HEALTH AND SAFETY PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PECK IRON AND METAL
NORFOLK COUNTY, VIRGINIA

REVISION 2

Prepared for:

U.S. Environmental Protection Agency Region 3
1650 Arch Street
Philadelphia, PA 19103

U.S. EPA Contract Number: EP-S3-07-05
Work Assignment Number: 044R1COA3Z4

January 2015
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Objectives of Field Work: To conduct a Remedial Investigation (RI)/Feasibility Study (FS) to select a remedy that eliminates, reduces, or controls risks to human health and the environment. Objectives of the fieldwork include:

- Conduct a visual surface inspection for munitions debris (MD)/munitions and explosives of concern (MEC) anomaly avoidance;
- Conduct a gamma radiation survey of the Site surface and subsurface soils;
- Conduct a building inspection for the presence of potential asbestos containing materials (ACMs) and the collection of polychlorinated biphenyl (PCB) and lead wipe samples;
- Identify and delineate Site contaminants in surface and subsurface soils, groundwater, sediment, and surface water on site, and on off-site properties, and within Paradise Creek; and
- Determine whether biota in Paradise Creek is affected by possible site contamination.

Field work will include MEC anomaly avoidance; gamma radiation surveying; groundwater sampling, direct push technology (DPT) drilling and soil sampling, test pit excavating; monitoring well installation, and surface water, sediment, and biota sampling within Paradise Creek.

Description and Features: The Site is an inactive 33-acre scrap metal facility located at 3850 Elm Avenue in Portsmouth, Norfolk County, Virginia; a mixed heavy industrial and commercial area within the City of Portsmouth (Figure 1). The Site is located on tax parcels 03860020, 03860025, 03860026, 03860028, and 03860029. The Site is currently owned by The Peck Company, Inc. (Peck) which acquired the property in the late 1940s. Properties adjacent to the Site and potentially impacted from former site waste handling activities include ARREFF Terminals, Inc (tax parcel 03860040), Sherwin Williams (tax parcel 03860027), the U.S. Navy Scott Center Annex (tax parcel 20000020), and Wheelabrator Portsmouth, Inc. (tax parcel 03860011). The Site is bordered by Paradise Creek to the south, Elm Avenue to the north, and Victory Boulevard to the east. Wheelabrator Portsmouth, Inc. borders the site to the southeast and the Norfolk Naval Shipyard partially borders the site to the west and southeast. Paradise Creek is a tributary of the Southern Branch of the Elizabeth River. In 2003, a six acre parcel of the Site bordering Paradise Creek was donated to the Elizabeth River Project (ERP) for permanent conservation as a wetland buffer. In the spring of 2003, ERP completed a wetland restoration of this 6-acre area. Currently, only a small segment of the Site borders Paradise Creek.

The elevation of the property ranges from mean sea level (msl) to approximately 10 feet above msl. The Site is relatively flat with a small mounded area, nearly 25 feet above msl, located in the southeastern portion of the Site. The property consists predominantly of unpaved surfaces such as compacted stone and gravel, although partially vegetated areas also are present. Accumulations of scrap metal and miscellaneous debris are present throughout the property and extend beyond property boundaries in some areas. There are nine monitoring wells on site designated MW-1R, and MW-2 through MW-9.

The investigations have identified in soil the following contaminants of potential concern (COPCs): arsenic, cadmium, chromium, lead, nickel, mercury, silver and PCBs. According to several previous investigations, PCBs and lead soil impacts cover the extent of the Site, but appear to be most heavily concentrated in surface soils in the central area and extending into the eastern arm of the Site. The highest concentrations of the other metals were scattered throughout the Site. Subsurface soils show a similar impact pattern with only a scattering of subsurface soil samples containing high constituent concentrations. Within the groundwater beneath the southwestern portion of the Site and downdgradient of the central portion of the Site where the highest concentrations of PCBs in soils are present, PCBs were detected in the groundwater. Arsenic, chromium, nickel, lead and mercury have also been identified as COPCs in groundwater. PCBs were also detected in groundwater. The investigations have identified in sediment the following COPCs: PCBs, arsenic, cadmium, chromium, nickel, lead, mercury, and silver. Detailed information regarding previous analytical results and contaminant distribution across the Site has been included in Section 2 of HGL’s Site Management Plan (SMP).
In addition to chemical contaminants, MD was encountered in the site soils during the 2007 investigation. Types of MD discovered included: 2-inch naval round fuzed but not fired, high explosive anti-tank round, inert/training .50 caliber Browning machine gun rounds, machine gun, and casings. The MD encountered was determined to be inert. No information has been obtained regarding the locations where the MD items were encountered.
**Health and Safety Plan Form**

**U.S. Environmental Protection Agency**

**Region 3 RAC**

**Project Name:** Peck Iron and Metal RI/FS (EPA010)

**Work Assignment No.:** 044

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**Site History:** Prior to 1945, the Site was a former Proctor and Gamble facility. In 1945, Peck Iron purchased the facility. From 1945 to 1999, Peck Iron processed, stored, and shipped metal scrap from various military bases; other Federal, state, and local government agencies; and local businesses. Scrap metal handled at the facility included damaged and obsolete equipment, attachments, parts, and other miscellaneous materials, including scrapped naval vessels. The Department of Defense processed and sold scrap metal to the Site that was acquired from various military bases and Navy yards. Large, nongovernment sellers to Peck included Virginia Electric and Power, various railroads, landfills (sources of household appliances and miscellaneous scrap) and nearby ship repair facilities. In addition, PCB-containing transformers were disassembled at the Site and wires were burned to remove insulation for copper wire recovery.

Facility operations prior to the 1980s took place in and around the cinderblock buildings in the center and along the northwestern arm of the property. One of the buildings contained a hydraulic guillotine that shear cut steel. Another building served as a sorting and storage room for nonferrous metals and contained a small furnace to melt aluminum scrap. A locker room and machine shop was located in the front of the sorting and storage building. Based upon an aerial photographic study of the Site, scrap metal storage and handling activities occurred across the entire Site (Figures 2.4 through 2.7 in HGL’s June 2013 SMP). PCB transformer oil disposal activities have been documented as occurring in the central and southern portions of the Site (Figure 2.21 in HGL’s June 2013 SMP).

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**Waste Types:**

- Liquid
- Solid
- Sludge
- Gas
- Unknown
- Other Specify

**Waste Characteristics:** Check as many as applicable.

- [ ] Corrosive
- [ ] Toxic
- [ ] Inert Gas
- [ ] Other Specify:
- [ ] Flammable
- [ ] Volatile
- [ ] Unknown
- [ ] Reactive
- [ ] Carcinogenic

**Work Zones:** Describe the Exclusion, Contamination Reduction, and Support Zones in terms on-site personnel will recognize.

A 20-foot exclusion zone (EZ) will be established around the work area being investigated. The EZ will be clearly marked with traffic cones or caution tape. Within the work zone, only authorized staff, subcontractors and regulators will be allowed access to this area. Only personnel wearing the appropriate level of personnel protection equipment (PPE) will be allowed within the EZ. Exclusion, contaminant reduction zones, and support zones will be set up in relation to the task and defined HGL as the situation dictates.

