: 7697-37-2
Molecular Weight: 63.00
Chemical Formula: HNO_3 in H_2O
Product Codes:
J.T. Baker: 5639
Mallinckrodt: 3510

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	6 - 13%	Yes
Water	7732-18-5	> 87%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Oxidizer)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Yellow (Reactive)

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.
Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

---

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes

before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.
Explosion:
May react explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.
Fire Extinguishing Media:
If involved in a fire, use water spray.
Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Nitric Acid:
OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4 ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). Nitric acid is an oxidizer and should not come in contact with cartridges and canisters that contain oxidizable materials, such as activated charcoal. Canister-type respirators using sorbents are ineffective.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Suffocating, acrid.
Solubility:
Infinitely soluble.
Specific Gravity:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.
Conditions to Avoid:
Heat and incompatibilities.

---

11. Toxicological Information

For Nitric Acid: Investigated as a mutagen and reproductive effector.

```
--------\Cancer Lists\------------------------------------------------------
                                         ---NTP Carcinogen---
Ingredient                               Known    Anticipated    IARC Category
------------------------------------     -----    -----------    -------------
Nitric Acid (7697-37-2)                   No          No             None
Water (7732-18-5)                         No          No             None
```

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH NOT MORE THAN 70% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------------------------------

Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------------------------------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: Yes         (Mixture / Liquid)
```

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0** Other: **Oxidizer**
Label Hazard Warning:
POISON! DANGER! OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Store in a tightly closed container.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Material Safety Data Sheet
(MSDS-HCL)

PRODUCT IDENTIFICATION	
Product Name	Hydrochloric Acid Solution 20 Deg. Be – 31.5% 22 Deg. Be – 35.2%
Trade Names and Synonyms	Hydrogen Chloride (Aqueous) Muriatic Acid
Manufacturer/Distributor	Trans Chem, Inc. 1415 Mengel Road Baton Rouge, Louisiana 70807 (504) 355-9977 Various others
Transportation Emergency	**800-255-3924 (24 hrs -- *CHEM • TEL*)**

HAZARDOUS COMPONENTS			
Material or Component	**CAS No.**	**TLV**	**PEL**
Hydrochloric Acid	7647-01-0	$7mg/m^3$	5PPM
N/A = Not assigned NE = Not established			

PHYSICAL DATA	
Boiling Point	127° F
Vapor Pressure	24mm Hg – 20 Deg. Be 100mm Hg – 22 Deg. Be
Solubility in Water	Complete
Specific Gravity	1.16 @ 15.5° C 20 Deg. Be 1.1789 @ 15.5° C 22 Deg. Be
Melting Point	N/A
Vapor Density	Similar to Water
Evaporation Rate	Not Applicable
Appearance and Odor	Clear Colorless to Yellowish Fuming Liquid, Pungent and Irritating

HAZARDOUS REACTIVITY
Stable under ordinary conditions of use and storage. Does not polymerize. Incompatible with aluminum and aluminum alloys, carbon steel, copper and copper alloys, and nylon. Hydrogen gas will be formed if acid contacts metal.

FIRE AND EXPLOSION DATA	
Flashpoint	Not Flammable
Extinguishing Media	Use any means suitable for extinguishing surrounding fire.
Decomposition Products	Contact with most metals may produce Hydrogen gas to potentially explosive limits.
Unusnal Explosion	Containers may explode when heated. Consult the 2000 Emergency Response Guidebook, Guide 157 for further details.

HEALTH HAZARDS / FIRST AID	
Inhalation	Inhalation causes severe irritation of upper respiratory tract. FA: Remove person to to fresh air. If not breathing, give artificial respiration. Call physician.
Ingestion	CORROSIVE ! Ingestion of Hydrochloric Acid can cause burns of the mouth, throat, esophagus and gastrointestinal tract. FA: DO NOT INDUCE VOMITING. Give large quantities of water or milk of magnesia. Never give anything by mouth to an unconscious person. Get immediate medical attention.
Skin Contact	CORROSIVE ! Can cause redness, pain and skin burns. Can cause some tissue destruction. FA: Immediately flush with water.
Eye Contact	CORROSIVE ! FA: Continuously flush eyes with large amounts of water for at least 20 minutes. If irritation continues, seek medical attention.

SPILL OR LEAK PROCEDURES	
Spill/leak	In the event of a spill or leak, keep upwind. Ventilate enclosed areas until spill or leak is contained, neutralized and prepared for removal.
Waste disposal	Disposal of waste material or residue may be subject to federal, state, or local regulation. Before transporting waste material see 49 CFR 172.

SPECIAL PROTECTION INFORMATION	
Ventilation	Use only in areas with adequate ventilation.
Eye Protection	Use chemical safety goggles, plus a safety shield is recommended. Contact lenses should not be worn when working with this material.
Skin Protection	Wear impervious protective clothing; i.e., Boots, Gloves, Lab Coat, Apron or Coveralls to prevent skin contact.
Other	If working in an area of potential exposure, use an NIOSH approved respirator when material is fuming and exceeds the TLV.

STORAGE CONDITIONS
Store and handle only in containers suitably lined with or constructed of materials specified, by the manufacturer, for the product. Protect against physical damage. Keep separated from incompatible materials.

REGULATORY INFORMATION	
Proper shipping name	Hydrochloric acid
Hazard class	8
UN Number	UN1789
DOT Label & Placard	Corrosive
NFPA / HMIS Ratings	Health – 3; Flammability – 0; Reactivity – 0
SARA Title III	Reporting Sections 302, 311 & 313

The information contained in this Material Safety Data Sheet is based upon available data and believed to be correct; however, as such has been obtained from various sources, including the manufacturer and independent laboratories, it is given without warranty or representation that it is complete, accurate, and can be relied upon. *OWEN COMPLIANCE SERVICES, INC.* has not attempted to conceal in any manner the deleterious aspects of the product listed herein, but makes no warranty as to such. Further, *OWEN COMPLIANCE SERVICES, INC.* cannot anticipate nor control the many situations in which the product or this information may be used; there is no guarantee that the health and safety precautions suggested will be proper under all conditions. It is the sole responsibility of each user of the product to determine and comply with the requirements of all applicable laws and regulations regarding its use. This information is given solely for the purposes of safety to persons and property. Any other use of this information is expressly prohibited.

For further information contact:

David W. Boston, President
OWEN COMPLIANCE SERVICES, INC.
8805 Forum Way
P.O. Box 40150
Fort Worth, TX 76140
Telephone number: 817-551-0660
FAX number: 817-551-1032

MSDS prepared by:

Allen M. Sweeney
Original publication date: 8/5/1999
Revision date 11/2/00

CITGO No. 1 Diesel Fuel, All Grades

Material Safety Data Sheet

CITGO Petroleum Corporation
P.O. Box 3758
Tulsa, OK 74102-3758

MSDS No. AG1DF

Revision Date 03/20/2003

IMPORTANT: Read this MSDS before handling or disposing of this product and pass this information on to employees, customers and users of this product.

Emergency Overview

Physical State	Liquid.		
Color	Clear to light amber.	**Odor**	Characteristic, kerosene-like.

WARNING!
Combustible liquid; vapor may cause flash fire.
Harmful or fatal if swallowed - can enter lungs and cause damage.
Mist or vapor can irritate the respiratory tract.
Liquid contact can cause eye or skin irritation.
May be harmful if inhaled or absorbed through the skin.
Overexposure can cause central nervous system (CNS) depression and/or other target organ effects.
Diesel engine exhaust can cause upper respiratory tract irritation and reversible pulmonary effects.
Spills may create a slipping hazard.

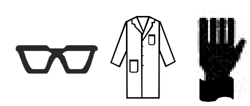
Hazard Rankings

		HMIS	NFPA
Health Hazard	*	1	0
Fire Hazard		2	2
Reactivity		0	0

*** = Chronic Health Hazard**

Protective Equipment

Minimum Recommended
See Section 8 for Details



SECTION 1: IDENTIFICATION

Trade Name	CITGO No. 1 Diesel Fuel, All Grades	**Technical Contact**	(918) 495-5940 or (918) 495-5933
Product Number	Various	**Medical Emergency**	(918) 495-4700
CAS Number	8008-20-6	**CHEMTREC Emergency (United States Only)**	(800) 424-9300
Product Family	Fuels.		
Synonyms			

SECTION 2: COMPOSITION

This product may be composed, in whole or in part, of any of the following refinery streams:

Kerosene [CAS No.: 8008-20-6]
Hydrodesulfurized Kerosine (Petroleum) [CAS No.: 64742-81-0]
Hydrodesulfurized Middle Distillate (petroleum) [CAS No.: 64742-80-9]
Straight-run Middle Distillate (Petroleum) [CAS No.: 64741-44-2]
Hydrodesulfurized Light Catalytic Cracked Distillate (Petroleum) [CAS No.: 68333-25-5]
Light Catalytic Cracked Distillate (Petroleum) [CAS No.: 64741-59-9]

This product contains the following chemical components:

Component Name(s)	CAS Registry No.	Concentration (%)

1) Nonane, all isomers	Mixture.	20 - 30
2) Ethylmethylbenzenes (Ethyltoluenes)	25550-14-5	1 - 3
3) Naphthalene	91-20-3	0 - 3
4) Trimethylbenzenes, all isomers	25551-13-7	0 - 2
5) Biphenyl (Diphenyl)	92-52-4	0 - 2
6) Ethylbenzene	100-41-4	0 - 1
7) Xylene, all isomers	1330-20-7	0 - 1
8) 1, 2, 4 Trimethylbenzene	95-63-6	0 - 1
9) Cumene	98-82-8	0 - 1

SECTION 3: HAZARDS IDENTIFICATION

Also see Emergency Overview and Hazard Ratings on the top of Page 1 of this MSDS.

Major Route(s) of Entry Skin contact. Eye contact. Inhalation.

Signs and Symptoms of Acute Exposure

Inhalation

Breathing mist or vapors concentrations well above occupational exposure levels can irritate the mucous membranes of the nose, throat, bronchi, and lungs, and may cause transient central nervous system (CNS) depression. CNS symptoms include headache, dizziness, nausea, intoxication, blurred vision, slurred speech, flushed face, confusion, weakness, fatigue, loss of consciousness, convulsions, coma, and death, depending on the concentration and/or duration of exposure.

Eye Contact

This product can cause eye irritation with short-term contact with liquid, mists or vapor. Symptoms include stinging, watering, redness, and swelling. In severe cases, permanent eye damage can result.

Skin Contact

Animal test results on similar materials suggest that this product can cause moderate to severe skin irritation. Short-term contact symptoms include redness, itching, and burning of the skin. Also, certain components of this material may be absorbed through the skin and produce CNS depression effects (see "Inhalation" above). If the skin is damaged, absorption increases. Prolonged and/or repeated contact may cause severe dermatitis and/or more serious skin disorders. Chronic symptoms may include drying, swelling, scaling, blistering, cracking, and/or severe tissue damage.

Ingestion

If swallowed, this material may irritate the mucous membranes of the mouth, throat, and esophagus. It can be readily absorbed by the stomach and intestinal tract. Symptoms include a burning sensation of the mouth and esophagus, nausea, vomiting, dizziness, staggering gait, drowsiness, loss of consciousness, and delirium, as well as additional central nervous system (CNS) effects (see "Inhalation" above).

Due to its light viscosity, there is a danger of aspiration into the lungs during vomiting. Aspiration of a small amount of liquid can cause severe pulmonary edema and lipoid or chemical pneumonia which can result in death. Progressive CNS depression, respiratory insufficiency, and ventricular fibrillation may also result in death.

Chronic Health Effects Summary

Secondary effects of ingestion and subsequent aspiration into the lungs may cause pneumatocele (lung cavity) formation and chronic lung dysfunction.

This product contains petroleum middle distillates similar to those shown to produce skin tumors on laboratory rodents following repeated application. All tumors appeared during the latter portion of the typical 2-year lifespan of the animals. Certain studies have shown that washing the animal's exposed skin with soap and water between treatments greatly reduces the potential tumorigenic effects. These effects are unlikely to occur if good personal hygiene is practiced.

This material and/or its components have been associated with developmental and/or reproductive toxicity, genotoxicity, immunotoxicity, and carcinogenicity. Refer to Section 11 of this MSDS for additional health-related information.

Conditions Aggravated by Exposure

Medical conditions aggravated by exposure to this material may include skin disorders, chronic respiratory diseases, neurological conditions, liver or kidney dysfunction.

Target Organs

This material may cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eyes, central nervous system (CNS).

Carcinogenic Potential

This material contains ethylbenzene and naphthalene at concentrations at or above 0.1%. Ethylbenzene is considered possibly carcinogenic to humans by IARC. (See Section 11.) NTP has determined that exposure to diesel exhaust particulates, a complex mixture of combustion products of diesel fuel, is reasonably anticipated to be a human carcinogen.

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present, the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA Health Hazard Classification				OSHA Physical Hazard Classification					
Irritant	X	**Toxic**		**Combustible**	X	**Explosive**		**Pyrophoric**	
Sensitizer		**Highly Toxic**		**Flammable**		**Oxidizer**		**Water-reactive**	
Corrosive		**Carcinogenic**		**Compressed Gas**		**Organic Peroxide**		**Unstable**	

SECTION 4: FIRST AID MEASURES

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid. For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

Inhalation
Move victim to fresh air. If victim is not breathing, immediately begin rescue breathing. If breathing is difficult, 100 percent humidified oxygen should be administered by a qualified individual. Seek medical attention immediately. Keep the affected individual warm and at rest.

Eye Contact
Check for and remove contact lenses. Flush eyes with cool, clean, low-pressure water for at least 15 minutes while occasionally lifting and lowering eyelids. Do not use eye ointment unless directed to by a physician. Seek medical attention if excessive tearing, irritation, or pain persists.

Skin Contact
Remove contaminated shoes and clothing. Flush affected area with large amounts of water. If skin surface is damaged, apply a clean dressing and seek medical attention. Do not use ointments. If skin surface is not damaged, clean affected area thoroughly with mild soap and water. Seek medical attention if tissue appears damaged or if pain or irritation persists.

Ingestion
Do not induce vomiting. If spontaneous vomiting is about to occur, place victim's head below knees. If victim is drowsy or unconscious, place on the left side with head down. Never give anything by mouth to a person who is not fully conscious. Do not leave victim unattended. Seek medical attention immediately.

Notes to Physician
Inhalation overexposure can produce toxic effects. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for upper respiratory tract inflammation, bronchitis, and pneumonitis. Vigorous anti-inflammatory/steroid treatment may be required at first evidence of upper airway or pulmonary edema. Administer 100 percent humidified supplemental oxygen with assisted ventilation, as required.

If ingested, this material presents a significant aspiration/lipoid or chemical pneumonitis hazard. As a result, induction of emesis is not recommended. Consider administration of an aqueous slurry of activated charcoal followed by a cathartic such as magnesium citrate or sorbitol. Also, treatment may involve careful gastric lavage if performed soon after ingestion or in patients who are comatose or at risk of convulsing. Protect the airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. If vital signs become abnormal or symptoms develop, obtain a chest x-ray and liver function tests. Antibiotics are indicated if pulmonary bacterial infection occurs. Monitor for cardiac function and arterial blood gases in severe exposure cases.

SECTION 5: FIRE FIGHTING MEASURES

NFPA Flammability Classification	NFPA Class-II combustible liquid.		
Flash Point Method	CLOSED CUP: 38°C (100°F). (Pensky-Martens. (Minimum))		
Lower Flammable Limit	AP 0.7 %	**Upper Flammable Limit**	AP 5 %
Autoignition Temperature	>254°C (489.2°F)		
Hazardous Combustion Products	Carbon dioxide, carbon monoxide, smoke, fumes, unburned hydrocarbons and trace oxides of sulfur and/or nitrogen.		

Special Properties
Combustible Liquid! This material releases vapors when heated above ambient temperatures. Vapors can cause a flash fire. Vapors can travel to a source of ignition and flashback. A vapor and air mixture can create an explosion hazard in confined spaces such as sewers. Use only with adequate ventilation. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media
SMALL FIRE: Use dry chemicals, carbon dioxide, foam, water fog, or inert gas (nitrogen).
LARGE FIRE: Use foam, water fog, or water spray. Water fog and spray are effective in cooling containers and adjacent structures. However, water can cause frothing and/or may not extinguish the fire. Water can be used to cool the external walls of vessels to prevent excessive pressure, autoignition or explosion. DO NOT use a solid stream of water directly on the fire as the water may spread the fire to a larger area.

Protection of Fire Fighters
Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies. Evacuate area and fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles. Cover pooling liquid with foam. Containers can build pressure if exposed to radiant heat; cool adjacent containers with flooding quantities of water until well after the fire is out. Withdraw immediately from the area if there is a rising sound from a venting safety device or discoloration of vessels, tanks, or pipelines. Be aware that burning liquid will float on water. Notify appropriate authorities if liquid enter sewers or waterways.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.

Combustible Liquid! Release can result in a fire hazard. Evacuate all non-essential personnel from release area. Establish a regulated zone with site control and security. Eliminate all ignition sources. Stop the leak if it can done without risk. A vapor-suppressing foam may be used to reduce vapors. Properly bond or ground all equipment used when handling this material. Avoid skin contact. Do not walk through spilled material. Verify that responders are properly trained and wearing appropriate personnel protective equipment. Dike far ahead of a liquid spills. Do not allow released material to entry waterways, sewers, basements, or confined areas. This material will float on water. Absorb or cover with dry earth, sand or other non-combustible material. Use clean, non-sparking tools to collect absorbed material. Place spent sorbent materials, free liquids and other clean-up debris into proper waste containers for appropriate disposal. Certain releases must be reported to the National Response Center (800/424-8802) and state or regulatory authorities. Comply with all laws and regulations.

SECTION 7: HANDLING AND STORAGE

Handling
Combustible Liquid!
A static electrical charge can accumulate when this material is flowing through pipes, nozzles or filters and when it is agitated. A static spark discharge can ignite accumulated vapors particularly during dry weather conditions. Always bond receiving containers to the fill pipe before and during loading. Always keep nozzle in contact with the container throughout the loading process. Do not fill any portable container in or on a vehicle. Special precautions, such as reduced loading rates and increased monitoring, must be observed during "switch loading" operations (i.e., loading this material in tanks or shipping compartments that previously containing gasoline or similar low flash point products).

Fire hazard increases as product temperature approaches its flash point. Use non-sparking tools. Keep container closed and drum bungs in place. Remove spillage immediately from walking areas. Do not handle or store near heat, sparks or other potential ignition sources. Do not handle or store with oxidizing agents. Avoid breathing mist or vapor. Never siphon by mouth. Do not taste or swallow. Avoid contact with eyes, skin and clothing. Use gloves constructed of impervious materials and protective clothing if direct contact is anticipated. Provide ventilation to maintain exposure potential below applicable exposure levels. Avoid water contamination. Wash thoroughly after handling. Prevent contact with food or tobacco products.

Cutting or welding of empty containers can ignite residues with explosive force. Do not pressurize or expose empty containers to flames, sparks or heat. Observe all label warnings and precautions. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product. Return empty drums to a qualified reconditioner. When performing repairs and maintenance on contaminated equipment, keep unnecessary persons from hazard area. Eliminate heat, flame and other potential ignition

 Continued on Next Page

sources. Drain and purge equipment, as necessary, to remove material residues. Remove contaminated clothing. Wash exposed skin thoroughly with soap and water after handling.

Storage

Store in a cool, dry, well-ventilated place. Keep containers tightly closed. Do not store this product near heat, flame or other potential ignition sources. Do not store with oxidizers. Do not store this product in unlabeled containers. Do not puncture or incinerate containers. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers or waste residues of this product. Ground all equipment containing this material. All electrical equipment in areas where this material is stored or handled must meet all applicable requirements of the NFPA's National Electrical Code (NEC). Store and transport in accordance with all applicable laws.

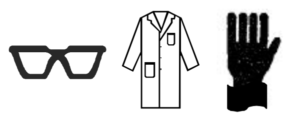
SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor or mists below the applicable workplace exposure limits indicated below. All electrical equipment should comply with the National Electric Code. An emergency eye wash station and safety shower should be located near the work-station.

Personal Protective Equipment

Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required.



Eye Protection

Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. Suitable eye wash water should be readily available.

Hand Protection

Avoid skin contact. Use gloves (e.g., disposable PVC, neoprene, nitrile, vinyl, or PVC/NBR). Wash hands with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities or leaving work. DO NOT use gasoline, kerosene, solvents or harsh abrasives as skin cleaners.

Body Protection

Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discarded contaminated leather goods.

Respiratory Protection

Airborne concentration will determine the level of respiratiory protection required. Respiratory protection is normally not required unless the product is heated or misted. For known or anticipated vapor or mist concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter if adequate protection is provided. For unknown vapor concentrations or concentrations exceeding respirator protection factors, use a positive-pressure, pressure-demand, self-contained breathing apparatus (SCBA). Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 20% of the lower flammable limit under any circumstances. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134).

General Comments

Warning! Use of this material in spaces without adequate ventilation may result in generation of hazardous levels of combustion products and/or inadequate oxygen levels for breathing. Odor is an inadequate warning for hazardous conditions.

Occupational Exposure Guidelines

Substance	**Applicable Workplace Exposure Levels**

 Continued on Next Page

1) Diesel Fuel	**ACGIH TLV (United States).** TWA: 100 mg/m^3
2) Kerosene	**NIOSH** TWA: 100 mg/m^3
3) Nonane, all isomers	**ACGIH (United States).** TWA: 200 ppm
4) Trimethylbenzenes, all isomers	**ACGIH (United States).** TWA: 25 ppm
5) Naphthalene	**ACGIH (United States). Skin** TWA: 10 ppm STEL: 15 ppm **OSHA (United States).** TWA: 10 ppm
6) Biphenyl (Diphenyl)	**ACGIH (United States** TWA: 0.2 ppm **OSHA (United States** TWA: 0.2 ppm

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES (TYPICAL)

Physical State	Liquid.	**Color**	Clear to light amber.	**Odor**	Characteristic, kerosene-like.
Specific Gravity	0.82 (Water = 1)	**pH**	Not Applicable.	**Vapor Density**	4 (Air = 1)
Boiling Range	AP 150º C (AP 302º F)			**Melting/Freezing Point**	Not available.
Vapor Pressure	<0.3 kPa (<2 mmHg) (at 20°C)			**Viscosity (cSt @ 40°C)**	AP 3
Solubility in Water	Very slightly soluble in cold water.			**Volatile Characteristics**	AP 825 g/l VOC (W/V)
Additional Properties	Density = AP 6.8 lbs/gal.; Viscosity (ASTM D2161) = 30 - 40 SUS @ 100º F				

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability	Stable.	**Hazardous Polymerization**	Not expected to occur.
Conditions to Avoid	Keep away from heat, flame and other potential ignition sources. Keep away from strong oxidizing conditions and agents.		
Materials Incompatibility	Strong acids, alkalies, and oxidizers such as liquid chlorine, other halogens, hydrogen peroxide and oxygen.		
Hazardous Decomposition Products	No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS.		

SECTION 11: TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 and the Hazards Identification in Section 3 of this MSDS.

Toxicity Data

Middle distillates, petroleum:
The products represented by this MSDS contain a mixture of petroleum hydrocarbons commonly referred to as "middle distillates." Laboratory data have associated some middle distillates with skin cancer when the material is applied repeatedly over the lifetime of the test animal. Middle distillates similar to the products represented by this MSDS have been associated with liver and kidney damage in subchronic (90-day) inhalation studies of male rats. The relevance of these findings to human health is unclear.

Naphthalene:
ORAL (LD50): Acute: 1800 mg/kg [Rat]. 533 mg/kg [Mouse]. 1200 mg/kg [Guinea pig].

DERMAL (LD50): Acute: 969 mg/kg [Mouse].
INHALATION (LC50): Acute: >340 mg/m^3 1 hour(s) [Rat].

Naphthalene is a potential irritant to eyes, skin and lungs. Ingestion of naphthalene has been associated with severe red blood cell and liver damage leading to death. Following prolonged or repeated exposures, naphthalene has been shown to cause cataracts, optical neuritis, hemolytic and aplastic anemia, jaundice and possibly neurotoxicity. In animal studies, naphthalene caused fetal effects and decreased spleen weights in pregnant female mice. In an NTP sponsored study, naphthalene produced a dose related increase in tumors at the 30 and 60 ppm exposure level in both male and female rats. Higher incidences of respiratory epithelial adenomas, olfactory epithelial neuroblastomas and non-neoplastic lesions of the nose were observed as compared to controls. Cytogenic studies with Chinese hamster ovary cells have demonstrated sister chromatid exchanges and chromosomal aberrations. The relevance of these studies to human health is unclear.

Trimethylbenzenes, all isomers:
The TCLo for humans is 10 ppm, with somnolence and respiratory tract irritation noted. In inhalation studies with rats, four of ten animals died after exposures of 2400 ppm for 24 hours. An oral dose of 5 mL/kg resulted in death in one of ten rats. Minimum lethal intraperitoneal doses were 1.5 to 2.0 mL/kg in rats and 1.13 to 12 mL/kg in guinea pigs. Levels of total hydrocarbon vapors present in the breathing atmosphere of these workers ranged from 10 to 60 ppm. Mesitylene (1, 3, 5 Trimethylbenzene) inhalation at concentrations of 1.5, 3.0, and 6.0 mg/L for six hours was associated with dose-related changes in white blood cell counts in rats. No significant effects on the complete blood count were noted with six hours per day exposure for five weeks, but elevations of alkaline phosphatase and SGOT were observed. Central nervous system depression and ataxia were noted in rats exposed to 5,100 to 9,180 ppm for two hours.

Biphenyl (Diphenyl):
INHALATION, TCLo, Acute: 4,400 ug/m^3 for 4 hours [Human] - Flaccid paralysis of peripheral nerves without anesthesia and nausea or vomiting.
ORAL, LD50, Acute: >2,600 mg/kg [Cat screening level].
ORAL, LD50, Acute: 2,400 mg/kg [Rat and Rabbit].
ORAL, LD50, Acute: 1,900 mg/kg [Mouse] - Somnolence, hypermotility and diarrhea.
DERMAL, LD50, Acute: >5,010 mg/kg [Rabbit screening level].

Ethylbenzene:
ORAL (LD_{50}): Acute: 3,500 mg/kg [Rat].
DERMAL (LD_{50}): Acute: 17,800 uL/kg [Rabbit].
INTRAPERITONEAL (LD_{50}): Acute: 2,624 mg/kg [Rat].
NTP completed a 2-year inhalation bioassay of ethylbenzene in rodents. The study was conducted in rats and mice at exposure concentrations of 0, 75, 200 and 750 ppm. No significant effects were observed at the 75 and 200 ppm levels. However, compared to chamber controls, the severity of nephropathy was increased in rats at the 750 ppm level; and male rats had higher incidences of renal tubule carcinomas. Step section analyses of the kidneys found a significant increase hyperplasia and renal tubule adenomas in both male and female rats. Also at this 750 ppm level, male mice had a higher incidence of alveolar/bronchiolar adenomas and carcinomas and female mice had increased hepatocellular adenomas and carcinomas when compared to chamber controls. Also, hyperplasia was observed in the thyroid gland of both sexes of mice and in the pituitary gland of female mice. The relevance of these findings to human health is unclear. However, based upon this data, the IARC has designated ethylbenzene as possibly carcinogenic to humans (Group 2B).

Diesel exhaust particulate:
Lung tumor and lymphomas were identified in rats and mice exposed to unflitered diesel fuel exhaust in chronic inhalation studies. Further, epidemiological studies have identified increase incidences of lung cancer in US railroad workers and bladder cancer in bus and truck drivers possibly associated with exposure to diesel engine exhaust. NTP has determined that exposure to diesel exhaust particulates, a complex mixture of combustion products of diesel fuel, is reasonably anticipated to be a human carcinogen. In addition, NIOSH has identified complete diesel exhaust as a potential carcinogen.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity

Freshwater Toxicity:
Concentration: 2400 ppm Exposure: 48 hrs. Species: Juven. Am. Shad (*Squalius cephalus*) Effect: TLM
Concentration: >127 ppm Exposure: 96 hrs. Species: Bluegill (*Lepomis macrochirus*) Effect: LC50

Saltwater Toxicity
Concentration: 10 ppm Exposure: 96 hrs. Species: Menhaden (*Brevoortia patronus*) Effect: LC50
Concentration: 10 ppm Exposure: 96 hrs. Species: Grass Shrimp Effect: LC50

Environmental Fate

If spilled, this material will normally evaporate. Hydrocarbon components may contribute to atmospheric smog. If released to the subsoils, petroleum middle distillate fuels will strongly adsorb to soils. Groundwater should be considered as an exposure pathway. Liquid and vapor can migrate through the subsurface and preferential pathways (such as utility line backfill) to downgradient receptors.

Middle distillates are potentially toxic to freshwater and saltwater ecosystems. Distillate fuels will normally float on water. In stagnant or slow-flowing waterways, a hydrocarbon layer can cover a large surface area. As a result, this oil layer can limit or eliminate natural atmospheric oxygen transport into the water. With time, if not removed, oxygen depletion in the waterway can cause a fish kill or create an anaerobic environment. Also, this coating action can also kill plankton, algae, and water birds.

SECTION 13: DISPOSAL CONSIDERATIONS

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal methodologies for spent materials and residues at the time of disposition.

Maximize material recovery for reuse or recycling. If spilled material is introduced into a wastewater treatment system, chemical and biological oxygen demand (COD and BOD) will likely increase. Vapor emissions from a bio-oxidation process contaminated with this material might be a potential health hazard.

Recovered non-usable material may be regulated by US EPA as a hazardous waste due to its ignitibility (D001). In addition, conditions of use may cause this material to become a hazardous waste, as defined by Federal or State regulations. It is the responsibility of the user to determine if the material is a hazardous waste at the time of disposal. Transportation, treatment, storage, and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR Parts 260 through 271). State and/or local regulations might be even more restrictive. Contact the RCRA/Superfund Hotline at (800) 424-9346 or your regional US EPA office for guidance concerning case specific disposal issues.

SECTION 14: TRANSPORT INFORMATION

The shipping description below may not represent requirements for all modes of transportation, shipping methods or locations outside of the United States.

US DOT Status

A U.S. Department of Transportation (DOT) regulated material. The following U. S. DOT hazardous materials shipping description applies to bulk packaged material that is transported by highway or rail. Alternate shipping descriptions may be required for product transported by marine vessel, air or other method and for non-bulk packaged material.

Proper Shipping Name

Diesel Fuel, No. 1, Combustible liquid, NA1993, PG III

Hazard Class

DOT Class: Combustible liquid with a flash point greater than 37.8°C (100°F).

Packing Group(s) III

UN/NA ID NA 1993 or UN 1202

Reportable Quantity

A Reportable Quantity (RQ) has not been established for this material.

Placards

Emergency Response Guide No.	128
HAZMAT STCC No.	49 122 12
MARPOL III Status	Not a DOT "Marine Pollutant" per 49 CFR 171.8.

SECTION 15: REGULATORY INFORMATION

TSCA Inventory	This product and/or its components are listed on the Toxic Substances Control Act (TSCA) inventory.
SARA 302/304	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified.
SARA 311/312	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories: Fire, Acute (Immediate) Health Hazard, Chronic (Delayed) Health Hazard
SARA 313	This product contains the following components in concentrations above de minimis levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA: Naphthalene [CAS No.: 91-20-3] Concentration: 0 - 2% 1, 2, 4 Trimethylbenzene [CAS No.: 95-63-6] Concentration: 0 - 1%
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. Chemical substances present in this product or refinery stream that may be subject to this statute are: Naphthalene [CAS No.: 91-20-3] RQ = 100 lbs. (45.36 kg) Concentration: 0 - 3% Ethylbenzene [CAS No.: 100-41-4] RQ = 1000 lbs. (453.6 kg) Concentration: 0.5% Xylene, all isomers [CAS No.: 1330-20-7] RQ = 100 lbs. (45.36 kg) Concentration: 0.5% Cumene [CAS No.: 98-82-8] RQ = 5000 lbs. (2268 kg) Concentration: 0.5% Benzene [CAS No.: 71-43-2] RQ = 10 lbs. (4.536 kg) Concentration: <0.05%
CWA	This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.
California Proposition 65	This material may contain the following components which are known to the State of California to cause cancer, birth defects or other reproductive harm, and may be subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5): Naphthalene: 0 - 3% Toluene: <0.05% Benzene: <0.05% Diesel exhaust particulate
New Jersey Right-to-Know Label	Diesel Fuel
Additional Regulatory Remarks	Federal Hazardous Substances Act, related statutes, and Consumer Product Safety Commission regulations, as defined by 16 CFR 1500.14(b)(3) and 1500.83(a)(13): This product contains "Petroleum Distillates" which may require special labeling if distributed in a manner intended or packaged in a form suitable for use in the household or by children. Precautionary label dialogue should display the following: **DANGER: Contains Petroleum Distillates! Harmful or fatal if swallowed! Call Physician Immediately. KEEP OUT OF REACH OF CHILDREN!**

 Continued on Next Page

SECTION 16: OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

REVISION INFORMATION

Version Number 1.0

Revision Date 03/20/2003

Print Date Printed on 03/20/2003.

ABBREVIATIONS

AP: Approximately EQ: Equal >: Greater Than <: Less Than NA: Not Applicable ND: No Data NE: Not Established

ACGIH: American Conference of Governmental Industrial Hygienists
AIHA: American Industrial Hygiene Association
IARC: International Agency for Research on Cancer
NTP: National Toxicology Program
NIOSH: National Institute of Occupational Safety and Health
OSHA: Occupational Safety and Health Administration
NPCA: National Paint and Coating Manufacturers Association
HMIS: Hazardous Materials Information System
NFPA: National Fire Protection Association
EPA: US Environmental Protection Agency

DISCLAIMER OF LIABILITY

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED REGARDING ITS CORRECTNESS. SOME INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE SUBSTANCE ITSELF. THIS MSDS WAS PREPARED AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE PRODUCT IS USED AS A COMPONENT IN ANOTHER PRODUCT, THIS MSDS INFORMATION MAY NOT BE APPLICABLE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION OR PRODUCTS FOR THEIR PARTICULAR PURPOSE.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE, AND DISPOSAL OF THE PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

* * * * * END OF MSDS * * * * *

CITGO Gasolines, All Grades Unleaded

Material Safety Data Sheet

CITGO Petroleum Corporation
P.O. Box 4689
Houston, TX 77210

MSDS No.	UNLEAD
Revision Date	05/23/2005

IMPORTANT: Read this MSDS before handling or disposing of this product and pass this information on to employees, customers and users of this product.

Emergency Overview

Physical State	Liquid.		
Color	Transparent, clear to amber or red.	**Odor**	Pungent, characteristic gasoline.

DANGER:
Extremely flammable liquid; vapor may cause flash fire or explosion.
Vapor may travel considerable distance to source of ignition and flash back.
Use Only as a Motor Fuel. Do Not Siphon by Mouth.
Harmful or fatal if swallowed - Can enter lungs and cause damage.
High concentrations of vapor reduce oxygen available for breathing and may cause suffocation.
May be harmful if inhaled or absorbed through the skin.
Mist or vapor may irritate the eyes, mucous membranes, and respiratory tract.
Liquid contact may cause eye and skin irritation.
Overexposures may cause central nervous system (CNS) depression and target organ effects (See Section 3).
Harmful or fatal if swallowed - Can enter lung and cause damage.
Inhalation overexposure can increase the heart's susceptibility to arrhythmias (irregular beats).
Contains Benzene - Cancer Hazard.
Long term exposure to gasoline vapor has caused cancer in laboratory animals.
Avoid Spills. Spills may present both a physical and an environmental hazard.

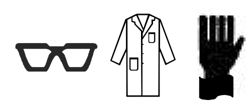
Hazard Rankings

	HMIS	NFPA
Health Hazard	* 2	1
Fire Hazard	3	3
Reactivity	0	0

*** = Chronic Health Hazard**

Protective Equipment

Minimum Recommended
See Section 8 for Details



SECTION 1. PRODUCT IDENTIFICATION

Trade Name	CITGO Gasolines, All Grades Unleaded	**Technical Contact**	(800) 248-4684
Product Number	Various	**Medical Emergency**	(832) 486-4700
CAS Number	Mixture.	**CHEMTREC Emergency (United States Only)**	(800) 424-9300

Product Family Motor fuels.

Synonyms Unleaded Gasolines; Motor Gasolines; Petrol; Automobile Motor Fuels; Finished Gasolines; Gasoline, Regular Unleaded; Gasoline, Mid-grade Unleaded; Gasoline, Premium Unleaded; Reformulated Gasolines (RFG); Reformulated Motor Fuels; Oxygenated Motor Spirits; Gasoline, Regular Reformulated; Gasoline, Mid-grade Reformulated; Gasoline, Premium Reformulated.

SECTION 2. COMPOSITION

Gasoline is a complex and variable mixture that originates from finished refinery streams. These streams can contain the hydrocarbons and oxygenated chemicals (oxygenates) listed below that are regulated or are associated with certain potential health effects. The typical concentration of oxygenates in gasoline does not exceed 18% (v/v).

Component Name(s)	CAS Registry No.	Concentration (%)
Methyl tertiary-Butyl Ether (MTBE)	1634-04-4	0 - 15
Tertiary-Amyl Methyl Ether (TAME)	994-05-8	0 - 15
Ethyl tertiary Butyl Ether (ETBE)	637-92-3	0 - 15
Tertiary-Amyl Ethyl Ether (TAEE)	919-94-8	0 - 15
Diisopropyl Ether (DIPE)	108-20-3	0 - 15
Ethanol	64-17-5	0 - 10
Toluene	108-88-3	<20
Xylene, all isomers	1330-20-7	<18
n-Hexane	110-54-3	<8
Trimethylbenzenes, all isomers	25551-13-7	<5
Benzene	71-43-2	<5
Cumene	98-82-8	<4
Ethylbenzene	100-41-4	<4
Cyclohexane	110-82-7	<3
Naphthalene	91-20-3	<2
Styrene	100-42-5	<1

SECTION 3. HAZARDS IDENTIFICATION

Also see Emergency Overview and Hazard Ratings on the top of Page 1 of this MSDS.

Major Route(s) of Entry Skin contact. Eye contact. Inhalation. Ingestion.

Signs and Symptoms of Acute Exposure

Inhalation Breathing high concentrations may be harmful. Mist or vapor can irritate the throat and lungs. Breathing this material may cause central nervous system depression with symptoms including nausea, headache, dizziness, fatigue, drowsiness, or unconsciousness. Breathing high concentrations of this material, for example, in an enclosed space or by intentional abuse, can cause irregular heartbeats which can cause death.

Eye Contact This product can cause eye irritation with short-term contact with liquid, mists or vapor. Symptoms include stinging, watering, redness, and swelling. In severe cases, permanent eye damage can result.

Skin Contact This material can cause skin irritation. The severity of irritation will depend on the amount of material that is applied to the skin and the speed and thoroughness that it is removed. It is likely that some components of this material are able to pass into the body through the skin and may cause similar effects as from breathing or swallowing it. If the skin is damaged, absorption increases.

Ingestion

If swallowed, this material may irritate the mucous membranes of the mouth, throat, and esophagus. It can be readily absorbed by the stomach and intestinal tract. Symptoms include a burning sensation of the mouth and esophagus, nausea, vomiting, dizziness, staggered gait, drowsiness, loss of consciousness and delirium, as well as additional central nervous system (CNS) effects.

Due to its light viscosity, there is a danger of aspiration into the lungs during swallowing and subsequent vomiting. Aspiration can result in severe lung damage or death. Cardiovascular effects include shallow rapid pulse with pallor (loss of color in the face) followed by flushing (redness of the face). Also, progressive CNS depression, respiratory insufficiency and ventricular fibrillation leads to death.

Chronic Health Effects Summary

Intentional misuse by deliberately concentrating and inhaling gasoline can be harmful or fatal. Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage ("Petrol Sniffers Encephalopathy"), delirium, seizures and sudden death are associated with repeated abuse of gasoline or naphtha.

Chronic effects of ingestion and subsequent aspiration into the lungs may include pneumatocele (lung cavity) formation and chronic lung dysfunction.

Benzene, a component of this product, causes blood disorders and damages the bone marrow (certain types of anemia, leukemia, and lymphoma). It is also capable of causing changes in living cells' genetic material (chromosomes). Benzene is considered to be a mutagen and a cancer-causing agent (leukemogen).

Repeated and prolonged overexposure to n-hexane has been associated with peripheral nerve tissue damage. Adverse effects include numbness, tingling, pain, and loss of muscle control in the extremities, disorientation, impaired vision and reflexes, decline in motor function and paralysis.

Prolonged or repeated overexposure to toluene, a component of this product, has been associated with reproductive effects in experimental animals and in long-term chemical abuse situations. Long-term overexposure to toluene has been associated with impaired color vision. Also, long-term overexposure to toluene in occupational environments have been associated with hearing damage.

Prolonged or repeated overexposure to xylene, a component of this product, has been associated with hearing damage in laboratory animals. Repeated overexposure may cause injury to bone marrow, blood cells, kidney, and liver.

Refer to Section 11 of this MSDS for additional health-related information.

Conditions Aggravated by Exposure

Disorders of the following organs or organ systems that may be aggravated by significant exposure to this material or its components include: Skin, Respiratory System, Liver, Kidneys, Central Nervous System (CNS), Cardiovascular System, Blood-forming system

Target Organs

May cause damage to the following organs: blood, kidneys, lungs, the reproductive system, liver, mucous membranes, heart, peripheral nervous system, cardiovascular system, upper respiratory tract, skin, auditory system, bone marrow, central nervous system (CNS), eye, lens or cornea.

Carcinogenic Potential

This material may contain benzene, ethylbenzene, naphthalene or styrene at concentrations above 0.1%. Benzene is considered to be a known human carcinogen by OSHA, IARC and NTP. IARC has identified ethylbenzene, styrene, naphthalene, gasoline and gasoline engine exhaust as possibly carcinogenic to humans (Group 2B) based on laboratory animal studies.

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present, the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA Health Hazard Classification				OSHA Physical Hazard Classification					
Irritant	X	Sensitizer		Combustible		Explosive		Pyrophoric	
Toxic		Highly Toxic		Flammable	X	Oxidizer		Water-reactive	
Corrosive		Carcinogenic	X	Compressed Gas		Organic Peroxide		Unstable	

SECTION 4. FIRST AID MEASURES

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid. For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

Inhalation
Immediately move victim to fresh air. If victim is not breathing, immediately begin rescue breathing. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). If breathing is difficult, 100 percent humidified oxygen should be administered by a qualified individual. Seek medical attention immediately. If exposed to benzene in an emergency situation, a medical evaluation should be completed at the end of the work-shift in accordance with OSHA requirements.

Eye Contact
Flush eyes with cool, clean, low-pressure water for at least 15 minutes. Hold eyelids apart to ensure complete irrigation of the eye and eyelid tissue. If easily accomplished, check for and remove contact lenses. If contact lenses cannot be removed, seek immediate medical attention. Do not use eye ointment. Seek medical attention.

Skin Contact
Remove contaminated shoes and clothing. Flush affected area with large amounts of water. If skin surface is damaged, apply a clean dressing and seek medical attention. Do not use ointments. If skin surface is not damaged, clean affected area thoroughly with mild soap and water. Seek medical attention if tissue appears damaged or if pain or irritation persists.

Ingestion
Do not induce vomiting. If spontaneous vomiting is about to occur, place victim's head below knees. If victim is drowsy or unconscious, place on the left side with head down. Never give anything by mouth to a person who is not fully conscious. Do not leave victim unattended. Seek medical attention immediately.

Notes to Physician
INHALATION: Inhalation overexposure can produce toxic effects. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for upper respiratory tract inflammation, bronchitis, and pneumonitis. Administer supplemental oxygen with assisted ventilation, as required.

This material (or a component) sensitizes the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material. Administion of sympathomimetic drugs should be avoided.

INGESTION: If ingested, this material presents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended. Consider activated charcoal and/or gastric lavage. If patient is obtunded, protect the airway by cuffed endotracheal intubation or by placement of the body in a Trendelenburg and left lateral decubitus position.

SECTION 5. FIRE FIGHTING MEASURES

NFPA Flammability Classification NFPA Class-IB flammable liquid.

Flash Point Closed cup: -43°C (-45°F). (Tagliabue [ASTM D-56])

Lower Flammable Limit AP 1.4 % **Upper Flammable Limit** AP 7.6 %

Autoignition Temperature 280°C (536°F)

Hazardous Combustion Products Carbon dioxide, carbon monoxide, smoke, fumes, unburned hydrocarbons, aldehydes and other products of incomplete combustion.

Special Properties Flammable Liquid! This material releases vapors at or below ambient temperatures. When mixed with air in certain proportions and exposed to an ignition source, its vapor can cause a flash fire. Use only with adequate ventilation. Vapors are heavier than air and may travel long distances along the ground to an ignition source and flash back. A vapor and air mixture can create an explosion hazard in confined spaces such as sewers. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media SMALL FIRE: Use dry chemicals, carbon dioxide, foam, or inert gas (nitrogen). Carbon dioxide and inert gas can displace oxygen. Use caution when applying carbon dioxide or inert gas in confined spaces.
LARGE FIRE: Use foam, water fog, or water spray. Water May Be Ineffective. Water may not extinguish the fire. Water fog and spray are effective in cooling containers and adjacent structures. However, water can be used to cool the external walls of vessels to prevent excessive pressure, autoignition or explosion. DO NOT use a solid stream of water directly on the fire as the water may spread the fire to a larger area.

Protection of Fire Fighters Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies. Evacuate area and fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles. Cover pooling liquid with foam. Containers can build pressure if exposed to radiant heat; cool adjacent containers with flooding quantities of water until well after the fire is out. Withdraw immediately from the area if there is a rising sound from a venting safety device or discoloration of vessels, tanks, or pipelines. Be aware that burning liquid will float on water. Notify appropriate authorities of potential fire and explosion hazard if liquid enter sewers or waterways.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.

Flammable Liquid! Release causes an immediate fire or explosion hazard. Evacuate all non-essential personnel from immediate area and establish a "regulated zone" with site control and security. A vapor-suppressing foam may be used to reduce vapors. Eliminate all ignition sources. All equipment used when handling this material must be grounded. Stop the leak if it can done without risk. Do not touch or walk through spilled material. Remove spillage immediately from hard, smooth walking areas. Prevent spilled material from entering waterways, sewers, basements, or confined areas. Absorb or cover with dry earth, sand, or other non-combustible material and transfer to appropriate waste containers. Use clean, non-sparking tools to collect absorbed material.

For large spills, secure the area and control access. Prevent spilled material from entering sewers, storm drains, other drainage systems, and natural waterways. Dike far ahead of a liquid spill to ensure complete collection. Water mist or spray may be used to reduce or disperse vapors; but, it may not prevent ignition in closed spaces. This material will float on water and its run-off may create an explosion or fire hazard. Verify that responders are properly HAZWOPER-trained and wearing appropriate respiratory equipment and fire-resistant protective clothing during cleanup operations. In an urban area, cleanup spill as soon as possible; in natural environments, cleanup on advice from specialists. Pick up free liquid for recycle and/or disposal if it can be accomplished safely with explosion-proof equipment. Collect any excess material with absorbant pads, sand, or other inert non-combustible absorbent materials. Place into appropriate waste containers for later disposal. Comply with all applicable local, state and federal laws and regulations.

SECTION 7. HANDLING AND STORAGE

Handling

FLAMMABLE LIQUID AND VAPOR. **USE ONLY as a motor fuel.** DO NOT siphon by mouth. DO NOT use as a lighter fluid, solvent or cleaning fluid. Prior to handling or refueling, stop all engines and auxillary equipment. Turn off all electronic equipment including cellular telephones. DO NOT leave nozzle unattended during filling or refueling a vehicle. DO NOT re-enter vehicle while refueling. Keep nozzle spout in contact with the container during the entire filling operations.

A static electrical charge can accumulate when this material is flowing through pipes, nozzles or filters and when it is agitated. A static spark discharge can ignite accumulated vapors particularly during dry weather conditions. Always bond receiving containers to the fill pipe before and during loading. Always keep nozzle in contact with the container throughout the loading process. Do not fill any portable container in or on a vehicle. Special precautions, such as reduced loading rates and increased monitoring, must be observed during "switch loading" operations (i.e., loading this material in tanks or shipping compartments that previously contained middle distillates or similar products).

A spill or leak can cause an immediate fire hazard. Keep containers closed and do not handle or store near heat, sparks, or any other potential ignition sources. Do not contact with oxidizable materials. Do not breathe vapor. Use only with adequate ventilation and personal protection. Never siphon by mouth. Avoid contact with eyes, skin, and clothing. Prevent contact with food and tobacco products. Do not take internally.

When performing repairs and maintenance on contaminated equipment, keep unnecessary persons away from the area. Eliminate all potential ignition sources. Drain and purge equipment, as necessary, to remove material residues. Follow proper entry procedures, including compliance with 29 CFR 1910.146 prior to entering confined spaces such as tanks or pits. Use gloves constructed of impervious materials and protective clothing if direct contact is anticipated. Provide ventilation to maintain exposure potential below applicable exposure limits. Use appropriate respiratory protection when concentrations exceed any established occupational exposure level (See Section 8). Promptly remove contaminated clothing. Wash exposed skin thoroughly with soap and water after handling.

Protect the environment from releases of this material. Prevent discharges to surface waters and groundwater. Maintain handling, transfer and storage equipment in proper working order.

Misuse of empty containers can be dangerous. Empty containers may contain material residues which can ignite with explosive force. **Cutting or welding of empty containers can cause fire, explosion, or release of toxic fumes from residues.** Do not pressurize or expose empty containers to open flame, sparks, or heat. Keep container closed and drum bungs in place. All label warnings and precautions must be observed. Return empty drums to a qualified reconditioner. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling, or disposing of empty containers and/or waste residues of this material.

 Continued on Next Page

Storage

Store and transport in accordance with all applicable laws. Keep containers tightly closed. Store in a cool, dry, well-ventilated place. Clearly label all containers. Do not allow containers to be kept in enclosed vehicles. Keep away from all ignition sources. Ground all equipment containing this material. Containers must be able to withstand pressures that are created from changes in product temperature. Product samples and other small containers of this flammable liquid should be stored in a separate safety cabinet or room. All electrical equipment in areas where this material is stored or handled should be installed and operated in accordance with applicable regulatory requirements and the National Electrical Code.

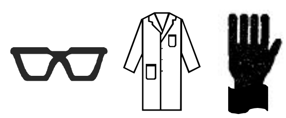
SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls

Provide ventilation or other engineering controls to keep the airborne concentrations of vapor or mists below the applicable workplace exposure limits indicated below. All electrical equipment should comply with the National Electric Code. An emergency eye wash station and safety shower should be located near the work-station.

Personal Protective Equipment

Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required.



Eye Protection

Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. A suitable emergency eye wash water and safety shower should be located near the work station.

Hand Protection

Avoid skin contact. Use gloves (e.g., disposable PVC, neoprene, nitrile, vinyl, or PVC/NBR). Wash hands with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities or leaving work. DO NOT use this material as a skin cleaner.

Body Protection

Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discard contaminated leather goods.

Respiratory Protection

For known vapor concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator if adequate protection is provided. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For airborne vapor concentrations that exceed the recommended protection factors for organic vapor respirators, use a full-face, positive-pressure, supplied air respirator. Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 10% of the lower flammable limit of this product.

General Comments

Warning! Use of this material in spaces without adequate ventilation may result in generation of hazardous levels of combustion products and/or inadequate oxygen levels for breathing. Odor is an inadequate warning for hazardous conditions.

Occupational Exposure Guidelines

Substance	Applicable Workplace Exposure Levels

Gasoline	**ACGIH (United States).** TWA: 300 ppm 8 hour(s). STEL: 500 ppm 15 minute(s).
Toluene	**ACGIH (United States). Skin** TWA: 50 ppm 8 hour(s). **OSHA (United States).** TWA: 200 ppm 8 hour(s). CEIL: 300 ppm PEAK: 500 ppm
Xylene, all isomers	**ACGIH (United States).** TWA: 100 ppm 8 hour(s). STEL: 150 ppm 15 minute(s). **OSHA (United States).** TWA: 100 ppm 8 hour(s).
Tertiary-Amyl Methyl Ether (TAME)	**ACGIH TLV (United States).** TWA: 20 ppm 8 hour(s).
Methyl tertiary-Butyl Ether (MTBE)	**ACGIH (United States).** TWA: 50 ppm 8 hour(s).
Ethyl tertiary Butyl Ether (ETBE)	**ACGIH TLV (United States).** TWA: 5 ppm 8 hour(s).
n-Hexane	**ACGIH (United States). Skin** TWA: 50 ppm 8 hour(s). **OSHA (United States).** TWA: 500 ppm 8 hour(s).
Cumene	**ACGIH (United States).** TWA: 50 ppm 8 hour(s). **OSHA (United States). Skin** TWA: 50 ppm 8 hour(s).
Trimethylbenzenes, all isomers	**ACGIH (United States).** TWA: 25 ppm 8 hour(s).
Benzene	**ACGIH (United States). Skin** TWA: 0.5 ppm 8 hour(s). STEL: 2.5 ppm 15 minute(s). **OSHA (United States). Skin Notes: See Table Z-2 for exclusions in 20 CFR 1910.1028 to the PEL.** TWA: 1 ppm 8 hour(s). STEL: 5 ppm 15 minute(s).
Ethylbenzene	**ACGIH (United States).** TWA: 100 ppm 8 hour(s). STEL: 125 ppm 15 minute(s). **OSHA (United States).** TWA: 100 ppm 8 hour(s).
Cyclohexane	**ACGIH (United States).** TWA: 100 ppm 8 hour(s). **OSHA (United States).** TWA: 300 ppm 8 hour(s).
Naphthalene	**ACGIH (United States). Skin** TWA: 10 ppm 8 hour(s). STEL: 15 ppm 15 minute(s). **OSHA (United States).** TWA: 10 ppm 8 hour(s).
Styrene	**ACGIH (United States).** TWA: 20 ppm 8 hour(s). STEL: 40 ppm 15 minute(s). **OSHA (United States).** TWA: 100 ppm 8 hour(s). STEL: 200 ppm 15 minute(s). PEAK: 600 ppm

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (TYPICAL)

Physical State	Liquid.	**Color**	Transparent, clear to amber or red.	**Odor**	Pungent, characteristic gasoline.
Specific Gravity	0.72 - 0.77 (Water = 1)	**pH**	Not applicable	**Vapor Density**	3 to 4 (Air = 1)

Boiling Range	38 to 204°C (100 to 400°F)	**Melting/Freezing Point**	Not available.
Vapor Pressure	220 to 450 mm Hg at 20°C (68°F) or 6 to 15 Reid-psia at 37.8°C (100°F).	**Volatility**	720 to 770 g/l VOC (w/v)
Solubility in Water	Hydrocarbon components of gasoline are slightly soluble in water. Oxygenate components, such as MTBE, are more soluble than the hydrocarbon components. Ethanol has greater solubility in water than hydrocarbon components or other oxygenate components.	**Viscosity (cSt @ 40°C)**	<1

Flash Point Closed cup: -43°C (-45°F). (Tagliabue [ASTM D-56])

Additional Properties Average Density at 60°F = 6.0 to 6.4 lbs./gal. (ASTM D-2161)

SECTION 10. STABILITY AND REACTIVITY

Chemical Stability	Stable.	**Hazardous Polymerization**	Not expected to occur.

Conditions to Avoid Keep away from heat, flame and other potential ignition sources. Keep away from strong oxidizing conditions and agents.

Materials Incompatibility Strong acids, alkalies and oxidizers such as liquid chlorine, other halogens, hydrogen peroxide and oxygen.

Hazardous Decomposition Products No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS.

SECTION 11. TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 and the Hazards Identification in Section 3 of this MSDS.

Toxicity Data

Gasoline:
VAPOR (TELo) Acute: 140 ppm (Human) (8 hours) - Mild eye irritant.
VAPOR (TELo) Acute: 500 ppm (Human) (1 hour) - Moderate eye irritant.
INHALATION (TCLo) Acute: 900 ppm (Human) (1 hour) - CNS and pulmonary effects.
DERMAL (TDLo) Acute: 53 mg/kg (Human) - Skin allergy effects.
INHALATION (LC50) Acute: 101,200 ppm (Rat, Mouse, & Guinea Pig) (5 minutes).

Gasoline Containing 15% MTBE:
ORAL (LD50) Acute: >5,000 mg/kg (Rat screen level).
DERMAL (LD50) Acute: >2,000 mg/kg (Rabbit screen level).
INHALATION (LC50) Acute: >5,200 ppm (Rat screen level) (8 hours).
DRAIZE EYE Acute: Mild eye irritant. (Rabbit).

DRAIZE DERMAL Acute: Moderate skin irritant. (Rabbit).
BUEHLER DERMAL Acute: Non-sensitizing. (Guinea Pig).
28-Day DERMAL Sub-Chronic: Severe skin irritant. (Rabbit).

A major epidemiological study concluded that there was no increased risk of kidney cancer associated with gasoline exposures for petroleum refinery employees or neighboring residents. Another study identified a slight trend in kidney cancers among service station employees following a 30-year latency period. Two-year inhalation toxicity studies with fully vaporized unleaded gasoline (at concentrations of 67, 292 and 2,056 ppm in air) produced kidney damage and kidney tumors in male rats, but not in female rats or mice of either sex. Results from subsequent scientific studies suggest that the kidney damage, and probably the kidney tumor response, is limited to the male rat. The kidney tumors apparently were the result of the formation of alpha-2u-globulin, a protein unique to male rats. This finding is not considered relevant to human exposure. Under conditions of the study, there was no evidence that exposure to unleaded gasoline vapor is associated with developmental toxicity. Experimental studies with laboratory animals did suggest that overexposure to gasoline may adversely effect male reproductive performance. Also, in laboratory studies with rats, the maternal and developmental "no observable adverse effect level" (NOAEL) was determined to be 9,000 ppm (75% of the LEL value). Female mice developed a slightly higher incidence of liver tumors compared to controls at the highest concentration. In a four week inhalation study of Sprague Dawley® rats, gasoline vapor condensate was determined to induce sister chromatid exchanges in peripheral lymphocytes. IARC has listed gasoline as possibly carcinogenic to humans (Group 2B).

Pentanes, all isomers:
Studies of pentane isomers in laboratory animals indicate exposure to extremely high levels (roughly 10 vol.%) may induce cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

Toluene:
Effects from Acute Exposure:
Deliberate inhalation of toluene at high concentrations (e.g., glue sniffing and solvent abuse) has been associated with adverse effects on the liver, kidney and nervous system and can cause CNS depression, cardiac arrhythmias and death. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects.

Effects from Repeated or Prolonged Exposure:
Studies of workers indicate long-term exposure may be related to impaired color vision and hearing. Some studies of workers suggest long-term exposure may be related to neurobehavioral and cognitive changes. Some of these effects have been observed in laboratory animals following repeated exposure to high levels of toluene. Several studies of workers suggest long-term exposure may be related to small increases in spontaneous abortions and changes in some gonadotropic hormones. However, the weight of evidence does not indicate toluene is a reproductive hazard to humans. Studies in laboratory animals indicate some changes in reproductive organs following high levels of exposure, but no significant effects on mating performance or reproduction were observed. Case studies of persons abusing toluene suggest isolated incidences of adverse effects on the fetus including birth defects. Findings in laboratory animals were largely negative. Positive findings include small increases in minor skeletal and visceral malformations and developmental delays following very high levels of maternal exposure. Studies of workers indicate long-term exposure may be related to effects on the liver, kidney and blood, but these appear to be limited to changes in serum enzymes and decreased leukocyte counts. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland following very high levels of exposure. The relevance of these findings to humans is not clear at this time.

Heptane, all isomers:
n-Heptane was not mutagenic in the Salmonella/microsome (Ames) assay and is not considered to be carcinogenic.

 Continued on Next Page

Xylene, all isomers:
Effects from Acute Exposure:
ORAL (LD_{50}), Acute: 4,300 mg/kg [Rat].
INHALATION (LC_{50}), Acute: 4,550 ppm for four hours [Rat].
DERMAL (LD_{50}), Acute: 14,100 uL/kg [Rabbit].
Overexposure to xylene may cause upper respiratory tract irritation, headache, cyanosis, blood serum changes, CNS damage and narcosis. Effects may be increased by the use of alcoholic beverages. Evidence of liver and kidney impairment were reported in workers recovering from a gross over-exposure.

Effects from Prolonged or Repeated Exposure:
Impaired neurological function was reported in workers exposed to solvents including xylene. Studies in laboratory animals have shown evidence of impaired hearing following high levels of exposure. Studies in laboratory animals suggest some changes in reproductive organs following high levels of exposure but no significant effects on reproduction were observed. Studies in laboratory animals indicate skeletal and visceral malformations, developmental delays, and increased fetal resorptions following extremely high levels of maternal exposure. Adverse effects on the liver, kidney, bone marrow (changes in blood cell parameters) were observed in laboratory animals following high levels of exposure. The relevance of these observations to humans is not clear at this time.

Ethyl tertiary Butyl Ether (ETBE):
ETBE can cause eye, skin and mucous membrane irritation. In a four week inhalation study, moderate ataxia was observed in rats at the highest dose level (4,000 ppm). The test animals appeared normal within 15 minutes of termination of exposure. A no observed adverse effect level (NOAEL) of 500 ppm was indicated by the study authors based on neurotoxic effects. In two unpublished 90 day inhalation studies, rats and mice were exposed six hour/day, five days/week at concentrations of 0, 500, 1750 and 5000 ppm of ETBE vapor. The male rats exhibited time and concentration-dependent nephropathy consistent with alpha-2µ-globulin formation. An ETBE NOAEL for male rats of 500 ppm was suggested based on a finding of testicular lesions. In human studies with eight males, slight, but significant ($p<0.05$) decreases in objective pulmonary function measures after exposure to ETBE at concentrations of 25 and 50 ppm for two hours.

Tertiary-Amyl Methyl Ether (TAME):
TAME was found to be negative for the induction of structural chromosome aberrations (both metabolically-activated and non-activated) in Chinese hamster ovary (CHO) cells. Inhalation of TAME vapors at concentrations above 250 ppm produced reversible CNS depression in rats and mice. In a four week inhalation study, increases in liver weights with no tissue injury were observed in rats exposed to a TAME concentration of 500 ppm. Birth defects in mice and fetotoxicity in both rats and mice were observed after inhalation exposures to maternally toxic concentrations of TAME.

Methyl tertiary-Butyl Ether (MTBE):
Acute symptoms associated with human exposure to MTBE appear to be mild and transient. In laboratory studies, rats and mice exposed to high doses of MTBE exhibited blood chemistry changes and liver and kidney abnormalities. In laboratory studies, MTBE vapor exposure at the high dose concentration was associated with an increased incidence of liver tumors in female mice. Also, at high dose concentration exposures, MTBE was associated with an increased incidence of kidney and testicular (Leydig cell) tumors in male rats. Additional oncogenicity studies on rats resulted in testicular tumors following administration by ingestion. These data are not generally considered relevant to humans. NTP has not identified MTBE as either a known carcinogen or reasonably anticipated to be carcinogenic to humans. In animal studies, developmental and reproductive toxicity related to MTBE inhalation exposures was observed only at concentrations that were maternally toxic. MTBE was shown to be maternally toxic at 4,000 and 8,000 ppm levels when mice were exposed for six hours per day during their pregnancy. Also, a decrease in the number of successful pregnancies and a reduction in birth weights were observed at these exposure levels. Birth defects (cleft palate) were observed at the high dose level. These data suggest that the risk of developmental and reproductive toxicity in humans is negligible as a result of anticipated

exposures to MTBE.

Diisopropyl Ether (DIPE):
Increased kidney and liver weights were observed in rats and mice in subchronic and chronic inhalation studies of DIPE. Also, evidence of microscopic changes (hyaline droplets) were reported in liver tissue and kidney tubules of rabbits and male rats exposed to DIPE at concentrations of 7,100 ppm. These findings were similar those found in gasoline studies. Overexposure by inhalation of pregnant rats to DIPE at concentrations of 3,095 and 6,745 ppm increased the frequency of rudimentary 14th ribs in the offspring. This effect was not observed at exposure concentrations of 430 ppm. The significance of these findings to human exposure is unclear.

Ethanol:
Inhalation exposure to ethanol vapor at concentrations above applicable workplace exposure levels is expected to produce eye and mucus membrane irritation. Human exposure at concentrations from 1000 to 5000 ppm produced symptoms of narcosis, stupor and unconsciousness. Subjects exposed to ethanol vapor in concentrations between 500 and 10,000 ppm experienced coughing and smarting of the eyes and nose. At 15,000 ppm there was continuous lacrimation and coughing. While extensive acute and chronic effects can be expected with ethanol consumption, ingestion is not expected to be a significant route of exposure to this product.

Butane, all isomers:
Studies in laboratory animals indicate exposure to extremely high levels of butanes (1-10 or higher vol.% in air) may cause cardiac arrhythmias (irregular heartbeats) which may be serious or fatal.

n-Hexane:
This material contains n-hexane. Long-term or repeated exposure to n-hexane can cause permanent peripheral nerve damage. Initial symptoms are numbness of the fingers and toes. Also, motor weakness can occur in the digits, but may also involve muscles of the arms, thighs and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. Co-exposure to methylethyl ketone or methyl isobutyl ketone increases the neurotoxic properties of n-hexane. In laboratory studies, prolonged exposure to elevated concentrations of n-hexane was associated with decreased sperm count and degenerative changes in the testicles of rats.

Cumene:
Effects from Acute Exposure:
Overexposure to cumene may cause upper respiratory tract irritation and severe CNS depression.

Effects from Prolonged or Repeated Exposure:
Studies in laboratory animals indicate evidence of adverse effects on the kidney and adrenal glands following high level exposure. The relevance of these findings to humans is not clear at this time.

Trimethylbenzenes, all isomers:
Studies of Workers:
Levels of total hydrocarbon vapors present in the breathing atmosphere of these workers ranged from 10 to 60 ppm. The TCLo for humans is 10 ppm, with somnolence and respiratory tract irritation noted.

Studies in Laboratory Animals:
In inhalation studies with rats, four of ten animals died after exposures of 2400 ppm for 24 hours. An oral dose of 5 mL/kg resulted in death in one of ten rats. Minimum lethal intraperitoneal doses were 1.5 to 2.0 mL/kg in rats and 1.13 to 12 mL/kg in guinea pigs. Mesitylene (1, 3, 5 Trimethylbenzene) inhalation at concentrations of 1.5, 3.0, and 6.0 mg/L for six hours was associated with dose-related changes in white blood cell counts in rats. No significant effects on the complete blood count were noted with six hours per day exposure

 Continued on Next Page

for five weeks, but elevations of alkaline phosphatase and SGOT were observed. Central nervous system depression and ataxia were noted in rats exposed to 5,100 to 9,180 ppm for two hours.

Benzene:

ORAL (LD50):	Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse].
INHALATION (LC50):	
(VAPOR):	Acute: 10000 ppm 7 hour(s) [Rat]. 9980 ppm 8 hour(s) [Mouse].

Studies of Workers Over-Exposed to Benzene:
Studies of workers exposed to benzene show clear evidence that over-exposure can cause cancer of the blood forming organs (acute myelogenous leukemia) and aplastic anemia, an often fatal disease. Studies also suggest over-exposure to benzene may be associated with other types of leukemia and other blood disorders. Some studies of workers exposed to benzene have shown an association with increased rates of chromosome aberrations in circulating lymphocytes. One study of women workers exposed to benzene suggested a weak association with irregular menstruation. However, other studies of workers exposed to benzene have not demonstrated clear evidence of an effect on fertility or reproductive outcome in humans. Benzene can cross the placenta and affect the developing fetus. Cases of aplastic anemia have been reported in the offspring of persons severely over-exposed to benzene.

Studies in Laboratory Animals:
Studies in laboratory animals indicate that prolonged, repeated exposure to high levels of benzene vapor can cause bone marrow suppression and cancer in multiple organ systems. Studies in laboratory animals show evidence of adverse effects on male reproductive organs following high levels of exposure but no significant effects on reproduction have been observed. Embryotoxicity has been reported in studies of laboratory animals but effects were limited to reduced fetal weight and skeletal variations.

Ethylbenzene:
Effects from Acute Exposure:
ORAL (LD50), Acute: 3,500 mg/kg [Rat].
DERMAL (LD50), Acute: 17,800 uL/kg [Rabbit].
INTRAPERITONEAL (LD50), Acute: 2,624 mg/kg [Rat].

Effects from Prolonged or Repeated Exposure:
Findings from a 2-year inhalation study in rodents conducted by NTP were as follows: Effects were observed only at the highest exposure level (750 ppm). At this level the incidence of renal tumors was elevated in male rats (tubular carcinomas) and female rats (tubular adenomas). Also, the incidence of tumors was elevated in male mice (alveolar and bronchiolar carcinomas) and female mice (hepatocellular carcinomas). IARC has classified ethyl benzene as “possibly carcinogenic to humans” (Group 2B). Studies in laboratory animals indicate some evidence of post-implantation deaths following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate limited evidence of renal malformations, resorptions, and developmental delays following high levels of maternal exposure. The relevance of these findings to humans is not clear at this time. Studies in laboratory animals indicate some evidence of adverse effects on the liver, kidney, thyroid, and pituitary gland.

Cyclohexane:
Cyclohexane can cause eye, skin and mucous membrane irritation, CNS depressant and narcosis at elevated concentrations. In experimental animals exposed to lethal concentrations by inhalation or oral route, generalized vascular damage and degenerative changes in the heart, lungs, liver, kidneys and brain were identified.

Cyclohexane has been the focus of substantial testing in laboratory animals. Cyclohexane was not found to be genotoxic in several tests including unscheduled DNA synthesis, bacterial and mammalian cell mutation assays, and in vivo chromosomal aberration. An increase in chromosomal aberrations in bone marrow cells of rats exposed to cyclohexane was reported in the 1980's. However, a careful re-evaluation of slides from this study by the laboratory which conducted the study indicates these findings were in error, and that no significant chromosomal effects were observed in animals exposed to cyclohexane. Findings indicate long-term exposure to cyclohexane does not promote dermal tumorigenesis.

Naphthalene:
Studies in Humans Overexposed to Naphthalene:
Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from over-exposure to naphthalene. Persons with Glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have also been reported from over-exposure to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect.

Studies in Laboratory Animals:
Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) *in vitro.*

Styrene:
Neurological injury associated with chronic styrene exposure include distal hypesthesia, decreased nerve conduction velocity, and altered psychomotor performance. These effects did not occur with exposures to airborne concentrations that were less than 100 ppm. Increased deaths from degenerative neurological disorders were found in a comprehensive epidemiological study of Danish reinforced plastics workers. These workers were reported to have a 2.5-fold increased risk for myeloid leukemia with clonal chromosome aberrations. Also, there are several studies that suggest potential reproductive effects in humans and experimental animals from overexposure to styrene. Styrene was not mutagenic in the standard (liquid phase) Ames Salmonella/microsome assay, but was weakly positive when tested in the vapor phase. IARC has listed styrene as possibly carcinogenic to humans (Group 2B).

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicity

Unleaded gasoline is potentially toxic to freshwater and saltwater ecosystems. Various grades of gasoline exhibited range of lethal toxicity (LC_{100}) from 40 PPM to 100 PPM in ambient stream water with Rainbow Trout (*Salmo irideus*). A 24-hour TLm (Median Toxic Limit) was calculated to be 90 PPM with juvenile American Shad (*Squalius cephalus*). In Bluegill Sunfish (*Lepomis macrochirus*), Grey Mullet (*Chelon labrosus*) and Gulf Menhaden (*Brevoortia patronus*), gasoline exhibited a 96-hour LC_{50} of 8 PPM, 2 PPM, and 2 PPM, respectively.

The aquatic toxicity of Methyl tertiary-Butyl Ether (MTBE) is considered to be relatively low. In the crustacean Harpacticoid Copepods (*Nitrocra spinipes*), MTBE exhibited an LC_{50} (96-hour) of 1,000 PPM to 10,000 PPM depending upon various water temperatures. In Bleak Fish (*Alburnus alburnus*), MTBE exhibited an LC_{50} (24-hour) of 1,700 PPM and an LC_{50} (96-hour) of 1,000 PPM at 10° C. In Golden Orfe Fish (*Leuciscus idus melanotus*), MTBE exhibited an LC_{50} (48-hour) of 1,000 PPM and an LC_{100} of 2,000 PPM.

Environmental Fate

Avoid spilling gasoline. Spilled gasoline can result in environmental damage. Spilled gasoline can penetrate soil and contaminate ground water. Although gasoline is biodegradable, it may persist for prolonged time periods, particularly where oxygen levels are reduced. The hydrocarbon components of gasoline are slightly soluble in water. Gasoline hydrocarbon components do not readily dissolve in water but can be adsorbed to soils.

Gasoline contains components that are potentially toxic to freshwater and saltwater ecosystems. It will normally float on water. The components of gasoline will evaporate rapidly. Evaporated hydrocarbon components may contribute to atmospheric smog.

MTBE and other oxygenates are more soluble than other gasoline components. In addition, oxygenates such as MTBE do not adsorb to soils, sediments or suspended particulate matter as readily as other gasoline components. MTBE does not degrade as readily as other gasoline components once in ground water or subsoil. MTBE is not expected to bioconcentrate in the aquatic environment.

SECTION 13. DISPOSAL CONSIDERATIONS

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal methodologies for spent materials and residues at the time of disposition.

Maximize material recovery for reuse or recycling. Recovered non-usable material may be regulated by US EPA as a hazardous waste due to its ignitibility (D001) and/or its toxic (D018) characteristics. Conditions of use may cause this material to become a "hazardous waste", as defined by federal or state regulations. It is the responsibility of the user to determine if the material is a RCRA "hazardous waste" at the time of disposal. Transportation, treatment, storage and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR 260 through 40 CFR 271). State and/or local regulations may be more restrictive. Contact your regional US EPA office for guidance concerning case specfic disposal issues.

SECTION 14. TRANSPORT INFORMATION

The shipping description below may not represent requirements for all modes of transportation, shipping methods or locations outside of the United States.

US DOT Status A U.S. Department of Transportation regulated material.

Proper Shipping Name Gasoline, 3, UN 1203, PG II
Gasohol, 3, NA 1203, PGII (Use only for gasoline blended with less than 20% ethanol)

Hazard Class 3 DOT Class: Flammable liquid.

Packing Group(s) II

UN/NA Number UN1203 or NA1203

Reportable Quantity A Reportable Quantity (RQ) has not been established for this material.

Placard(s)

Emergency Response Guide No. 128

MARPOL III Status Not a DOT "Marine Pollutant" per 49 CFR 171.8.

SECTION 15. REGULATORY INFORMATION

TSCA Inventory

This product and/or its components are listed on the Toxic Substances Control Act (TSCA) inventory.

SARA 302/304 Emergency Planning and Notification

The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified.

SARA 311/312 Hazard Identification

The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories:

fire, Acute (Immediate) Health Hazard, Chronic (Delayed) Health Hazard

SARA 313 Toxic Chemical Notification and Release Reporting

This product contains the following components in concentrations above de minimis levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA:
Toluene [CAS No.: 108-88-3] Concentration: <20%
Xylene, all isomers [CAS No.: 1330-20-7] Concentration: <18%
Methyl tertiary-Butyl Ether (MTBE) [CAS No.: 1634-04-4] Concentration: <15%
n-Hexane [CAS No.: 110-54-3] Concentration: <8%
Cumene [CAS No.: 98-82-8] Concentration: <4%
Benzene [CAS No.: 71-43-2] Concentration: <5%
Ethylbenzene [CAS No.: 100-41-4] Concentration: <4%
1, 2, 4 Trimethylbenzene [CAS No.: 95-63-6] Concentration: <4%
Cyclohexane [CAS No.: 110-82-7] Concentration: <3%
Naphthalene [CAS No.: 91-20-3] Concentration: <2%
Styrene [CAS No.: 100-42-5] Concentration: <1%

CERCLA

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. Chemical substances present in this product or refinery stream that may be subject to this statute are:
Toluene [CAS No.: 108-88-3] RQ = 1000 lbs. (453.6 kg) Concentration: <20%
Xylene, all isomers [CAS No.: 1330-20-7] RQ = 100 lbs. (45.36 kg) Concentration: <18%
Methyl tertiary-Butyl Ether (MTBE) [CAS No.: 1634-04-4] RQ = 1000 lbs. (453.6 kg) Concentration: <15%
n-Hexane [CAS No.: 110-54-3] RQ = 5000 lbs. (2268 kg) Concentration: <8%
2,2,4-Trimethylpentane [CAS No.: 540-84-1] RQ = 1000 lbs. (453.6 kg) Concentration: <5%
Benzene [CAS No.: 71-43-2] RQ = 10 lbs. (4.536 kg) Concentration: <5%
Cumene [CAS No.: 98-82-8] RQ = 5000 lbs. (2268 kg) Concentration: <4%
Ethylbenzene [CAS No.: 100-41-4] RQ = 1000 lbs. (453.6 kg) Concentration: <4%
Cyclohexane [CAS No.: 110-82-7] RQ = 1000 lbs. (453.6 kg) Concentration: <3%
Naphthalene [CAS No.: 91-20-3] RQ = 100 lbs. (45.36 kg) Concentration: <2%
Styrene [CAS No.: 100-42-5] RQ = 1000 lbs. (453.6 kg) Concentration: <1%

Clean Water Act (CWA)

This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.