**Hazards of Concern:**

- [ ] Heat Stress
- [ ] Cold Stress
- [ ] Explosive/Flammable
- [ ] Oxygen Deficient
- [ ] Radiological
- [ ] Biological: stinging insects, venomous reptiles, poisonous plants
- [ ] Other Specify: Potential MEC

- [ ] Noise
- [ ] Inorganic
- [ ] Organic Chemicals
- [ ] Motorized Traffic
- [ ] Heavy Machinery
- [ ] Slips, Trips, and Falls

**Principle Disposal Methods and Practices for investigation derived waste. Summarize below:**

Investigation-derived waste (IDW) consisting of soil cuttings and water (decontamination and purge water) will be generated during the RI/FS. IDW disposed of according to the IDW disposal plan which consists of storing IDW on site for analytical characterization and of-site disposal by an IDW management subcontractor. Used PPE and other site generated rubbish not contaminated by site activities will be disposed of at a local municipal landfill.

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**Note here any incidents at this site that will affect any standard operating procedures (SOPs):**

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*Contact Regional Health and Safety Officer (HSO) for further project planning*
**Project Specific Hazardous Material Summary:** Check waste type and media in which the material is contained; estimate quantity if material exists in bulk quantities.

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Solids</th>
<th>Sludges</th>
<th>Solvents</th>
<th>Oils</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amounts/Units:</td>
<td>Amounts/Units:</td>
<td>Amounts/Units:</td>
<td>Amounts/Units:</td>
<td>Amounts/Units:</td>
<td>Amounts/Units:</td>
</tr>
<tr>
<td>□ Acids</td>
<td>□ Fly ash</td>
<td>□ Paint</td>
<td>□ Halogenated (chloro, bromo)</td>
<td>□ Oily Wastes</td>
<td>□ Laboratory</td>
</tr>
<tr>
<td>□ Pickling Liquors</td>
<td>□ Asbestos</td>
<td>□ Pigments</td>
<td>□ Solvents</td>
<td>□ Gasoline</td>
<td>□ Pharmaceutical</td>
</tr>
<tr>
<td>□ Caustics</td>
<td>□ Milling/Mine Tailings</td>
<td>□ Metal Sludges</td>
<td>□ Hydrocarbons</td>
<td>□ Diesel Oil</td>
<td>□ Hospital</td>
</tr>
<tr>
<td>□ Pesticides</td>
<td>□ Ferrous Smelter</td>
<td>□ POTW Sludge</td>
<td>□ Alcohols</td>
<td>□ Lubricants</td>
<td>□ Radiological</td>
</tr>
<tr>
<td>□ Dyes/Inks</td>
<td>□ Non-ferrous Smelter</td>
<td>□ Aluminum</td>
<td>□ Ketones</td>
<td>□ PCBs</td>
<td>□ Municipal</td>
</tr>
<tr>
<td>□ Cyanides</td>
<td>□ Metals: Lead</td>
<td>□ Distillation Bottoms</td>
<td>□ Ethers</td>
<td>□ Polycyclic Aromatics</td>
<td>□ Construction</td>
</tr>
<tr>
<td>□ Phenols</td>
<td>□ Other: Specify: Potential in Site soils and air.</td>
<td>□ Other: Specify:</td>
<td>□ Other: Specify: Based on previous investigations, site soil and sediment media may contain PCBs up to 3,460 mg/kg.</td>
<td>□ Other: Specify:</td>
<td>□ Munitions</td>
</tr>
<tr>
<td>□ Halogens</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>□ Other</td>
</tr>
<tr>
<td>□ Dioxins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Specify:</td>
</tr>
<tr>
<td>□ Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Several MD items have been found on the surface at the site. All MD items to-date have been inert.</td>
</tr>
</tbody>
</table>

**Sample bottle preservatives will be handled by site personnel during the sampling events.**

**Overall Hazard Evaluation:** □ High  □ Medium  □ Low  □ Unknown (Where tasks have different hazards, evaluate each. Attach additional sheets if necessary.)

**Justification:**
Chemicals/Solvents the risk is considered low – solvent concentrations and chemical volumes are low. Solids and Oils the risk is considered to be medium. The lead concentrations are high enough to warrant the use of respirators during dust generating activities. Also the PCBs concentrations are high enough to warrant the use of Saranex coverall and boot covers. The presence of radioactive materials has been identified at the Site; however, based upon gamma scanning measurements obtained to date, and effective clearance from any anomaly is 3 feet per the Radiation Protection Plan (RPP). Also, the uncertainty of MD items and radioactive materials, if present, increased the risk at the Site.

**Fire/Explosion Potential:** □ High  □ Medium  □ Low  □ Unknown

**Background Review:** □ Complete  □ Incomplete
Previous investigation results are described in detail in Section 2 of HGL’s June 2013 SMP.
<table>
<thead>
<tr>
<th>Known Contaminants</th>
<th>Highest Observed Concentration (specify units and media)</th>
<th>TLV ppm or mg/m³ (specify)</th>
<th>IDLH ppm or mg/m³ (specify)</th>
<th>STEL/Ceiling Limit</th>
<th>Symptoms/Effects of Acute Exposure</th>
<th>Photoionization Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>64,000 mg/kg in soils, 50 µg/L in groundwater, 450 mg/kg in sediment</td>
<td>0.05 mg/m³</td>
<td>100 mg/m³</td>
<td>--</td>
<td>Weakness, exhaustion, insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, anemia</td>
<td>Unknown</td>
</tr>
<tr>
<td>PCBs</td>
<td>3,460 mg/kg in soils, 0.01944 µg/L in groundwater</td>
<td>0.5 mg/m³</td>
<td>5 mg/m³</td>
<td>--</td>
<td>Irritation to the eyes, chloracene, liver damage, reproduction effects</td>
<td>Unknown</td>
</tr>
<tr>
<td>Arsenic</td>
<td>21 µg/L in groundwater, 380 mg/kg in soil, 21 mg/kg in sediment</td>
<td>0.01 mg/m³</td>
<td>5 mg/m³</td>
<td>--</td>
<td>Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of the skin</td>
<td>NA</td>
</tr>
<tr>
<td>Cadmium</td>
<td>370 mg/kg in soil, 3.3 mg/kg in sediment</td>
<td>0.01 mg/m³</td>
<td>9 mg/m³</td>
<td>--</td>
<td>Pulmonary edema, dyspnea, cough, chest tightening, substernal pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, anemia, emphysema, proteinuria, mild anemia</td>
<td>NA</td>
</tr>
<tr>
<td>Chromium</td>
<td>93 µg/L in groundwater, 31,000 mg/kg in soil, 1400 mg/kg in sediment</td>
<td>0.5 mg/m³</td>
<td>250 mg/m³</td>
<td>--</td>
<td>Irritation to the eyes and skin, lung fibrosis</td>
<td>NA</td>
</tr>
<tr>
<td>Nickel</td>
<td>800 µg/L in groundwater, 28,000 mg/kg in soil, 1100 mg/kg in sediment</td>
<td>0.1 mg/m³</td>
<td>10 mg/m³</td>
<td>--</td>
<td>Sensitation dermatitis, allergic asthma, pneumonitis</td>
<td>NA</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.24 µg/L in groundwater, 110 mg/kg in soil, 2.2 mg/kg in sediment</td>
<td>0.025 mg/m³</td>
<td>10 mg/m³</td>
<td>--</td>
<td>Irritation to the eyes and skin, cough, chest pain, dyspnea, bronchitis pneumonitis, tremor, insomnia, irritability, indesision, headache, fatigue, stomatitis, salivation, GI disturbance, anorexia, weight loss, proteinuria</td>
<td>NA</td>
</tr>
<tr>
<td>Silver</td>
<td>3 mg/kg in sediment</td>
<td>0.01 mg/m³</td>
<td>10 mg/m³</td>
<td>--</td>
<td>Blue-gray eyes, nasal, septum, throat and skin irritation, ulceration of the skin, GI disturbance</td>
<td>NA</td>
</tr>
</tbody>
</table>

ACGIH = American Conference of Governmental Industrial Hygienists  
OSHA = Occupational Safety and Health Administration  
CA = Human carcinogen  
CAS = Chemical Abstracts Service  
IDLH = Immediately Dangerous to Life and Health  
(NIOSH standard enforced by law)  
LEL = Lower Explosive Limit  
mg/m³ = milligrams per cubic meter  
mg/kg = milligrams per kilogram  
NE = Not established  
µg/L = micrograms per Liter  
NIOSH = National Institute for Occupational Safety and Health  
ppm = parts per million  
STEL = Short Term Exposure Limit (15 minute TWA)  
TLV = Threshold Limit Values (Recommended by ACGIH)  
TWA = Time-Weighted Average (Average concentration for a normal 8-hour working day or 40-hour working week)
### Activity Hazard Analysis – Complete Corresponding Detailed PPE Section for each task

<table>
<thead>
<tr>
<th>Task Number/Activity Description/ Site Location</th>
<th>Potential Hazards</th>
<th>Controls</th>
<th>Primary / Secondary PPE Level</th>
<th>Exposure Monitoring Required/ Frequency</th>
</tr>
</thead>
</table>
| 1. Mobilization/Demobilization (Subtask 3.1)  | Slips, trips falls; Thermal/Cold stress; Biological issues; Site security; and Vehicle related. | 1. Review the Activity Hazard Analysis (AHA) located in Attachment 1 for the following activities:  
AHA 44.01 - General Site Hazards;  
AHA 44.02 - Mobilization/Demobilization;  
AHA 44.03 - Subcontractor Oversight Activities – General;  
AHA 44.04 - Visual Site Survey;  
AHA 44.05 –MD/MEC Surface and Subsurface Avoidance-Surveying Layout Escort;  
AHA 44.06 - Soil and Sediment Sample Processing;  
AHA 44.07 - Excavation and Trenching;  
AHA 44.08 - Drilling-Sample Processing;  
AHA 44.09 - Decontamination of Equipment and Personnel;  
AHA 44.10 - Stream Surface Water Sampling from Shore;  
AHA 44.11 - Stream Sampling by Boat;  
AHA 44.12 - Boat Use for Site Access;  
AHA 44.13 - Monitoring Well Installation;  
AHA 44.14 - Groundwater Well Development and Sampling;  
AHA 44.15 - Well and Borehole Abandonment;  
IDW Management;  
AHA 44.16 - Sampling and Analysis; and  
AHA 44.17 - IDW Management. | D/D | None |
| 2. All site personnel must read and comply with the site specific Lead Compliance Plan (Attachment 3) Lead Awareness Training Program (Attachment 4), MEC avoidance SOP (Attachment 5) and the RPP (Attachment 6). | Note – All SOPs associated with radiation protection, radiation monitoring, and radiation handling practices are included in the RPP (Attachment 6). | | |
| 3. Practice care in areas potentially around vehicular traffic. | | | |
| 4. All personnel traveling should be cognizant of the travel routes and minimize distractions. Hurricane evacuation zones and required evacuation routes from the site are included as Attachment 2. Note: all personnel must evacuate the Site if hurricane and tropical storms are anticipated to pass over the Virginia Tidewater area. | | | |
| 5. Minimize loads being carried to 50 pounds (lbs) or less. | | | |
| 6. A second person should be utilized to carry equipment and/or supplies weighing greater than 35 lbs. | | | |
| 7. All site personnel must read and comply with the site specific Lead Compliance Plan (Attachment 3) and Lead Awareness Training Program (Attachment 4). | | | |
### Activity Hazard Analysis – Complete Corresponding Detailed PPE Section for each task

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<tr>
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<th>Exposure Monitoring Required/ Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Site Soil Investigation (Subtask 3.2)</td>
<td>Slips, trips falls; Vehicle traffic; Chemical exposure; Thermal/Cold stress;</td>
<td>1. All crew members and visitors, upon their first visit to the Site will undergo site-specific training, including radiation protection training and munitions of concern training.</td>
<td>D/C</td>
<td>Required: Per the RPP, gamma radiation screening will be conducted on items and soil samples/bucket of soil retrieved from the sampling location during advancement of the test pits and boreholes. Frequency: Immediately upon brought to the surface. Required: With photoionization detector (PID) collect reading during borehole drilling, advancement of test pits, and when boreholes and/or test pits have been left open. Frequency: Every 15 minutes within the breathing zone at the open borehole and around the perimeter of the EZ and upon opening each soil coring. Required: Conduct dust monitoring continuously during subsurface intrusion investigations per Section 3.8 in HGL’s SMP. Frequency: Record readings continuously during borehole advancement and dust generating activities.</td>
</tr>
</tbody>
</table>
### Activity Hazard Analysis – Complete Corresponding Detailed PPE Section for each task

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<thead>
<tr>
<th>Task Number/Activity Description/Site Location</th>
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<th>Primary / Secondary PPE Level</th>
<th>Exposure Monitoring Required/ Frequency</th>
</tr>
</thead>
</table>
| 4. Groundwater Sampling (Subtask 3.5)          | Slips, trips falls; Vehicle traffic; Chemical exposure; Thermal/Cold stress; Biological issues; Lifting issues/back strains; Faulty equipment/equipment used improperly; Inhalation of contaminated dust; Radiation from the gamma radiation survey instrument; and Potential discovery of MD/MEC Items. | 1. All crew members and visitors, upon their first visit to the Site will undergo site-specific training, including radiation protection training and munitions of concern training.  
2. Use Saranex coveralls and booties. Use appropriate PPE for exposure to biological concerns.  
3. Practice care in areas potentially around vehicular traffic.  
4. Use gloves, safety goggles/glasses, hard hat, Saranex coveralls and booties, and half face respirator with dual organic vapor and particulate cartridges when conducting onsite drilling and/or test pitting if dust is generated.  
5. Proper training for use of proposed equipment.  
6. Minimize loads being carried to 50 lbs or less.  
7. A second person should be utilized to carry equipment and/or supplies weighing greater than 35 lbs.  
8. Personnel SHALL NOT enter open test pits under any circumstances.  
9. Perform dust monitoring to insure dust generation is not conducted.  
10. Only authorized and experienced personnel will utilize the gamma radiation survey equipment.  
11. Practice MEC anomaly avoidance procedures (MEC anomaly avoidance SOP has been attached to this HASP).  
12. All field personnel will receive MEC hazards awareness instruction per HGL SOP 15.02.  
13. UXO-qualified personnel will instruct non-UXO personnel to not touch or disturb any potential MEC or unknown items.  
14. If MEC is found, the item will not be collected, stored, or removed from the site. | D/C                                                                 | MD/MEC Exposure Surface Monitoring Required: Borehole ground surface visual and geophysical screening for MD/MEC hazards.  
MD/MEC Exposure Surface Monitoring Frequency: Conduct visual and geophysical survey before initiating each borehole.  
MD/MEC Exposure Downhole Monitoring Required: Borehole below ground surface visual and geophysical screening for MEC hazards.  
MD/MEC Exposure Downhole Monitoring Frequency: Conduct incremental screening for anomalies at the end of each 2-foot increment for MEC hazards.  
Required: Per the RPP, gamma radiation screening will be conducted on soil and groundwater removed from the well borings during borehole advancement, on groundwater purged during well development, and on groundwater purged from and sampled during the first groundwater quarterly sampling event. Gamma radiation monitoring of the groundwater purged and sampled during groundwater quarterly events 2, 3, and 4 may be required based upon the first quarterly groundwater monitoring results.  
Frequency: Immediately upon brought to the surface  
Air Monitoring Required: Collect PID and combustible gas readings during well borehole drilling and PID readings when first opening monitoring wells and during groundwater purging and sampling.  
Air Monitoring Frequency: During borehole advancement, collect PID readings every 15 minutes within the breathing zone at the open borehole and around the perimeter of the EZ. |
### Activity Hazard Analysis – Complete Corresponding Detailed PPE Section for each task