California Proposition 65

	This material may contain the following components which are known to the State of California to cause cancer, birth defects or other reproductive harm, and may be subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5): Gasoline (Wholly Vaporized and Engine Exhaust), Benzene [CAS No. 71-43-3], Toluene [CAS No. 108-88-3], Ethylbenzene [CAS No.100-41-4] and Naphthalene [CAS No.91-20-3]
New Jersey Right-to-Know Label	Gasoline [NJDEP CAS No. 8006-61-9]
Additional Regulatory Remarks	As minimum requirements, CITGO recommends that the following advisory information be displayed on equipment used to dispense gasoline in motor vehicles. Additional warnings specified by various regulatory authorities may be required: "DANGER: Extremely Flammable. Use as a Motor Fuel Only. No Smoking. Stop Engine. Turn Off All Electronic Equipment including Cellular Telephones. Do Not Overfill Tank. Keep Away from Heat and Flames. Do Not leave nozzle unattended during refueling. **Static Sparks Can Cause a Fire, especially when filling portable containers.** Containers must be metal or other material approved for storing gasoline. PLACE CONTAINER ON GROUND. DO NOT FILL ANY PORTABLE CONTAINER IN OR ON A VEHICLE. Keep nozzle spout in contact with the container during the entire filling operation. **Harmful or Fatal if Swallowed. Long-Exposure Has Caused Cancer in Laboratory Animals.** Avoid prolonged breathing of vapors. Keep face away from nozzle and gas tank. Never siphon by mouth." WHMIS Class B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). WHMIS Class D-2B: Material causing other toxic effects (TOXIC).

SECTION 16. OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

REVISION INFORMATION

Version Number	7.0
Revision Date	05/23/2005
Print Date	Printed on 05/23/2005.

ABBREVIATIONS

AP: Approximately EQ: Equal >: Greater Than <: Less Than NA: Not Applicable ND: No Data NE: Not Established

ACGIH: American Conference of Governmental Industrial Hygienists	AIHA: American Industrial Hygiene Association
IARC: International Agency for Research on Cancer	NTP: National Toxicology Program
NIOSH: National Institute of Occupational Safety and Health	OSHA: Occupational Safety and Health Administration
NPCA: National Paint and Coating Manufacturers Association	HMIS: Hazardous Materials Information System
NFPA: National Fire Protection Association	EPA: US Environmental Protection Agency

DISCLAIMER OF LIABILITY

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED REGARDING ITS CORRECTNESS. SOME INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE SUBSTANCE ITSELF. THIS MSDS WAS PREPARED AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE PRODUCT IS USED AS A COMPONENT IN ANOTHER PRODUCT, THIS MSDS INFORMATION MAY NOT BE APPLICABLE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION OR PRODUCTS FOR THEIR PARTICULAR PURPOSE.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE, AND DISPOSAL OF THE PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

***** END OF MSDS *****

Material Safety Data Sheet

24 Hour Assistance:
1-847-367-7700
Rust-Oleum Corp.
www.rustoleum.com

Section 1 - Chemical Product / Company Information

Product Name:	PRO LSPR 6PK MARK FLUORESCENT ORANGE	Revision Date:	05/31/2011
Identification Number:	2554838		
Product Use/Class:	Topcoat/Aerosols		
Supplier:	Rust-Oleum Corporation 11 Hawthorn Parkway Vernon Hills, IL 60061 USA	Manufacturer:	Rust-Oleum Corporation 11 Hawthorn Parkway Vernon Hills, IL 60061 USA
Preparer:	Regulatory Department		

Section 2 - Composition / Information On Ingredients

Chemical Name	CAS Number	Weight % Less Than	ACGIH TLV-TWA	ACGIH TLV-STEL	OSHA PEL-TWA	OSHA PEL CEILING
Liquefied Petroleum Gas	68476-86-8	30.0	N.E.	N.E.	N.E.	N.E.
Aliphatic Hydrocarbon	64742-89-8	20.0	100 ppm	N.E.	100 ppm	N.E.
Toluene	108-88-3	15.0	20 ppm	N.E.	200 ppm	300 ppm
Magnesium Silicate	14807-96-6	10.0	2 mg/m3	N.E.	0.1 mg/m3 (Respirable)	N.E.
Hydrotreated Light Distillate	64742-47-8	5.0	200 mg/m3	N.E.	N.E.	N.E.
Naphtha	8032-32-4	5.0	N.E.	N.E.	N.E.	N.E.
Pigment Orange 13	3520-72-7	1.0	N.E.	N.E.	N.E.	N.E.
Ethylbenzene	100-41-4	1.0	100 ppm	125 ppm	100 ppm	N.E.

Section 3 - Hazards Identification

*** Emergency Overview ***: Contents Under Pressure. Harmful if inhaled. May affect the brain or nervous system causing dizziness, headache or nausea. Vapors may cause flash fire or explosion. Harmful if swallowed. Extremely flammable liquid and vapor.

Effects Of Overexposure - Eye Contact: Causes eye irritation.

Effects Of Overexposure - Skin Contact: Prolonged or repeated contact may cause skin irritation. Substance may cause slight skin irritation.

Effects Of Overexposure - Inhalation: High vapor concentrations are irritating to the eyes, nose, throat and lungs Avoid breathing vapors or mists. High gas, vapor, mist or dust concentrations may be harmful if inhaled. Harmful if inhaled.

Effects Of Overexposure - Ingestion: Aspiration hazard if swallowed; can enter lungs and cause damage. Substance may be harmful if swallowed.

Effects Of Overexposure - Chronic Hazards: May cause central nervous system disorder (e.g., narcosis involving a loss of coordination, weakness, fatigue, mental confusion, and blurred vision) and/or damage. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage.

Primary Route(s) Of Entry: Skin Contact, Skin Absorption, Inhalation, Ingestion, Eye Contact

Section 4 - First Aid Measures

First Aid - Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes holding eyelids open. Get medical attention. Do NOT allow rubbing of eyes or keeping eyes closed.

First Aid - Skin Contact: Wash with soap and water. Get medical attention if irritation develops or persists.

First Aid - Inhalation: If you experience difficulty in breathing, leave the area to obtain fresh air. If continued difficulty is experienced, get medical assistance immediately.

First Aid - Ingestion: Aspiration hazard: Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. Get immediate medical attention.

Section 5 - Fire Fighting Measures

Flash Point: -156 F (Setaflash)

Extinguishing Media: Film Forming Foam, Carbon Dioxide, Dry Chemical, Water Fog

Unusual Fire And Explosion Hazards: FLASH POINT IS LESS THAN 20 °. F. - EXTREMELY FLAMMABLE LIQUID AND VAPOR! Perforation of the pressurized container may cause bursting of the can. Isolate from heat, electrical equipment, sparks and open flame. Water spray may be ineffective. Closed containers may explode when exposed to extreme heat. Vapors may form explosive mixtures with air. Vapors can travel to a source of ignition and flash back. Keep containers tightly closed.

Special Firefighting Procedures: Evacuate area and fight fire from a safe distance.

Section 6 - Accidental Release Measures

Steps To Be Taken If Material Is Released Or Spilled: Remove all sources of ignition, ventilate area and remove with inert absorbent and non-sparking tools. Dispose of according to local, state (provincial) and federal regulations. Do not incinerate closed containers. Contain spilled liquid with sand or earth. DO NOT use combustible materials such as sawdust.

Section 7 - Handling And Storage

Handling: Wash thoroughly after handling. Wash hands before eating. Avoid breathing vapor or mist. Use only in a well-ventilated area. Follow all MSDS/label precautions even after container is emptied because it may retain product residues.

Storage: Keep containers tightly closed. Isolate from heat, electrical equipment, sparks and open flame. Do not store above 120 ° F. Store large quantities in buildings designed and protected for storage of NFPA Class I flammable liquids. Contents under pressure. Do not expose to heat or store above 120 ° F.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Prevent build-up of vapors by opening all doors and windows to achieve cross-ventilation. Use explosion-proof ventilation equipment. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Respiratory Protection: A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. A NIOSH/MSHA approved air purifying respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits.

Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or in any other circumstances where air purifying respirators may not provide adequate protection.

Skin Protection: Nitrile or Neoprene gloves may afford adequate skin protection. Use impervious gloves to prevent skin contact and absorption of this material through the skin.

Eye Protection: Use safety eyewear designed to protect against splash of liquids.

Other protective equipment: Refer to safety supervisor or industrial hygienist for further information regarding personal protective equipment and its application.

Hygienic Practices: Wash thoroughly with soap and water before eating, drinking or smoking.

Section 9 - Physical And Chemical Properties

Vapor Density:	Heavier than Air	Odor:	Solvent Like
Appearance:	Aerosolized Mist	Evaporation Rate:	Faster than Ether
Solubility in H2O:	Slight	Freeze Point:	N.D.
Specific Gravity:	0.876	pH:	N.A.
Physical State:	Liquid		

(See section 16 for abbreviation legend)

Section 10 - Stability And Reactivity

Conditions To Avoid: Avoid temperatures above 120° F. Avoid all possible sources of ignition.

Incompatibility: Incompatible with strong oxidizing agents, strong acids and strong alkalies.

Hazardous Decomposition: By open flame, carbon monoxide and carbon dioxide. When heated to decomposition, it emits acrid smoke and irritating fumes.

Hazardous Polymerization: Will not occur under normal conditions.

Stability: This product is stable under normal storage conditions.

Section 11 - Toxicological Information

Chemical Name	LD50	LC50
Liquefied Petroleum Gas	N.E.	N.E.
Aliphatic Hydrocarbon	>5000 mg/kg (Rat, Oral)	N.E.
Toluene	636 mg/kg (Rat, Oral)	>26700 ppm (Rat, Inhalation, 1Hr)

Magnesium Silicate	N.E.	TCLo: 11 mg/m3 (Inhalation)
Hydrotreated Light Distillate	>3160 mg/kg (Skin)	N.E.
Naphtha	>5000 mg/kg (Rat, Oral)	N.E.
Pigment Orange 13	>5000 mg/kg (Rat)	N.E.
Ethylbenzene	3500 mg/kg (Rat, Oral)	N.E.

Section 12 - Ecological Information

Ecological Information: Product is a mixture of listed components.

Section 13 - Disposal Information

Disposal Information: Dispose of material in accordance to local, state and federal regulations and ordinances. Do not allow to enter storm drains or sewer systems.

Section 14 - Transportation Information

	Domestic (USDOT)	International (IMDG)	Air (IATA)
Proper Shipping Name:	Consumer Commodity	Aerosols	Aerosols
Hazard Class:	ORM-D	2.1	2.1
UN Number:	N.A.	UN1950	UN1950
Packing Group:	N.A.	N.A.	N.A.
Limited Quantity:	No	Yes	Yes

Section 15 - Regulatory Information

CERCLA - SARA Hazard Category

This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

IMMEDIATE HEALTH HAZARD, CHRONIC HEALTH HAZARD, FIRE HAZARD, PRESSURIZED GAS HAZARD

SARA Section 313:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR part 372:

Chemical Name	CAS Number
Toluene	108-88-3

Toxic Substances Control Act:

Listed below are the substances (if any) contained in this product that are subject to the reporting requirements of TSCA 12(B) if exported from the United States:

U.S. State Regulations: As follows -

New Jersey Right-to-Know:

The following materials are non-hazardous, but are among the top five components in this product.

Chemical Name	**CAS Number**
Limestone	1317-65-3

Pennsylvania Right-to-Know:

The following non-hazardous ingredients are present in the product at greater than 3%.

Chemical Name	**CAS Number**
Limestone	1317-65-3
Polymer Anchored Orange Dye Dispersion	MIXTURE
Modified Alkyd	PROPRIETARY

International Regulations: As follows -

CANADIAN WHMIS:

This MSDS has been prepared in compliance with Controlled Product Regulations except for the use of the 16 headings.

CANADIAN WHMIS CLASS: AB5 D2A D2B

Section 16 - Other Information

HMIS Ratings:

Health: 2*	Flammability: 4	Reactivity: 0	Personal Protection: X

NFPA Ratings:

Health: 2	Flammability: 4	Instability: 0

VOLATILE ORGANIC COMPOUNDS, g/L: 547

REASON FOR REVISION: Regulatory Update

Legend: N.A. - Not Applicable, N.E. - Not Established, N.D. - Not Determined

Rust-Oleum Corporation believes, to the best of its knowledge, information and belief, the information contained herein to be accurate and reliable as of the date of this material safety data sheet. However, because the conditions of handling, use, and storage of these materials are beyond our control, we assume no responsibility or liability for personal injury or property damage incurred by the use of these materials. Rust-Oleum Corporation makes no warranty, expressed or implied, regarding the accuracy or reliability of the data or results obtained from their use. All materials may present unknown hazards and should be used with caution. The information and recommendations in this material safety data sheet are offered for the users' consideration and examination. It is the responsibility of the user to determine the final suitability of this information and to comply with all applicable international, federal, state, and local laws and regulations.

WD-40®

Fire 2 Reactivity 0 Health 2 Special 0

NFPA

MATERIAL SAFETY DATA SHEET

I. PRODUCT IDENTIFICATION

Manufacturer:	WD-40 Company	Telephone:	
		Emergency only:	1-(800) 424-9300 (CHEMTREC)
Address:	1061 Cudahy Place (92110)	Information:	(619) 275-1400
	P.O. Box 80607	Chemical Name:	Organic Mixture
	San Diego, California	Trade Name:	WD-40 Aerosol
	92138-0607		

II. HAZARDOUS INGREDIENTS

Chemical Name	CAS Number	%	Exposure Limit ACGIH/OSHA
Aliphatic Petroleum Distillates	8052-41-3	45-50	100 ppm PEL
Petroleum Base Oil	64742-65-0	15-25	5 mg/M^3 TWA (mist)
LVP Hydrocarbon Fluid	64742-47-8	12-18	1200 mg/M^3 TWA
Carbon Dioxide	124-38-9	2-3	5000 ppm PEL
Non-hazardous Ingredients		‹ 10	

III. PHYSICAL DATA

Boiling Point:	323°F (minimum)	Evaporation Rate:	Not determined
Vapor Density (air=1):	Greater than 1	Vapor Pressure:	110 ±5 PSI @ 70°F
Solubility in Water:	insoluble	Appearance:	Light amber
Specific Gravity (H_20=1):	0.832 @ 72°F	Odor:	Characteristic odor
Percent Volatile (volume):	74%	VOC:	412 grams/liter (49.5%)

IV. FIRE AND EXPLOSION

Flash Point:	131°F Tag Closed Cup
Flammable Limits:	(Solvent Portion) [Lel] 1.0% [Uel] 6.0%
Extinguishing Media:	CO_2, Dry Chemical, Foam.
Special Fire Fighting Procedures:	Contents Under Pressure
Unusual Fire and Explosion Hazards:	FLAMMABLE - U.F.C. level 3 AEROSOL

V. HEALTH HAZARD / ROUTE(S) OF ENTRY

Threshold Limit Value — Aliphatic Petroleum Distillates (Stoddard Solvent) lowest TLV (ACGIH 100 ppm.)

Symptoms of Overexposure
- **Inhalation (Breathing):** May cause anesthesia, headache, dizziness, nausea and upper respiratory irritation.
- **Skin contact:** May cause drying of skin and/or irritation.
- **Eye contact**: May cause irritation, tearing and redness.
- **Ingestion (Swallowed):** May caused irritation, nausea, vomiting and diarrhea.

First Aid Emergency Procedures
- **Ingestion (Swallowed):** Do not induce vomiting, seek medical attention.
- **Eye Contact:** Immediately flush eyes with large amounts of water for 15 minutes.
- **Skin Contact:** Wash with soap and water.
- **Inhalation (Breathing):** Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.

Pre-existing medical conditions such as eye, skin and respiratory disorders may be aggravated by exposure.

DANGER!
- **Aspiration Hazard:** If swallowed, can enter lungs and may cause chemical pneumonitis. Do not induce vomiting. Call Physician immediately.

Suspected Cancer Agent — The components in this mixture have been found to be noncarcinogenic by NTP, IARC and OSHA

Yes___ No_X_

VI. REACTIVITY DATA

Stability:	Stable _X_	Unstable____
Conditions to avoid:	NA	
Incompatibility:	Strong oxidizing agents	
Hazardous decomposition products:	Thermal decomposition may yield carbon monoxide and/or carbon dioxide.	
Hazardous polymerization:	May occur ____	Will not occur_X_

VII. SPILL OR LEAK PROCEDURES

Spill Response Procedures

Spill unlikely from aerosol cans. Leaking cans should be placed in plastic bag or open pail until pressure has dissipated.

Waste Disposal Method

Empty aerosol cans should not be punctured or incinerated; bury in land fill. Liquid should be incinerated or buried in land fill. Dispose of in accordance with local, state and federal regulations.

VIII. SPECIAL HANDLING INFORMATION

Ventilation:	Sufficient to keep solvent vapor less than TLV.
Respiratory Protection:	Advised when concentrations exceed TLV.
Protective Gloves:	Advised to prevent possible skin irritation.
Eye Protection:	Approved eye protections to safeguard against potential eye contact, irritation or injury.
Other Protective Equipment:	None required.

IX. SPECIAL PRECAUTIONS

Keep from sources of ignition. Avoid excessive inhalation of spray particles, do not take internally. Do not puncture, incinerate or store container above 120°F. Exposure to heat may cause bursting. Keep can away from electrical current or battery terminals. Electrical arcing can cause burn-through (puncture) which may result in flash fire, causing serious injury. Keep from children.

X.TRANSPORTATION DATA (49 CFR 172.101)

Domestic Surface

Description:	Consumer Commodity
Hazard Class:	ORM-D
ID No:	None
Label Required:	Consumer commodity (ORM-D)

XI. REGULATORY INFORMATION

All ingredients for this product are listed on the TSCA inventory.

SARA Title III chemicals:	None
California Prop 65 chemicals:	None
CERCLA reportable quantity:	None
RCRA hazardous waste no:	D001 (Ignitable)

SIGNATURE: R. Miles RMiles TITLE: Technical Director

REVISION DATE: NOVEMBER 2003 SUPERSEDES: MARCH 2001

NA: Not applicable NDA: No data available $<$ = Less than $>$ = More than

We believe the statements, technical information and recommendations contained herein are reliable. However, the data is provided without warranty, expressed or implied. It is the user's responsibility both to determine safe conditions for use of this product and assume loss, damage or expense, direct or consequential, arising from its use. Before using product, read label.

APPENDIX B

SAMPLING AND ANALYSIS PLAN

FINAL

Revision 1

SAMPLING AND ANALYSIS PLAN

Exploratory Investigation for Magnetic Anomaly Source in Bulb

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
RICHMOND, CALIFORNIA

Project No: 19533A

Prepared for

University of California, Berkeley
Office of Environment, Health, and Safety
University Hall 3rd Floor
Berkeley, CA 94720

Prepared by

CABRERA SERVICES
RADIOLOGICAL•ENGINEERING•REMEDIATION

473 Silver Lane
East Hartford, CT 06118

October 2014

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

ATTACHMENTS

ACRONYMS/ABBREVIATIONS

CoC	Chain of Custody
°C	degrees Celsius
Cabrera	Cabrera Services Inc.
CAM	California Assessment Manual
DQOs	data quality objectives
DTSC	Department of Toxic Substances Control
FSP	Field Sampling Plan
GM	Geiger-Mueller
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
PAH	polyaromatic hydrocarbons
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCBs	polychlorinated biphenyls
pCi/g	picocuries per gram
PID	photoionization detector
QA	Quality Assurance
QC	Quality Control
QCSAP	Quality Control/ Sampling and Analyses Plan
RBC	Richmond Bay Campus
RFS	Richmond Field Station
RPD	relative percent difference
SVOCs	semivolatile organic compounds
TPH-e	total extractable petroleum hydrocarbons
TPH-p	total purgeable petroleum hydrocarbons
UC Berkeley	University of California, Berkeley
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
Work Plan	Exploratory Excavation Work Plan

1.0 INTRODUCTION

This Quality Control/ Sampling and Analysis Plan (QCSAP) describes sample collection and laboratory analyses requirements associated with exploratory excavation at the location of a magnetic anomaly at the University of California, Berkeley (UC Berkeley) Richmond Bay Campus (RBC) site in Richmond, California. This plan is an appendix to *Exploratory Excavation Work Plan,* (Work Plan). The data gathered as a result of this QCSAP will be used primarily for verification of the presence of potential buried drums and identification of drum contents.

While this QCSAP is intended to accurately reflect the planned activities for this project, site conditions may warrant approved deviations. Significant modifications from this QCSAP, if any, will be communicated to UC Berkeley for approval and will be duly recorded in site records.

The UC Berkeley RBC is an academic teaching and research facility located at 1301 South 46th Street, Richmond, California, along the southeast shoreline of the city of Richmond on the San Francisco Bay to the northwest of Point Isabel (see Figure 1) consisting of the Former Richmond Field Station (RFS) and the Regatta Property west of the Former RFS. The Former RFS is a 170 acre property consisting of 96 acres of upland areas that includes a remnant coastal terrace prairie, and 74 acres of tidal salt marsh, mudflats and transitional habitat. The Former RFS has been used primarily for large-scale engineering research since the University acquired the property in 1950 and currently supports a range of research and resource conservation values. (UC Berkeley, 2014).

Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the RFS. In 1950, UC purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering and later, other campus departments and private tenants. The RFS is currently subject to a State of California DTSC Site Investigation and Remediation Order (Docket No. ISE-RAO 06/07-004, dated September 15, 2006) due to the presence of legacy chemical contamination from industrial and UC operations. Portions of the RFS site have been remediated by excavation and off-haul of contaminated soils.

Several large former and existing chemical and industrial sites border the RFS property to the north, west, and east. A former Pacific Gas and Electric Company facility was located to the north of the RFS. The former Kaiser Shipyard and the Butler Steel Products facilities were located to the southwest of the RFS in the current location of the Marina Bay housing development. Bio-Rad Laboratories continues to be located to the west of the RFS.

The adjacent property to the east of RFS is the location of former chemical production operations previously owned by several entities, including Stauffer and Zeneca called the former Zeneca site. (Tetratech 2008). Historically, radioisotopes were used at the former Zeneca site for laboratory research and in 1950 uranium was melted for experimental purposes in an electron beam furnace at the Stauffer-Temescal Company located on site. Additionally, industrial processes relating to production of metal pentachlorides, superphosphate and aluminum sulfate were potential sources of residual naturally occurring radiological materials. A detailed description of the project site, previous investigations, and history of radiological use is provided in the Historical Use Assessment of the Transition Area “Bulb” Alleged Buried Drum Area (UC Berkeley, 2014) attached in Appendix D of the Work Plan.

The Transition Area (see Figure 2 of the Work Plan) of the RFS is a 5.5 acre area of fill material that was placed on top of historic Bay mud flats and early growth salt marsh patches beginning in the early 1950s and continuing until the early 1970s. The Transition Area is defined to the north by the former California Cap Company seawall (portions either removed or now under artificial fill placed at the site) and to the south by the current marsh high tide line (approximately 4.5 feet above mean sea level). Historic aerial photos show creation of the Transition Area, with the placement of a City of Richmond sewer line in a pyrite cinder filled embankment in the 1940s and then with soil and other fill material beginning approximately 1953 and nearing completion in 1969, including the rounded Bay-ward extension that has historically been known as the "Bulb" (UC Berkeley, 2014).

Portions of the Transition Area have been subject to remediation (see Figure 2 of the Work Plan). The western portion of the Transition Area has not been subject to remediation with the exception of a small removal action in October 2008 of four cubic yards of soil and solid waste approximately 200 feet from this investigation area. Fill in the Bulb ranged from 2.5 to 7.5 feet based on borings completed in 2002 with an average depth of 4.6 feet (Tetratech, 2008 p.66).

The Bulb is a gently mounded area of soil covered with ruderal, generally non-native vegetation dominated by a perennial non-native bunchgrass Harding grass (Phalaris aquatic) and also containing native and non-native shrubs and forbs such as Coyote Bush, poison oak and fennel.

In November 2006, DTSC completed a magnetometer survey of the Bulb using a Geometrics G-856 magnetometer. An anomaly roughly 20 by 36 feet was detected in the location shown on Figure 5. This area of this investigation will be refined during a magnetometer survey that will be conducted just prior to the exploratory excavation (UC Berkeley, 2014).

2.0 SAMPLING AND ANALYSIS PLAN

This document has been prepared to provide the sampling program, analytical methods, and quality control (QC) measures for the project site. The purpose of the QCSAP is to assure that data collected meet the intended objectives of the sampling efforts and that the data are of known documented quality.

2.1 LABORATORIES AND TESTING SERVICES

The laboratories used for this project will be chosen on a best-value basis in order to select the most reliable and responsive laboratories. All laboratories used for chemical analyses will be certified by the California Department of Health Services Environmental Laboratory Accreditation Program. Cabrera will monitor the status of laboratory certifications and assure that certifications do not expire during the project. Validated data generated by contracted laboratories will be used to document concentrations of chemical analytes.

The certified laboratory data will be reviewed, verified, and used to characterize and profile wastes that are generated during the project for recycling or disposal. Laboratories generating analytical data will perform in accordance with project requirements described in this plan.

2.2 PLAN ORGANIZATION

The following areas will be addressed in the sections of the QCSAP:

- Data Quality Objectives (DQOs)
- Sample Locations and Collection
- Sample Handling and Custody
- Analytical Methods
- Data Quality Indicators and Goals

2.3 DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative statements developed by data users to specify the quality and quantity of data needed from a particular data collection activity to support decisions or regulatory actions. DQOs may be established for both quantitative and qualitative tasks.

This plan provides methods for control and review of data collected during the field event so that the environmental measurements, sample collection, sample analysis, and data analyses are scientifically sound, technically and legally defensible, and of known, documented quality. The data must be of sufficient quality to facilitate a delineation and comparison of contamination for waste profile purposes.

The DQO development process outlined in Guidance for the Data Quality Objective Process (USEPA, 1994) was followed to develop DQOs for the project.

The seven steps required to achieve appropriate DQOs for the project are:

- Step 1: Statement of the Problem
- Step 2: Identification of Decisions
- Step 3: Identify Inputs to Decisions

- Step 4: Definition of Study Boundaries
- Step 5: Development of Decision Rules
- Step 6: Specification of Limits on Decision Errors
- Step 7: Optimization of Design for Obtaining Data

For brevity and conciseness, details for each of the seven DQO steps are presented in tabular format in Table 1.

2.4 SAMPLING PLAN

The samples collected under this plan will follow the procedures detailed in the following sections. Sampling activities will occur as required during execution of the Work Plan. Soil samples will be collected concurrently during exploratory excavation to document findings. Radiation measurements will be obtained in the exploratory excavation.

2.4.1 Sampling Locations

Soil samples will be collected from the excavation(s). The number of soil samples will be determined in the field by DTSC and UC Berkeley. Soil sample locations may be guided by results from the photoionization (PID) or radiation detector. Additional samples may also be collected based on visual observation (e.g. soil staining). Soil sampling will be performed in accordance with Cabrera OP-352, *Subsurface Soil Sampling*. Field screening will be performed in accordance with Cabrera OP-037, *Use of Photoionization Detector* or OP- 020, *Operation of Contamination Survey Meters*. All Cabrera OPs are presented in Attachment A.

If the drums are found, but they are severely corroded, then samples will be collected remotely, as possible, in the excavation using the excavator bucket. All attempts will be made to collect a volumetric sample of the contents of the drum(s). If drums are found and they are intact and unopened, then a drum will be brought to the surface and loaded directly into a B-25 container on-site. Non-invasive surveys (i.e., gross gamma counting, in situ gamma spectroscopy) will be performed as possible. The lid to the B-25 container will then be secured and the B-25 container moved to the access-restricted drum storage area to the west of B110. Within 30 days, the drum will be sampled using all health & safety precautions (placed into a HEPA filtered tented containment or equivalent protection and opened by staff in Level A PPE). If needed, the drum and its contents will be moved to the campus Hazardous Materials Facility for eventual disposal after receiving the analytical data on the contents. All sample locations will be documented on sketches or schematic diagrams and on Daily Field Activity Report, in accordance with Cabrera OP-359, *Operating Procedure for Field Activity Documentation*. Sampling activities will also be documented with representative photographs.

Radiation measurements will be obtained near the surface of the excavations and inside the excavations. Measurements with a sodium iodide scintillation detector will be used to measure gamma radiation levels within an inch of the surface and subsurface soil, per OP-020.

2.4.2 Sample Collection

Soil samples will be collected as requested by DTSC and UC Berkeley personnel in the field. Soil samples will be collected by a grab sample with assistance from the excavator, per OP-352. Care will be taken to collect the sample away from the sides of the excavator bucket. Drum contents will be sampled only if site conditions (as described in Section 2.4.1) allow from the excavator bucket. All investigation soil/drum content samples collected will be field screened with a Ludlum 44-20 sodium iodide scintillation detector and Ludlum Model 44-9 (Geiger-Mueller [GM] pancake probe) detector (per OP-020), or equivalents, to determine if the radiation readings are consistent with background levels prior to laboratory submittal. If elevated levels are detected, then the applicable analytical laboratory will be consulted to determine the maximum acceptable sample activity that they may receive for analysis. The sample will be placed in an appropriate container per Table 2. Samples will be labeled with a unique identifier and processed for shipment to the laboratory.

2.4.3 Sample Handling and Custody

This subsection describes the requirements for sample containers, handling, custody, packaging, and shipping.

2.4.3.1 Sample Containers

Soil samples will be placed in pre-cleaned containers specified for each analytical method. Table 2 provides additional information on sample containers, preservatives, and holding times.

2.4.3.2 Sample Handling

Approved site-specific personal protective equipment, such as gloves, will always be used when collecting a sample to prevent cross-contamination from sample to sample and to assure worker health and safety. A new pair of gloves will be used to collect and handle each sample to prevent cross contamination. Samples will be placed in a cooler with wet ice for shipment to the contacted laboratory, in accordance with Cabrera OP-062, S*ample Handling, Packaging and Shipping*.

2.4.3.3 Sample Labeling

Each sample will be assigned a unique identifier using the following designations:

- "RBC" – Richmond Bay Campus sample
- "MMDDYY" – Sample Date
- "1" – Sequential number
- "S" – designator to indicate sidewall sample or B – to indicate bottom sample or D – to indicate drum sample

The following sample label would indicate the third sample collected from the site on October 15, 2014 at an excavation bottom location:

"RBC-101514-3B"

The sample collection date and time, requested analyses, client, and sampler will also be identified on the label.

2.4.3.4 Sample Custody

Each sample will be entered onto a Cabrera Sample Tracking Log and laboratory Chain of Custody (CoC) and recorded in accordance with the contracted laboratory for this project and

Cabrera OP-066, *Operating Procedure for Sample Tracking Log*. Samples will be placed in shipping containers sealed with custody tape and sent to the laboratory via a courier. Laboratory couriers will provide a signed sample receipt with a discrete individual number when they pick up samples at the site, transferring custody to the laboratory at that time. If commercial carrier or courier is used, the laboratory will check the custody tape on each shipping container upon receipt to ensure that the shipping container has not been tampered with. After ensuring that the shipping container has not been tampered with, the laboratory representative will sign the CoC, noting the time and date of receipt, and thereby assuming custody of the samples.

2.4.3.5 Sample Documentation

Field personnel will document sampling activities on a Daily Field Activity Report, per OP-359. Each page of the log will be signed and dated by the individual(s) making entries. Field personnel will enter notes and observations on the log and will also take photographs to document field activities. A record of the photographs, including the date of the photograph, photographer, frame number, and subject will be maintained on a photograph log.

Samples will be documented daily on a sample-tracking log, per OP-066. The tracking log will list the sample number, type, location, specific location, shipment date, the CoC number, the laboratory location, and the parameters to be analyzed. Any discarded samples will be noted on the sample tracking log.

2.4.3.6 Temperature

Samples will be stored at 4 degrees Celsius (°C) ± 2°C prior to shipment to the laboratory. Shipping containers will be packed with ice before shipment to ensure that the samples arrive at the laboratory chilled to 4°C ± 2°C. The ambient temperature of the sample shipping containers, when received at the laboratory, will be measured from a temperature blank only and recorded on the CoC form. Sample shipping containers received at the laboratory within 4 hours of sample collection and at less than or equal to 10°C will not be subject to normal temperature requirements. Radiological samples do not require specific temperature storage requirements and will be handled separately from the other samples.

2.4.3.7 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with the certified laboratory procedures and OP-062. The sample container will be placed in a shipping container (typically a cooler) allowing sufficient room between the samples to place ice and/or packing material. The samples will be maintained under proper CoC documentation. The sample container will be tightly sealed and custody tape placed around or over the top. The container will be inspected for integrity and the drain plug sealed with tape.

The contracted laboratory will be notified 24 hours prior to sample collection to arrange for sample pickup at the site or for delivery to the laboratory. The container will be marked and labeled, and custody relinquished to the courier.

2.4.4 Decontamination of Sampling Equipment

Dedicated sampling equipment will be used where possible to minimize decontamination requirements. Non-dedicated sampling equipment (i.e., volatile organic compounds [VOC] sampler, etc.) will be decontaminated between sample locations by the following steps:

- Wash with soap and water
- Rinse with tap water
- Rinse with deionized water

If radiological contamination is suspected then all surfaces of each piece of equipment will be surveyed with a GM pancake detector to determine the presence of contamination. Decontamination activities will be performed in accordance with Cabrera OP-373, *Environmental Operating Procedure for Field Equipment Decontamination*.

2.5 ANALYTICAL METHODS SUMMARY

Analytical methods for radiological parameters are summarized in Table 2. Analytical methods for non-radiological parameters are provided in the *Phase I Groundwater Field Sampling Workplan* (FSP; Tetratech, 2010). It is anticipated that sample analyses will be completed on a standard turn-around-time schedule, although some samples may require analyses on a rush turn-around schedule. Standard turn-around-time for laboratory results will be a maximum of 14 calendar days while rush turn-around-time is typically within 24 to 48 hours from receipt of the samples at the laboratory, except for radiochemical analyses that may have up to a standard 28 day turn-around time. Final data packages will be provided within 14 calendar days. The methods outlined have been selected on the basis of technical merit to achieve the data quality objectives of the project. The certified laboratory analytical methods and QC sample collection are described in the following subsections.

2.5.1 Certified Laboratory Analysis

Samples will be analyzed for the following:

- California Assessment Manual (CAM)-17 metals per United States Environmental Protection Agency (USEPA) Method 6010/7470/7471
- VOCs per USEPA Method 8260B
- semivolatile organic compounds (SVOCs) per USEPA Method 8270
- polychlorinated biphenyls (PCBs) and pesticides per USEPA Method 8081/8082
- polyaromatic hydrocarbons (PAHs) per USEPA Method 8270SIM
- total purgeable petroleum hydrocarbons (TPH-p) per USEPA Method 8015B
- total extractable petroleum hydrocarbons (TPH-e) per USEPA Method 8015B
- gamma spectroscopy per USEPA Method 901.1M or equivalent
- alpha spectroscopy (isotopic uranium) per DOE HASL 300 or equivalent

The project-specific analytical reporting limits, QC sampling requirements, and holding times are discussed in the following subsections.

2.5.2 Analytical Methods and Reporting Limits

Project-specific analyte lists and reporting limits for radiological analyses are presented in Table

3. Project-specific analyte lists and reporting limits for non-radiological analyses are presented in the *Phase I FSP* (Tetratech, 2010). Certified laboratories will report analytical results in milligrams per kilogram (mg/Kg), milligram per liter (mg/L), or in picocuries per gram (pCi/g).

2.5.3 Quality Control Samples

Quality control samples will be collected in association with certified laboratory samples on a per matrix basis. At a minimum, one field duplicate sample will be collected for every 10 non-waste profile samples (10 percent).

2.5.4 Holding Times

Samples shall be analyzed within the holding times presented in Table 2 and the *Phase I FSP* (Tetratech, 2010).

2.6 FIELD DOCUMENTATION

This section describes the procedure for properly documenting activities in the field during the course of the project. A photographic record of field activities will also be maintained. The requirements for field documentation are presented in Cabrera OP-059 *Operating Procedure for Field Activity Documentation*.

This section outlines the standard practices and procedures to be used when documenting a sampling event. All documentation will be completed with indelible ink. Corrections to documentation will consist of placing a single line through an incorrect entry, noting corrected information, and initializing and dating the changes.

During the field investigation, Daily Field Activity Reports will be prepared. These reports will be entered in an electronic format on a computer so that they can be transferred through email more efficiently to project personnel. Daily Field Activity Reports will be emailed to the UC Berkeley project manager on a daily basis (prior to noon for the preceding day’s activities).

Daily Field Activity Reports will serve to document the daily activities occurring on the project. The weather for each day and any additional environmental conditions or observations pertinent to field activities will be documented. The level of personal protective equipment worn at the site for that day will be recorded. A list of team members present and their role on the project as well as visitors to the immediate investigation area will be included. Any meetings or briefings will be summarized. Significant issues that may require coordination with UC Berkeley will be summarized. Work completed for the day and project will be documented. Any changes or delays in the project will also be documented, along with any safety issues that may arise. Any issue requiring UC Berkeley approval or decision will be communicated verbally in a timely fashion.

2.7 ANALYTICAL DATA QUALITY INDICATORS AND GOALS

The term "data quality" refers to the level of accuracy associated with a particular data set. The data quality associated with environmental measurement data is a function of the sampling plan rationale and procedures used to collect the samples, as well as of the analytical methods and instrumentation used in making the measurements. Each component is a potential source of bias that may affect the overall accuracy and/or precision of measurement. Data quality evaluation will be based on several indicators including precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) of the analytical methods.