<table>
<thead>
<tr>
<th>Task Number/Activity Description/ Site Location</th>
<th>Potential Hazards</th>
<th>Controls</th>
<th>Primary / Secondary PPE Level</th>
<th>Exposure Monitoring Required/ Frequency</th>
</tr>
</thead>
</table>
| 5. Paradise Creek investigation (Subtask 3.6)  | Slips, trips falls; Vehicle traffic; Chemical exposure; Thermal/Cold stress; Biological issues; and Lifting issues/back strains. | 1. All crew members and visitors, upon their first visit to the Site will undergo site-specific training, including radiation protection training and munitions of concern training.  
2. Use appropriate PPE to minimize/eliminate exposure to biological, chemical, and equipment safety concerns.  
3. Practice care in areas potentially around vehicular traffic.  
4. Use gloves, safety goggles/glasses, hard hat, Saranex coveralls and booties.  
5. Proper training for use of proposed equipment.  
6. Minimize loads being carried to 50 lbs or less.  
7. A second person should be utilized to carry equipment and/or supplies weighing greater than 35 lbs.  
8. Personnel SHALL NOT enter utility vaults or enclosed spaces.  
9. While working within 5 feet of standing water or around drainage features where there is the possibility to fall into water, a U.S. Coast Guard (USCG)-approved flotation device (USCG Number: 160.080/75/0) must be worn at all times.  
10. Use USCG-approved flotation devices (USCG Number: 160.060/75/0) when on the boat or immediately adjacent to the shoreline at all times.  
11. Do not stand up in the boat and always 2 people in the boat at all times. A third person should be on shore as a spotter. | D/D | Required: Per the RPP, gamma radiation screening will be conducted on sediment and surface water retrieved from all sampling locations.  
Frequency: At shoreline after sample collection. |
<table>
<thead>
<tr>
<th>Task Number/Activity Description/Site Location</th>
<th>Potential Hazards</th>
<th>Controls</th>
<th>Primary / Secondary PPE Level</th>
<th>Exposure Monitoring Required/ Frequency</th>
</tr>
</thead>
</table>
| 6. IDW Management (Subtask 3.9)               | Splash hazard, Exposure to chemicals; Vehicular traffic; Chemical exposure; Thermal/Cold stress; Biological issues; Lifting issues/strained back Faulty equipment/equipment used improperly | 1. All crew members and visitors, upon their first visit to the Site will undergo site-specific training, including radiation protection training and munitions of concern training. 2. Use gloves, safety goggles/glasses, Saranex coveralls and booties when working onsite; 3. Practice care when crossing railroad train tracks; 4. Minimize loads being carried to 50 lbs or less; 5. A second person should be utilized to carry equipment and/or supplies weighing greater than 35 lbs. 6. Proper training for use of proposed equipment. 7. Conduct Subcontractor oversight, do not perform subcontractor tasks. | D/D | Required: Per the RPP, gamma radiation screening will be conducted on IDW generated at the Site including soils, groundwater, wash water, used PPE, used equipment and supplies. Items expressing potential radiological contamination will be segregated and stored in accordance with the RPP.  
Frequency: Immediately upon generation and containerization. Each time the radiation waste storage unit is access by AVESI, radiation readings will be collected to ensure proper labeling and extent of the unit’s exclusion zone. |

| 7. Building Inspections                       | Confined spaces; Low oxygen environments; Miscellaneous chemicals/wastes stockpiled by Site owner; Faulty wiring; No lighting; Slips, Trips, Falls | 1. A minimum of a 2 person field crew shall conduct the sampling within the buildings; 2. No crew members will access electrical wiring or electrical utility boxes; 3. Field crews will not access portions of the buildings that are covered in water; 4. No confine spaces will be access by field crew. Sampling activities will be limited only to portions of the building with easy access and egress. 5. Flashlights and/or headlights will be utilized by field crew. 6. Use gloves, safety goggles/glasses, Saranex coveralls, boots, and hardhats when working inside the buildings. 7. Minimize loads being carried to 50 lbs or less; 8. A second person should be utilized to carry equipment and/or supplies weighing greater than 25 lbs. 9. Proper training for use of proposed equipment; 10. Conduct Subcontractor oversight, do not perform subcontractor tasks. | D/C | Required: Conduct dust monitoring using a handheld dust meter carried with one of the field crew members.  
Frequency: Record readings continuously while within site buildings.  
Air Monitoring Required: Combustible gas readings will be collected while field crew members are in site buildings.  
Air Monitoring Frequency: Collect combustible gas readings continuously while in site buildings. |
### Health and Safety Plan Form

#### U.S. Environmental Protection Agency

**Region 3 RAC**

**Project Name:** Peck Iron and Metal RI/FS (EPA010)

**Work Assignment No.: 044**

- **PPE Levels = A, B, C, D** – definitions of these levels available in Corporate Health and Safety (H&S) Manual.
- **Exposure Monitoring = PID, PDR (dust monitor), CGI, O₂ meter, etc.**

**Does the project require continuous air monitoring during the project?**

- [x] Yes  [ ] No  
  If Yes, Contact the Regional Health and Safety Coordinator (HSC) for additional project safety planning.

**Protective Equipment:** Specify by task. Indicate type and/or material as necessary. Use copies of this sheet if needed.

#### Task Number: 1, 6

<table>
<thead>
<tr>
<th>Primary PPE Level: D</th>
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</thead>
<tbody>
<tr>
<td><strong>Respiratory:</strong> [ ] Not Needed</td>
</tr>
<tr>
<td>SCBA, Airline:</td>
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<tr>
<td>APR Full face:</td>
</tr>
<tr>
<td>Cartridge:</td>
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<tr>
<td>Escape Mask:</td>
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<td>Other:</td>
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<tr>
<td><strong>Prot. Clothing:</strong> [ ] Not Needed</td>
</tr>
<tr>
<td>Encapsulated Suit:</td>
</tr>
<tr>
<td>Splash Suit: Chest waders</td>
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<tr>
<td>Apron:</td>
</tr>
<tr>
<td>Saranex Coverall:</td>
</tr>
<tr>
<td>Cloth Coverall:</td>
</tr>
<tr>
<td>High Visibility Vests: hats</td>
</tr>
<tr>
<td>Other:</td>
</tr>
<tr>
<td><strong>Head &amp; Eye:</strong> [ ] Not Needed</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Goggles:</td>
</tr>
<tr>
<td>Hard Hat: When overhead hazards exist</td>
</tr>
<tr>
<td>Hearing Protection: If noise exposure is possible</td>
</tr>
<tr>
<td>Other:</td>
</tr>
<tr>
<td><strong>Gloves:</strong> [ ] Not Needed</td>
</tr>
<tr>
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</tr>
<tr>
<td>Work gloves:</td>
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<tr>
<td>Other:</td>
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<tr>
<td><strong>Boots:</strong> [ ] Not Needed</td>
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<tr>
<td>Other – specify below:</td>
</tr>
<tr>
<td>Boots: Steel or Composite Toe</td>
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<tr>
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<td>Rubber:</td>
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#### Task Number: 2, 3, 4, 7

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<tr>
<td>Cloth Coverall:</td>
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<tr>
<td>High Visibility Vests, hats</td>
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<tr>
<td>Other:</td>
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<tr>
<td><strong>Head &amp; Eye:</strong> [ ] Not Needed</td>
</tr>
<tr>
<td>Safety Glasses:</td>
</tr>
<tr>
<td>Face Shield:</td>
</tr>
<tr>
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<tr>
<td>Hard Hat: When overhead hazards exist</td>
</tr>
<tr>
<td>Hearing Protection:</td>
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<tr>
<td>Other:</td>
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<td><strong>Gloves:</strong> [ ] Not Needed</td>
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#### Task Number: 5

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<tr>
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<tr>
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<tr>
<td>Rubber:</td>
</tr>
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</table>

*Health clearance meets all the medical surveillance requirements of 29 Code of Federal Regulations (CFR) 1910.120. Medical surveillance certification for on-site personnel is presented in HGL Policy 3.1. Subcontractors are required to meet the medical requirements of 20 CFR 1910.120, if applicable.
**Health and Safety Plan Form**  
U.S. Environmental Protection Agency  
Region 3 RAC  
Project Name: Peck Iron and Metal RI/FS (EPA010)  
Work Assignment No.: 044

**Does the project have any permit required confined spaces that will need to be entered to accomplish the identified project tasks?**
- [ ] Yes  
- [ ] No  
If Yes, Attach the Permit Required Confined Space Entry Checklist (available via the Intranet) and contact the regional HSC for additional project safety planning.

**Health and Safety Monitoring Equipment: Specify by task. Indicate type as necessary. Attach additional sheets as necessary.**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Task</th>
<th>Action Guidelines</th>
<th>Comments (Include schedules of use)</th>
</tr>
</thead>
</table>
| Combustible Gas Indicator   | 2 (Site Soil Investigations – subsurface soil investigations); 4 (Groundwater Sampling – Well installations); and 7 (Building Inspections). | 0-5% LEL: No explosion hazard  
5-10% LEL: Potential explosion hazard; notify Site Safety and Health Officer (SSHO)  
10% LEL: Explosion hazard; interrupt | ![Not Needed](https://example.com/)

Type: **MultiRAE Plus**

| Schonstedt Magnetometer     | 2 (Site Soil Investigations), 3 (Site Wetland Investigations – temporary well installations) and 4 (Groundwater Sampling – Well installations). | If magnetic anomalies are detected at the surface; the proposed location will be relocated | ![Not Needed](https://example.com/)

| Downhole Magnetometer       | 2 (Site Soil Investigations), 3 (Site Wetland Investigations – temporary well installations) and 4 (Groundwater Sampling – Well installations). | If magnetic anomalies are detected at the surface; the proposed location will be relocated | ![Not Needed](https://example.com/)

Type: To be determined by UXO Tech II or higher

| Radiation Survey Meter     | 2 (Site Soil Investigations); 3 (Site Drainage and Wetland Investigations); 4 (Groundwater Sampling – Well installations and development and first groundwater quarterly event); 5 (Paradise Creek Investigation) and 6 (IDW Management – during IDW generation and initial storage). | As specified in the RPP (Attachment 6). | ![Not Needed](https://example.com/)

Type: To be determined by subcontractor

| Photoionization Detector   | 2 (Site Soil Investigations – subsurface soil sampling), 3 (Site Wetland Investigations – temporary well installations) and 4 (Groundwater Sampling – Well installations). | Specify: Sustained readings above 10 units above background for 5 minutes, evacuate and allow venting for a minimum of 15 minutes. After 15 minutes walk back to the site with while monitoring with a PID, if elevated readings are still encountered, collect a trichloroethylene (TCE) and vinyl chloride colorimetric tube readings. If TCE concentrations are greater than 10 then contact the HGL CIH to re-evaluate the site investigation strategy. Detectable Odor: If odor of any kind is detected, cease work, move to fresh air. | ![Not Needed](https://example.com/)

Type: **MultiRAE Plus**

| Personal Dust Monitor       | 2 (Site Soil Investigations – subsurface soil sampling), 3 (Site Wetland Investigations – temporary well installations) and 4 (Groundwater Sampling – Well installations). | Specify: Personal dust monitoring will be conducted IAW the Lead Compliance Plan included as an attachment to this HASP. | ![Not Needed](https://example.com/)

Type: **MCE Cassette**

| Respirable Dust Monitor     | 2 (Site Soil Investigations – subsurface soil sampling), 3 (Site Wetland Investigations – temporary well installations) and 4 (Groundwater Sampling – Well installations). | Specify: Prior to conducting work, a background screening will be conducted to determine the action level for dust monitoring. Up to 5 background locations will be utilized to collect readings. The action level will be determined by adding 150 milligrams per cubic meter (mg/m³) to the background readings. Dust monitoring activities will be conducted at the perimeter of the EZ during drilling activities. Take continuous readings. If dust measurements greater than 150 mg/m³ above background are recorded, then begin spraying the area of agitation (i.e., the borehole) with a fine water mist to minimize/eliminate dust generation. | ![Not Needed](https://example.com/)
Decontamination Procedures

Potential Radiological Contaminated Waste, PPE and Equipment

Decontamination procedures and waste handling procedures are specified in the RPP.

Personalized Decontamination

Wash well before hand to mouth contact is made. A shower will be taken as soon as possible after leaving the field. Workers will remove protective clothing in this order:

Wet or dry decontamination procedures will be selected per project.

Dry Decon Procedure

Place all disposable PPE in a garbage bag as removed in the following order:

1. brush off work boots, remove disposable over boots, or booties
2. remove gloves
3. remove safety glasses
4. remove Saranex or cloth coverall, if used
5. remove respirator, if used
6. remove inner gloves
7. wash hands/face before eating/drinking

Sampling Equipment Decontamination

All sampling equipment will be thoroughly decontaminated as follows:

1. wash and scrub with low phosphate detergent
2. potable tap water rinse 1
3. potable tap water rinse 2
4. thoroughly rinse with deionized water, If specified by the Work Plan
5. air dry
6. wrap in aluminum foil for transport , If specified by the Work Plan

Heavy Equipment Decontamination

All heavy equipment and tool parts that contact subsurface soil are constructed of heavy gauge steel and have no natural or synthetic components that could absorb and retain most soil-borne organic contaminants.

Prior to removal from the work site, potential contaminated soil/groundwater will be scraped or brushed from the exterior surfaces.

The drill rig, augers and any other large equipment in the EZ will be taken to a decontamination pad and steam cleaned.

Wet Decon Procedure

1. wash overboots in soapy water and rinse
2. remove overboots or booties
3. remove gloves
4. remove safety glasses
5. remove Saranex or cloth coverall, if used
6. remove respirator, if used
7. remove inner gloves
8. wash hands/face before eating/drinking

Containment and Disposal Method

All disposable PPE will be double-bagged prior to disposal. Decontamination water to be disposed of IAW the IDW Management Plan.

Containment and Disposal Method

Decontamination water to be disposed of IAW the IDW Management Plan.

Containment and Disposal Method

All disposable PPE will be double-bagged before disposal. Decontamination water to be disposed of IAW the IDW Management Plan.