Sources of accuracy that can be traced to the sampling component of environmental data collection are the sampling plan design, sample handling, sample transportation, and use of OPs. The important components to ensuring accuracy are proper calibration and the elimination of sources of potential contamination.

One of the largest components of total accuracy associated with environmental data collection originates from the sampling process. All sampling conducted in support of this project will incorporate review of sample location identifications and other field data prior to execution in order to minimize potential uncertainty.

Uncertainty cannot be eliminated entirely from environmental data. The amount of uncertainty that is tolerable depends on the objective of the sampling program and the intended use of the data collected. The purpose of this project's program, as described in this QCSAP, is to ensure that the data collected are of known and documented quality, and are useful for the purposes for which they were collected.

Where data have elevated reporting limits, Cabrera and the UC Berkeley technical team will review the data to determine the implications for risk evaluation. This review will be conducted of preliminary data in order to assure timely recollection of samples if required. If it is determined that the elevated detection limits are acceptable to allow risk evaluation, no further sampling or analysis will be conducted. If the elevated detection limits would adversely impact risk evaluation, then sampling and analytical methods will be investigated by the Cabrera and UC Berkeley technical team to determine what course of action will be required to facilitate the laboratory obtaining the appropriate detection limits.

The data quality objectives for the analyses performed for this project will be assessed in terms of PARCCS. These objectives were developed based on USEPA method guidelines and previous analytical and field experience. The manner in which PARCCS objectives will be evaluated is presented below.

2.7.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. Precision data will be assessed from the analysis of field and laboratory duplicates. Precision will be expressed in terms of a relative percent difference (RPD). Precision shall be evaluated through the analysis of field and laboratory duplicate samples. Field duplicate samples shall be performed for all inorganic and radiochemical analyses at a rate of one in 10 (one duplicate sample for each batch up to a maximum of 10 samples). Laboratory duplicate samples shall be performed for all inorganic and radiochemical analyses at a rate of one in 20 (one duplicate sample for each batch up to a maximum of 20 samples). Laboratory precision goals are presented in Table 3 and the *Phase I FSP* (Tetratech, 2010).

Laboratory duplicate samples not meeting QC criteria shall be rerun once. Failure of different target compounds to meet QC criteria on successive runs in cases where more than one target compound has been identified shall constitute failure.

2.7.2 Accuracy

Accuracy is the nearness of a result or the mean of a set of results to the true value. Accuracy will be assessed through the analysis of Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD). The results are expressed as a percent recovery. Radiochemical analysis will not include a LCSD. Laboratory accuracy goals are presented in Table 3 and the *Phase I* FSP (Tetratech, 2010).

2.7.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that relates to the proper design of the sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected.

Appropriate sampling techniques and the rationale used to select sampling locations, as described in the Work Plan and this QCSAP, will generate representative data for this project.

2.7.4 Completeness and Comparability

The comparability criterion is a qualitative characteristic that is an expression of the confidence with which one data set can be compared to another. Comparability is concerned with whether the field sampling techniques, analytical procedures, and concentration units of one data set can be compared with another. Data comparability will be achieved at the laboratory by using standard analytical methods and standard units of measurement, as specified in the methods.

Completeness is defined as the percentage of valid data relative to the total number of tests conducted. Valid data are comprised of those data that meet all of the acceptance criteria. The completeness goal for this project for all QC parameters, except holding times, will be 90 percent. The project goal for holding times will be 100 percent. Completeness shall be calculated by dividing the number of complete sample results by the total number of sample analyses listed in the sampling plan. Based on the severity of percent incompleteness and the impact of any incomplete data, Cabrera will discuss potential resampling or reanalysis to fill the data gap.

Completeness of the quality assurance and quality control (QA/QC) program shall be evaluated qualitatively and quantitatively. The qualitative evaluation of completeness shall be determined as a function of all events contributing to the sampling event, including items such as correct handling of CoCs, etc. The quantitative description of completeness is defined as the percentage of laboratory controlled QC parameters that are acceptable. QC parameters that will be assessed for completeness will include analysis of laboratory duplicates for RPD, analysis of LCS/LCDs for percent recovery, holding times, and preservation. The requirement for the quantitative assessment of completeness shall be 90 percent. The goal for holding times will be 100 percent. The requirement for holding times will be guided by the analytical holding times specified by SW846 or other guidance documents specified in this plan.

2.7.5 Sensitivity

Sensitivity goals are the laboratory reporting limits for the analytical method. Laboratory reporting limits are presented in Table 3 and the *Phase I FSP* (Tetratech, 2010).

2.8 DATA VERIFICATION

Data verification is the systematic process for reviewing a set of data against pre-established criteria to determine the quality of the data. The laboratory will review their data for nonconformances and consistency. Upon receipt of the analytical data package from the laboratory, Cabrera project personnel will check the following items:

- Data package includes all requested deliverables
- Samples were analyzed as requested
- Sample holding times were met
- QC sample results were within established control limits
- Appropriate detection limits were obtained
- Preservation met
- CoC maintained
- Sample integrity maintained
- Calibration criteria met
- Blank sample results reported correctly

A systematic effort will be made to identify any outliers and/or errors prior to the reporting of the data to DTSC. Outliers (data values that are significantly different from the population) can result from improper sampling or analytical methodology, matrix interference, errors in data transcription, and real but extreme changes in analytical parameters. Outliers that result from errors found during data validation will be identified. Outliers that cannot be attributed to analytical, calculation or transcription errors will be retained in the database for further evaluation. Final data will be reviewed in accordance with the project specific criteria specified in this QCSAP and the method specific criteria stated in the analytical method. Results from the data review will be included in the appropriate technical report and submitted to DTSC.

2.9 DATA REPORTING

Once the analytical data have been reviewed by the laboratory, the following information will be provided in each data package and issued to the Cabrera technical manager in a paginated report for each sample delivery group.

- For each analytical method, the laboratory shall report all analytes as a detected concentration or as less than the reporting limits. All samples with out of control spike recoveries being attributed to matrix interference will be designated as such. Dilution factors, date of digestion, date of analysis, and method detection limits shall be reported for each analyte and method.
- Reports of method blanks shall include all analytes for each analytical method. Analytical results for each sample should be clearly associated with a particular method blank. Any detected concentration found in method blanks shall be reported. Reports of concentrations below the practical quantitation limits are necessary to evaluate low-level determinations of target compounds in samples.

- Results for laboratory duplicates shall be reported with RPD limits for duplicate analyses.
- LCS/LCD results shall be reported with control limits for LCS/LCD analyses. Analytical results for each sample should be clearly associated with a particular LCS/LCD.
- Results of initial and continuing calibration for all analyses shall be included in the data package. Calibration verification standard and blank are analyzed at the beginning of the analysis and after every tenth sample. The concentrations of the standards used for analysis and the date and time of analysis must be included. Daily calibration information shall be linked to sample analyses by summary or by daily injection or analysis logs.
- Data results for radiochemical analyses will be reported at the detected activity with associated error. The minimum detectable activity will be reported for each analysis.

The contract laboratory shall prepare a summary of all samples with detected concentrations of target compounds indexed by method and by sample identification.

The comprehensive certificate of analysis shall contain a narrative section identifying samples not meeting QC criteria and any other out of control condition. The narrative shall describe the corrective action taken. If "matrix effects" are invoked as a cause for out of control recoveries, a subsection of the narrative shall present a detailed justification for this assertion to include a summary of all relevant quality control data.

The data package shall be prepared at the conclusion of the sampling and analytical work. If requested, draft analytical results and preliminary QC data only shall be submitted to Cabrera as soon as they are available. Draft analyses results do not have to satisfy all of the requirements of this section, but should contain basic QC information such as method blank results.

The QC information provided will be used by Cabrera project staff to evaluate the quality of the data. The results of this evaluation will be summarized and included in the appropriate technical report.

3.0 REFERENCES

University of California, Berkeley, (UC Berkeley) 2014. *Radioactive Materials Investigation Historic Use Assessment Transition Area "Bulb" Alleged Buried Drum Area*. Richmond Field Station, Richmond, CA. May

United States Environmental Protection Agency (USEPA), 1986, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, including Updates I, II, and IIA, Washington, D.C.

USEPA, 1994. Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process, EPA QA/G-4 Interim Final, Quality Assurance Management Staff, Washington, DC.

Cabrera Services, Inc. (Cabrera), 2014. *Exploratory Excavation Work Plan, Exploratory Investigation for Magnetic Anomaly Source in Bulb*, University of California, Berkley, Richmond Field Station, Richmond, CA. September.

Tetra Tech, Inc. (Tetra Tech, formerly Tetra Tech EM Inc. from 1996-2012) 2008. *Current Conditions Report*, University of California, Berkeley, Richmond Field Station, Richmond, California. November 21.

Tetra Tech 2010. *Phase I Groundwater Field Sampling Workplan*, University of California, Berkeley, Richmond Field Station, Richmond, California. June 2. http://rfs-env.berkeley.edu/documents/2010.6.02.RFS.FSWPhase1Final.pdf

TABLES

Table 1: Data Quality Objectives

Step 1 State the Problem	Step 2 Identification of Decisions	Step 3 Identify Inputs to Decisions	Step 4 Definition of Study Boundaries	Step 5 Decision Rules	Step 6 Limits on Decision Errors	Step 7 Sampling Design
A metal anomaly detected during a previous geophysical survey maybe potential burial site for drums. Proper identification of the metal anomaly, and if applicable drum characterization, will assist in determining if a threat to human health and environment exists.	The primary decision associated with the project is to determine the source of the magnetic anomaly. If drums are found then an additional decision is to collect data to assist in determining if a threat to human health and the environment exists. The following decisions must be made or actions must be taken for proper identification of chemical or radiological analytes which may pose a threat to human health and the environment: Is there soil contamination, or contamination present in buried drums, that could be a threat to human health or the environment?	The following input will be used to make the decisions listed in Step 2: • Analytical results from sampling and analysis. • Results from a previous field geophysical investigation • Field observations during trench excavations. • Results from field screening using real-time instrumentation during excavation activities. • Standard analytical methods published by the EPA, state regulatory authorities, or the ASTM exist for all the chemical, radiological, and physical tests required to make removal action decisions. • Analytical services of certified laboratories will be used to perform the sample analyses.	The boundaries of the study consist of an area identified to contain a magnetic anomaly.The area is anticipated to be limited to approximately 50 ft by 50 ft. There are no temporal constraints on the project.	The following "if…then" statements will serve as the decision rules for the project: • "If soil samples or the results of field surveys for VOCs, H_2S and/or radiation indicate the presence of contamination above twice background levels for radiation or above background levels for metals, or above laboratory detection limits for VOCs, SVOCs, or pesticides/ PCBs then there may be a threat to human health or the environment, and further remedial action will be considered for the site."	The following limits on decision error will be implemented: Laboratory quality control limits consistent with project objectives will be implemented as listed in Section 2.6.	Field screening and biased judgmental soil sampling will be used to document concentrations of the analytes from excavations and encountered drums. Three types of sample locations are anticipated: • Soil samples from excavation • Drum content samples Samples will be collected from the excavation as determined by project stakeholders (DTSC, UC Berkeley) to document analyte concentrations. Samples may also be collected if field screening instrumentation (e.g, PID or Geiger-Mueller beta/gamma detector) indicate concentrations or levels above background. Soil samples will be analyzed for the following analytes: • CAM-17 metals per PA Method 6010/7470/7471 • VOCs per EPA Method 8260B • SVOCs per EPA Method 8270 • PCBs and pesticides per EPA Method 8081/8082 • PAHs per EPA Method 8270SIM •TPH-e, TPH-p per EPA Method 8015B • gamma spectroscopy per EPA Method 901.1 or equivalent • alpha spectroscopy (isotopic uranium) per DOE HASL 300 or equivalent

Table 2: Summary of Sample Collection and Analysis

Location/ Matrix	Analytes	Analytical Methods[1]	Number of Samples (estimated)	Sample Container	Preservative	Holding Time	Sample Volume
Excavation or Drums / Solid	Gamma Spectroscopy	EPA 901.1M or equivalent	5	1 liter wide mouth plastic jar	None	6 months	750 g
	Gamma Spectroscopy (21-day ingrowth for radium-226)	EPA 901.1M or equivalent	5	1 liter wide mouth plastic jar	None	6 months	750 g
	Isotopic Uranium	DOE HASL 300 or equivalent	5	125 ml glass jar	None	6 months	100 g
Frac Tank/Liquid	Gamma spectroscopy	EPA 901.1M or equivalent	1	1 liter poly	HNO_3 to pH<2	6 months	1 L
	Isotopic Uranium	DOE HASL 300 or equivalent	1	1 liter poly	HNO_3 to pH<2	6 months	1 L

Notes: 1) Analytical methods referenced from U.S. Environmental Protection Agency (EPA), 1986, *Test Methods for Evaluating Solid Waste, SW-846, Third Edition, including Updates I, II, and IIA,* Washington, D.C.

2) All non-radiological samples will be collected and analyzed in accordance with the *Phase I Groundwater Field Sampling Workplan* (Tetratech, 2010).

Table 3: Laboratory Reporting and Quality Control Limits

Radiochemistry	MDA solids (pCi/g)	MDA liquids (pCi/l)	LCS Recovery
Gamma Spectroscopy	0.1 (referenced to Cs-137)	20.0	80%-120% (Cs-137 & Co-60)
Isotopic uranium	0.5	1.0	80%-120%

Notes:
Laboratory reporting and quality control limits for all non-radiological analyses are provided in the *Phase I Groundwater Field Sampling Workplan* (Tetratech, 2010).
pCi/g = picocuries per gram
pCi/L = picocuries per liter
MDA= minimum detectable activity
LCS = laboratory control spike
Cs-137 = cesium-137
Co-60 = cobalt-60

ATTACHMENT A

OPERATING PROCEDURES

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

OPERATING PROCEDURE

FOR

OPERATION OF CONTAMINATION SURVEY METERS

OP-020

REVISION 1.0

Reviewed by:

4/112/13

David Wunsch, Quality Assurance Manager | Date

Approved by:

Henry Siegrist

4/12/2013

Henry Siegrist, CHP, PE, Radiation Safety Officer | Date

1.0 PURPOSE

This procedure provides the methods for Cabrera Services Inc. (CABRERA) to use when operating alpha/beta survey meters in performing contamination surveys. Adherence to this procedure will provide a reasonable assurance that the surveys performed have reproducible results.

2.0 APPLICABILITY

This procedure will be used by CABRERA personnel to measure fixed and removable alpha and/or beta/gamma emitting radioactive material on facility surfaces, equipment, waste packages, personnel, personnel protective clothing, etc.

3.0 DEFINITIONS

3.1 Restricted Area – An area containing radioactive material(s) to which access is controlled, by the licensee, to protect individuals from exposure to ionizing radiation.

3.2 Alpha/Beta Contamination Survey – A survey technique used to determine fixed and removable alpha/beta contamination.

3.3 Acceptance Range – A range of values that describe an acceptable daily instrument source check result.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

4.1 Precautions

4.1.1 Ensure that thin Mylar or mica windows on the probe face are protected from punctures, during survey operations.

4.1.2 In the case of the 44-110 tritium windowless meter, very fragile anode wires are behind the screen. **Note:** Do not allow objects to pass beyond the protective wire screen as damage to the detector can occur.

4.1.3 If any instrument inconsistencies are observed (e.g., unusually high or low background readings, source checks outside the acceptable range, etc.), remove the instrument from use, label it “OUT OF SERVICE” and report the condition to the Radiation Safety Officer (RSO), Site Radiation Safety Lead (SRSL), or a duly authorized representative.

4.2 Limitations

Typical operating temperature ranges for detectors are -20 to 50 degrees Celsius (°C) [-4 to 122 degrees Fahrenheit (°F)].

4.3 Requirements

4.3.1 Calibration sources must be traceable to the National Institutes of Science and Technology.

4.3.2 A battery check, general observation of instrument condition, high voltage check, and source response check will be performed each day before instrument use. An end of daily work activities final verification of instrument operability may also be provided, as required by site work plans.

4.3.3 Survey instrument calibrations will be performed by a calibration facility licensed by the Nuclear Regulatory Commission or an Agreement State.

4.3.4 Instruments used to perform routine surveys will be used in accordance with the applicable CABRERA administrative and operational procedures. Authorized suppliers of properly calibrated and maintained equipment will supply/calibrate instruments.

4.3.5 Prior to field mobilization, project SRSL and identified radiological leads will review approved work plans to ensure identified survey equipment is appropriate. Where practical, equipment familiarization with expected ranges to be used, typical efficiency of detection, and templates to be used in the field with the particular instrument are desired.

4.3.6 Personnel performing the survey will ensure that this procedure is the most current and approved revision.

4.3.7 Personnel performing the survey will review QC records to ensure that the instrument passed the source-check prior to use.

4.3.8 The RSO or their duly authorized representative will review any applicable completed forms and templates for accuracy and completeness.

4.3.9 All entries documented on pertinent forms must be dated and initialed by personnel performing the survey to be valid.

5.0 EQUIPMENT

5.1 Equipment counting efficiencies should be determined by qualified CABRERA personnel to verify efficiencies of calibrated instruments prior to use. Routine survey equipment includes, but is not limited to:

5.1.1 Alpha Surveys – Ludlum Model 43-5 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.1.2 Beta/Gamma Surveys – Ludlum Model 44-9 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

5.2 Proportional meters may be advantageous for use in situations where the suspected contamination type is unknown or the contamination contains mixed alpha and beta/gamma components. Alpha and beta/gamma contamination can be detected simultaneously with proportional meters. Proportional meters that may be used for a contamination survey include, but are not limited to:

5.2.1 Hand-held meters – Ludlum Model 43-93 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.2 Gas proportional floor meters – Ludlum Model 43-37 probe coupled with a Ludlum Model 2360 meter or an equivalent meter/probe combination.

5.2.3 Radionuclide-specific meters – Includes meters such as a tritium contamination meter: Ludlum Model 44-110 probe coupled with a Ludlum Model 2221 meter or equivalent meter/probe combination.

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

6.0 RESPONSIBILITIES

6.1 <u>Project Manager</u> (PM) – Ensuring that personnel assigned the task of operating contamination survey meters know and understand this procedure, are adequately trained, and have access to a current copy.

6.2 <u>Radiation Safety Officer</u> (RSO) – Verifying that personnel comply with this procedure and are trained in the use of the contamination survey meters described in this procedure.

6.3 <u>Site Radiation Safety Lead</u> (SRSL) – During field assignments, the SRSL is responsible for ensuring that this procedure is properly implemented and will review approved work plans to ensure identified survey equipment is appropriate. When the RSO is not on site, the SRSL will act as the RSO's duly authorized representative for radiological issues.

6.4 <u>Radiation Protection Technician</u> (RPT) – The RPT operating contamination survey meters is responsible for knowing, understanding, and complying with this procedure and may be required to review approved work plans to ensure identified survey equipment is appropriate.

7.0 PROCEDURE

7.1 Instrument Inspection

7.1.1 Select the contamination survey meter and probe to be used in the survey.

7.1.2 Before each use, perform the following checks:

- Verify the probe/meter has a current calibration label.
- Visually inspect the probe/meter for physical damage or defects.
- Position the meter switch to “BAT” and check to see that the needle falls within the “Bat Test” checkband.
  - If the needle falls below the “Bat Test” checkband, install new battery(ies).
  - If the needle still falls outside the “Bat Test” checkband after the installation of new batteries, tag the instrument “OUT OF SERVICE” and notify the RSO or their duly authorized representative.
- Check alpha detectors for light leaks by pointing the Mylar window of the detector towards a light source (preferably sunlight) and observing for a change in the meter indication.

7.1.3 Remove and tag the instrument “OUT OF SERVICE” if it fails any of the criteria in steps 7.1.1 and 7.1.2 and notify the RSO or their duly authorized representative.

Note: Any defects, damages, or other physical abnormalities require that the instrument be removed from service and the RSO or their duly authorized representative be notified.

7.2 Initial Preparations

7.2.1 Assure that the necessary daily quality control (QC) checks have been performed prior to instrument use.

7.2.2 Obtain the necessary forms, smears, and protective clothing that will be used during the survey. This information can be obtained from the Radiation Work Permit (RWP) or the SRSL.

7.2.3 Position the meter fast/slow (“F/S”) switch to “S” as appropriate.

7.2.4 Position the meter switch to the appropriate range scale.

7.2.5 Ensure that the QC acceptance range has been calculated utilizing CABRERA count rate templates. Current templates can be obtained from the RSO and may be found in the CCDR.

7.3 Daily QC Check

7.3.1 Ensure both the source and detector are in documented, reproducible positions which will be used each time this check is performed.

7.3.2 Allow the instrument reading to stabilize (approximately 30 seconds) and place the QC source on its designated position, near the detector, and record the value on the QC template.

7.3.3 Compare the reading to the acceptance range and response check criteria on the count rate QC template. If the response reading falls outside of the acceptance range, tag the instrument "OUT OF SERVICE" and notify the RSO or their duly authorized representative.

7.4 Contamination Survey Techniques

CAUTION*:* The window area of the detectors is covered with either a very thin layer of aluminized Mylar or mica. In the case of the tritium windowless detector, small anode wires are present behind the protective screen. Windows and fragile anode wires can be easily punctured or broken when surveying areas that have protruding fragments. Ensure that care is used and that such potentially damaging fragments are removed, prior to performing surveys, or avoided.

Note: To maintain the calibrated detection efficiency, the detector must be held at the appropriate height when surveying, which is determined during calibration. For example, if a beta probe's efficiency was calculated at ½ inch from the calibration source, the detector must be held at ½ inch from the surface being surveyed to maintain calibrated detection efficiency.

Avoid contacting the detector probe to the area being surveyed. This potentially could contaminate the probe.

7.4.1 Initially, verify the instrument selector switch is in the x0.1 position or on the lowest scale. Scale settings may change during surveys.

7.4.2 For a stationary reading, place the detector over the area to be measured and allow the meter to stabilize. Record the average meter indication in either counts per minute (cpm) or total counts recorded on the ratemeter, in a set time interval, on the radiological survey form/template.

7.4.3 For a scan survey, move the detector slowly over the surface, at the rate described in the site work plan and record data, as described by the plan.

7.5 Final Verification

If required by the site work plan, upon completion of work activities, repeat steps 7.1.1 and 7.1.2 as a final verification that the instrument is working properly.

8.0 REFERENCES

- Radiation Safety Program, Cabrera Services Inc., Manual
- OP-187, *Records Management*, Cabrera Services Inc., Operating Procedure
- OP-001, *Radiological Surveys*, Cabrera Services Inc., Operating Procedure
- OP-009, *Use and Control of Radioactive Sources*, Cabrera Services Inc., Operating Procedure

9.0 REQUIRED RECORDS

Results will be documented electronically in the "Alpha Beta Counting and Smear Worksheet" and Smear and/or Static worksheets should be printed out and filed along with the radiological Survey Form in Attachment B of OP-001. All records, including electronic records, must be managed in accordance with OP-187.

10.0 ATTACHMENTS

None

CABRERA SERVICES

RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

USE OF PHOTOIONIZATION DETECTORS
OPERATIONAL PROCEDURE
OP-037

Effective Date

01/01/2009

Revision 1

Prepared By:

CABRERA SERVICES, INC.

East Hartford, CT

Approval Page

Prepared By: Paul H Schwartz Date: 1/27/09

Paul H. Schwartz, CIH, CSP – Manager, Health and Safety

Reviewed By: ______________________ Date: __________

Jerry R. Jones - Senior Project Manager

Approved By: Leonard Johnson Date: 1/27/09

Leonard Johnson – Chief Operating Officer

Table of Contents

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide instructions and information about the use of photoionization detectors (PID). The PID is used for the evaluation of airborne chemical contaminants whose molecules can be ionized by ultraviolet light energies that are generally less than 11.7 electron volts (eV). This procedure is generic and does not apply to any specific manufacturer's product. Photoionization detectors will vary from one manufacturer to another and use of each instrument must comply with each manufacturers' instructions.

2.0 APPLICABILITY

This document is to be followed whenever a PID is used in the field to evaluate personal exposures or volatilization of contaminants from soil or water. The Cabrera Services, Inc. (CABRERA) designee as Manager, Health and Safety will document any amendments and/or variances to the procedures outlined in this document.

3.0 PRINCIPLE OF OPERATION

Photoionization detectors (PIDs) employ ultraviolet radiation to ionize contaminant molecules. Positive ions and free electrons are formed which migrate to the detector's electrode(s), resulting in an electric current that is proportional to the contaminant concentration at the detector.

The ability of a chemical to be ionized is a function of its ionization potential (IP). If the energy of the UV lamp is greater than or equal to the IP of the chemical being sampled, then the chemical will be detected. Typically, PID detectors will come equipped with a UV lamp at 10–10.6 eV. The Ionization Potential for selected chemicals are shown in Table 1. Higher energy lamps are available to detect chemicals which have high IPs. For example, methylene chloride requires use of the 11.7 eV lamp for detection because the IP for methylene chloride is 11.35 eV. In general, these higher energy lamps have a much shorter lifetime than the 10.6 eV lamps.

3.1 General Requirements

A field instrument should never be used without first reading through the owners' manual because improper operation of an PID can yield erroneous readings that could place site workers in jeopardy if the instrument is used to monitor ambient air quality.

A working knowledge of the sampling equipment is a basic requirement for understanding the sampling procedures. Familiarity with the environmental regulations of the United States Environmental Protection Agency (USEPA) and the state in which work is taking place is also required.

As with all field work, familiarity with the site-specific work plan and the health and safety plan (HASP) is imperative.

3.2 Definitions

- **Zero gas**

Zero gas is a reference gas used during calibration to set the instrument to zero concentration. When a zero gas with no hydrocarbon content is introduced into the instrument, the detector will still respond with a small signal. This signal is a result of background ionization. During calibration, zero gas is applied to quantify the background ionization current.

Zero Gas Recommendations: The preferred zero gas is hydrocarbon-free air. However, for applications where you are only interested in concentration changes relative to an ambient environment, fresh air can be used as the zero gas. When background gas is present, it is recommended that hydrocarbon-free air be used to zero the unit. Zeroing the monitor with hydrocarbon-free air reduces the background count, improves response, and decreases the stabilization time required to span the instrument.

- **Span gas**

Span gas is a reference gas used during calibration to determine the slope (response per unit concentration) of the response curve.

Span gas Recommendation: It is strongly recommended that the span gas used during calibration be well within the concentration range you expect to encounter in the survey area. Although there are many standard gases that can be used for calibration, isobutylene is the most common and is normally used for most applications.

- **Response Factors**

When a compound is ionized by a photoionization detector, it yields a current. This response is a characteristic property of the specific compound and it is influenced by its molecular structure. As a result, the slope of the response curve (defined in picoamperes per ppm) is different for different chemicals. The response factor is defined as the ratio of the detector response for isobutylene (Isobutylene has a response factor of one) to the detector response for the sample gas. Response factors to a wide range of substances have been determined experimentally.

Many PID instruments are programmed with internal response factors based upon isobutylene gas and the instrument can be set up to read ppm for the gas of interest. Direct calibration of the instrument, or verification of the calibration if stored response factors are used to calibrate the instrument, is desirable. This can be done by testing a known concentration of an atmosphere containing the chemical of interest prepared in a gas bag.

- **Intrinsic Safety**

PID instruments must be listed by the Underwriters Laboratories, as an Intrinsically Safe Apparatus approved for use in Class I, Division I, Groups A, B, C, D; Class II Division I, Groups E, F, G and Class III, Hazardous Locations when used in accordance with the manufacturer's Instruction Manual.

3.3 *Calibration*

3.3.1 Zero the instrument

Follow the manufacturer's instructions to calibrate the instrument to a zero reading. This will involve connection of the instrument probe to a container of zero gas which allows the instrument to be zeroed. If zero air gas is unavailable, the instrument can be zeroed to clean ambient air (i.e., move away from work areas, storage facilities, motor vehicles and any other potential source of vapors before calibrating).

3.3.2 Calibrate the instrument using calibration gas

Follow the manufacturer's instructions to calibrate the instrument using a standard calibration gas. This will involve connection of the instrument probe to a container of calibration gas. Frequently, isobutylene gas in air is used as a calibration gas. The meter can then be used to read directly in isobutylene units. If gases other than isobutylene are measured, the isobutylene units can be converted using the appropriate response obtained from the instrument's manual for the PID model being used. For example, if the response factor listed in the manual for benzene (relative to isobutylene) is 0.5 and if a meter which had been calibrated with isobutylene was used to measure benzene, the actual benzene concentration in air will be one half of the meter reading. Thus, if the meter reads 5.8 ppm isobutylene in a benzene atmosphere, the benzene concentration is actually 2.9 ppm. Similarly, if the meter reads 10 ppm isobutylene in an atmosphere of ethyl acetate, the ethyl acetate concentration is 38 ppm because the response factor for ethyl acetate is 3.8.

Isobutylene is a flammable gas and falls under DOT Hazardous Materials Transportation regulations. Cylinders of calibration gas cannot be carried on aircraft by individuals and can only be shipped by authorized carriers. Calibration gases will be used at the Corporate Office in East Hartford, CT to insure the instrument operates properly before being shipped to a project site. However, each project will be responsible for obtaining calibration gases while the instrument is used in the field.

3.3.3 Special Considerations

Photoionization sensitivity is dependent upon the age of the lamp and cleanliness of the lamp window. The accumulation of organic deposits on the surface of the lamp will reduce the sensitivity of the meter. The meter also has a reduced sensitivity in high humidity. For the most accurate results, it is best to calibrate the meter using representative air.

Some manufacturers report that a "quenching effect" can be observed in which the UV lamp light rays are scattered by the presence of non-ionizable gas molecules. Water vapor, carbon dioxide, methane, and carbon monoxide can all produce a low reading for the gas of interest if it is present in the air being sampled.

3.4 Operation

When calibration is completed, the instrument is ready to use. If the instrument has a manual range setting (e.g., readout x10, x100, x1,000), set it for the anticipated contaminant concentrations.

If analyzing air for perimeter/area conditions, or personal exposure, sample for as long as is necessary to establish documentation of what concentrations are present during site activities. Efforts must be made to capture worst-case conditions as well as levels during normal activities.

If analyzing soil or water, place the end of the sampling probe near the material being tested. The internal fan will draw an air sample through the probe tip. Avoid placing the probe too close to the sample to reduce the intake of excessive soil and dirt which may damage the probe or cause the fan to lock.

Be particularly careful not to allow the probe to draw in moisture. Even a small amount of moisture can condense on the lamp and affect its performance (or cause it to stop working). If this happens, shut off the instrument and follow the owner's manual procedures for disassembling, inspecting and cleaning the lamp. Be extremely careful not to scratch or mar the surface of the lamp when cleaning or drying it. Use only a very soft cloth or tissue. In-line moisture traps are available for use in wet conditions.

Some PIDs are sensitive to air currents; widely fluctuating readings will usually indicate air movement past the end of the probe.

PID readings are relative to the ambient air temperature; the same sample will yield a higher concentration reading at a higher ambient air temperature than at a lower air temperature. For consistency, try to monitor all soil samples at room temperature (not less than 70 degrees F (21° C)).

Record the ambient air temperature at which the samples were measured for all measurements.

When finished using the instrument, check the amount of charge left in the battery. Follow the manufacturer's instructions for shutting the instrument off.

If the battery is not sufficiently charged for another day's use, recharge it. Follow the manufacturer's instructions regarding recommended battery charge/discharge procedures.

Inspect the lamp between daily uses to make sure its surface is clean, dry and undamaged. If cleaning is necessary, follow the owner's manual procedures for disassembling, inspecting and cleaning the lamp. Be extremely careful not to scratch or mar the surface of the lamp when cleaning or drying it Use only a very soft cloth or tissue. If the lamp surface is scratched, inform the person in charge of instrument maintenance.

Most instruments have one or more filters (air inlet and/or outlet filters) that should be removed, inspected and cleaned between daily uses.

Before using the instrument, allow it to equilibrate with its surroundings. This should take about five minutes. The instrument should not be exposed to or used during precipitation events (snow or rain). The PID may become unstable under foggy or high humidity conditions. Electrical power lines or transformers may cause interference with the instrument and cause measurement errors. Typically, there is a three to five second delay in read-out depending on the instrument's sensitivity to the contaminant.

3.5 Maintenance

Follow the manufacturer's recommendations for maintaining the detector in optimal condition. This will include routine cleaning of the UV lamp and frequent replacement of the dust filter. Because of the fragile nature of the lithium fluoride window on the 11.7 eV lamps, special precautions must be followed and cleaning should only be done using Freon or chlorinated solvents. The exterior of the instrument can be wiped clean with a damp cloth and mild detergent, if necessary. Keep the cloth away from the sample inlet and do not attempt to clean the instrument while it is connected to a power source. It is always a good idea to have spare batteries, possibly a battery charger and a jeweler's screwdriver for adjustments as part of the equipment list.

4.0 REFERENCES

Mine Safety Appliances Company, Pittsburgh, PA. Passport® PID II Organic Vapor Monitor User's Manual. 2000.

Occupational Safety and Health Administration, Washington, DC 20210. OSHA Technical Manual (OTM), TED 01-00-015 [TED 1-0.15A], Chapter 3. Technical Equipment: On-Site Measurements. OTM chapters are current as of the date of the original OTM publication, September 22, 1995

Table 1. Ionization Potentials of Chemical Contaminants

Material	IP (eV)
(di) Phenyl ether	8.09
1,1 Dichloroethylene	<11.0
1,1,1-Trichloroethane	11.00
1,1,2,2-Tetrachloroethane (skin)	11.10
1,1,2-Trichloroethane (skin)	11.00
1,1-Dichloroethane	11.10
1,1-Dimethyl hydrazine (skin)	8.05
1,2 Dichloroethylene	10.00
1,3-Dichloro propene (skin)	9.82
1-Nitropropane	10.81
222Radon with daughters	10.70
2-Aminopyridine	8.00
2-Butanone (MEK)	9.53
2-Butoxyethanol (skin)	10.00
2-Nitropropane	10.71
2-Pentanone	9.39
Acetaldehyde	10.21
Acetic acid	10.66
Acetic anhydride	10.00
Acetone	9.69
Acetonitrile	12.22
Acetophenone	9.27
Acetylene	11.40
Acrolein	10.10
Acrylamide (skin)	9.50
Acrylic acid (skin)	10.90
Acrylonitrile	10.91
Adiponitrile (skin)	10.91
Allyl alcohol (skin)	9.67
Allyl chloride	10.05
Ammonia	10.18
Amyl acetates (skin)	9.90
Aniline (skin)	7.70
Anisidine (skin)	7.44
Arsine	9.89
Benzene	9.25

Material	IP (eV)
Hydrogen bromide	11.62
Hydrogen chloride	12.74
Hydrogen cyanide (skin)	13.73
Hydrogen fluoride	15.77
Hydrogen peroxide	10.54
Hydrogen selenide	9.88
Hydrogen sulfide	10.46
Hydroquinone	7.95
Indene	8.81
Iodine	9.28
Iron pentacarbonyl	7.95
Isoamyl acetate	9.95
Isoamyl alcohol	10.09
Isobutyl acetate	9.97
Isobutyl alcohol	10.09
Isophorone	9.07
Isopropyl acetate	9.98
Isopropyl alcohol	10.15
Isopropyl amine	8.72
Isopropyl aniline (skin)	7.50
Isopropyl ether	9.20
Ketene	9.61
Maleic anhydride	9.90
MAPP mixture	10.36
Mercury - alkyl compounds (skin)	9.00
Mercury and compounds (skin)	10.40
Mesityl oxide (skin)	9.08
Methane	12.80
Methanol (skin)	10.85
Methoxyethanol (skin)	9.60
Methyl acetate	10.27
Methyl acetylene	10.36
Methyl acrylate (skin)	9.90
Methyl amyl ketone	9.33
Methyl aniline (skin)	7.34
Methyl bromide (skin)	10.53

Benzyl chloride	10.60	Methyl butyl ketone	9.34
Boron tribromide	9.70	Methyl chloride	11.28
Boron trifluoride	15.50	Methyl cyclohexane	9.85
Bromine	10.55	Methyl cyclohexanol	9.80
Bromine pentafluoride	>15	Methyl ethyl ketone (MEK)	9.53
Bromoform (skin)	10.51	Methyl formate	10.81
Butadiene	9.07	Methyl hydrazine (skin)	7.67
Butane	10.63	Methyl iodide (skin)	9.54
Butyl acetate	10.00	Methyl isobutyl ketone	9.30
Butyl alcohol (sec & tert)	10.10	Methyl isocyanate (skin)	10.67
Butyl mercaptan	9.14	Methyl mercaptan	9.44
Butylamine (skin)	8.71	Methyl methacrylate	9.70
Butyltoluene	8.28	Methyl styrene	8.35
Camphor	8.76	Methyl t-butyl ether	<9.40
Carbon dioxide	13.80	Methylal	10.00
Carbon disulfide (skin)	10.10	Methylamine	8.97
Carbon monoxide	14.00	Methylene chloride	11.35
Carbon tetrabromide	>11.5	Morpholine (skin)	8.88
Carbon tetrachloride (skin)	11.5	Naphthalene	8.12
Chlorine	11.50	Naphthylamine (alpha & beta)	7.30
Chlorine dioxide	10.40	n-Butyl alcohol (skin)	10.04
Chlorine trifluoride	13.00	n-Hexane	10.17
Chloroacetaldehyde	10.60	Nickel carbonyl	8.28
Chloroacetone (skin)	<11.0	Nicotine (skin)	8.01
Chloroacetophenone	9.40	Nitric acid	11.95
Chlorobenzene	9.10	Nitric oxide	9.25
Chlorobromomethane	10.80	Nitroaniline (skin)	8.85
Chlorodifluoromethane (Freon 22)	12.50	Nitrobenzene (skin)	9.92
Chloroform	11.40	Nitrochlorobenzene (skin)	9.99
Chloromethyl methyl ether	10.25	Nitroethane	10.88
Chloroprene (skin)	8.80	Nitrogen dioxide	9.78
Chlorostyrene	8.80	Nitrogen trifluoride	12.97
Chlorotoluene	8.83	Nitromethane	11.08
Chrysene	7.75	Nitrosodimethyl amine (skin)	8.69
Cresol (skin)	9.00	Nitrotoluene (skin)	9.82
Crotonaldehyde	9.70	Nonane	10.21
Cumene (skin)	8.80	Octane	9.82
Cyanogen	13.60	Osmium tetroxide	12.60
Cyanogen chloride	12.50	Oxygen difluoride	13.11
Cyclohexane	9.90	Ozone	12.50
Cyclohexanol (skin)	10.00	Pentaborane	9.90
Cyclohexanone (skin)	9.10	Pentachloro nitrobenzene	<10.6

Cyclohexene	9.00
Cyclohexylamine	7.50
Cyclopentadiene	8.58
Cyclopentane	10.52
Decaborane (skin)	9.90
Diazomethane	9.00
Diborane	11.40
Dichlorobenzene (skin)	9.10
Dichlorodifluoromethane	11.80
Dichlorofluoro methane	12.39
Dichlorotetra-fluoroethane	12.20
Diethyl ketone	9.32
Diethylamine	8.00
Difluorodibromo methane	11.10
Diisobutyl ketone	9.04
Diisopropylamine (skin)	7.70
Dimethyl acetamide (skin)	8.80
Dimethyl phthalate	9.75
Dimethylamine	8.20
Dimethylaniline (skin)	7.14
Dimethylformamide (skin)	9.12
Dinitrobenzene (skin)	10.71
Dioxane (skin)	9.13
Diphenyl	8.27
Diphenylamine	7.40
Enflurane	<11.0
Epichlorohydrin (skin)	10.64
Ethane	>11.0
Ethanolamine	8.96
Ethyl acetate	10.10
Ethyl acrylate (skin)	10.30
Ethyl alcohol	10.48
Ethyl amyl ketone	9.19
Ethyl benzene	8.76
Ethyl bromide (skin)	10.29
Ethyl butyl ketone	9.15
Ethyl chloride	10.97
Ethyl ether	9.53
Ethyl formate	10.61
Ethyl mercaptan	9.29
Ethyl silicate	9.77
Ethylamine (skin)	8.86
Ethylene	10.50
Ethylene chlorohydrin	10.90

Pentane	10.34
Perchloryl fluoride	13.60
Phenol (skin)	8.50
Phenyl mercaptan	8.32
Phenyl phosphine	7.36
Phenylene diamine (skin)	7.58
Phenylhydrazine (skin)	7.64
Phosgene	11.55
Phosphine	10.00
Phosphorus (yellow)	11.10
Phosphorus trichloride	9.91
Phthalic (Acid)	10.0
Phthalic anhydride	10.0
Propane	11.00
Propanoic acid	10.24
Propargyl alcohol (skin)	10.51
Propriolactone	9.70
Propyl acetate	10.07
Propyl alcohol (skin)	10.22
Propyl nitrate	11.07
Propylene dichloride	10.87
Propylene oxide	9.81
Propyleneimine (skin)	9.00
Pyridine	9.27
Quinone	9.68
Silicon tetrahydride	9.30
Sodium azide (skin)	11.70
Sodium hydroxide	9.00
Stibine	9.58
Stoddard solvent	<10.4
Styrene (skin)	8.47
Sulfur chloride	9.40
Sulfur dioxide	12.34
Sulfur hexafluoride	15.30
Sulfuryl fluoride	13.00
Terphenyls (skin)	8.01
Tetrachlorodifluoroethane	11.30
Tetrachloroethylene	9.32
Tetraethyl lead (skin)	11.10
Tetrahydrofuran	9.45
Toluene (skin)	8.82
Toluidine (skin)	7.44
Trichloroethylene	9.45
Trichlorofluoromethane	11.80

(skin)			
Ethylene dibromide (skin)	9.45	Trichlorotrifluoroethane	11.99
Ethylene dichloride	11.05	Triethylamine	7.50
Ethylene oxide	10.56	Trifluorobromomethane	11.40
Ethylenediamine	8.60	Trimethylamine	7.82
Ethyleneimine (skin)	9.20	Trinitrotoluene (TNT) (skin)	10.59
Ferbam (dust)	7.72	Triphenylamine	6.86
Fluorine	15.70	Tritium (3H)	>13
Formaldehyde	10.88	Vinyl acetate	9.19
Formamide (skin)	10.20	Vinyl bromide	9.80
Formic acid (skin)	11.05	Vinyl chloride	10.00
Furfural (skin)	9.21	Vinyl cyclohexene (skin)	<10.0
Heptane	9.90	Vinyl cyclohexene dioxide (skin)	8.93
Hexachloroethane (skin)	11.22	Vinyl toluene	8.20
Hexafluoroacetone (skin)	11.81	Xylene	8.44
Hexane (other isomers)	10.17	Xylidine (skin)	7.65
Hydrazine (skin)	8.10	Zinc chloride fume	12.90

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

OPERATING PROCEDURE

FOR

SAMPLE LABELING

OP-061

REVISION 0.1

Carl Young
Digitally signed by Carl Young, PG
DN: CN = Carl Young, PG, C = US, O = Cabrera Services, OU = Baltimore
Reason: I am the author of this document
Date: 2007.08.20 16:55:16 -04'00'

Prepared By: ______________________ Date: ______

Richard R. Allen
Digitally signed by Rick Allen
DN: CN = Rick Allen, C = US, OU = Cabrera Services, Inc.
Reason: I have reviewed this document
Date: 2007.08.27 09:08:07 -04'00'

Reviewed By: ______________________ Date: ______

Leonard Johnson
Digitally signed by Leonard Johnson
DN: cn=Leonard Johnson, o=Cabrera Services, Inc., ou=Corporate, email=ljohnson@cabreraservices.com, c=US
Date: 2007.09.18 09:37:14 -04'00'

Approved By: ______________________ Date: ______

1.0 PURPOSE

This procedure provides the methods Cabrera Services, Inc. (CABRERA) personnel shall utilize when documenting field activities. Adherence to this procedure will provide assurance that the analyses performed have reproducible results.

2.0 APPLICABILITY

Personnel shall utilize this procedure to label environmental samples. Personnel must assure that the specifications of this SOP agree with the specifications listed in the Project Work Plans.

3.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

3.1 Precautions

Not applicable

3.2 Limitations

Not applicable.

3.3 Requirements

3.3.1 Sample names are unique identifiers. Sample codes must be assigned such that they discriminate a sample from any other samples.

3.3.2 Sample numbers must be recorded in at least four places:

1) On the sample container
2) On the Chain-of-Custody
3) On a Sample Control Log
4) In the field notebook.

3.3.3 Personnel using this procedure shall be familiar with the Project Work Plans.

3.3.4 Field Personnel shall discuss deviations to the Project Work Plans with the Project Manager. Any deviations, plus conversations with the PM shall be documented in the project field notebook.

4.0 REFERENCES

- none

5.0 DEFINITIONS

5.1 Project Management Plans. These plans usually consist of the following parts:

- Project Work Plan (PWP) - The project work plan includes project team members, roles, and responsibilities, project schedule and cost tracking mechanisms, quality assurance and quality control (QA/QC) measures, particularly with respect to deliverables, project reporting, and project team communications.

- Field Sampling Plan (FSP) – The FSP provides specific directions for conducting each separate field sampling activity. For each field activity, the rationale and design for the work is presented and field procedures for that specific activity are described. Field Operations and Documentation are also described, including a discussion on field logbooks, photographic records, sample documentation, field analytical records, and documentation procedures for data management and retention.
- Quality Assurance Project Plan (QAPP) - The focus of the QAPP is primarily on the analytical methods and quality assurance/quality control (QA/QC) procedures that are used to analyze environmental samples and manage the data. The QAPP presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with the investigation.
- Site Safety and Health Plan (SSHP) - The SSHP provides evacuation routes for the site and immediate area; site-specific safety information; MSDS for any relevant chemicals of concern; and names and telephone numbers of common emergency contact personnel for the worksite.

5.2 Quality Assurance (QA) - All procedures, practices, records, and documentation required to provide confirmation that activities are compliant with regulations or specifications, or both.

5.3 Quality Control (QC) - Actions that control the attributes of the analytical process, standards, reagents, measurement equipment, components, system, or facility according to predetermined quality requirements.

6.0 EQUIPMENT

- none

7.0 RESPONSIBILITIES

7.1 Project Manager (PM) - The PM is responsible for the contents of the Project Management Plans, and hence the design of the sample numbering system.

7.2 Field Site Manager (FSM) - The FSM is responsible for the execution of field activities, in discussion with the PM. The FSM is responsible for correctly applying the sample numbering system. The FSM is responsible for entering information into the field notebooks.

7.3 Personnel - Personnel include all CABRERA personnel who are responsible for reading, understanding, signing, and complying with the provisions of this procedure. Site workers should document that they have read this SOP by placing their signatures on the sign-off page(s) of the project work management plans.

8.0 INSTRUCTIONS

Sample labels provide specific information that is permanently affixed to the sample container using a water-proof label.

Sample labels are necessary to prevent misidentification of samples. Preprinted sample labels are to be used unless alternative labels are approved by the project manager. Where necessary, the label will be protected from water and solvents with clear covering of transparent tape. Each label will contain the following information:

- Name or initials of the collector
- Date, place, and time of collection
- Job name and number
- Sample number and/or boring number and depth
- Preservative (if required).

9.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

OPERATING PROCEDURE

FOR

SAMPLE HANDLING, PACKAGING & SHIPPING

OP-062

REVISION 0.1

Prepared By: Carl Young Digitally signed by Carl Young, PG
DN: CN = Carl Young, PG, C = US, O = Cabrera Services, OU = Baltimore
Reason: I am the author of this document
Date: 2007.08.20 16:57:02 -04'00' Date: ______

Reviewed By: Richard R. Allen Digitally signed by Rick Allen
DN: CN = Rick Allen, C = US, OU = Cabrera Services, Inc.
Reason: I have reviewed this document
Date: 2007.08.27 09:15:16 -04'00' Date: ______

Approved By: Leonard Johnson Digitally signed by Leonard Johnson
DN: cn=Leonard Johnson, o=Cabrera Services, Inc., ou=Corporate, email=ljohnson@cabreraservices.com, c=US
Date: 2007.09.18 09:37:52 -04'00' Date: ______

1.0 PURPOSE

This procedure provides the methods Cabrera Services, Inc. (CABRERA) personnel shall utilize when handing, packaging and shipping field samples. Adherence to this procedure will provide assurance that the analyses performed have reproducible results.

2.0 APPLICABILITY

Personnel shall utilize this procedure for all environmental field samples. Personnel must assure that the specifications of this SOP agree with the specifications listed in the Project Work Plans.

3.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

3.1 Precautions

Many environmental field samples are preserved using concentrated acids. These preservatives are typically placed in otherwise empty containers by the laboratory. Personnel must wear appropriate PPE and exercise appropriate care when handling sample containers. Preservative may leak from containers during shipment, or may be released into packaging from broken containers. Preservative can be splashed into the air when containers are opened.

USDOT and common carriers may levy severe penalties if fluids of any kind are found to be leaking from coolers.

3.2 Limitations

Not applicable.

3.3 Requirements

3.3.1 Sample names are unique identifiers. Sample codes must be assigned such that they discriminate a sample from any other samples.

3.3.2 Sample numbers must be recorded in at least four places:

1) On the sample container
2) On the Chain-of-Custody
3) On a Sample Control Log
4) In the field notebook.

3.3.3 Personnel using this procedure shall be familiar with the Project Work Plans.

3.3.4 Field Personnel shall discuss deviations to the Project Work Plans with the Project Manager. Any deviations, plus conversations with the PM shall be documented in the project field notebook.

4.0 REFERENCES

- none

5.0 DEFINITIONS

5.1 Project Management Plans. These plans usually consist of the following parts:

- Project Work Plan (PWP) - The project work plan includes project team members, roles, and responsibilities, project schedule and cost tracking mechanisms, quality assurance and quality control (QA/QC) measures, particularly with respect to deliverables, project reporting, and project team communications.
- Field Sampling Plan (FSP) – The FSP provides specific directions for conducting each separate field sampling activity. For each field activity, the rationale and design for the work is presented and field procedures for that specific activity are described. Field Operations and Documentation are also described, including a discussion on field logbooks, photographic records, sample documentation, field analytical records, and documentation procedures for data management and retention.
- Quality Assurance Project Plan (QAPP) - The focus of the QAPP is primarily on the analytical methods and quality assurance/quality control (QA/QC) procedures that are used to analyze environmental samples and manage the data. The QAPP presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with the investigation.
- Site Safety and Health Plan (SSHP) - The SSHP provides evacuation routes for the site and immediate area; site-specific safety information; MSDS for any relevant chemicals of concern; and names and telephone numbers of common emergency contact personnel for the worksite.

5.2 Quality Assurance (QA) - All procedures, practices, records, and documentation required to provide confirmation that activities are compliant with regulations or specifications, or both.

5.3 Quality Control (QC) - Actions that control the attributes of the analytical process, standards, reagents, measurement equipment, components, system, or facility according to predetermined quality requirements.

6.0 EQUIPMENT

- Either pre-printed or on-site printed sample labels
- Bubble wrap
- Ice
- Gallon-size water-tight freezer bags
- Trash bags

- Coolers
- Packing tape
- Anti-tamper custody seals
- Shipping labels

7.0 RESPONSIBILITIES

7.1 Project Manager (PM) - The PM is responsible for the contents of the Project Management Plans, and hence the design of the sample numbering system.

7.2 Field Site Manager (FSM) - The FSM is responsible for the execution of field activities, in discussion with the PM. The FSM is responsible for correctly applying the sample numbering system. The FSM is responsible for entering information into the field notebooks.

7.3 Personnel - Personnel include all CABRERA personnel who are responsible for reading, understanding, signing, and complying with the provisions of this procedure. Site workers should document that they have read this SOP by placing their signatures on the sign-off page(s) of the project work management plans.

8.0 INSTRUCTIONS

The procedures for sample handling, packaging, and shipment, when combined with the procedures for sample custody, containers, and preservation are the final steps in ensuring that representative samples are submitted to the laboratories for the appropriate chemical analyses. The Cabrera field representative is responsible for properly and safely following the procedures presented in this section so that holding times are not exceeded, proper preservation temperatures are maintained during shipment, and the samples are packaged so sample containers are not broken during transportation to the laboratory.

Cabrera's procedures for sample handling are as follows unless site-specific planning documents (such as a QAPP) require alternate procedures:

- All samples are to be handled by as few people as possible. If one person collects the samples and another delivers them to the laboratory, the chain of custody form must document the change of possession by the appropriate dated signatures.
- The Cabrera field representative who collects and/or processes the samples is responsible for the correct storage and preservation (usually coolers with blue ice) of the samples until they are delivered to the laboratories.
- The Cabrera field representative who delivers (or arranges delivery of) the samples to the laboratory is responsible for ensuring that sufficient preservation material (blue ice) is present in the shipment container so that the preservation temperature is maintained during transportation

to the laboratory. This is especially critical if the samples are being transported via overnight common courier (such as Federal Express) during the middle of the summer. Always err on the side of placing too much ice in the shipment container; re-sampling will always be more expensive than an extra bag of ice.

The procedures to be employed by the Cabrera field representative for sample packaging will vary based on the types of samples, containers, and method of shipment to the laboratory. Cabrera's procedures for sample packaging are as follows unless site-specific planning documents (such as a QAPP) require alternate procedures:

- For 40 ml volatile organic analysis (VOA) sample bottles, the Cabrera field representative should either have a foam block for the samples or sufficient plastic bags and shipping material (such as bubble wrap). The foam block is preferable for protecting the VOA bottles from breaking. Otherwise, the Cabrera field representative must wrap VOA bottles in bubble wrap and place a maximum of three wrapped VOA bottles into a plastic Ziploc, bag. For each shipping container, sufficient cooling material is placed into the container (see next bullet), and the container is filled with Ziploc bags of samples. The chain of custody form is to be signed by the person delivering the samples to the laboratory and the form is sealed into a Ziploc, bag and taped to the inside lid of the shipping container. Lastly, the container is taped shut and, if required, custody seals are placed on the container.
- If samples are to be shipped, it is extremely important that ice be packed in such a way the water from melting ice is prevented from leaking out of the coolers. Cooler drains shall be taped shut. A trash bag should be placed in the empty cooler before any samples or other packaging is used. Ice should be placed in a double layer of water-tight (e.g., Ziploc) bags.
- For other types of samples and containers, the process is generally the same except that each sample bottle should be wrapped in a protective layer of material and placed into separate, sealed plastic bags (Ziploc, bags, if possible).
- f the samples are very high concentration (total chemical concentration greater than or equal to 15 percent) and are to be shipped by overnight common courier, the use of shipment cans and vermiculite is required for safe transportation. Also note that labeling of these types of high concentration samples (cans and coolers) must comply with Department of Transportation labeling requirements.
- The chain-of-custody should be placed in the cooler on top of any packaging. Protect the chain-of-custody inside a water-tight freezer bag. If the cooler has been scanned, smeared and cleared for potential radioactive contamination, place a copy of the survey in the bag with the chain-of-custody.

- Seal the cooler closed with packing tape. Apply two custody seals, intercalated within the layers of packing tape.

For shipment of samples, the most important consideration is making the arrangements for transporting the samples to the laboratory before starting any sampling episode. If the samples are to be sent by overnight common courier, the prior arrangements include obtaining pickup service or determining where and when the samples can be dropped off. It may also be necessary to modify the sampling schedule to match the latest pickup/drop off times for overnight delivery. For samples collected or shipped on Friday, Saturday, or Sunday, the Cabrera field representative should ensure that laboratory personnel will be present to accept the shipment. If sample coolers sit on a loading dock for a day or more sample integrity may be compromised as the ice or blue ice melts. The project manager and/or the Cabrera field representative should also check with the laboratory to be used for the project and determine if they have a dedicated courier service. While there may be a fee for this service, in some circumstances this service will be the most cost-effective method of shipment.

9.0 ATTACHMENTS

None

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

OPERATING PROCEDURE

FOR

SAMPLE TRACKING LOG

OP-066

REVISION 0

Carl Young
Digitally signed by Carl Young, PG
DN: CN = Carl Young, PG, C = US, O = Cabrera Services, OU = Baltimore
Reason: I am the author of this document
Date: 2007.08.20 17:06:11 -04'00'

Prepared By: ______________________________ Date: ______

Richard R. Allen
Digitally signed by Rick Allen
DN: CN = Rick Allen, C = US, OU = Cabrera Services, Inc.
Reason: I have reviewed this document
Date: 2007.08.27 09:16:51 -04'00'

Reviewed By: ______________________________ Date: ______

Leonard Johnson
Digitally signed by Leonard Johnson
DN: cn=Leonard Johnson, o=Cabrera Services, Inc., ou=Corporate, email=ljohnson@cabreraservices.com, c=US
Date: 2007.09.18 09:40:18 -04'00'

Approved By: ______________________________ Date: ______

1.0 PURPOSE

This procedure provides the methods Cabrera Services, Inc. (CABRERA) personnel shall utilize to track the disposition of samples, and to associate quality control samples with primary samples. It includes options for generating labels and printing Chain-of-custodies. The log has been created in an Excel spreadsheet.

2.0 APPLICABILITY

Personnel shall utilize this procedure when collecting samples of environmental media for analysis. Refer to Cabrera licensed procedures listed in Section 4.0 for further guidance on requirements for sample labeling, handling, shipping and chain of custody procedures. Personnel must assure that the specifications of this SOP agree with the specifications listed in the Project Work Plans, and must resolve discrepancies.

3.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

3.1 Precautions

The spreadsheet contains many linked cells. Site workers who will be expected to enter data onto the sample tracking forms should be familiar with this procedure.

3.2 Limitations

None.

3.3 Requirements

3.3.1 Sample tracking, labeling, and chain of custody procedures are all required by USEPA for investigations conducted under the Resource Conservation and Recovery Act (RCRA)(USEPA, 1986).

3.3.2 Personnel using this procedure shall be familiar with the Project Work Plans.

3.3.3 Field Personnel shall discuss deviations from the Project Work Plans with the Project Manager. Any deviations, plus conversations with the PM shall be documented in the project field notebook.

4.0 REFERENCES

Cabrera Standard Operating Procedures:

- OP-008 – Chain of Custody
- OP-059 – Field Activity Documentation
- OP-060 – Sample Numbering
- OP-061 – Sample Labeling
- OP-062 – Sample Handling, Packaging & Shipment
- OP-064 – Onsite Sample Storage

USEPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, PB87-107751, [EPA 530 R93-001]

5.0 DEFINITIONS

5.1 Sample Tracking Log

A quality control form that lists all of the samples collected, lists the analyses to be performed and tracks their destination.

5.2 Chain of Custody

The chain of custody lists and describes a shipment of samples that leave the custody of the sampler and are transferred to the custody of the laboratory. For a complete description of the chain of custody, review OP-008 – Chain of Custody.

5.3 Project Management Plans

These plans usually consist of the following parts:

Project Work Plan (PWP) - The project work plan includes project team members, roles, and responsibilities, project schedule and cost tracking mechanisms, quality assurance and quality control (QA/QC) measures, particularly with respect to deliverables, project reporting, and project team communications.

Field Sampling Plan (FSP) – The FSP provides specific directions for conducting each separate field sampling activity. For each field activity, the rationale and design for the work is presented and field procedures for that specific activity are described. Field Operations and Documentation are also described, including a discussion on field logbooks, photographic records, sample documentation, field analytical records, and documentation procedures for data management and retention.

Quality Assurance Project Plan (QAPP) - The focus of the QAPP is primarily on the analytical methods and quality assurance/quality control (QA/QC) procedures that are used to analyze environmental samples and manage the data. The QAPP presents the project organization, objectives, procedures, functional activities, and specific QA/QC activities associated with the investigation.

Site Safety and Health Plan (SSHP) - The SSHP provides evacuation routes for the site and immediate area; site-specific safety information; MSDS for any relevant chemicals of concern; and names and telephone numbers of common emergency contact personnel for the worksite.

5.4 Quality Assurance (QA)

All procedures, practices, records, and documentation required to provide confirmation that activities are compliant with regulations or specifications, or both.

5.5 Quality Control (QC)

Actions that control the attributes of the analytical process, standards, reagents, measurement equipment, components, system, or facility according to predetermined quality requirements.

6.0 EQUIPMENT

a) The Excel workbook named; **OP-066 Sample Tracking Log rev0.xls**

b) Laptop computer (for field use), equipped with Microsoft Excel. Also, a barcode font should be loaded. A free Code 39 bar code font is available at:

   http://www.barcodesinc.com/free-barcode-font/

   Download the Free 3 of 9 Extended font. Copy it to the Windows Font folder from the Control Panel, which has the Fonts directory. Select \File \Install New Font and follow the directions.

c) Printer for chain-of-custody

d) Label printer – Dymo LabelWriter 400 or equivalent

e) Power supply – for remote locations, **a battery and ac/dc inverter** may be used

f) [2] USB cables: one for each printer

g) Shipping labels, 2" x 4" – Dymo part numbers 30323 or 30573 or equivalent

h) Paper for the printer

See SOP No. OP-062 – Sample Handling, Packaging & Shipment for equipment needed for sample management.

7.0 RESPONSIBILITIES

7.1 Project Manager (PM) - The PM is responsible for the contents of the Project Management Plans, and hence the applicable standard operating procedures. The PM ensures proper application of those plans during project execution. The PM assures that the quality systems are being implemented.

7.2 Field Site Manager (FSM) - The FSM is responsible for the execution of field activities, under the direction of the PM and in accordance with the project plans. The FSM is responsible for correctly applying the standard operating procedures, including entering information into the field notebooks. The FSM is responsible for justifying and documenting any deviations between the SOPs and actual field operations. The FSM may delegate upkeep of the Sample Tracking Log to another team member, but the FSM is responsible for controlling the quality of the work.

7.3 Corporate Health and Safety Officer (HSO) - The HSO is responsible for establishing and maintaining records regarding medical evaluations, fit testing, respirator issues, and respirator maintenance. The HSO may also conduct fit testing, if necessary.

7.4 Project Team Members - Site workers are responsible for reading, understanding, and complying with the provisions of this procedure. Site workers should document that they have read this SOP by placing their signatures on the sign-off page(s) of the project work management plans.

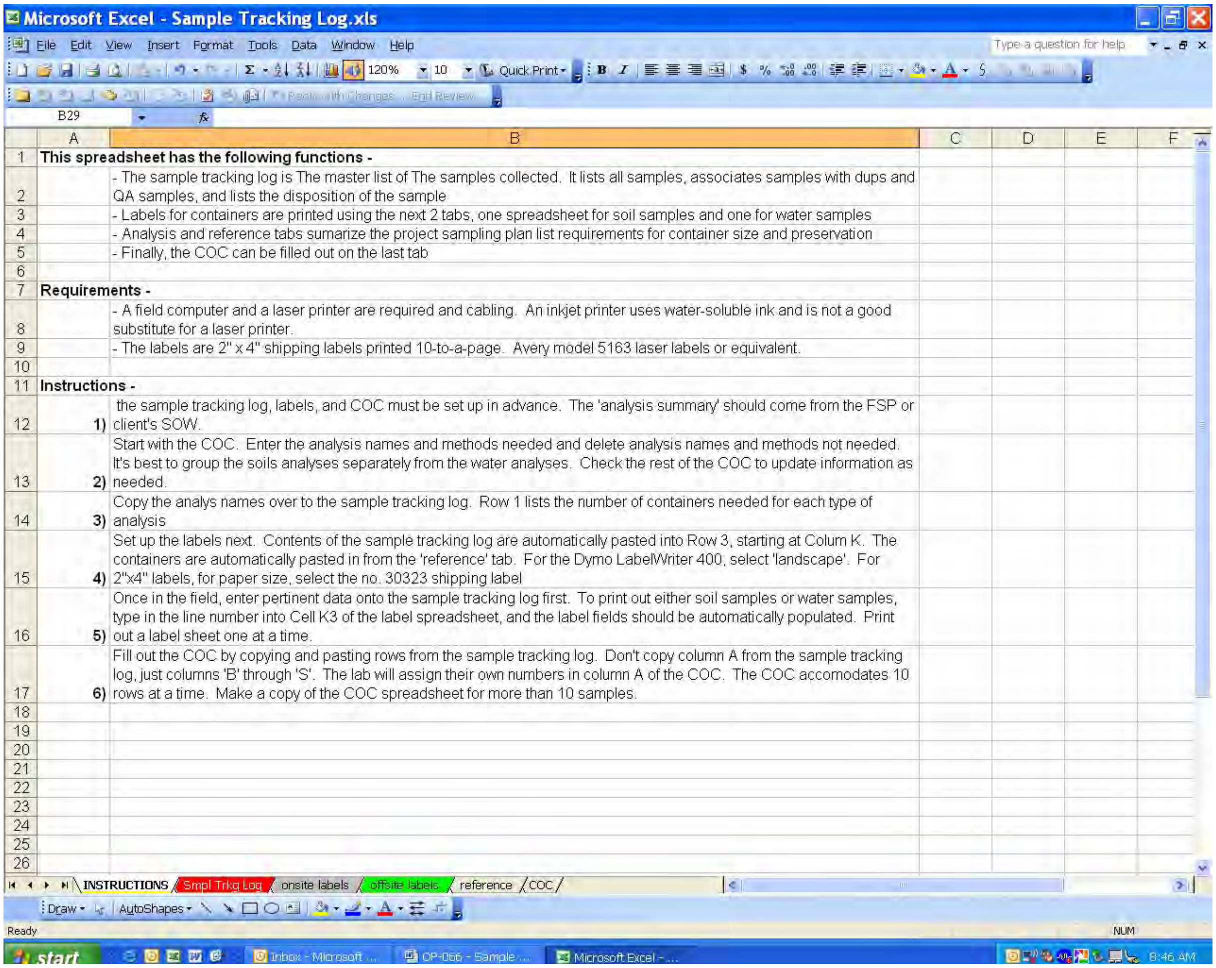
8.0 INSTRUCTIONS

The sample tracking log, labels, and COC must be set up in advance.

8.1 *Setup*

The sample tracking log **[OP-066 Sample Tracking Log rev0.xls]** contains six tabs (see Figure 1):

- o INSTRUCTIONS
- o Sample Tracking Log
- o Onsite Labels
- o Offsite Labels
- o Reference
- o COC



Microsoft Excel - Sample Tracking Log.xls

	A	B
1	**This spreadsheet has the following functions -**	
2		- The sample tracking log is The master list of The samples collected. It lists all samples, associates samples with dups and QA samples, and lists the disposition of the sample
3		- Labels for containers are printed using the next 2 tabs, one spreadsheet for soil samples and one for water samples
4		- Analysis and reference tabs sumarize the project sampling plan list requirements for container size and preservation
5		- Finally, the COC can be filled out on the last tab
6		
7	**Requirements -**	
8		- A field computer and a laser printer are required and cabling. An inkjet printer uses water-soluble ink and is not a good substitute for a laser printer.
9		- The labels are 2" x 4" shipping labels printed 10-to-a-page. Avery model 5163 laser labels or equivalent.
10		
11	**Instructions -**	
12	1)	the sample tracking log, labels, and COC must be set up in advance. The 'analysis summary' should come from the FSP or client's SOW.
13	2)	Start with the COC. Enter the analysis names and methods needed and delete analysis names and methods not needed. It's best to group the soils analyses separately from the water analyses. Check the rest of the COC to update information as needed.
14	3)	Copy the analys names over to the sample tracking log. Row 1 lists the number of containers needed for each type of analysis
15	4)	Set up the labels next. Contents of the sample tracking log are automatically pasted into Row 3, starting at Colum K. The containers are automatically pasted in from the 'reference' tab. For the Dymo LabelWriter 400, select 'landscape'. For 2"x4" labels, for paper size, select the no. 30323 shipping label
16	5)	Once in the field, enter pertinent data onto the sample tracking log first. To print out either soil samples or water samples, type in the line number into Cell K3 of the label spreadsheet, and the label fields should be automatically populated. Print out a label sheet one at a time.
17	6)	Fill out the COC by copying and pasting rows from the sample tracking log. Don't copy column A from the sample tracking log, just columns 'B' through 'S'. The lab will assign their own numbers in column A of the COC. The COC accomodates 10 rows at a time. Make a copy of the COC spreadsheet for more than 10 samples.

INSTRUCTIONS / Smpl Trkg Log / onsite labels / offsite labels / reference / COC

Figure 1 - Instructions Tab

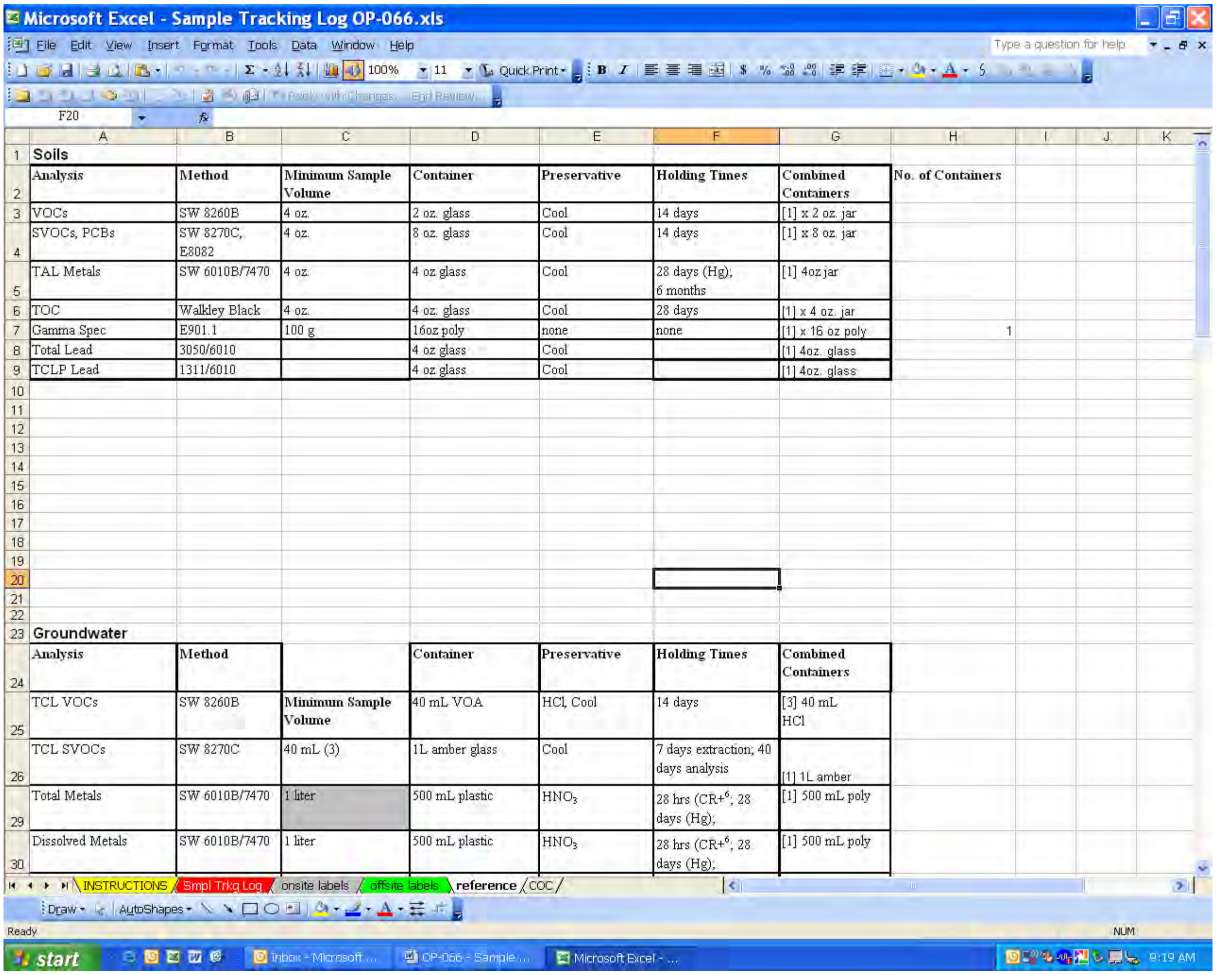
8.1.1 Reference Tab

An 'analysis summary' should come from the project FSP or from the client's SOW. The analysis summary typically lists the analyses to be performed, analysis method, sample containers, preservatives, and hold times. The analysis summary should be pasted into the Reference Tab (see Figure 2). The workbook contains a standard list of analyses, but if these are to be used, they should be checked against the project work plans.

The descriptions of the analysis type, container and preservative are used on the sample labels. The workbook links some of the label cells to the reference cells.

8.1.2 COC Tab

The COC has been set up in ‘portrait’ format rather than the customary ‘landscape’ format in order to accommodate more samples (see Figure 3).


Microsoft Excel - Sample Tracking Log OP-066.xls

Soils

Analysis	Method	Minimum Sample Volume	Container	Preservative	Holding Times	Combined Containers	No. of Containers
VOCs	SW 8260B	4 oz.	2 oz. glass	Cool	14 days	[1] x 2 oz. jar	
SVOCs, PCBs	SW 8270C, E8082	4 oz.	8 oz. glass	Cool	14 days	[1] x 8 oz. jar	
TAL Metals	SW 6010B/7470	4 oz.	4 oz glass	Cool	28 days (Hg); 6 months	[1] 4oz jar	
TOC	Walkley Black	4 oz.	4 oz. glass	Cool	28 days	[1] x 4 oz. jar	
Gamma Spec	E901.1	100 g	16oz poly	none	none	[1] x 16 oz poly	1
Total Lead	3050/6010		4 oz glass	Cool		[1] 4oz. glass	
TCLP Lead	1311/6010		4 oz glass	Cool		[1] 4oz. glass	

Groundwater

Analysis	Method		Container	Preservative	Holding Times	Combined Containers
TCL VOCs	SW 8260B	Minimum Sample Volume	40 mL VOA	HCl, Cool	14 days	[3] 40 mL HCl
TCL SVOCs	SW 8270C	40 mL (3)	1L amber glass	Cool	7 days extraction; 40 days analysis	[1] 1L amber
Total Metals	SW 6010B/7470	1 liter	500 mL plastic	HNO_3	28 hrs (CR^{+6}; 28 days (Hg);	[1] 500 mL poly
Dissolved Metals	SW 6010B/7470	1 liter	500 mL plastic	HNO_3	28 hrs (CR^{+6}; 28 days (Hg);	[1] 500 mL poly

INSTRUCTIONS / Smpl Trkg Log / onsite labels / offsite labels / reference / COC

Figure 2 The Reference Tab

Enter the project information in rows 5 through 8 of the COC. This information typically includes:

- Project Name

- Project Number

- Cabrera Contact name, phone & fax numbers

Enter the analysis names and methods needed and delete analysis names and methods not needed. It's best to group the soils analyses separately from the water analyses for the sake of clarity. The analysis names and method numbers will then be automatically updated onto the Sample Tracking Log.

The 'sample description' rows (line 10 and below) of the COC are to be pasted in from Columns B through Q of the Sample Tracking Log. Column A "Lab ID" is for the use of the lab and they will assign their own numbers in this column. The COC accommodates 25 samples on Page 1 and an additional 25 samples on Page 2. Make a copy of the COC spreadsheet for use the next day.