Hazardous Materials Inventory (Material Safety Data Sheets [MSDSs] for Investigation-Associated Substances available in HGL Corporate Intranet)

<table>
<thead>
<tr>
<th>Preservatives</th>
<th>Decontamination</th>
<th>Calibration Gases and Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrochloric Acid (HCl)</td>
<td>Alconox™</td>
<td>Isobutylene</td>
</tr>
<tr>
<td>Ascorbic Acid</td>
<td>Liquinox™</td>
<td>pH Standard</td>
</tr>
<tr>
<td>Nitric Acid (HNO₃)</td>
<td>Acetone</td>
<td>Methane</td>
</tr>
<tr>
<td>Other:</td>
<td>Methanol</td>
<td>Standard</td>
</tr>
<tr>
<td>Sulfuric Acid (H₂SO₄)</td>
<td>Other:</td>
<td>Pentane</td>
</tr>
<tr>
<td>Sodium Hydroxide (NaOH)</td>
<td>Mineral Spirits</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Zinc Acetate (AnOAc)</td>
<td></td>
<td>Zobell Solution</td>
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</tbody>
</table>

Spill Response: The following materials will be kept on site for spill response (check all appropriate materials)

- Absorbent Pads
- Granular absorbent material (non flammable)
- Polyethylene Sheeting
- Waste Container
- Shovels or assorted hand tools

If a hazardous waste spill or material release to the air, soil, or water at the site is observed, the EPA site representative and the local Fire Department will be immediately notified. An assessment will be made of the magnitude and potential impact of the release. If it is safe to do so, site personnel will attempt to locate the source of the release, prevent further release, and contain the spilled and/or affected materials.
### Emergency Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Management – HGL</td>
<td>703-736-4526</td>
</tr>
<tr>
<td>Project Manager – Brett Brodersen</td>
<td></td>
</tr>
<tr>
<td>Digi/Utility Clearance – Virginia One Call</td>
<td>800-552-7001</td>
</tr>
<tr>
<td>Health Department</td>
<td>800-864-7001</td>
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<tr>
<td>Sheriff's Department</td>
<td>757-393-8210</td>
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<tr>
<td>Fire Department– Portsmouth Fire Station</td>
<td>911/757-393-8521</td>
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### Contingency Plans (summarize below):

**Medical Emergency**

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<tbody>
<tr>
<td>Hospital Address: 600 Gresham Drive, Norfolk, VA 23510</td>
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<td>Main line: 757-388-3000</td>
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**Health and Safety Plan Approvals**

<table>
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<th>Name of Contact at Hospital:</th>
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<td>Name of 24-Hour Ambulance: 911</td>
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**For: Stephen Davis, CIH, Corporate H&S Director**

**Site: Peck Iron and Metal RI/FS**

**Distance to Hospital: 5.8 miles**
Figure 2: Hospital Route Map
Distance to Hospital: 5.8 miles

Drive Time: 15 minutes
The following personnel have read and fully understand the contents of this HASP and further agree to all requirements contained herein.

<table>
<thead>
<tr>
<th>Site: Peck Iron and Metal RI/FS</th>
<th>Work Assignment No.: 044</th>
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<tbody>
<tr>
<td>Name and Responsibility</td>
<td>Affiliation</td>
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ATTACHMENT 1
ACTIVITY HAZARD ANALYSES
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### Job Steps

<table>
<thead>
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<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Review-H&S needs               | Inadequate preparation which can lead to personal injuries, property damage and project delays | Read HASP. Conduct H&S review. Answer the following questions:  
- Have all site hazards been recognized?  
- Do you have all the necessary equipment to evaluate and control for site hazards? For example: Correct PID lamp and PID calibration records are current? Do you know relative response or correction factor for chemicals of concern?  
- Are engineering, administrative and PPE controls ready to be implemented as needed?  
- Are emergency safety supplies and first aid supplies available and complete? | M   |
| 2. Transportation-vehicle maneuvering | Traffic                                                                 | Practice defensive driving and always wear safety belt.  
- Assure vehicle is adjusted per your personal specifications and is in good working order and all cargo is secured and distractions are minimized.  
- Familiarize yourself with the route and directions.  
- Be cognizant of road conditions and vehicle size limitations at all times.  
- Match driving speed to the conditions. | M   |
|                                   | Road conditions: ruts, snow, ice, puddles, poor traction                | Use a spotter to help maneuver in tight conditions.  
- Avoid backing if possible.  
- Check all blind spots before you attempt to move vehicle.  
- Sound horn before backing and move slowly.  
- Remember that loaded haul trucks have the right of way. | M   |
|                                   | Maneuvering in tight areas/potential vehicle or personnel damage        |                                                                                                                                                                                                                                         | M   |

### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Probability</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
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<td>Critical</td>
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<td>Marginal</td>
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<td>M</td>
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<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
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</tbody>
</table>