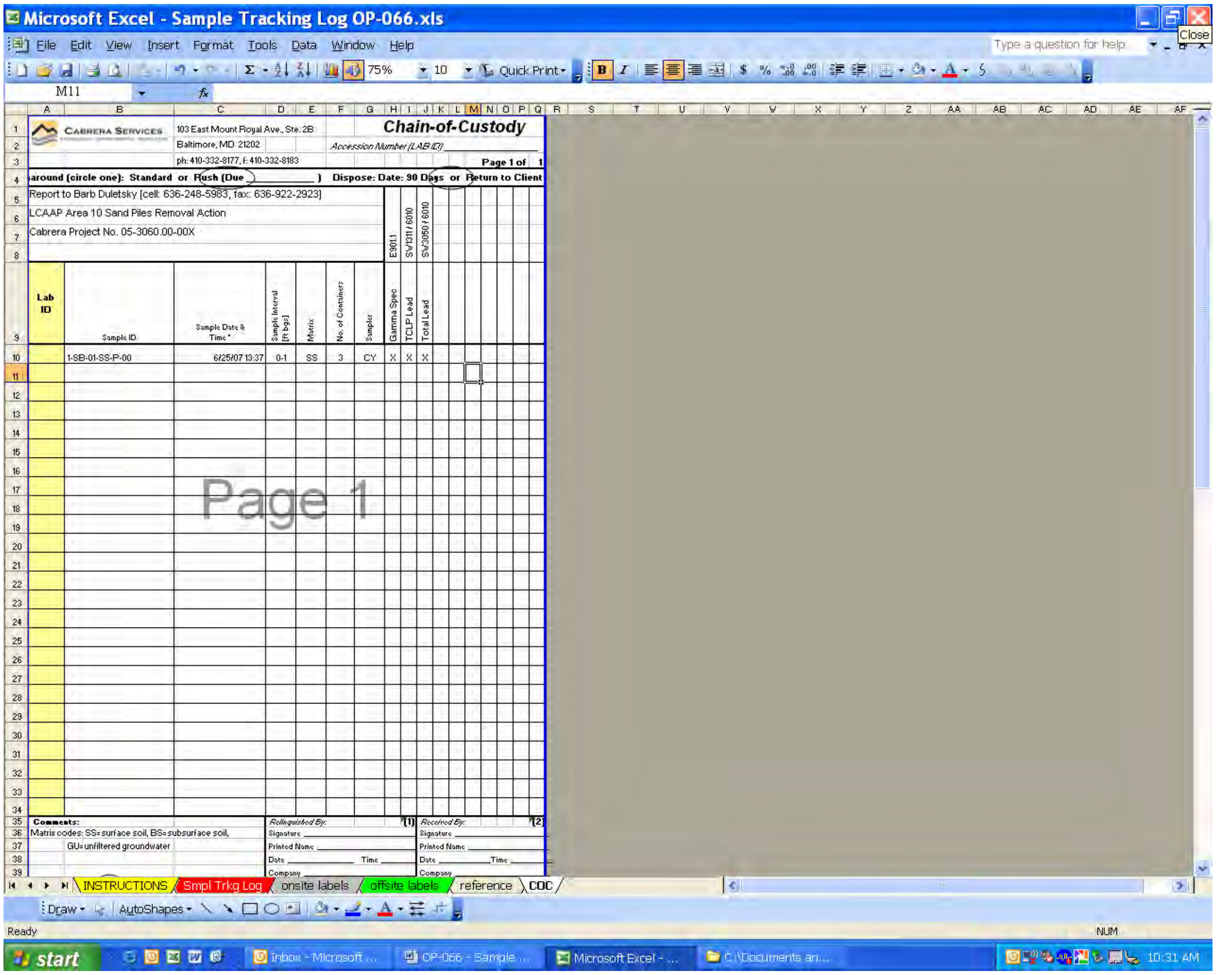


Figure 2 Chain of Custody

To print the COC, if you have more than 25 samples, simply select the ‘Print’ icon. If there are 25 samples or less, do not use the ‘print’ icon, but instead select ‘\File \Print…’ from the drop-down menus, then print only Page 1 of the COC.

After the Chain of Custody is printed, unused columns and rows are typically ‘lined through’ to prevent the addition of unwanted information. Cells can be ‘lined through’ in Excel by changing the ‘fill color ‘of the unused rows and columns to gray.

The COC must be printed twice in order to send the ‘original’ to the lab and to retain a copy for project records. If a copier isn’t available, any handwriting made on the original must be exactly duplicated on the copy. Alternatively, if the only handwriting needed on the COC is in the signature box, the COC may be signed digitally using Adobe Acrobat, then only one paper original needs to be printed, and the ‘copy’ can be saved digitally.

8.1.3 Labels

Labels have been formatted to print onto 2” x 4” shipping labels using a label printer. This type of label is thermally-printed and therefore water-resistant. A label printer

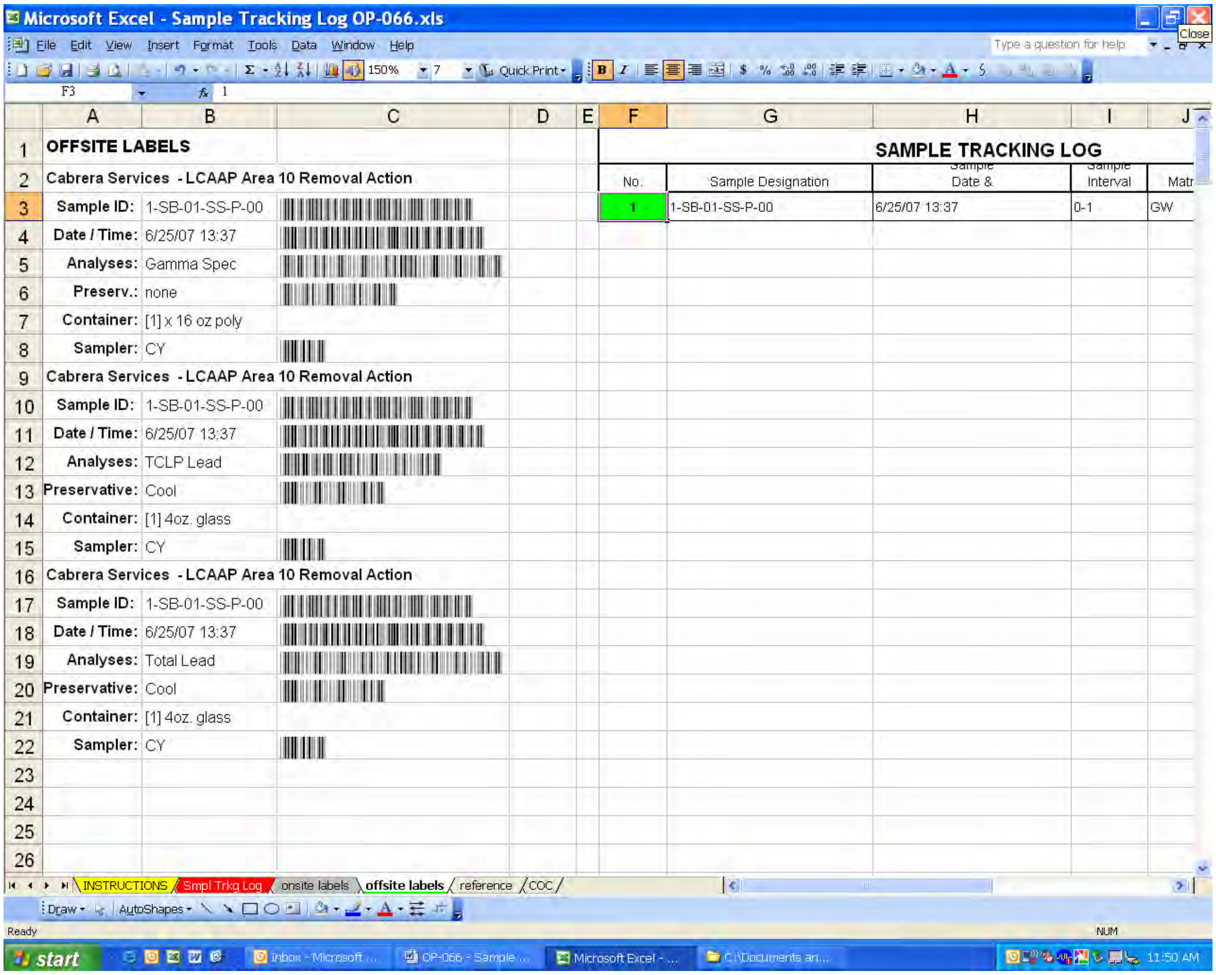


Figure 4 The Label Tabs

has advantages over laser printers in that only the labels needed are printed, and they can be printed in the field instead of in advance of field work.

The 'label' tabs have been set up to print all of the labels needed for a single row of information entered onto the sample tracking log. Contents of the sample tracking log are automatically pasted into Row 3 of the 'label' tab, starting at Colum K. The 'containers' and 'preservative' information has been set up to be automatically pasted in from the 'reference' tab. One can simply type this information directly, if desired. Bar-code information is updated automatically. The bar codes are in Code 39 format and are intended to be used by the lab to reduce data transcription errors.

To print a label, enter the line number from the Sample Tracking Log of the sample one wishes to label, into Cell F3 (which is shaded green). The sample information is then entered automatically onto the label. For the Dymo LabelWriter 400 printer, select 'landscape'. For paper size, select the no. 30323 'shipping label'.

8.1.4 Sample Tracking Log

The Sample Tracking Log is set up by entering the number of containers needed for each analysis type in Row 1 (these cells are shaded yellow). The analysis names are automatically entered from the COC.

Once in the field, enter pertinent data onto the sample tracking log. Enter the sample name and sample time, which must be entered in 'mm/dd/yy hh:mm' Excel format. Enter sample depths and codes for matrices as specified in the project work plans.

The total number of containers associated with each sample (Column F) is updated automatically. Associate duplicates with primary samples by typing in the row number of the duplicate into Column T of the primary sample row – vice versa for the duplicate sample row. Associate trip blanks and rinse blanks by typing in the row numbers for these blanks into Column T of every pertinent primary and field duplicate.

Enter the sampler's initials into column G. Then select which analyses will be performed by placing an 'X' in the appropriate column.

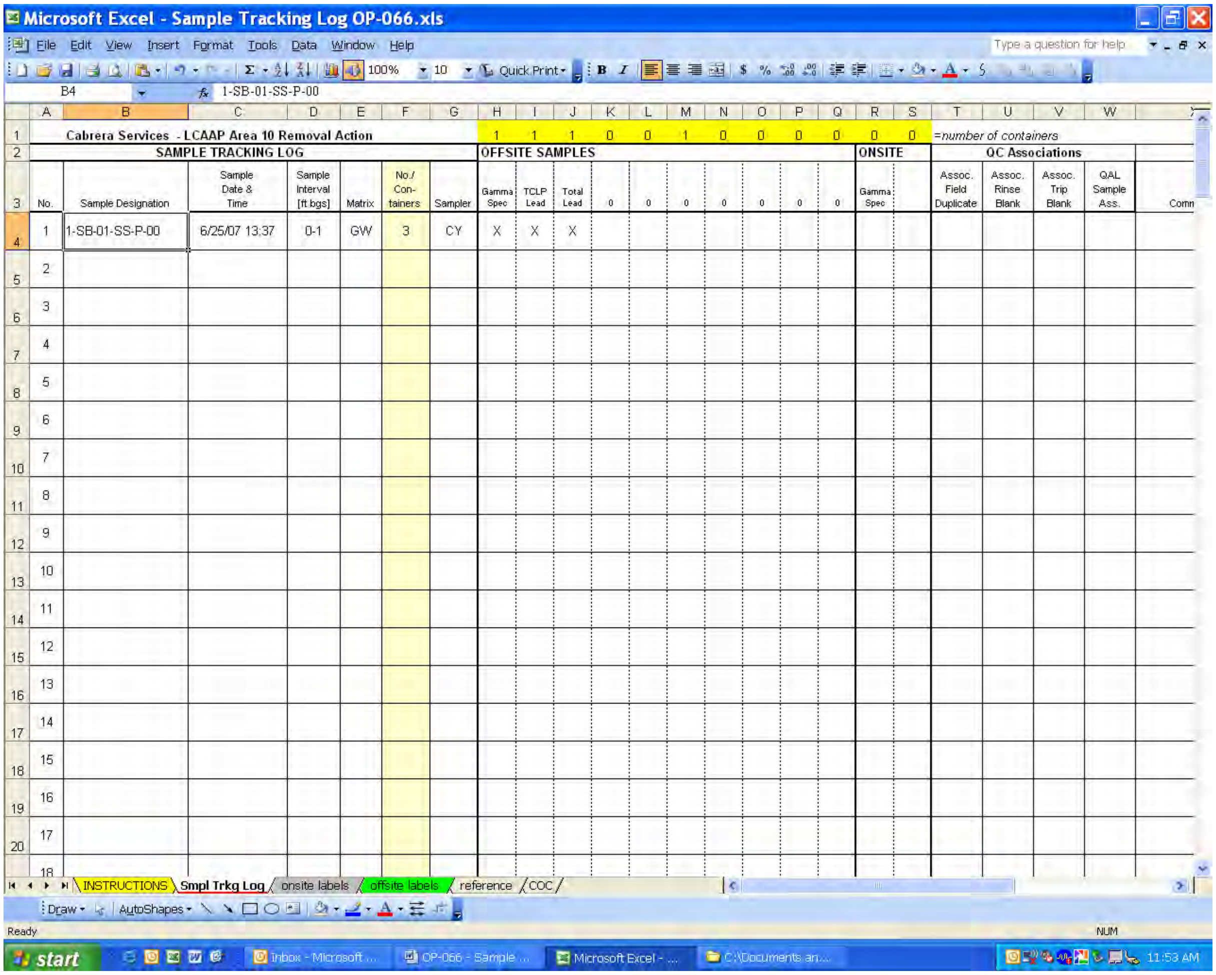


Figure 5 The Sample Tracking Log

9.0 ATTACHMENTS

None

OPERATING PROCEDURE

FOR

Investigation Derived Waste Management

OP- 336

Revision 1

PREPARED BY:

Carl Young, PG | Date

APPROVAL BY:

5/17/12

Kim Nelson, PG, President/COO | Date

1.0 Purpose

This procedure provides the requirements to ensure the proper management of investigation derived waste (IDW).

2.0 Applicability

This procedure applies to onsite collection and documentation of IDW at sites where hazardous materials could be encountered; it does not apply to specific disposal options or to the specific analytical requirements for waste characterization. Management of IDW, from field programs, is very specific to state regulatory requirements, program requirements, or client requirements.

This procedure will be used by Cabrera Services Inc. personnel to ensure proper control of IDW such as soil cuttings, drilling fluids, purged groundwater, and decontamination fluids.

3.0 Definitions

There are no special definitions associated with this procedure.

4.0 Precautions, Limitations and Requirements

4.1 Precautions

4.1.1 Be aware of all site-specific safety hazards.

4.1.2 Understand the type and quantity of IDW generated.

4.1.3 Be aware of all specific state regulatory requirements, program requirements, or client requirements for the management of IDW from field programs.

4.1.4 Always consult the project work plan and senior staff before making decisions.

4.2 Limitations

This procedure is limited to the management if IDW and does not cover requirements for other types of waste.

4.3 Requirements

4.3.1 Know the project-specific scope of investigation.

4.3.2 Understand project health and safety procedures.

4.3.3 Oversee and document subcontractor activities.

4.3.4 Maintain compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

5.0 Equipment

The following equipment may be required for managing IDW.

- Photoionization detector (PID) for screening according to the project-specific work plan.

- Pumps
- Bailers
- 55-gallon drums for IDW collection

6.0 Responsibilities

6.1 Project Manager (PM) – Ensuring that personnel are familiar with this procedure, adequately trained in the use of this procedure, and have access to a current copy of this procedure.

6.2 Field Operations Leader – Monitoring compliance with this procedure and training personnel in the use of proper IDW management.

6.3 Field Geologist/Scientist – Ensuring that this procedure is implemented during field assignments.

7.0 Procedure

Management of IDW can fall into these five categories:

- soil cuttings (solids)
- liquids from drilling (drilling water/mud)
- liquids from monitoring well development and purging
- decontamination fluids
- solid waste consisting of personal protective equipment and trash

Soil cuttings, drilling water/mud, or development water treated as IDW should be segregated by “area of contamination” (AOC). An AOC is typically considered the well or boring location or the location of a specific well cluster.

7.1 Management of Soil Cuttings IDW from Drilling Program

7.1.1 If appropriate, spread plastic sheeting on ground for collection of soil cuttings.

7.1.2 Screen the soil cutting (auger cuttings or soil from drive and wash or mud tub) with field instrumentation (e.g., PID, radiation meter, field gas chromatograph) as stated in the project work plan.

7.1.3 If soil cuttings do not pass the screening procedures mentioned above, collect and containerize soil cuttings (i.e., auger cuttings or soil from a drive and wash or mud tub) in 55-gallon drums.

7.1.4 Label and transport drums or roll offs to a centrally-located, temporary storage area. For large piles of soil cutting, collect appropriate composite samples and cover with plastic sheeting to avoid erosion.

7.1.5 Document the collection of soil cuttings in field notes. Record all pertinent data including location, physical characteristics of material (texture, water content, odor, field instrumentation readings associated with material, etc.). Record the number of drums or estimated volume of IDW in field notes.

7.1.6 Oversee physical transfer of the cuttings to drums by drilling subcontractor. Supervise workers to assure that proper health and safety and containerization procedures are being followed.

7.1.7 Label individual drums with site name, location identification, description of contents, field instrument readings, and any appropriate labeling required for transport include the following:

- Type of waste (i.e. soil, water, decontamination fluids)
- Point of origin (i.e. boring or well number)
- Site name
- Job number
- Screening results
- Date

7.1.8 If more than one drum is needed per AOC, label drums sequentially using the format: 1 of 3, 2 of 3, etc.

7.1.9 Assure and document that drums are sealed and that material is transported, upon completion of the IDW containment, to a safe staging area that is restricted from all unauthorized access set by the regulatory agency or client.

7.1.10 Screen ground surface under former soil cuttings to confirm that no residual contamination remains. If residual contamination is observed, remove and place in IDW soil drums generated from this AOC.

7.1.11 Document proposed final disposition of IDW. Document client contact who has been informed of the IDW disposal procedures.

7.2 Management of Drilling Water/Mud and Development Water IDW

7.2.1 Drilling water/mud consisting of water/bentonite and suspended solids from drilling, at a specific AOC, can be containerized in drums or pumped into a tank for transfer to a larger tank or treatment system.

7.2.2 Development water, that is collected as wells are pumped or surged, can be collected in the same manner mentioned above.

7.2.3 Normally drilling fluids and development water from a specific AOC do not have to be segregated from one another.

Development water should be pumped directly into 55-gallon drum or tank and a screening sample should be collected once the container is full.

- Containerize development water.
- Document in field log book all pertinent data related to volume, physical characteristics of material, odors, field instrumentation readings, etc.
- Label drums according to procedure described in 7.2.

7.3 Management of Decontamination Fluids IDW

7.3.1 All liquid from drilling equipment and decontamination should flow to a sump from where it can be pumped out and containerized in the appropriate manner.

7.3.2 Solids should be shoveled from the equipment pad into 55-gallon drums for screening prior to disposal.

7.3.3 Decontamination fluids from sampling activities should also be collected and containerized at a central location for sampling and/or disposal.

7.3.4 Normally decontamination fluids are not segregated by AOC, except in cases where specific AOCs are known to be highly contaminated. Documentation and containerization of the decontamination fluids should proceed in the same manner as described in preceding discussions.

- Collect and contain all fluids and solids from the decontamination operations at a central area.
- Document handling of decontamination fluids.
- Label drums of decontamination fluids as in section 7.2.

8.0 References

- ASTM D 5092-90; Standard Practice For Design and Installation of Groundwater Monitoring Wells in Aquifers
- USEPA, 1992, Guide to Management of Investigation-Derived Wastes, EPA 9345.3-03FS Site Specific Health and Safety Plan
- USEPA, 1991. Management of Investigation-Derived Wastes During Site Inspections. EPA/540/G-91/009.

9.0 Required Records

- Field logbook and/or notes

10.0 Attachments

There are no attachments associated with this procedure.

OPERATING PROCEDURE

FOR

SUBSURFACE SOIL SAMPLING

OP-352

Revision 3.0

Prepared by:

_______________________________________ _______________

Carl Young, Senior Hydrogeologist Date

Approved by:

5/17/12

_______________________________________ _______________

Kim Nelson, PG, President/COO Date

1.0 Purpose

This procedure provides the methods personnel will use to sample subsurface soil. Adherence to this procedure will provide assurance that the analyses performed have accurate and reproducible results. This procedure is not intended to provide procedures for soil borings.

2.0 Applicability

Personnel will utilize this procedure to sample subsurface soil for laboratory analysis unless otherwise directed by the project work plan.

3.0 Definitions

3.1 Bucket Auger – Bucket augers consist of a stainless steel (SS) “T” handle, detachable SS handle extensions, and the SS bucket. They are better for direct sample recovery 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 1 foot.

3.2 Continuous Flight Auger – Continuous flight augers can collect samples directly from the flights, but discrete sampling from a specific depth interval is not possible. They are not recommended unless the sampling goal is a composite sample of the soil column.

3.3 Shelby Tube – A thin-walled steel cylinder that is pushed into the ground to acquire a soil sample.

3.4 Subsurface Soil – Subsurface soil is anything deeper than the surface soil. Surface soil is usually defined as the interval from 0 to 6 inches (in) but may be as deep as 2 feet. Check the work plan for the project-specific definition of surface soil. The work plan may intend that surface soil be sampled in the same manner as subsurface soil.

3.5 Split Spoon – A steel cylinder used for soil sampling that is assembled in pieces to allow retrieval of the soil sample. See Exhibit1.

Exhibit 1: Split Spoon

4.0 Precautions, Limitations and Requirements

4.1 Precautions

4.1.1 The site should be checked for buried utilities. Prior to intrusive sampling, the appropriate subsurface utility location service will be notified (i.e., "Call Before You Dig" or dialing “311”).

4.1.2 Field staff will use the Personal Protective Equipment (PPE) specified in the Work Plan. The minimum PPE for subsurface soil sampling includes hearing protection, steel-toed shoes, safety glasses, protective gloves, and a hard hat.

4.2 Limitations – The work plan may list deviations from this OP and should address certain of the following options:

- State if the sample depth interval will be biased (based on field meter readings) or systematic (based on a pre-determined depth interval).
- Specify the sample interval, which is typically a six-inch segment but may vary, especially if the sample volume is large. The default is a six-inch interval.

4.3 Requirements

4.3.1 Personnel conducting soil boring investigations must have received prior instruction in hollow-stem augers or direct-push technology.

4.3.2 Personnel must read the work plans before performing the work.

4.3.3 Equipment decontamination should be addressed in the work plans, which may reference OP-373 *Field Equipment Decontamination*.

4.3.4 Disposition of Investigation Derived Waste (IDW) must also be considered in the work plans, which may reference OP-336 *IDW Management*.

5.0 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
- Stainless steel bowls
- Sample containers
- 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
- Spatula
- Plastic or stainless steel spoons
- Trowel

6.0 Responsibilities

6.1 Project Manager – The project manager is responsible for assuring that the field team understands the project objectives and has copies of the project work plans and that the field team has reviewed the plans and pertinent procedures before undertaking the work. The project manager is responsible for determining the sample design, including which of the options described in Section 4.2 are to be selected.

6.2 Field Site Manager – The field site manager is responsible for assuring that the necessary materials and equipment are available. The field site manager will verify that the field personnel have reviewed and understand this procedure.

6.3 Sampler – Usually a scientist or technician, this person is responsible for reading the work plans and procedures in advance of undertaking the work. The sampler will ask the field site manager or project manager about any details that do not seem clear. He/she must notify the field site manager and/or project manager about unusual conditions; especially conditions that would cause deviations from the work plans or this procedure. The sampler is responsible for documenting the sampling event.

7.0 Procedure

7.1 Soil Sampling by Hollow-Stem Auger

A hollow-stem auger excavates soil to the ground surface to bring the augers to the top of the intended sampling interval. A Shelby tube or split spoon is then advanced beneath the auger through the sampling interval, which is typically three feet. Sampling consists of the following steps:

7.1.1 Assure that the Shelby tube of the split spoon has been decontaminated.

7.1.2 Once the split spoon has been advanced through the sampled interval, the driller will withdraw the drill rods. If using a Shelby tube, it will be removed and the soil sample will be hydraulically extruded into a trough. If using a split spoon, the driller will unscrew the show and tail assembly and give the filled spoons to the Sampler. Note (or ask) which end is the bottom.

7.1.3 Discard the top of the core that consists of material that has sloughed into the bore hole.

7.1.4 Monitor organic vapor readings with a PID by scanning the core. Record the PID readings on the boring log.

7.1.5 Log soil textures on the boring log. **Note:** Missing core lengths can result from advances, which are pushed deeply into the sampling column, and soil stops moving up into the sample tube. Therefore, the missing core is from the bottom of the advancement and measurements should be adjusted accordingly.

7.1.6 Collect volatile organic compounds (VOC) samples using an EnCore™ sampler. Either at the location of the highest VOC reading or as specified in the work plan.

7.1.7 Collect the samples for the other analytes from the same depth interval.

7.1.8 Clean the tops and threads of the sample jars and secure the caps.

7.1.9 Store the soil samples on ice, except for the radiological samples.

7.1.10 Record the information in the field logbook according to OP-059.

7.1.11 Excess core may be returned to the borehole unless otherwise specified in the work plan.

7.1.12 Decontaminate the non-disposable sampling equipment according to OP-373 or as specified in the work plan.

7.1 Soil Sampling by Direct Push Technology

Direct Push Technology involves advancing a hollow tube into the subsurface under hydraulic pressure. Samples can be collected continuously or from specified depths. To collect soil samples proceed with the following steps:

7.1.1 Assure that the driller is using a decontaminated sample tube and new liner.

7.1.2 Once the sample tube has been advanced to the specified depth, it is withdrawn from the hole by the driller. The driller will remove the cutting shoe, pull out the acetate liner, and give it to the Sampler. The Sampler will observe the driller's work and ask him which end of the sample is the bottom.

7.1.3 Cut the liner open with two longitudinal cuts to expose the soil. Use a utility knife with a hooked blade, often provided by the driller.

7.1.4 Discard the top of the core that consists of material that has sloughed into the bore hole.

7.1.5 Monitor organic vapor readings with a PID by scanning the core. Record the PID readings on the boring log.

7.1.6 Log soil textures on the boring log. **Note:** Missing core lengths can result from advances, which are pushed deeply into the sampling column, and soil stops moving up into the sample tube. Therefore, the missing core is from the bottom of the advancement and measurements should be adjusted accordingly.

7.1.7 Collect VOC samples using an EnCore™ sampler. Either at the location of the highest VOC reading or as specified in the work plan.

7.1.8 Collect the samples for the other analytes from the same depth interval.

7.1.9 Clean the tops and threads of the sample jars and secure the caps.

7.1.10 Store the soil samples on ice, except for the radiological samples.

7.1.11 Record the information in the field logbook according to OP-059.

7.1.12 Excess core may be returned to the borehole unless otherwise specified in the work plan.

7.1.13 Decontaminate the non-disposable sampling equipment according to OP- 373 or as specified in the work plan.

7.2 Test Pit/Trench Excavation

Sampling from a backhoe-dug test pit or trench is conducted when detailed examination of soil characteristics (e.g., horizontal, structure, color, etc.) is required. For all excavations, an Activity Hazard Analysis is required. For excavations deeper than 4 feet, an excavation plan is required. Personnel will adhere to the following techniques when sampling from a backhoe-dug test pit or trench:

7.2.1 Using the backhoe, dig a trench approximately three feet wide and one foot below the cleared sampling location. Place excavated soils on plastic sheets.

7.2.2 Trenches deeper than four feet will not be entered due to safety restrictions unless the work is performed under an Excavation Plan. Monitor the excavation for organic vapor concentrations.

7.2.3 Use a shovel to remove a one to two-inch soil layer from the vertical face of the pit where sampling is to be conducted. Collect samples using a pre-cleaned trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face, at the sampling point, to remove any soil that may have fallen from above, and to expose fresh soil for sampling. Samples may often be collected directly from the backhoe bucket.

7.2.4 If VOC analysis is to be performed, use a pre-cleaned stainless steel lab spoon or equivalent to transfer sample into appropriate labeled sample container(s). Fill the sample jar completely to eliminate as much headspace as possible and tightly secure cap(s).

7.2.5 Place remainder of sample into a plastic, stainless steel, or other appropriate container and mix thoroughly to obtain a homogenous interval. Either: (a) place sample into appropriate labeled container(s) and tightly secure cap(s); or (b) if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly. When compositing is complete, place the sample into appropriate labeled container(s).

7.2.6 Abandon the pit or excavation in accordance with applicable location and/or state regulations. Willow excavation may generally be backfilled with the removed soil material.

8.0 References

Cabrera Procedure OP-008, *Chain of Custody*

Cabrera Procedure OP-059, *Field Activity Documentation*

Cabrera Procedure OP-060, *Sample Numbering*

Cabrera Procedure OP-061, *Sample Labeling*

Cabrera Procedure OP-062, *Sample Handling, Packaging & Shipping*

Cabrera Procedure OP-073, *Field Equipment Chemical Decontamination*

USEPA Environmental Response Team, 2000, SOP 2012 – *Soil Sampling*

USEPA, 1980, *Samplers and Sampling Procedures for Hazardous Waste Streams*, EPA/600/2-80/018

USEPA, 1984, *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II*, EPA/600/4-84-076

USEPA, 1989, *Soil Sampling Quality Assurance User's Guide*, EPA/600/8-89/046

USEPA, 1992, *Preparation of Soil Sampling Protocols: Techniques and Strategies*, EPA/600/R-92/128

9.0 Required Records

- Field Log Book
- Field Data Record – Surface/Subsurface Soil Sampling
- Test Pit Log
- Soil Boring Log

10.0 Attachments

- Attachment A – Field Forms (Soil Boring Log, Field Data Record – Surface/Subsurface Soil Sampling and Test Pit Log)

Attachment A
Field Forms

CABRERA SERVICES
RADIOLOGICAL · ENVIRONMENTAL · REMEDIATION

Soil Boring Log

Boring No:

Boring Location info:

Project:
DuPont BRA Data-Gap Sampling

Proj. No.
05-3136.00-003

date:
time:

page:
of:

By:

water depth / time:

water depth / time:

drilling method: Geoprobe

diam: 2-in [nom]

start/finish:

surface conditions:

elevation:

depth (show units)	Soil Texture	Well Construction	% recovery	sample int /no.	OVA [ppm]	GM Scan	FIDLER Scan	Description: textures, color, moisture, odor, firmness, fractures, strata, cavities, fossils, contamination, etc.

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: ______

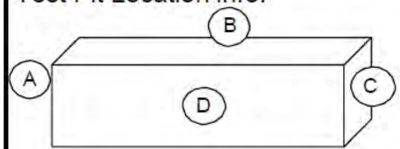
RECEIVED BY: ______

CABRERA SERVICES

Test Pit Log

Test Pit No:

Test Pit Location info:



Project: Proj. No.

date: page:
time: of:

test pit logged by:

weather conditions:

water level/depth:

Pit dimensions:
length: width: depth:

Equipment used:	Driller's Name/Company:
start/finish:	elevation:

depth (show units)	Soil Texture	Consistence or Density	color	mottles	H_2O content	Sample no. and Type	**Description: textures, color, moisture, odor, firmness, fractures, strata, cavities, fossils, contamination, etc.**

OPERATING PROCEDURE

FOR

FIELD ACTIVITY DOCUMENTATION

OP-359

Revision 1.0

Prepared/Reviewed by:

Carl Young, Senior Project Manager — Date

Approved by:

Chris Wright, Director of Applied Sciences — 03/18/2014 Date

1.0 PURPOSE

This Operating Procedure (OP) provides the methods Cabrera Services, Inc. (Cabrera) personnel shall utilize when documenting field activities. Adherence to this procedure will assure that the field work is properly documented to meet the established project quality objectives by capturing field conditions, details regarding the work performed to include changes or variations to the planned SOW, and other pertinent details regarding the execution of the field effort. Additionally, this documentation will allow for an adequate description of the work performed in subsequent reports.

2.0 APPLICABILITY

Personnel shall utilize this procedure when conducting any field activity. Clear and complete written documentation of field activities is an essential part of a field project. Field notes will become a permanent part of the project records and should be regarded as a client-deliverable document. The keeping of field logs is a requirement under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1988). Personnel should approach field documentation with the understanding that all of the field work should be able to be written into a report using the field notes alone, by an author who did not take part in field operations.

3.0 DEFINITIONS

3.1 Project Management Plans – A set or work plans usually consisting of a Project Work Plan (PWP), a Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP). Other plans may be added to the Project Management Plans depending on the complexity of the project, client needs, and regulatory requirements.

4.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

Field activities shall be documented in a project field notebook. The notebook must be bound, and entries must be made in ink. Pages must be sequentially numbered. An entry should be made for each day that activities occur at the field site, including mobilization days and demobilization days. Entries must be dated and initialed by the person making the entry. Blank pages should be lined out and initialed.

Any measurement that is not made on a field form should be entered in the field notebook. Consider making notebook entries that are redundant to field form entries for important measurements.

Field Personnel shall discuss deviations from the Project Work Plans with the Project Manager and receive approval prior to doing such. These actions shall be documented in the project field notebook at a minimum.

5.0 EQUIPMENT

Field notebooks shall be water-resistant, with permanently-bound with consecutively-numbered pages (examples include Rite-in-the-Rain Part Numbers 350N, 353N or equivalent).

Although not required by this procedure, field forms may be produced on water-proof paper (Rite-in-the-Rain Part Number 8511 or equivalent).

Indelible ink pens with permanent, black or blue indelible ink, or permanent water-proof fine-point markers should be used.

6.0 RESPONSIBILITIES

6.1 Project manager (PM): The PM is responsible for ensuring that the assigned personnel are familiar with this procedure and that the required aspects of the field work are being properly documented.

6.2 Field Site Manager (FSM) - The FSM is responsible for ensuring that field personnel are entering information into the field notebooks for their assigned tasks. The FSM is responsible for custody of the field forms and field notebooks that are kept by the project team. This responsibility may be delegated to the Cabrera Quality Control System Manager (CQCSM) if that person is on-site.

6.3 Field Personnel - All field personnel who are responsible for reading and complying with the provisions of this procedure. All field personnel may make entries to field forms and field notebooks.

7.0 PROCEDURE

These procedures are to be used by the Cabrera field representative for all field investigations unless project-specific planning documents or other written, approved documents supersede. Should the Cabrera FSM be faced with a situation where alternative field procedures must be used because of site conditions, he/she should notify the PM of the conditions and the suggested alternative procedures.

7.1 Project Documentation

7.1.1 It is essential that all field work be documented completely and correctly because (1) a written record of events in the field is more reliable and accessible than personal memory and (2) field records could later be used as evidence for litigation. Field documentation is an important part of a project's permanent record, and it should be concise and factual.

Emotional, speculative, or humorous statements regarding events, subcontractors, clients, owners, or site visitors must not be included.

7.1.2 A project field logbook will be kept by the FSM (minimum), and by individual Field Personnel based on the project scope and tasks. The following information must be included in each day's entry:

- The project name, number, and site address will be recorded on the inside front cover of the field logbook.
- Each daily entry shall start at the top of a new page, and include the name of the person (FSM and/or Field Personnel) recording the information, date, time on-site, and the task being recorded.
- Notations in the field logbook will be made in logbook fashion, noting the time and date of all entries. All pertinent information regarding the site will be documented as near to real-time as possible using military-time format (for example, 1:15 pm becomes 1315 hrs).
- Weather conditions shall be noted in the morning and throughout the course of the day to reflect any changes.
- At the conclusion of each day, the person maintaining the field logbook will sign and date the day's documentation entries.
- No blank pages will be permitted. If a page is not completely filled in, a line will be drawn through the blank portion and initialed by the person making the entry.
- Information recorded on other project documentation (boring logs, well installation/development logs) does not need to be repeated in the field logbook at the same level of detail to avoid transcription errors; however, the supplemental log should be referenced in the field notes.
- All field logbooks will be kept in a secure place during the duration of the project.

7.1.3 Mistakes shall not be erased or obliterated. Instead, the mistake shall be crossed out with a single horizontal line and the initials of the reviewer should then be written in along with the date that the mistake was crossed out. Corrections or clarifications can be added to the notebook, but must also contain the initials of the reviewer and the date that the correction or clarification was made.

7.2 Data Collection Logs and Forms

7.2.1 Various OPs include forms and/or logs to be used for data collection for specific tasks. Where applicable, these forms should be used as the primary means to document an activity. Several examples include:

- Soil Boring Logs
- Well Construction Forms
- Well Development Forms
- Groundwater Sampling Forms
- Chain of Custody Sheets
- Sampling Data Sheets
- Survey Data Collection Forms
- Safety Inspection Forms
- Incident Reporting Forms

The field log book should contain a reference to the individual data collection logs and forms to ensure they can be tied to the work performed and provide clarity regarding the full level of detail collected from the field effort.

7.3 Daily Reports

7.3.1 The FSM must submit a daily report to the PM describing the day's events, subcontractor(s) time, site visitors, summary of field conditions, change conditions, etc. Based on project specific needs, the agreed upon format of the Daily Report may vary, but the minimum information required has been included in the attached Cabrera Daily Report (Attachment A).

The level of detail provided within this template will allow the project to accurately record information from the field effort to support any potential change order requests and justify any deviations to the work plans.

7.3.2 Subcontractors may supply field reports and receipts to the FSM. These must be organized by the FSM (or designee) and become part of the Daily Report.

8.0 REFERENCES

- USEPA, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, EPA/540/G-89/004

9.0 REQUIRED RECORDS

- Data Collection Logs & Forms
- Field Logbook

10.0 ATTACHMENTS

Attachment A – Cabrera Daily Report

Attachment A

Cabrera Daily Report

OP 359, Field Activity Documentation

CABRERA SERVICES
RADIOLOGICAL · ENGINEERING · REMEDIATION

CABRERA DAILY REPORT

1. PROJECT INFORMATION

PROJECT NAME/LOCATION:		DATE:
		REPORT NO.
CONTRACT #:	CABRERA PROJECT #:	TASK #:
FIELD SITE MANAGER:	PROJECT MANAGER:	

2. WEATHER

TEMPERATURE RANGE:	WIND SPEED/DIRECTION:	
PRECIPITATION LAST 24 HOURS: ☐ YES ☐ NO	TYPE:	AMOUNT:
BAROMETRIC PRESSURE:	HUMIDITY:	HEAT INDEX RANGE:
WEATHER DELAYS: ☐ YES ☐ NO	DELAY TIME (HOURS):	

3. SUMMARY OF WORK

4. MATERIALS & EQUIPMENT BROUGHT ON-SITE

Receipt inspection required & completed? ☐ **Yes** ☐ **No**

5. INSPECTIONS		
TYPE	DESCRIPTION	ACTION
PREPARATORY		
INITIAL		
FOLLOW-UP		
ARE ANY DEFICIENCIES NOTED IN FOLLOW-UP INSPECTIONS? ☐ YES ☐ NO – IF YES, EXPLAIN:		

6. DEFICIENCIES CORRECTED			
DEFICIENCY #	REPORT REFERENCE	DESCRIPTION	ACTION

7. TESTS PERFORMED		
SPECIFICATION REFERENCE	TYPE	TEST & RESULT
ARE TEST RESULTS ATTACHED? ☐ YES ☐ NO ☐ NA – IF NO, EXPLAIN:		

8. CABRERA PERSONNEL ON-SITE		
EMPLOYEE NAME	TITLE	TASK(S) PERFORMED

9. SUBCONTRACTOR PERSONNEL ON-SITE				
SUBCONTRACTOR NAME	JOB DUTY	TASK(S) PERFORMED	# OF PERSONNEL	MAN-HOURS
		TOTALS		

10. EQUIPMENT & MATERIALS ON-SITE					
VENDOR	EQUIPMENT	SERIAL #.	ACTIVE OR IDLE	DATE RECEIVED	DATE RETURNED

11. MATERIAL GENERATED/STORED ON-SITE					
MATERIAL ID	SOLID, LIQUID, OR MIXED	DESCRIPTION OF MATERIAL	CONTAINER TYPE	DISPOSITION OR LOCATION OF MATERIAL	AMOUNT* (CY OR TONS)
					Totals	

ATTACH SEPARATE PAGES AS NEEDED. SEPARATE PAGES INCLUDED? ☐ YES ☐ NO

12. SAMPLE COLLECTION & ANALYSIS						
Sample ID	Media (Soil Water, Other)	Sampler Initials	On-Site or Off-Site Lab	Analyses / Type	Date Results Due	Freight Tracking #

ATTACH SEPARATE PAGES AS NEEDED. SEPARATE PAGES INCLUDED? ☐ YES ☐ NO

13. CHANGES/DELAYS/CONFLICTS
ANY CHANGES IN SITE CONDITIONS OCCUR TODAY? ☐ Yes ☐ No
IF YES, EXPLAIN:
DID A DELAY OR WORK STOPPAGE OCCUR TODAY? ☐ Yes ☐ No
IF YES, EXPLAIN:
HAS ANYTHING DEVELOPED IN THE WORK WHICH MAY LEAD TO A CHANGE? ☐ Yes ☐ No
IF YES, EXPLAIN:

14. VERBAL INSTRUCTIONS RECEIVED:

15. HEALTH & SAFETY SUMMARY	
SAFETY BRIEFINGS	
WAS A SAFETY MEETING HELD? ☐ YES ☐ NO	TOPIC DISCUSSED:
SAFETY INSPECTIONS	
WAS A SAFETY INSPECTION CONDUCTED? ☐ YES ☐ NO	
DEFICIENCIES NOTED: ☐ YES ☐ NO	DESCRIBE:
CORRECTIVE ACTIONS TAKEN: ☐ YES ☐ NO	DESCRIBE:
SUMMARY OF WORK PERFORMED	
TYPE OF WORK:	
CHEMICALS USED:	
PPE LEVEL:	
INCIDENT & NEAR MISS/OBSERVATION REPORTING	
ANY INCIDENTS ON-SITE TODAY? ☐ YES ☐ NO	DESCRIPTION:

CABRERA INCIDENT REPORTING FORM ATTACHED: ☐ **YES** ☐ **NO** **CLIENT SPECIFIC INCIDENT REPORTING FORM ATTACHED:** ☐ **YES** ☐ **NO**	
ANY NEAR MISSES/OBSERVATIONS ON-SITE TODAY? ☐ **YES** ☐ **NO**	**DESCRIPTION:**
H&S RECOMMENDATIONS	

16. REMARKS

17. VERIFICATION STATEMENT	
This report is complete and correct and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.	
NAME/TITLE:	**SIGNATURE:**
DATE:	

18. PROJECT MANAGER REVIEW & ACCEPTANCE	
REMARKS AND/OR EXCEPTIONS TO REPORT:	
ACCEPTANCE	
NAME/TITLE:	**SIGNATURE:**
DATE:	

CABRERA SERVICES
RADIOLOGICAL • ENGINEERING • REMEDIATION

Environmental Operating Procedure for Field Equipment Decontamination

OP-373

Revision 0

Prepared By: Carl Young
Carl Young P.G, Project Manager
7-28-11
Date:

Approved By: Chris Boes
Chris Boes P.G, Project Manager
28 July 11
Date:

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide technical 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 SOP 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

These are standard operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed will be documented and associated with the final report.

3.0 PRECAUTIONS, LIMITATIONS AND REQUIREMENTS

3.1 Precautions

- 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.
- Know project-specific scope of investigation.
- Know the requirements of the SSHP.
- Be aware of waste disposal concerns for waste-water generated from the decontamination process.

3.2 Limitations

- Protective clothing worn by the personnel involved in decontamination activities shall be determined in accordance with the SSHP.
- Decontamination cleaning solvent/solutions shall only be used in accordance with the directions and limitations listed on the manufacturer supplied MSDS.
- Respiratory protection devices required for decontamination operations shall be selected and used in accordance with the provisions of the SSHP.

3.3 Requirements

- Understand Project Health and Safety Procedures
- Understand the Field Sampling Plan

4.0 REFERENCES

EPA, Standard Operating Procedure No. 2006, 1994, Sampling Equipment Decontamination

5.0 DEFINITIONS AND ABBREVIATIONS

None.

6.0 EQUIPMENT

- Long and short handled brushes
- Bottle brushes
- Drop cloth/plastic sheeting
- Paper towels
- Plastic or galvanized tubs or buckets
- Pressurized sprayers (H_2O)
- Solvent sprayers
- Aluminum foil
- Trash bags
- 55-gallon drums
- Tap water
- Alconox
- ASTM Type II Reagent Water
- Methanol and hexane
- Personal Protective Equipment (PPE)

7.0 RESPONSIBILITIES

Project Manager (PM) – the PM is responsible for ensuring that personnel are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

Field Operations Leader (FOL) – The FOL is responsible for monitoring compliance with this procedure and training personnel in the decontamination of field sampling equipment.

Field Geologist/Scientist – During field assignments, the field geologist/scientist is responsible for ensuring that this procedure is implemented.

8.0 INSTRUCTIONS

The following procedure shall be used to decontaminate sampling and drilling devices, such as split spoons, bailers, and augers that can be hand-manipulated.

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 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 is the hotline, the boundary between the exclusion zone and the contamination reduction zone. The size of the decontamination corridor 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.

Another corridor may be required for the entry and exit of heavy equipment. Sampling and monitoring equipment and sampling supplies are all maintained outside of the CRC. Personnel don their equipment away from the CRC and enter the exclusion zone through a separate access control point at the hotline. One person (or more) dedicated to decontaminating equipment is recommended.

For sampling equipment and smaller drilling equipment:

1. 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.
4. Rinse equipment with pesticide-grade hexane.
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.

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.

The large equipment, including drill rigs, casings, rods, and bits, will be decontaminated as follows:

1. Wash the external and internal surfaces of equipment with high-pressure hot water and Alconox, or equivalent laboratory-grade detergent, to remove any accumulated material (e.g., mud).
2. Rinse with potable water.
3. After decontamination, all downhole equipment should be kept on the drill rig resting on clean plastic sheeting.

Decontamination of large equipment is typically the responsibility of the drilling contractor with oversight by the FOL or field geologist.

9.0 QUALITY ASSURANCE/RECORDS

9.1 Quality Assurance

- Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.
- Operations conducted using this procedure shall be reviewed for compliance at least annually.

9.2 Records

- The records generated by the use of this procedure are documented in accordance with the provisions of referenced CABRERA procedures, (logbook entries). No new records are created.
- Documented information shall be legible written in ink.
- Data shall not be obliterated by erasing or using white-out. Incorrect entries shall be corrected by striking a single line across the entry. The correction shall be entered, initialed, and dated.

10.0 ATTACHMENTS

None.

APPENDIX C

AIR MONITORING PLAN

FINAL

Revision 1

AIR MONITORING PLAN

Exploratory Investigation for Magnetic Anomaly Source in Bulb

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
RICHMOND, CALIFORNIA

Project No: 19533A

Prepared for

University of California, Berkeley
Office of Environment, Health, and Safety
University Hall 3rd Floor
Berkeley, CA 94720

Prepared by

CABRERA SERVICES
RADIOLOGICAL•ENGINEERING•REMEDIATION

473 Silver Lane
East Hartford, CT 06118

October 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS/ABBREVIATIONS

4LEAF	4LEAF, Inc.
ACGIH	American Conference of Governmental Industrial Hygienists
AMP	Air Monitoring Plan
ANSI	American National Standards Institute
BAAQMD	**B**ay Area Air Quality Management District
BTEX	benzene, toluene, ethylbenzene, xylene
BZ	breathing zone
Cabrera	Cabrera Services Inc.
CCR	California Code of Regulation
CFR	Code of Federal Regulations
COPCs	Chemicals of Potential Concern
DAC	derived air concentration
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ft	feet
H_2S	hydrogen sulfide
HV	high-volume
lpm	liters per minute
LV	low-volume
NRC	US Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PPE	Personal protective equipment
ppm	parts per million
RBC	Richmond Bay Campus
SHSP	Site-Specific Health & Safety Plan
SSHO	site safety and health officer
µCi/mL	microcuries per milliliter
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
mrem/hr	microRoentgen per hour
VOCs	volatile organic compounds
Work Plan	Exploratory Excavation Work Plan

1.0 INTRODUCTION

This Air Monitoring Plan (AMP) is intended to define protocols necessary for protecting on-site Richmond Bay Campus (RBC) workers, the surrounding off-site community, and contractors/consultants performing the planned exploratory excavation activities at RBC in Richmond, California, from the hazards associated with:

- Particulate matter from dust-generating activities,
- Internal and external radiation exposure from on-site contaminants,
- Volatile organic compounds from on-site contaminants, and
- Hydrogen sulfide from natural decomposition of organic matter.

This AMP provides essential information pertaining to potential hazards associated with this project and is to be used in conjunction with the Site-Specific Health and Safety Plan (SHSP) (Appendix A of the Exploratory Excavation Work Plan [Work Plan]).

UC Berkeley has contracted with Cabrera Services Inc. (Cabrera) to perform an exploratory excavation based on a previous magnetometer survey of the Bulb performed by the Department of Toxic Substances Control (DTSC) using a Geometrics G-856 magnetometer. An anomaly roughly 20 by 36 feet (ft) was detected in the location shown on Figure 2 of the Work Plan. This area of this investigation will be further refined or confirmed during a magnetometer survey that will be conducted just prior to the exploratory excavation activities. The area of excavation is anticipated to be approximately 8 ft to 12 ft below ground surface of fill material overlaying sandy silt and clay (Bay Mud). Excavated soils will be stockpiled adjacent to the excavations during the investigation and the trenches will be backfilled during the same work day. The following dust-generating activities have been identified and described in the Activity Hazard Analysis Tables (Attachment B of Appendix A, SHSP):

- Surgical excavation with periodic assessment surveys of subsurface conditions
- Backfilling.

As discussed in the SHSP, the required Level D personal protection equipment (PPE) for the above mentioned activities include:

- Steel-toed boots (American National Standards Institute [ANSI] Z41. 1)
- Hard hat (ANSI Z89. 1)
- Safety glasses with side shields (ANSI Z87. 1)
- Hearing protection
- Nitrile gloves and leather work gloves

The following sections describe the air monitoring to be performed and to identify and/or quantify airborne contaminants sufficiently to enable selection of the appropriate level of worker protection to be used. PPE requirements may be upgraded from Level D to higher levels of protection depending on air monitoring and/or radiation survey results.

2.0 AIR MONITORING STRATEGY

This section describes the strategy and procedures that will be employed to monitor worker health and safety and potential off-site migration of contaminants from site activities. The monitoring data will be used to support decisions to upgrade or downgrade worker PPE requirements, as well as identify the need for additional engineering controls to protect RBC workers or the surrounding off-site community. Action levels for chemical constituents were developed and are outlined in the 4LEAF, Inc. (4LEAF) Perimeter Air Monitoring Plan that is included as Attachment A to this Air Monitoring Plan.

For this project, real-time dust (total particulate) and air monitoring for volatile organic compounds (VOCs), hydrogen sulfide (H_2S), airborne particulate alpha/beta radiation and gamma radiation will be used to evaluate health and safety conditions and monitor potential off-site migration of contaminants from dust generating activities. Due to potential unpleasant sulfur emissions from natural occurring sources (i.e., decomposition) commonly found in the proposed tidal marsh sediments to be excavated, a H_2S meter will also be used to distinguish nuisance sulfur emissions and potentially harmful hydrogen sulfide emissions. The H_2S meter will used to monitor the excavation atmosphere and the breathing zone of the work area. Real-time air monitoring as discussed in this section will be used to evaluate breathing zone of the work area and any off-site migration of particulates.

2.1 LABORATORIES AND TESTING SERVICES

Personal (breathing zone), work area, and perimeter air monitoring will be performed during the project, and the data used to make decisions on upgrading or downgrading PPE and/or evaluating the effectiveness of dust suppression techniques. Air monitoring criteria and action levels for total particulate, VOCs, H_2S, alpha/beta radiation, and gamma radiation for the work area and the perimeter of the work area are presented below in Table 1 and Table 2, respectively:

Table 1. Work Area Air Action Levels

Chemical/Hazard Of Concern	Frequency	Action Level NIOSH / OSHA / NRC	Actions
Particulate at breathing zone (as measured with Mini-Ram, Dust-trak, or other direct-read instrument)	Ongoing monitoring during dust-generating tasks	Cal-OSHA PEL of 1 mg/m3 – nuisance PEL	Upgrade respiratory protection (Level C) for workers in this area. Upgrade engineering controls to control dust.
Volatile organic compounds (as measured with PID) at breathing zone	Ongoing monitoring during dust-generating tasks	5.0 parts per million (ppm) (sustained, i.e. greater than 2 minutes) above background within the breathing zone	Upgrade respiratory protection (Level B) for workers in this area.
H_2S (as measured with H_2S meter) at breathing zone	Ongoing monitoring during excavation activities	1 ppm (sustained, i.e. greater than 2 minutes) above background within the breathing zone	Upgrade respiratory protection (Level B) for workers in this area. Apply odor suppressors

Table 1. Work Area Air Action Levels			
Chemical/Hazard Of Concern	**Frequency**	**Action Level NIOSH / OSHA / NRC**	**Actions**
			or cover excavations
Alpha and beta radiation	Ongoing monitoring during excavation activities	2E-13 µCi/mL (10 CFR 20 Appendix B Action Level for occupational derived air concentration [DAC] values for unlisted radionuclides of concern)	Upgrade engineering controls to control dust. Upgrade respiratory protection (Level C) for workers in this area.
Gamma radiation	Ongoing monitoring during excavation activities	Twice normal background with successive readings showing significantly increasing levels (successive readings, i.e. soil samples collected at 0.5 ft to 1.0 ft distances from original sample location) or 1,000 microrem per hour (µrem/hr)	Stop excavation and notify Cabrera HP, DTSC, and UC Berkeley RRSO

Notes: NIOSH = National Institute for Occupational Safety and Health

OSHA = Occupational Safety and Health Administration

NRC = US Nuclear Regulatory Commission

Table 2. Perimeter Air Action Levels			
Chemical/Hazard Of Concern	**Frequency**	**Action Level NIOSH / OSHA / NRC**	**Actions**
Particulate at breathing zone (as measured with MIE Personal Data Rams [PDRs], Mini-Ram, Dust-trak, or other direct-read instrument)	Ongoing monitoring during dust-generating tasks	**Perimeter Action Level** (based on Aroclor-1248): 50 µg/m^3 above upwind (background) concentrations based on the Office of Environmental Health Hazard Assessment chronic recommended exposure limit	Upgrade engineering controls to control dust.
Alpha and beta radiation	Ongoing monitoring during excavation activities	1E-15 µCi/mL (10 CFR 20 Appendix B Action Level for effluent concentrations for unlisted radionuclides of concern)	Upgrade engineering controls to control dust.

2.2 AIR MONITORING DESIGN

Fugitive dust emissions during the site remediation efforts at the site will be minimized through implementation of engineering controls and proper work practices. Engineering controls will consist primarily of applying water spray to the active work areas to reduce dust. Equipment operators will be instructed to keep drop heights to a minimum when moving contaminated debris in order to keep airborne emissions to a minimum. The two perimeter monitors will be composed of one upwind and one downwind monitoring location selected in relation to the site work zones. One PDR will be placed at a height of five feet on fences or poles in the downwind direction of the excavation area to monitor for dust being generated in the excavations and one PDR will be placed upwind of the excavations to measure ambient dust concentrations. The wind directions within the immediate work areas will be identified with flags or streamers (i.e., banner tape) affixed to fencing and/or poles situated in the work area. Wind velocity will be measured using a calibrated wind sock and an anemometer, or equivalent.

Potential total particulate, VOCs, H_2S, and alpha/beta and gamma radiation will be monitored during exploratory activities.

2.3 AIR MONITORING STRATEGY

Air monitoring will consist of

1) direct-reading instrumentation (i.e., Mini-Ram, PID, H_2S meter, microR meter) to measure total particulate levels, VOCs, H_2S, alpha/beta radiation in breathing zone of the work area; and
2) air monitors (PDR and high/low-volume air samplers) for perimeter air monitoring to measure chemical and radiological particulate to help protect off-site receptors

Monitoring duration and frequency will be evaluated as collected data are generated and may be revised as the project progresses.

2.3.1 Total Particulate Air Monitoring

A perimeter total dust action level of 50 micrograms per cubic meter (μg/m^3) in addition to the ambient concentration recorded in the upwind direction of the work area for chemical constituents will be used for chemical constituents during dust generating activities to monitor potential off-site migration of dust. The perimeter total dust action level was developed based on the methodology outlined in 4LEAF Perimeter Air Monitoring Plan provide as Attachment A to this Air Monitoring Plan In the event that the action level of 50 μg/m^3 is exceeded, additional engineering controls (i.e., application of water) in the work area will be implemented in an effort to minimize off-site migration of dusts.

A Work Area action permissible exposure limit for dust of 1 mg/m^3 will be used during dust generating activities. This level is conservatively set at 10% of the CAL/OSHA limit of 10 mg/m^3. Levels in excess of this action level with trigger an upgrade of respiratory protection (Level C) for workers in this area, and/or increased engineering controls to control dust.

2.3.2 Volatile Organic Compounds Monitoring

A PID will be utilized to monitor work areas for organic vapors, or in the event that unknown vapors are encountered. The personnel action level is 5.0 ppm sustained above background in the breathing zone; sustained exposure in the breathing zone at or above the action level will require workers to upgrade to Level B.

2.3.3 Hydrogen Sulfide Monitoring

A H_2S meter will be utilized to monitor work areas for H_2S. A personnel action level of 10 ppm sustained for two minutes above background in the breathing zone will require workers to upgrade to Level B.

2.3.4 Radiological Air Monitoring

Radiological airborne hazards may be generated by handling of contaminated subsurface soils. Therefore, air sampling will be performed during excavation and soil stockpiling activities to monitor occupational and off-site effluent airborne concentrations. Airborne contamination surveys will be provided utilizing low-volume (LV) air samplers at flow rates of approximately 80 liters per minute (lpm) or high-volume (HV) air samplers at flow rates of approximately 15 cubic feet per minute (cfm). The selection of HV versus LV will be based on flow rates; estimated standard run times, total volume of air collected during standard monitoring durations, and required instrument detection capabilities to ensure compliance with regulatory and project-specific limits. Table 1 presents Occupational derived air concentration (DAC) Values and Effluent Air Concentrations for unknown (unlisted) radionuclides of concern. Additional detail regarding the air sampling program is provided in Section 5.6 of the SHSP (Appendix A of the Work Plan).

2.3.4.1 Breathing Zone Air Monitoring

Breathing zone (BZ) air monitoring will be performed during all intrusive activities. A BZ air sampler will be worn by the worker located nearest to the exposed subsurface soils. BZ air samplers will have filters installed that are exchanged after sufficient volume has been collected to ensure 50 percent of MDA is met.

Cabrera RSP OP-002, *Air Sampling and Analysis*, requires that air sampling be conducted where a potential exists to exceed 10 percent of any DAC. If these levels are exceeded, tracking of DAC-hours for all affected workers must be performed. Engineering controls, such as respiratory protection, may also be implemented as mitigation tools.

2.3.4.2 Effluent Air Monitoring

Site effluent airborne sampling will be performed to monitor and protect the general public. These monitors will be located at the perimeter of the work area at the same locations as the PDRs measuring total particulate (i.e., upwind and downwind). HV air samplers will be utilized to obtain sufficient air volumes to achieve required analytical sensitivities. Filters from HV air samplers will be exchanged daily.

2.3.5 Gamma Radiation Monitoring

A Ludlum 19 (microR meter) or equivalent will be utilized to monitor work areas for radiation exposure.

The action level will be as follows:

1) Twice normal background with significantly increasing successive sample readings per radiation specialist, or

2) 1,000 microrem per hour (μrem/hr).

If the action level is exceeded, the action level will require that all excavation activities cease; subsequently the excavations will be backfilled.

2.4 MONITORING INSTRUMENTATION

Monitoring instruments will be response checked each day of use following manufacturer's guidelines (note that particulate monitoring instruments are calibrated at the factory, and field calibration only serves as a zero and wide-span calibration).

ATTACHMENT A

PERIMETER AIR MONITORING PLAN

Perimeter Air Monitoring Plan

for the Bulb Magnetic Anomaly

Exploratory Excavation Investigation

Richmond Bay Campus

FINAL

Prepared for

University of California, Berkeley
317 University Hall, MC 1150
Berkeley, California, 94720-1150

Submitted: October 2, 2014

Prepared by

4LEAF, INC.

2110 Rheem Drive, Suite A
Pleasanton, California 94588

Brienne Meyer, CIH No. 10188

This Page Intentionally Left Blank

Table of Contents

This Page Intentionally Left Blank

1.0 INTRODUCTION

4LEAF, Inc. (4LEAF) has prepared this perimeter air monitoring plan (the "Plan") for the University of California, Berkeley (UC Berkeley) Office of Environment, Health and Safety (EH&S) in accordance with the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Site Investigation and Remediation Order, Docket No. ISE-RAO 06/07-004, dated September 15, 2006. This Plan outlines the air monitoring procedures for conducting the Bulb Magnetic Anomaly Exploratory Excavation Investigation at the Richmond Bay Campus (RBC) in Richmond, California (see attached Figure 2 from Cabrera Work Plan).

The air monitoring procedures were developed to protect RBC workers and off-site communities from exposure to chemicals of potential concern (COPCs) and to evaluate adequacy of dust control methods being applied by the contractor selected to perform the Bulb Magnetic Anomaly Exploratory Excavation Investigation and described in the Cabrera Services (Cabrera) Work Plan (Cabrera 2014).

2.0 AIR MONITORING

Air monitoring will be performed during all soil disturbance and excavation activities performed during the Bulb Magnetic Anomaly Exploratory Excavation Investigation. Based on the known COPCs, real-time dust monitoring will be performed during excavation activities to be performed during exploratory excavation activities to be performed in the Bulb area at RBC. Monitoring for radiological constituents will be performed by Cabrera personnel as described in the Cabrera Work Plan.

2.1 Real-time Perimeter Dust Monitoring

There is the possibility that minor amounts of dust will be released into the air during the Bulb Magnetic Anomaly Exploratory Excavation Investigation. Dust emissions will be minimized by spraying water on excavation-equipment buckets during excavation and dumping to eliminate visible dust. In addition, excavated soils will be placed in soil stockpiles to minimize wind-borne dust prior to placing the soils back into the exploratory excavations.

Air monitoring will be performed at the perimeter of the exploratory excavation areas to verify that dust control measures are adequate. Real-time air monitoring of total dust will be performed using real-time aerosol monitors [MIE Personal Data Rams (PDR)] with data loggers to provide immediate information for the total dust levels present. The lower detection limit for the operating range of the PDR is 0.001 milligrams per cubic meters (mg/m^3). The particle size maximum range of response for the PDR is 0.1 to 10 micro meters (µm). The PDRs will be set to automatically log dust levels over 5-minute periods and will be visually checked approximately every hour during the work day and the value manually recorded in the field logs by an on-site UC Berkeley representative to verify equipment operation and compliance with the target action levels. The data will be downloaded into a computer daily and will be posted on the RBC Environmental Website (http://rfs-env.berkeley.edu) within one week.

The PDRs will be calibrated daily according to the manufacturer's requirements and maintained in good working conditions. Spare batteries and one spare PDR unit will be maintained on site in the event a unit malfunctions during the work day. Dust measurements will be recorded upwind of the exploratory excavation areas at the start of work in the morning and after lunch break at mid-day to determine ambient dust concentrations for that day.

The PDRs will be positioned around the perimeter of the exploratory excavation at locations most likely to be in the direction of off-site dust migration depending on the identified wind direction on the day and time of work (see attached Figure 5 from Cabrera Work Plan). One PDR will be placed at a height of five feet in the downwind direction of the excavation area to monitor for dust being generated in the excavation and one PDR will be placed upwind of the excavation to measure ambient dust concentrations.

Wind speed and direction will be continuously monitored using a portable calibrated wind sock. Wind speed will also be measured every hour using a hand-held anemometer and the readings recorded in the daily field notes. The contractor will be notified verbally (and documented in the daily field notes) to stop work if real-time dust monitoring shows that perimeter action levels for dust are exceeded or if sustained wind speeds exceed 15 miles per hour (mph) (sustained for 15 minutes). For instances when the perimeter action levels for dust are exceeded, UC Berkeley's on-site representative will evaluate the potential cause(s) of the exceedance and direct the contractor to increase mitigation measures such as increasing dust suppression or require a change in work procedure (i.e. slower unloading of soil from the excavator bucket into soil stockpiles) to reduce dust generation.

UC Berkeley has calculated an action level of 50 $\mu g/m^3$ for fugitive dust concentrations for the perimeter (or fence line) of the exploratory excavation area. The perimeter dust action levels are protective of the most sensitive off-site receptors including children, elderly, and the ill. These perimeter dust action levels were established using the following methodology:

- *Determination of chemicals of potential concern (COPCs).* Chemicals detected in soils during previous site investigation activities were reviewed to determine those chemicals that are present in soils at concentrations exceeding the lowest of the risk-based concentration criteria and could be potentially associated with an adverse health risk if released into the air as dust. The risk-based concentration criteria are published in Appendix C of the Site Characterization Report (Tetra Tech 2013). Based on this review, Aroclor-1248 was identified as a chemical of potential concern (COPC) as exceeding the lowest of its respective risk-based concentration.

- *Calculation of COPC Concentrations in Dust.* A hypothetical worst-case dust concentration that an individual located outside of the excavation area could be exposed to was calculated for Aroclor-1248 by assuming all dust released from the excavation contained the maximum concentrations of the COPC found during previous site investigations. This adds conservatism to the calculated allowable dust concentration since the majority of soils in the exploratory excavation area most likely contain Aroclor-1248 at much lower concentrations than the maximum concentration. The California Ambient Air Quality Standard (CAAQS) PM_{10} standard of 50 micrograms per cubic meter ($\mu g/m^3$) was used as the benchmark dust concentration. The maximum soil concentration for Aroclor-1248 was converted to mg of Aroclor-1248 per mg of dust, and then multiplied by the PM_{10} standard to determine the worst-case Arolcor-1248 concentration in dust. For example, the maximum soil concentration of Aroclor-1248 reported in soil samples collected by Tetra Tech in July 2014 in the Bulb area is 5.7 mg/kg. If total dust concentrations were equivalent to the PM_{10} standard, the calculated worst-case Aroclor-1248 concentration in dust would be 0.000285 $\mu g/m^3$ (5.7 mg/kg x 0.000001 kg/mg x 50 $\mu g/m^3$ = 0.000285 $\mu g/m^3$).

- *Calculation of Risk-based Acceptable COPC Concentrations in Dust.* The acceptable risk-based Aroclor-1248 concentration in dust was calculated using a target risk of 1×10^{-6} since Aroclor-1248 is a carcinogenic compound. Exposures with risks less than the target levels are not considered significant. For carcinogenic compounds, the target risk was divided by the inhalation unit risk (IUR)[1] for Aroclor-1248 to determine an acceptable COPC concentration in dust. For Aroclor-1248, the target risk was divided by the IUR for Aroclor-1248 of 0.00057 $(m^3/\mu g)^{1-}$, resulting in an acceptable Aroclor-1248 concentration in dust of 0.0018 $\mu g/m^3$ (1×10^{-6} / 0.00057 $(m^3/\mu g)^{-1}$ = 0.0018 $\mu g/m^3$). Because the risk-based acceptable Aroclor-1248 concentration in dust was calculated using toxicity data (i.e., IUR) derived from chronic exposure studies, the risk-based acceptable concentration is protective of chronic exposure to Aroclor-1248.

- *Comparison of Worst-case COPC Concentration in Dust to Acceptable COPC Concentration in Dust and Calculation of Action Level for Total Dust.* The calculated worst-case Aroclor-1248 concentration in dust was compared to the acceptable COPC concentration. This comparison was made to determine if exposure to dust at the PM_{10} standard of 50 $\mu g/m^3$ could result in an unacceptable exposure to Aroclor-1248 for off-site receptors. As shown in Table 1, the worst-case Arolcor-1248 concentrations in dust did not exceed the acceptable COPC concentration in dust; therefore, the PM_{10} standard of 50 $\mu g/m^3$ will be used as the dust action level implemented during the exploratory excavation activities in the Bulb area.

[1] The IUR for Aroclor-1248 was obtained from the *Consolidated Table of OEHHA/Air Review Board (ARB) Approved Risk Assessment Health Values* (2013): PCBs (high risk) = 5.7E-04 $(\mu g/m^3)^{-1}$.

3.0 REFERENCES

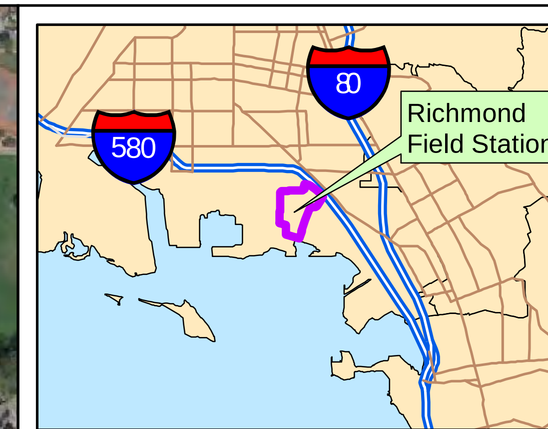
Cabrera, 2014. Draft Exploratory Excavation Work Plan, Exploratory Investigation for Magnetic Anomaly Source in Bulb, University of California, Berkeley, Richmond Field Station, Richmond, California, September 2014.

OEHHA, 2013. *Air Toxics Hot Spots Program Technical Support Document for the Derivation of Noncancer Reference Exposure Levels*, Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Branch, Oakland, CA. August 20, 2013.

Tetra Tech, 2013. *Site Characterization Report, Proposed Richmond Bay Campus, Research, Education, and Support Area and Groundwater within the Richmond Field Station Site*. May 28.

USEPA, 2013. *Integrated Risk Information System (IRIS)*, US Environmental Protection Agency, accessed October 16, 2013, at http://www.epa.gov/IRIS/.

FIGURES



Legend

- Upland Area
- Transition Area
- Western Transition Area
- Eastern Transition Area (Remediated)
- Western Stege Marsh
- Western Stege Marsh (Remediated)

0 200 400 800

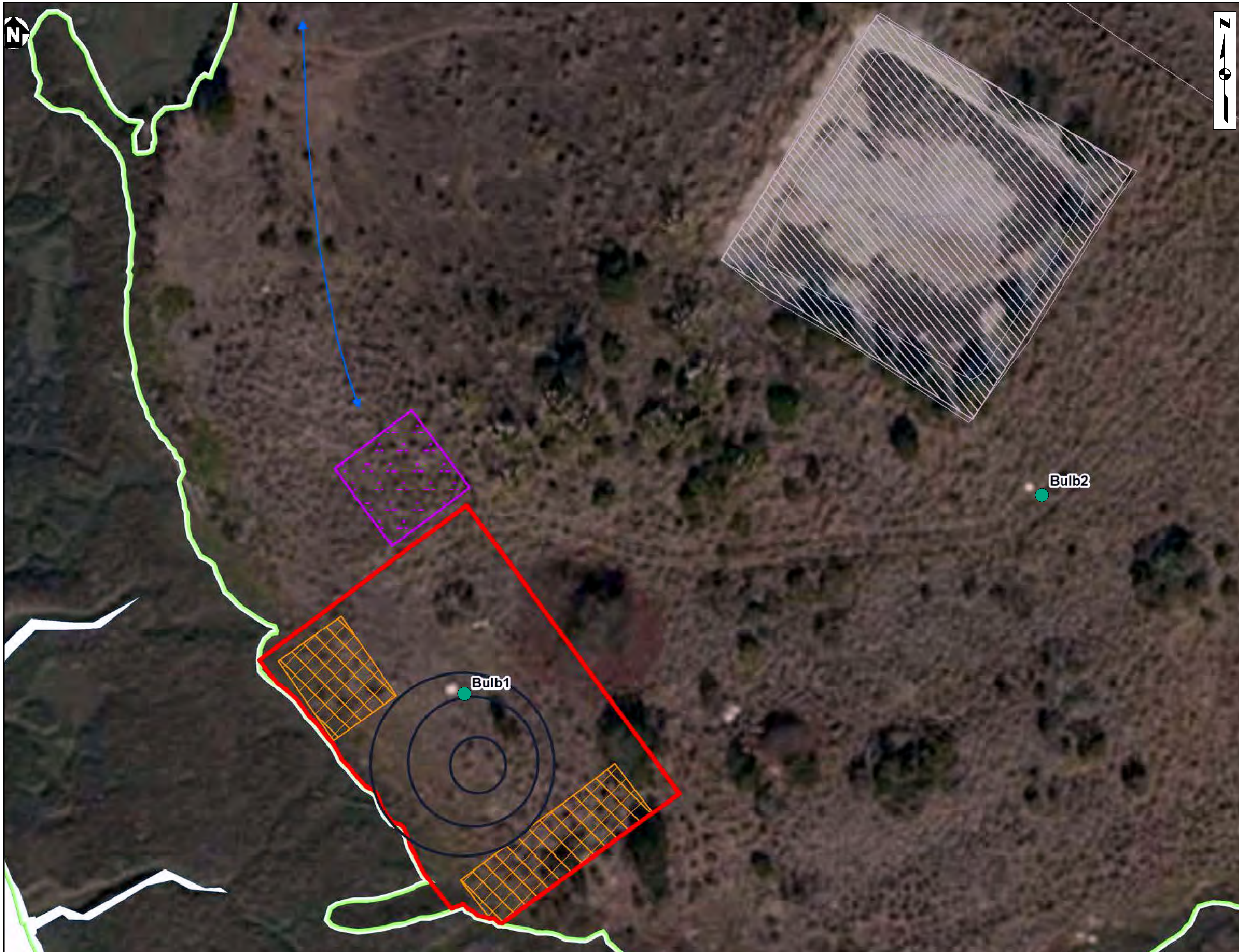
Feet

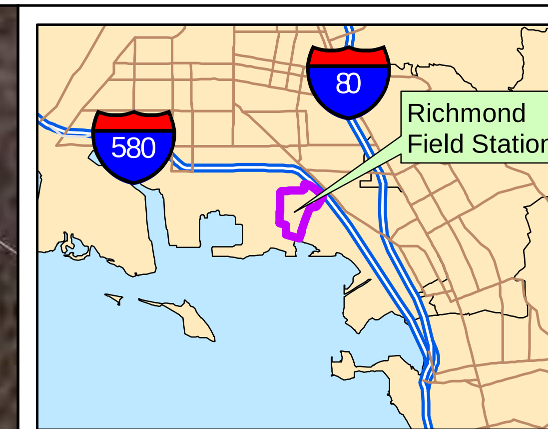
SITE LAYOUT

RICHMOND FIELD STATION SITE
UNIVERSITY OF CALIFORNIA, BERKLEY
RICHMOND, CALIFORNIA

8/2014	PROJECT NO. 15-1003.00	Figure 2

Cabrera Services
1106 N. Charles St, 300
Baltimore, MD 21201





Proposed Investigation Area [1]
Work Zone
Soil Stockpile
Support Zone
Asphalt/ Concrete Pad
Marsh Boundary
Surface Water
Piezometer Location
Access Route

Notes:
1. Starting with the innermost circle,
are will be investigated, stepping out
vertically and horizontally as necessary.

Estimated locations. Final Locations to be
presented in Attachment 1.

Reference: Magnetometer Survey at University
of California Richmond Field Station, Richmond
Department of Toxic Substance Control,
December 15, 2006.

0 10 20 40
Feet

SITE WORK ZONE DETAIL FOR ANOMALY EXCAVATION IN THE BULB

RICHMOND FIELD STATION SITE
UNIVERSITY OF CALIFORNIA, BERKLEY
RICHMOND, CALIFORNIA

8/2014	PROJECT NO. 15-1003.00	Figure 5

Cabrera Services
1106 N. Charles St, 300
Baltimore, MD 21201

TABLES

Table 1. Proposed Total Dust Action Level for Excavation Activities.

COPC	Acceptable COPC Concentration in Dust ($\mu g/m^3$)	Bulb Area: Max. Soil Conc. (mg/kg) [(a)]	Bulb Area: Worst-Case COPC Concentration in Dust ($\mu g/m^3$)
Aroclor-1248	0.0018 [(b)]	5.7	0.000285
	Total Dust Action Level:	**50 $\mu g/m^3$**	

Notes:
(a) Based on soil samples collected by Tetra Tech in Bulb area on July 24, 2014.
(b) Risk based value calculated using IURs and a target risk of 1E-06.

mg/kg milligrams per kilogram
$\mu g/m^3$ micrograms per cubic meter.

APPENDIX D

HISTORICAL USE ASSESSMENT

(PROVIDED ELECTRONICALLY ON ACCOMPANYING CD)

University of California, Berkeley

Richmond Field Station

Radioactive Materials Investigation
Historic Use Assessment
Transition Area "Bulb"
Alleged Buried Drum Area

Prepared by University of California, Berkeley
Office of Environment, Health & Safety

May 2014

University of California, Berkeley
Richmond Field Station
Radioactive Materials Investigation Historic Use Assessment
Transition Area "Bulb" Alleged Buried Drum Area

Table of Contents **Page**

University of California, Berkeley
Richmond Field Station
Radioactive Materials Investigation Historic Use Assessment
Transition Area "Bulb" Alleged Buried Drum Area

I. Introduction and purpose

In 2005, a former University maintenance staff worker announced publicly at DTSC meetings and in a radio station interview that he claimed to have been employed by the University at the Richmond Field Station in the late 1960s and had been tasked with assisting in the burial of drums of radioactive rocks originating from the UC Berkeley central campus and/or the Lawrence Berkeley National Laboratory. The drums were allegedly placed in trenches and covered with soil in an area at the edge of Western Stege Marsh at the RFS in an area known as the Bulb. Subsequent investigations and radiological monitoring in potential drums burial locations did not locate drums or find elevated radiation or radionuclide contamination. The purpose of this current investigation is to determine the source of a magnetic anomaly in one area identified as a possible drum burial location, particularly to determine if the anomaly source is buried steel drums or some other ferrous material. If drums are found, this investigation will attempt to determine whether the contents are radioactive in order to develop a subsequent work plan for future investigations and removal if necessary.

2. UC Berkeley Richmond Field Station Site Description

The University of California, Berkeley's (UC Berkeley) Richmond Field Station (RFS) is an academic teaching and research facility located at 1301 South 46th Street, Richmond, California, along the southeast shoreline of the city of Richmond on the San Francisco Bay to the northwest of Point Isabel (see Figure 1). The 170 acre property consists of 96 acres of upland areas that includes a remnant coastal terrace prairie, and 74 acres of tidal salt marsh, mudflats and transitional habitat. The RFS has been used primarily for large-scale engineering research since the University acquired the property in 1950 and currently supports a range of research and resource conservation values.

Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the RFS. In 1950, UC purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering and later, other campus departments and private tenants. The RFS is currently subject to a State of California Department of Toxic Substances Control (DTSC) Site Investigation and Remediation Order (Docket No. ISE-RAO 06/07-004, dated September 15, 2006) due to the presence of legacy chemical contamination from industrial and UC operations. Portions of the RFS site have been remediated by excavation and off-haul of contaminated soils.

Several large former and existing chemical and industrial sites border the RFS property to the north, west, and east. A former Pacific Gas and Electric Company (PG&E) facility was located to the north of the RFS. The former Kaiser Shipyard and the Butler Steel Products facilities were located to the southwest of the RFS in the current location of the Marina Bay housing development. Bio-Rad Laboratories (Bio-Rad) continues to be located to the west of the RFS.

The adjacent property to the east of RFS is the location of former chemical production operations previously owned by several entities, including Stauffer and Zeneca called the former Zeneca site. (Tetratech 2008). Historically, radioisotopes were used at the former Zeneca site for laboratory research and in 1950 uranium was melted for experimental purposes in an electron beam furnace at the Stauffer-Temescal Company located on site. Additionally, industrial processes relating to production of metal pentachlorides, superphosphate and aluminum sulfate were potential sources of residual naturally occurring radiological materials.

Figure 1 Richmond Field Station and Surrounding Areas

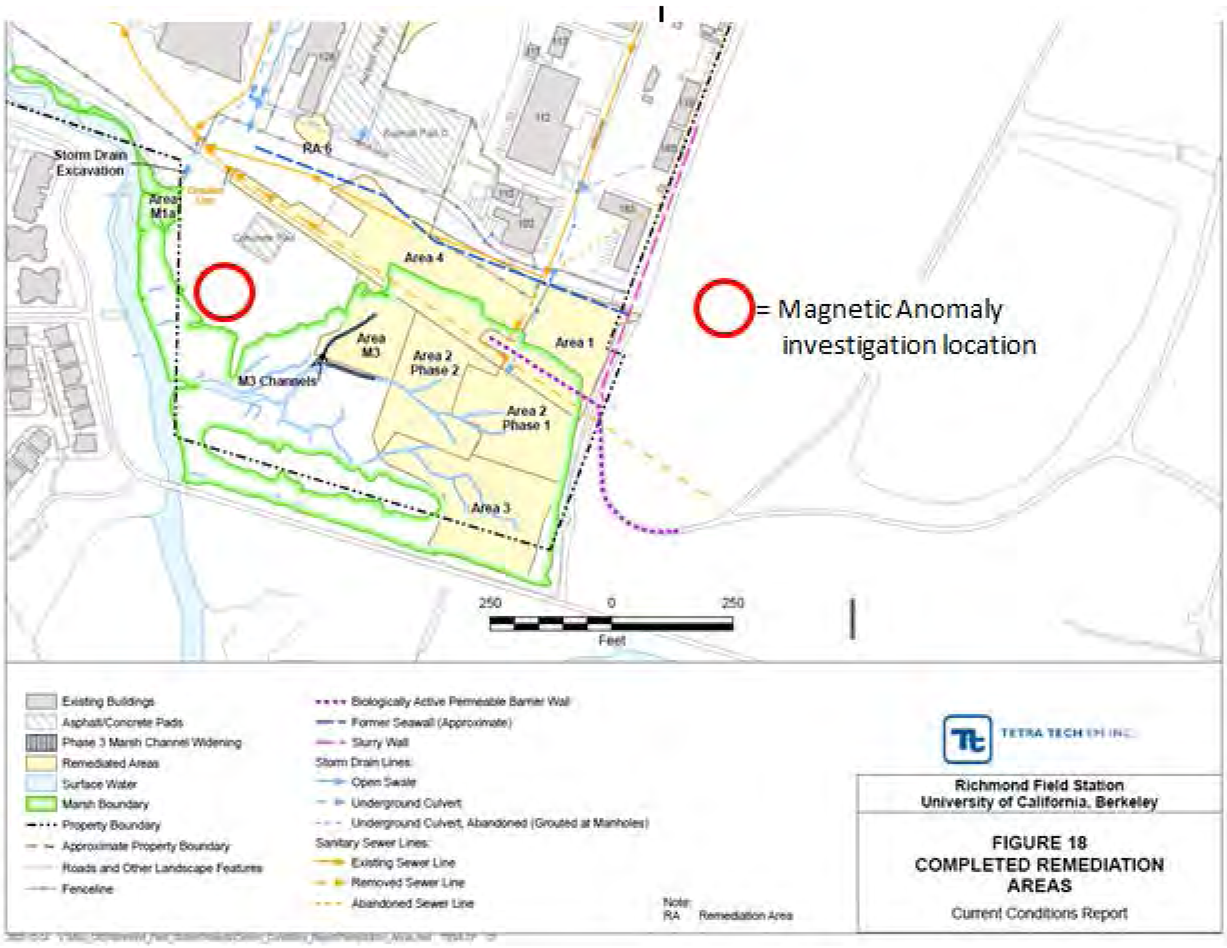
3. Investigation Area Description: Transition Area "Bulb"

The Transition Area (see Figure 2) of the RFS is a 5.5 acre area of fill material that was placed on top of historic Bay mud flats and early growth salt marsh patches beginning in the early 1950s and continuing until the early 1970s. The Transition Area is defined to the north by the former California Cap Company seawall (now buried) and to the south by the current marsh high tide line (approximately 4.5 feet above mean sea level). Historic aerial photos (see Appendix A) show creation of the Transition Area, with the placement of a City of Richmond sewer line in a pyrite cinder filled embankment in the 1940s and then with soil and other fill material beginning approximately 1953 and nearing completion in 1969, including the rounded Bay-ward extension that has historically been known as the "Bulb".

Figure 2 Investigation Area Location (red circle)

Portions of the Transition Area have been subject to remediation (see Figure 3). The western portion of the Transition Area has not been subject to remediation with the exception of a small removal action in October 2008 of four cubic yards of soil and solid waste approximately 200 feet from this investigation area. Fill in the Bulb ranged from 2.5 to 7.5 feet based on borings completed in 2002 with an average depth of 4.6 feet (Tetratech 2008 p.66)

Figure 3 Transition Area Completed Remediation Areas



Bulb Topography and Habitat

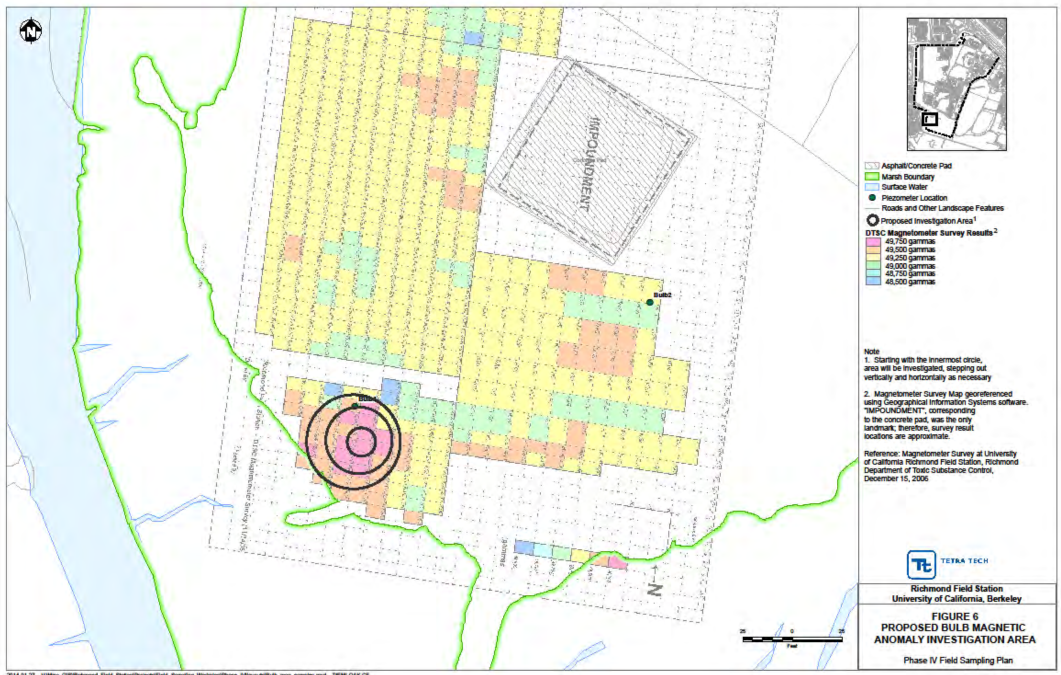
The Bulb is a gently mounded area of soil covered with ruderal, generally non-native vegetation dominated by a perennial non-native bunchgrass Harding grass (*Phalaris aquatic*) and also containing native and non-native shrubs and forbs such as Coyote Bush, poison oak and fennel (see Figure 4).

The border of the Bulb edge is the boundary of the jurisdictional salt marsh, designated at the high tide line elevation of 4.5’ NGVD29, and common plants here include marsh gumplant, pickleweed and salt grass. The planned center of the excavation area is at an elevation of 7’ NGVD. The Bulb slopes gently upward toward the center, reaching a maximum elevation of around 11 ‘ NGVD along the southern edge of the concrete mixing impoundment which was built during 2003 remediation for drying of sediment from marsh excavation. The Bulb is habitat for native and non-native flora and fauna. Typically fauna include Canada geese, skunks, groundsquirrels, gray fox, raccoons, oppossums, and feral cats. There are no known rare or threatened species of plants or animals in the upland Bulb, but the neighboring marsh is habitat for the Federally listed endangered California Clapper Rail (*Rallus longirostris obsoletus*), which may at times use the shrubs at the marsh/Bulb interface as refugia. Therefore, obtrusive work such as excavation is prohibited in the Bulb during the rail breeding season which spans from February 1 to August 31. Groundwater in the excavation area is found approximately 4 feet below ground level and is anticipated to be tidally influenced.

Figure 4 Bulb Topographic Map

In November 2006, DTSC completed a magnetometer survey of the Bulb using a Geometrics G-856 magnetometer. An anomaly roughly 20 by 36 feet was detected in the location shown on Figure 5. This area of this investigation will be refined during a magnetometer survey that will be conducted just prior to the exploratory excavation.

Figure 5 Magnetic Anomaly Map (Area of Investigation circled)



4. Allegation of Burial of Drums of Radioactive Rocks
In early 2005, DTSC was informed that a former RFS employee, Rick Alcaraz, claimed to have been one of a 35 member crew of groundskeepers and other staff who were instructed to transport drums from LBNL and campus to the RFS for burial. In subsequent interviews, Mr. Alcaraz described the burial process as follows:

> The time period was approximately 1966 to 1970.
> Drums on pallets from LBNL and campus locations including the Hearst Mining Building were placed a flat-bed truck or dump truck for transport to the RFS.
> Drums were 55 gallon, yellow or blue steel and beige on the inside, with thick plastic liners and weighed 500- 700 pounds each.
> The drums were securely closed but Mr. Alcaraz opened one and observed that it contained rocks.
> At the RFS the drums were placed in a trenches 30 feet deep that had water pumped out of it using pumps. The trenches were dug in an east-west direction. Water was found at around 10 feet below the surface.
> Drums were removed from the pallets and laid horizontally for burial in three layers with the top layer 10- 12 feet from the surface under layers of clear plastic.

Soon after Mr. Alcaraz provided this information he was also interviewed by the Berkeley radio station KPFA. As presented in the transcribed excerpt from the interview below, Mr. Alcaraz experienced health problems after opening the one drum that were suggested to him to be possible exposure to radiation. These claims are the source for radioactive content being a possible characteristic of material in the alleged buried drums.

> **Transcript from June 23, 2005 KPFA News Report**
> ‘Rick Alcaraz was the groundskeeper at the Field Station in the late 1960's. He says the University used marshy parts of the site as a dumping ground for everything from incinerator ash to mysterious barrels from the labs
>
> "We used to go up to Lawrence and pick up 55 gallon drums of rock -- we thought nothing of that. You know, rock? We weren't supposed to ask any questions, we were just supposed to bury them. But I was like 22, 23? I got nosy and looked inside."
>
> Alcaraz said he handled a couple rocks then put them back when a coworker warned him that they were "live." His problems started that night
>
> "My feet swelled up, my eardrums started bleeding, and my nose, and I'd cry blood. And my gums swelled up, and I went to Brookside hospital with this condition, & I told them what it was and they contacted my employer and they said I was allergic to the eucalyptus."
>
> Those symptoms are not commonly associated with allergies, but they are consistent with acute radiation poisoning.’

5. Investigations of the Bulb

This section describes investigations completed in the Bulb including a magnetometer survey and radiation surveys completed subsequent to the allegations of drum burial by Mr. Alcaraz.

Bulb Borings 2002

Borings have been advanced in the Bulb on two occasions.

December 2002: In 2002 eight borings (BLB1 through BLB-8, figure 6) were completed using a Geoprobe rig for chemical assessment of the fill soils and sediments and for a statigraphy analysis of the Bulb. Thickness of fill at the sampled locations ranged from 2.5 to 7.5 feet with an average of 4.6 feet (BBL 2005). The eight borings were only advanced to a maximum depth of 8 feet below ground surface, which is above the reported drum burial depth of 10- 12 feet bgs.

Figure 6 December 2012 Bulb Borings BLB-1 through BLB-8

November 2006 DTSC Magnetometer Survey

In November 2006, DTSC completed a magnetometer survey of the Bulb after Mr. Alcaraz decided it was the site that drums had been buried (he had previously identified the east end of Meeker Beach as the area but a January 2006 excavation completed by DTSC did not find any drums). As described in the report copied below, a magnetic anomaly was found at the southern edge of the Bulb. The location of the anomaly is shown on Figure 4.

MEMORANDUM

TO: Lynn Nakashima, Senior Hazardous Substances Scientist
Northern California – Coastal Cleanup Operations Branch
Department of Toxic Substances Control
700 Heinz Avenue
Berkeley, CA 94710

FROM: Michael O. Finch, PG
Geologic Services Unit
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

DATE: December 15, 2006
SUBJECT: MAGNETOMETER SURVEY AT UNIVERSITY OF CALIFORNIA, RICHMOND FIELD STATION, RICHMOND.

The Geologic Services Unit (GSU) of the Department of Toxic Substances Control (DTSC) was requested to provide a magnetometer survey at the University of California Richmond Field Station (Site) in an area commonly referred to as the "Bulb" to locate possible buried steel drums. The result of this survey follows.

Mark Vest and Michael Finch of the GSU arrived at the Site the morning of November 14, 2006, and established four grid systems: three 6 feet by 10 feet, and one 12 feet by 10 feet, to cover 36,000 square feet around the surface impoundment in the Bulb area as shown on the attached figure. Heavy vegetation prevented taking measurements at every location on the grids. A Geometrics G-856 magnetometer was used to conduct the survey. A magnetometer measures the earth's magnetic field strength at one point in space and time. The nearby presence of ferrous metals disrupts the magnetic field and produces a magnetic anomaly. A background reading of 49,300 +- 100 gamma was measured for this general location away from any obvious metal objects and is considered typical for this location in California. Magnetic soils were not noted at the Site, and significant scattered metallic debris was not observed that could interfere with the survey. These conditions can allow for detection of large ferrous bodies to depths of more than 20 feet below grade.

The completed survey showed a strong anomaly centered 170 feet south-southwest of the impoundment as shown in red on the attachment. This anomaly exhibits an approximate 900 gamma above background and covers roughly 20 by 36 feet. The anomaly shows the classic “bull’s eye” pattern and has the expected negative anomaly associated with large ferrous bodies. The depth of the ferrous body remains uncertain, however, if large enough (say the size of an automobile) it could be buried 20 feet below grade. Given the location of the Site next to San Francisco Bay and low surface elevation (less than 5 feet above sea level) a depth of 20 feet would be under more than 15 feet of water. A mass of five or so 55 gallon steel drums buried 5 to 10 feet below grade could give a similar magnetic anomaly. The GSU marked the anomaly in the field with a discarded skateboard.

No other strong anomalies were found in the grids and other elevated magnetometer readings are assumed to be caused by rebar or other debris seen at the Site. The northeastern side of the surface impoundment was briefly scanned for anomalies, but no readings above background were noted.

The GSU concludes that some kind of large ferrous body is buried 170 feet south of the Site impoundment at an unknown depth. The GSU recommends that this anomaly be excavated for further investigation. A hand-held metal detector may assist the excavation crew during this process.

If you have any further questions please telephone me at (916) 255-3583 or E-mail at mfinch@dtsc.ca.gov.
Attachment
cc: Mark Vest

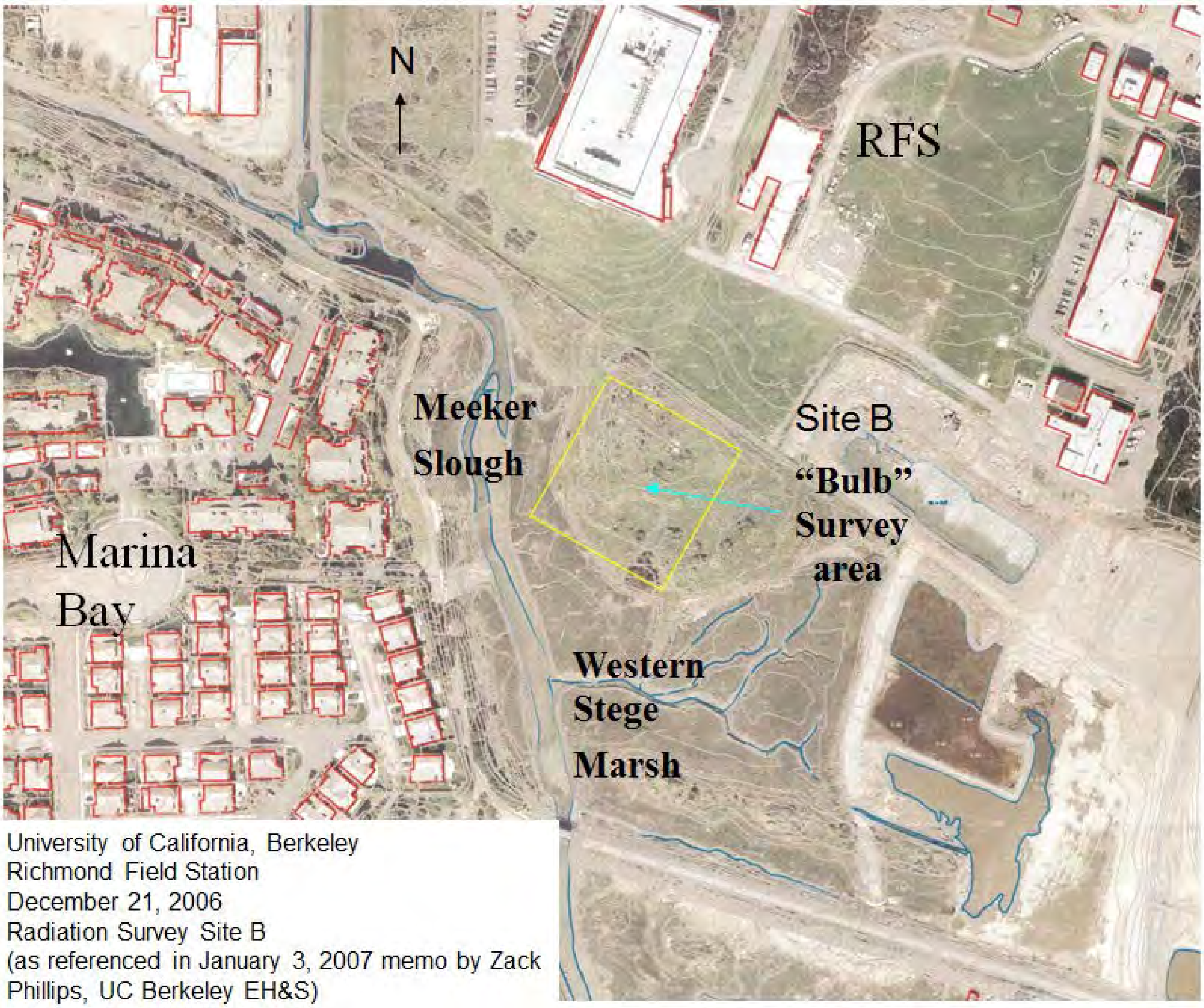
December 2006 Bulb Radiation Meter Surveys

In December 2006 two meter surveys were performed by the UC Berkeley EH&S Radiation Safety team in response to the November 2006 DTSC magnetometer surveys.

On December 8, 2006 a meter survey with an ion chamber (Ludlum model 5) as well as a GM meter (Ludlum model 16S) with both a pancake and scintillation probe were to survey the ground surface at and adjacent to the magnetic anomaly (See Figure 7 Area B). No readings above twice background were found.

On December 21, 2006 the another survey of the same area was performed by the UC Berkeley EH&S Radiation Safety team accompanied by two members of the Lawrence Berkeley National Laboratory Radiation Safety Team using three instruments: 1) Ludlum Model 222-1 Detector = 44-20 3x3 with a NaI Scint probe, 2) Ludlum Model 2350-1 Detector = 44-20 3x3 NaI Scint probe, and, 3) EG&G Ortec Detective Detector with a High-Purity Germanium Probe. The Ortec Detective is capable of real-time analysis of gamma energies and can determine which isotopes are producing the gamma emissions. No counts above background were found in the same survey Area B in Figure 7.

Figure 7, December 2006 Radiation Survey Area



2008 Western Transition Area Near Surface Soil Sampling and Campfire Time Critical Removal Action (TCRA) and Radiological Assessment

In January 2008 soil samples were collected in the Western Transition Area to evaluate the potential human health risk posed to workers performing weed abatement in the area. During the sampling activities, two small adjacent areas were identified (designated and WTAA-001WTAA-002) which appeared to be the result of previous, unauthorized campfires (see Figure 8). The two small areas contained visual surficial ash and debris such as empty cans and bottles. Soil sample results indicated elevated concentrations of polychlorinated biphenyls (PCBs) which could pose a risk to on-site workers conducting weed abatement or other work at the site. DTSC advised that a TCRA was necessary to remove the PCBs in soil in the two locations.

TCRA excavation activities took place on October 1, 2008. The two areas were dug using hand tools until an excavation volume limit of 4 cubic yards of soil was achieved and the excavation was then halted. During the excavation, bottles and metallic objects were unearthed, and visible debris remained at the excavation sidewalls. The two sites were backfilled with clean soil the next day on October 2, 2008.

Also on October 2, 2008, the campus Office of Environment, Health & Safety requested radiological sampling from a health physics consultant with ERS Solutions due to the presence of what appeared to be laboratory objects in solid waste in the excavations. Based on the type of debris, the date of the debris was estimated to be the mid- to late-1950s. A radiation meter survey using a Geiger Muller detector was completed. Swipes of debris for analysis using a liquid scintillation counter, and soil samples for analysis by gamma spectroscopy were collected. No radiation or radioactive materials in excess of background were found. (References: Tetratech 2009, ERS 2009)

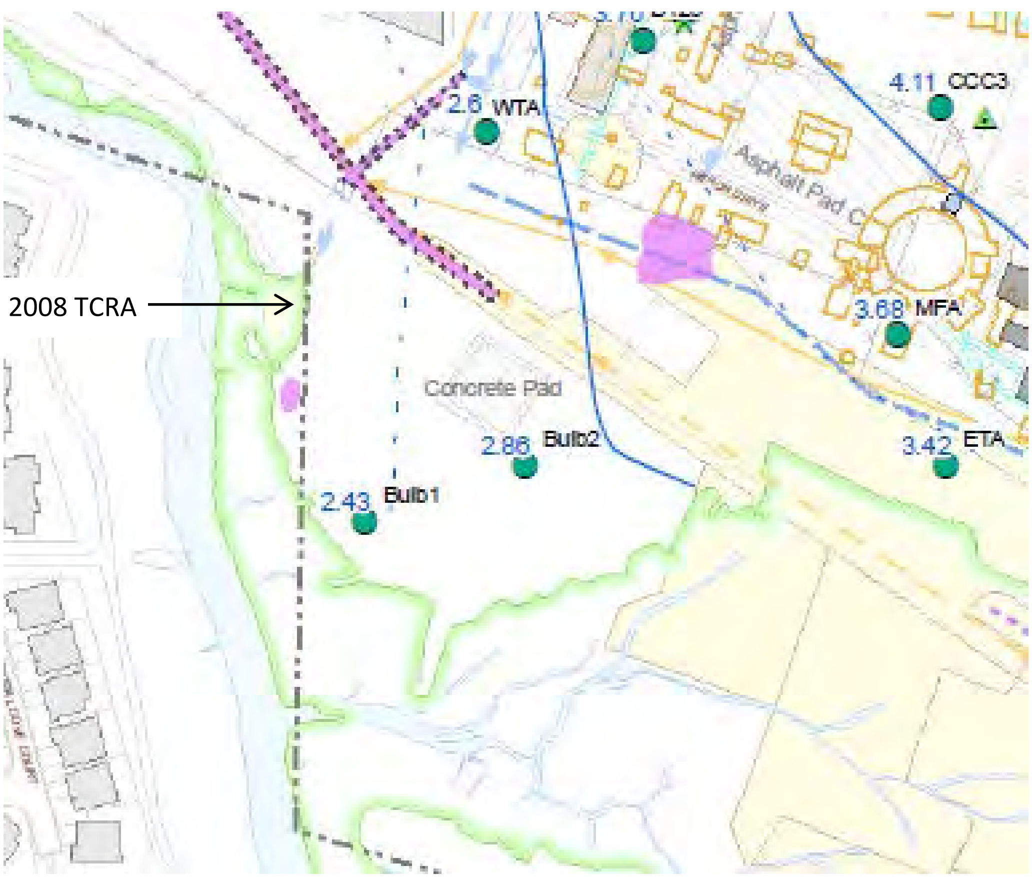
Figure 8 WTA TCRA Excavation Locations (WTAA-001 and WTAA-002)

2010 Monitoring Wells Installation- Bulb1 and Bulb2

In 2010 the Field Sampling Workplan was implemented at the RFS including the installation of 51 piezometers in order to characterize site-wide groundwater. 49 piezometers were installed from July 26 to August 12, 2010. The two Bulb piezometers Bulb1 and Bulb2 (see Figure 9) were installed on October 18, 2010, delayed from the others in order to prevent interference with the Clapper Rail breeding season which ends August 31. Well borings were drilled to 20 feet below grade. No debris or metal was encountered during drilling. Well Bulb1 was installed on the outer edge of the approximate area of the anomaly (see figure 4).

During the installation of piezometers Bulb1 and Bulb2, soil was collected and submitted to Eberline Analytical for gross alpha, gross beta, and tritium analysis. A soil sample was also collected from piezometer CTP and used for comparison to the Bulb results as a background concentration. The activity measured in soil from the locations Bulb1 and Bulb2 was not statistically different from soil evaluated from location CTP. Not statistically different in this case was defined as activity less than the background levels or within the 2 sigma error (95% confidence level) associated with each measurement (Tetra Tech 2011).

Figure 9 Monitoring Wells and Campfire TCRA Locations
(groundwater elevations above mean sea level in blue)



6. Radiological Materials Use

Radiological materials have been used in certain types of research at the RFS since the 1950s. The nature of this investigation is not centered on historic radiological materials use at the RFS because the allegations of drum burial claim the materials originated from the central campus or from LBNL. However, because there is evidence of burial of solid waste including laboratory equipment in the Bulb area, there is a remote possibility that radiological materials from RFS use may be discovered during excavation. Therefore, this section provides information on the historic use of radiological materials for the following three possible source areas as they relate to this investigation:

a) UC Berkeley Central Campus and Lawrence Berkeley National Lab,
b) Richmond Field Station, and
c) Neighboring properties.

6.a. UC Berkeley and Lawrence Berkeley National Lab

Many research and instructional activities use sources of ionizing radiation as a valuable tool to extend fundamental knowledge. These activities are an important part of the University of California's contribution to the society it serves, and is critical to its mission.

Radiological operations for UC Berkeley have been licensed by the Atomic Energy Commission since the passage of the Atomic Energy Act and continue to be authorized under the UC Berkeley Broad Scope Radioactive Materials License No. 1333-01. The license, issued by the California Department of Public Health, Radiological Health Branch authorizes UC Berkeley to perform research using radioactive materials at various university locations including the RFS.

Approval for campus use of radiological materials is provided by the Radiation Safety Committee (RSC) and the EH&S Radiation Safety Officer (RSO). Any use of radiation and radiological material at UC Berkeley must be preauthorized in writing. The written authorization is referred to as a Radiation Use Authorization (RUA). This document is fundamental to the UC Berkeley campus radiation safety program. The RSO conducts an evaluation of the radiation safety aspects of the proposed use. If additional information is required, the RSO may meet with the applicant to discuss the use. At the RSO's discretion, complex uses may need review by the RSC.

Oversight of use, inventory and disposal of radiological materials is provided by EH&S Radiation Safety Team. The Radiation Safety Team performs periodic surveys of areas in which radiation and/or radioactive materials are used. Surveys include inspecting labels and posting, use of dosimetry and meter readings, and wipe surveys of laboratory surfaces, including bench-tops, equipment, sealed sources and floors. The frequency of the surveys is based on a number of factors, such as perceived risk and past RUA compliance. The standard frequency of surveys is quarterly with leak testing of sources performed semi-annually.

The Radiation Safety Team also responds to radiological material spills and directs cleanup and disposal of wastes from spills. The EH&S Radioactive Waste Management Program is designed to protect individuals and the environment. Radiological waste from the RFS is either shipped directly off-site for disposal at licensed treatment, storage, and disposal facilities or is picked up from laboratories by

EH&S and transported to the Hazardous Materials Facility on the central campus in Berkeley. The materials are managed and prepared for decay on site or for off-site disposal.

Each RUA details the project limit for possession, radiological controls for use and disposal of radiological materials.

6.b. Richmond Field Station

Radiological materials have been used in certain types of research at the RFS since the 1950s. A summary of what is known of radioactive material use during the 1950s and 1960s is summarized in Table 1. In general the quantities of radioisotopes used have been small (normally in millicurie levels) based on RUA review. Many of the isotopes listed on RUA's were sealed sources found in equipment such as gas chromatographs and liquid scintillation counters and many were short lived, i.e. a half-life of less than 180 days.

Based on existing records and interviews with former California Department Health Services inspection and UC waste contractor staff it is believed that all radioactive wastes from the RFS were managed through off-site shipment and consolidation with other UC Berkeley radioactive wastes that were disposed of at approved radioactive disposal sites. There areno known history or records of radioactive wastes being buried at the RFS.

Table 1: University of California, Berkeley Richmond Field Station

Historical Radioactive Materials Use Locations Buildings and Outdoor Locations 1950s- 1960s

Building(s)	RUA	P.I.	Department	Room(s)	Isotopes	Dates of Use
110, 117	484	Oswald, William	Civil Engineering		H-3	9/64- 2/73
112	458	Kaufman, Warren	Civil Engineering	9, 10, 11	Sr-90, C-14, Ca-45, Sr-85, Ni-65, H-3	6/60- 6/65
112	461	Jenkins, David	Sanitary Engineering	7, 8, 10, 11, 18A, 23	C-14, Ni-63, Co-60, Bi-210, Pa-234, H-3	12/66- 5/78
Outside- unknown location	Unknown	Paris, Oscar	Zoology	100- 625 sq. meter enclosure	Ca-45 (3 mCi)	1965
B280- Vehicle Test Facility fog Chamber	Unknown	Unknown	Unknown	Unknown	Kr-85, 2700 Ci	1967
Research Well Field		Kaufman, Warren Todd, D.K., Ewing, B. Klein, G Inoue			I-131, Cs-134, Sr-89	1955- 1962 various experiments (Note: Sr90 and Y90 were associated with some of the Sr89 that was injected)

6.c. Neighboring Properties

Use of radioactive materials and presence of naturally occurring radioactive materials at the neighboring former Zeneca site has been the subject of lengthy investigations that were recently completed. On November 17, 2008 the State of California Department of Public Health, Radiological Health Branch (RHB) issued a letter to DTSC (CDPH RHB 2008) that concluded that there are no significant radiological issues currently present at the former Zeneca site that present a health and safety concern to workers or members of the general public for any future use. The RHB concluded that no further sampling or analysis is warranted. Therefore, it is unlikely that activities at the former Zeneca site impacted the RFS.

Bio-Rad corporation performed research using radioactive materials such as carbon-14, tritium, and phosphorous-32 under a State of California radioactive material license. Their facility was located in next to the RFS site. Documentation of a potential spill of cobalt 57 (half-life 271 days) was reported in 1987. Research by the RHB did not indicate other spills from the site.

7. RFS Radiological Decommissioning

B106 Decommissioning

B106 was historically the location of a sewage treatment laboratory where radioisotopes were used as tracers in research. The building was demolished in summer 2002 prior to the remediation activities performed in 2002 and 2003. Due to the historic use of the radioisotopes in the building, the EH&S Radiation Safety division completed a decommissioning survey between June and July 2002. Hundreds of wipe samples and radiation meter readings were collected from interior and exterior surfaces of B106. No radiation above background was detected (based on the assessment of the UC Berkeley Radiation Safety Officer at that time in comparison to levels typically found regionally and statewide).

Sewage Treatment Experimental Ponds

Two large ponds, one round and one rectangular, were used for studies on innovative methods of sewage treatment by principal investigator Dr. William Oswald. Dr. Oswald was among the first engineers to study the symbiotic interactions of algae and bacteria in treatment ponds, and to develop design methods for natural treatment systems powered primarily by solar energy. These ponds were demolished prior to the remediation activities performed in 2002 and 2003. Prior to demolition, 12 samples of soils, cinders, Bay sediment, sewage treatment pond sludge, and structural materials of the soils were collected on April 22, 2002, for analysis by gamma spectroscopy. The results showed no detected activity other than typical naturally occurring radioactive material and a few Cs-137 peaks consistent with expected background levels (based on the assessment of the UC Berkeley Radiation Safety Officer at that time in comparison to levels typically found regionally and state-wide).

B102 and B110

In April of 2012 Final Status Surveys were performed in B102 and B110. The surveys consisted of fixed alpha, beta, C-14 and H-3 measurements. Swipe surveys for alpha, beta, C-14 and H-3, scan surveys for alpha and beta and soil samples beneath both buildings for C-14 and H-3. Surveys were performed in accordance with MARSSIM. The buildings were classified as Class 3. No radiation levels exceeded background. The report was approved by CDPH with a license amendment in December 2012.

B112, 113, 117 and 150

In April and May 2013 Final Status Surveys were performed in B112, 113, 117 and 150. The surveys consisted of fixed alpha, beta, C-14 and H-3 measurements. Swipe surveys for alpha, beta, C-14 and H-3, scan surveys for alpha and beta and soil samples beneath both buildings for C-14 and H-3. Surveys were performed in accordance with MARSSIM. The buildings were classified as Class 3. No radiation levels exceeded background. A revised final report was submitted to CDPH in May 2014 and is pending approval.

8. References

CDPH RHB 2008, letter “Zeneca/Former Stauffer Chemical Company Site” from Gary Butner, Chief RHB to Barbara Cook, DTSC Performance Manager, November 17

BBL 2005. “Draft Conceptual Remedial Action Plan- Addendum Marsh Portion of Subunit 2B, Richmond Field Station” June 3, 2005 BBL http://rfs-env.berkeley.edu/pdf/2005.06.03.draft%20Conceptual%20RAP%20Addendum.%202B%20Marsh.pdf

ERS Solutions, 2009 “Richmond Field Station Radiological Survey Report Debris Pit” ERS Solutions February 2009

Tetratech, Inc. 2008. “Final Current Conditions Report” November 21, 2008 http://rfs-env.berkeley.edu/documents/2008.11.21.RFS.FinalCCRTextandTables.pdf

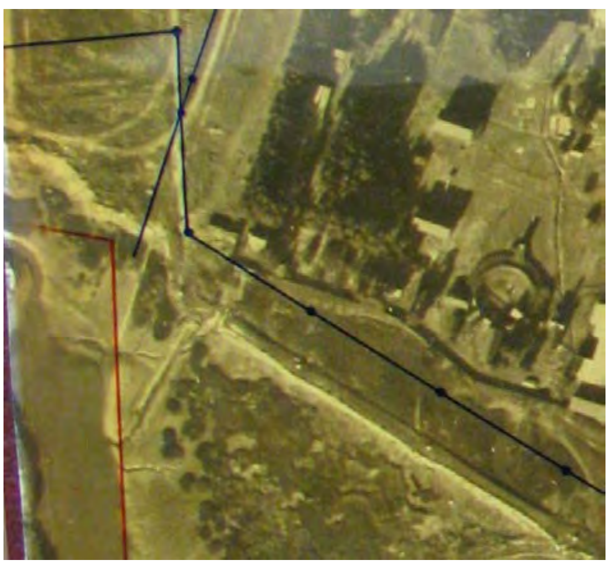
Tetratech, Inc. 2009 “Implementation Summary Report for a Time-Critical Removal Action at Two Subareas in the Western Transition Area, University of California, Berkeley, Richmond Field Station” May 26, 2009.

University of California, Berkeley
Richmond Bay Campus
Former Richmond Field Station
Radioactive Materials Investigation Historic Use Assessment
Transition Area "Bulb" Alleged Buried Drum Area

Appendix A
Historic Aerial Photos of Richmond Field Station
Western Transition Area "Bulb"

1946-47

1946-47



Late 1940s

Late 1940s

1953

“1950s”

1956

1957

1963

1968

1966

1969

1975

1979

1983

March 2008

2009 Google Earth

2013