### ACTIVITY HAZARD ANALYSIS 44.01

Date Prepared: 9/13/2013  
Project Name: Peck Iron and Metal RIFS  
Activity/Work Task: General Site Hazards  
Prepared By: Mark McGowan CIH, CHMM  
Revised By: Brett Brodersen (Project Manager)
<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. General site hazards</td>
<td>Site access control-unwanted entry</td>
<td>• Maintain a constant watch for intrusion of unauthorized personnel.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Establish positive site access control prior to on-site operations using barricades, signs or other methods.</td>
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<tr>
<td></td>
<td>Strains, sprains, awkward bending/lifting/positions and ergonomic hazards</td>
<td>• Follow General Safe Work Practices and daily task specific briefing procedures.</td>
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<td></td>
<td></td>
<td>• Size up the load before the lift.</td>
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<td></td>
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<td>• Use proper lifting techniques.</td>
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<td>• Maintain good personal fitness.</td>
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<td></td>
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<td>• Know your own limitations.</td>
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<td>• Ensure walking pathway is clear.</td>
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<td>• Do not lift greater than 50 lbs.</td>
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<td>• Use mechanical assistance or 2 man lift whenever possible.</td>
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<td>• Limit repetitive awkward motions and unbalanced lifting as much as possible.</td>
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<td>• Develop appropriate work-rest cycles.</td>
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<td></td>
<td>• DO NOT lift and twist torso at the same time.</td>
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<td></td>
<td>• Discuss and caution personnel about knowing their personal limitations when conducting strenuous activities.</td>
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<td></td>
<td>Overhead hazards</td>
<td>• Wear hard hat when there is a potential for head injury.</td>
<td>M</td>
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<td></td>
<td>Electrical</td>
<td>• Ensure that there is written certification of installation and grounding of all electrical power hook up installations and disconnections by a certified electrician. Institute Lock out/tag out program.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Traffic/Heavy Equipment-Struck by hazards-crushing hazards</td>
<td>• Select location away from traffic.</td>
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<td>• Place barricades for work site protection, if necessary.</td>
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<td>• Wear high visibility vest.</td>
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<td>• Stay clear of traffic and equipment.</td>
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<td>• Wear PPE (hardhat, safety glasses, hearing protection, hi-visibility vest, etc. (Level D minimum)).</td>
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<td>• Discuss active work areas in daily briefings.</td>
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<td>• Respect active work zones.</td>
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<td></td>
<td>• Make eye contact with operators of equipment to make sure they know your intentions. STAY CLEAR of earth moving equipment.</td>
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<td></td>
<td></td>
<td>• Note that machinery or equipment requiring an operator should not be permitted to run unattended.</td>
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<td></td>
<td></td>
<td>• Be alert to backup alarms and equipment material movement.</td>
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<td></td>
<td>• Minimize the number of ground personnel working around heavy equipment.</td>
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<td></td>
<td>Unhygienic conditions</td>
<td>• Restroom facilities, if installed on site, will be adequately provided and maintained.</td>
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<tr>
<td></td>
<td></td>
<td>• Maintain hand disinfectant, wipes, wash stations.</td>
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<tr>
<td>Job Steps</td>
<td>Hazards</td>
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</tr>
<tr>
<td>3. General site hazards (continued)</td>
<td>Fire</td>
<td>• Maintain at least one dry chemical fire extinguisher having a minimum UL rating of 1A5BC on site.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Driving/ walking over soft ground Uneven and rough terrain</td>
<td>• Choose location with level and firm soils. • Contact sub and note that gravel or wood chips may be needed to prevent entrapment in mud or water. • Watch footing when walking in mud or wet soils.</td>
<td>M</td>
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<tr>
<td></td>
<td>Getting lost/Personal safety</td>
<td>• Do not travel alone and bring a topographic map and compass or global positioning system. If you must work alone employ a “check-in” system and/or the buddy system. • Maintain adequate gear and equipment for possible emergencies.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Electric shock</td>
<td>• Require that all electrical power hook up, installations and disconnections be made or certified by a qualified electrician who will provide written certification of installation and grounding. • Make certain all electrical is de-energized if work is to be performed near live power. Institute Lock out/tag out.</td>
<td>L</td>
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<td></td>
<td>Unattended worker</td>
<td>• Employ the Buddy System. Maintain visual contact.</td>
<td>M</td>
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<td></td>
<td>Slip, trip and fall hazards</td>
<td>• Wear slip resistant footwear. • Keep work area picked up and as clean as feasible and free of tripping and fall hazards. • Exercise caution to prevent entrapment in mud or wet soils and avoid walking on loose soils which can give way. • Continually inspect the work area for slip, trip and fall hazards. • Note that egress routes are as clear and unobstructed as possible. Use extra caution when working on uneven ground.</td>
<td>M</td>
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<td></td>
<td>Soft ground-entrapment or cave in hazards</td>
<td>• Make initial visual check. • Stand back 3 feet from excavations. • Know evacuation routes.</td>
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<td></td>
<td>Flying debris-Eye, head, etc.</td>
<td>• Remain aware of surroundings and potential for flying debris and dust. • Wear safety glasses when there is a potential for flying debris. • Ensure eyewash is available. • Wear required PPE including: safety glasses with side shields, hardhats and high visibility safety vests.</td>
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<tr>
<td>3.</td>
<td>General site hazards (continued)</td>
<td>• Conduct visual inspection prior to work.</td>
<td>M</td>
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<tr>
<td></td>
<td>Biologicals: Contact with poisonous plants, allergens, insects and animal kingdom hazards (for example: spiders, hornets, reptiles, snakes, ticks, mosquitoes, bird and rodent droppings, biting and stinging insects, thorny plants)</td>
<td>• Survey and note (mark) areas of poisonous vegetation, insect (hornet wasp) and snake habitats, for example.</td>
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<td>• Use mosquito repellant with DEET, as required.</td>
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<td>• Know the local fauna and review emergency preparedness measures.</td>
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<td>• Review potential animal dangers specific to the site and, precautions (actions to take if run-in with wild animal) and treatments.</td>
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<td>• Inspect your body and clothing for ticks during outdoor activity and at the end of the day. Wear light colored clothing so ticks can be more easily seen. Remove ticks right away to prevent infections.</td>
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<td>• Wear long-sleeved shirts which should be tucked in. When in areas with tick potential tuck pants into socks and duct tape.</td>
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<td>• Review information for poison ivy, recognition and treatment.</td>
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<td>• Use barrier cream as necessary.</td>
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<td>• Use preferred footpaths.</td>
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<td>• Avoid walking in un-cleared areas with poison ivy or biological hazard potential.</td>
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<td>• Decontaminate with soap. Shower immediately upon leaving work.</td>
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<td></td>
<td>Ultraviolet (UV) exposure-Sunburn</td>
<td>• Wear sun protection factor (SPF) 15, minimum, sunscreen and reapply every few hours.</td>
<td>M</td>
</tr>
<tr>
<td>Noise-Hearing loss</td>
<td>• Wear hearing protection if noise levels from neighboring equipment exceeds 80 decibels (dBA) (if you cannot be heard speaking in a normal voice at arm’s distance).</td>
<td>M</td>
<td></td>
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<tr>
<td>Spills and leaks</td>
<td>• Maintain a portable spill response kit (if spills are possible) containing absorbent materials, non-sparking shovel, PPE and disposable supplies in a readily accessible location.</td>
<td>L</td>
<td></td>
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<tr>
<td>Hand tools/power tools-cut hazards, jamming, pinch points, struck-by</td>
<td>• Assure that hand tools are in good repair and used correctly. The right tool for the right job. Inspect tools daily prior to use and remove defective tools from service immediately.</td>
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<tr>
<td>Contact with equipment-Struck by</td>
<td>• Wear PPE with eye protection and leather gloves per the HASP for all tasks with potential for cuts or lacerations.</td>
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<tr>
<td>Heat or cold stress</td>
<td>• Conduct daily task specific briefings regarding the hazards associated with the tasks. All personnel will wear a minimum of Level D protection. All subcontractors will be required to attend the site specific hazards H&amp;S training. Maintain eye contact with equipment operators if is necessary to enter active work zones.</td>
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<td></td>
<td>• Establish a clear safety zones.</td>
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<tr>
<td></td>
<td>• Review H&amp;S program section regarding monitoring and controls necessary for heat or cold stress prevention. Take preventive and recovery measures as necessary. See HASP.</td>
<td>M</td>
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<tr>
<td></td>
<td>• Develop a work/rest regimen. Take breaks as needed, for rehydration and recovery.</td>
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<td></td>
<td>• Dress appropriately.</td>
<td></td>
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</tbody>
</table>
### AHA – General Site Hazards (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. General site hazards (continued)   | Severe weather related hazards (lightning, high winds, snow, rain, sleet)                                                           | • Be tuned in to the local weather reports.  
• Check weather forecasts for potential of hurricanes and/or tropical storms. If not prior to mobilizing to the site, rescheduled field work if hurricane/tropical storm is anticipated for Virginia Tidewater region. If onsite and hurricane/tropical storm is anticipated within several days for Virginia Tidewater region, conduct storm preparation activities at the site and evacuate the site (see Attachment 2) to the HGL Reston office if outside the predicted path of the storm.  
• STOP work as necessary when adverse (wind, lightning, rain) appears to be approaching the work area. Suspend work if storm is 5 miles away. Stop work if lightning is within a 30 second count (before thunder is heard) of the work area. Proceed to safe refuge. Return to work 30 minutes after last strike. (Follow 30/30 rule).  
• Do not remain under trees in severe winds.  
• Identify likely tornado refuge during site safety meeting.  
• Ensure that trailers are installed with appropriate anchorage capable of withstanding anticipated wind forces and comply with State and local standards for the installation of mobile homes. Removal of all strapping anchors and chocks in preparation for trailer removal from the work site shall be made by authorized vendors. | M   |
| 4. Specific High Hazard activities     | Multiple hazards                              | • Require a permit for these activities before beginning work.  
• Require Competent Person (CP) to evaluate planned activity for potential hazards. Written plan/procedure must be prepared for each activity as appropriate. | H   |
| 5. Performing work tasks for work periods longer than 8 hours | Fatigue associated with extended work shifts which includes general drowsiness and also associated driving fatigue | • Know your physical and psychological limitations.  
• Stop work/driving when necessary to take breaks and hydrate.  
• Stop work all together if fatigue endangers your safety or others. If appropriate find a replacement for your job tasks.  
• Schedule more demanding tasks for when endurance and alertness is best.  
• Postpone more demanding and hazardous jobs if fatigue has set in.  
• Follow guidelines of HASP for work-rest regimens under adverse conditions of heat or cold stress.  
• Limit moderate to heavy workloads by knowing your physical limitations in order that the risk of musculoskeletal injuries is minimized. | H   |
### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 6.        | Completion of work shift | Take home toxics-Contact with potentially contaminated materials | Note a source of Decontamination water on site. Do not bring contaminated PPE or boots into truck.  
Wear Saranex as necessary and washable or disposable over-boots in order to keep personal clothing clean and free of contaminated soils.  
Store and dispose of contaminated materials IAW regulations.  
Use liners to prevent contamination of truck.  
Shower immediately at end of work day.  
Check body for ticks, bites and signs of irritation or cuts.  
Store and dispose of contaminated materials IAW regulations.  
Follow good hygiene practices. No eating in contaminated areas.  
Prohibit washing of PPE while on a person. | M |

**Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.**
AHA – General Site Hazards (continued)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPE Level D:</td>
<td>Daily inspection (SSHO) _________________________</td>
<td>CP / Qualified Person (QP):</td>
</tr>
<tr>
<td>· Hard Hat</td>
<td>Housekeeping (daily)</td>
<td>CP/SSHO</td>
</tr>
<tr>
<td>· Safety Glasses</td>
<td>· Fire extinguisher (monthly)</td>
<td>Alternate CP/SSHO ___________________________________________</td>
</tr>
<tr>
<td>· Safety-Toed Boots</td>
<td>· Vehicle inspection (daily)</td>
<td>QP/First Aid and cardiopulmonary resuscitation (CPR)</td>
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<tr>
<td>· Work Gloves/Chemical resistant</td>
<td>· Eye Wash</td>
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<tr>
<td>· American National Standards</td>
<td>· Equipment and tools inspection (daily and</td>
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<td>Institute (ANSI) Class 2</td>
<td>before use)</td>
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<td>reflective warning vests</td>
<td>· Survey areas for poisonous plants, insects,</td>
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<td></td>
<td>and animals (each work area)</td>
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<tr>
<td>Other Equipment:</td>
<td>· Check body for ticks (each evening during tick</td>
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<td>· Generator</td>
<td>season)</td>
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<tr>
<td>· Fire Extinguishers</td>
<td>Identify closest usable tornado/hurricane</td>
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<td>· Emergency Eyewash</td>
<td>shelter that is available (each work area)</td>
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<tr>
<td>· First Aid Kit</td>
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<td>· Insect repellent – DEET</td>
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<td>· Hand tools</td>
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<td>· Spill containment supplies</td>
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<td>· First aid supplies</td>
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<td>· Containers as needed</td>
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<td>· Tarps</td>
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<tr>
<td>· Ground Fault Circuit Interrupter</td>
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<td>(GFCI) as needed</td>
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<td>· Heavy duty extension cords</td>
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<td>· Drinking water</td>
<td></td>
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<td>· Weather radio</td>
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<tr>
<td>· Heat stress monitoring</td>
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</table>

CP – risk assessment code
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Date Revised: 09/13/2013
Project Name: Peck Iron and Metal RIFS
Activity/Work Task: Mobilization/Demobilization (includes set-up, take down, and staging of equipment)
Prepared By: Mark McGowan CIH, CHMM
Revised By: Brett Brodersen (Project Manager)

## ACTIVITY HAZARD ANALYSIS 44.02

### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Severity</th>
<th>E=Extremely High Risk</th>
<th>H=High Risk</th>
<th>M=Moderate Risk</th>
<th>L=Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
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<td>Critical</td>
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<td>Marginal</td>
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<tr>
<td>Negligible</td>
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#### Risk Assessment Code Matrix

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<tr>
<th>Probability</th>
<th>Frequent</th>
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</table>

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Review – H&S needs     | Inadequate preparation which can lead to the pain and suffering of an accident or personal injury | Read HASP. Conduct H&S review. Answer the following questions:  
- Have all site hazards been recognized?  
- Do you have all the necessary equipment to evaluate and control site hazards? Lamp and calibration records correct and current?  
- Are engineering, administrative and PPE controls ready to be implemented as needed?  
- Are back up emergency safety supplies and first aid supplies available and complete? | M   |
| 2. Mobilize equipment, tools and safety gear | Strains, sprains, awkward bending/lifts and ergonomic hazards | Use proper lifting techniques.  
- Maintain good personal fitness.  
- Know your limitations.  
- Ensure walking pathway is clear.  
- Do not lift greater than 50 lbs.  
- Use mechanical assistance or 2 man lift whenever possible  
- Limit repetitive awkward motions. | M   |
| 3. Travel to site         | Traffic (road and site traffic)                                         | Assure vehicle is adjusted per your personal specifications and is in good working order and all cargo is secured and distractions are minimized. Familiarize yourself with the route and directions. | M   |
## AHA – Mobilization and Demobilization (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. On-site Mobilization</td>
<td>Traffic-Struck by hazards</td>
<td>• Select location away from traffic. • Place barricades for work site protection, if necessary. • Wear high visibility vest. • Stay clear of traffic and equipment. Have all necessary PPE (e.g., hardhat, safety glasses, hearing protection, vest, etc).</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Driving over soft ground</td>
<td>• Choose location with level and firm soils.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Uneven and rough terrain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site access control-unwanted entry</td>
<td>• Maintain a constant watch for intrusion of unauthorized personnel.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Electric shock</td>
<td>• Require that all electrical power hook up installations and disconnections be made or certified by a qualified electrician who will provide written certification of installation and grounding.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Slip, trip and fall hazards</td>
<td>• Wear slip resistant footwear. • Keep work area picked up and as clean as feasible and free of tripping and fall hazards.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Flying debris</td>
<td>• Wear safety glasses when there is a potential for flying debris. • Ensure eyewash is available.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Strains, sprains, awkward bending/lifts and ergonomic hazards – tow trailer activities</td>
<td>• Use proper lifting techniques. • Maintain good personal fitness. • Ensure walking pathway is clear. • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible. • Limit repetitive awkward motions. • Do not overexert or overstrain muscles/joints.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Noise-Hearing loss</td>
<td>• Wear hearing protection if noise levels from neighboring equipment exceeds 80 dBAs (i.e., if you cannot be heard speaking in a normal voice at arms distances).</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Spills and leaks</td>
<td>• Maintain a portable spill response kit (if spills are possible) containing absorbent materials, non-sparking shovel, PPE and disposable supplies in a readily accessible location.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Hand tools-cut hazards, jamming, pinch points, struck-by</td>
<td>• Assure that they are in good repair and used correctly. The right tool for the right job.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Contact with equipment- Struck by</td>
<td>• Conduct daily task specific briefings regarding the hazards associated with the tasks. All personnel will wear a minimum of Level D protection. All subcontractors will be required to attend the site specific hazards H&amp;S training. Maintain eye contact with equipment operators if is necessary to enter active work zones.</td>
<td>L</td>
</tr>
</tbody>
</table>
### AHA – Mobilization and Demobilization (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Removal and transport of equipment</td>
<td>Take home toxics</td>
<td>• Note a source of decontamination water on site. Do not bring contaminated PPE or</td>
<td>M</td>
</tr>
<tr>
<td>and supplies from the site</td>
<td></td>
<td>boots into truck.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Use liners to prevent contamination of truck.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Same hazards as in step 4 above</td>
<td>• See action to eliminate or minimize hazards in step 4.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. General site work</td>
<td>Environmental hazards</td>
<td>• Refer to General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>• Biologicals (plants, insects, wildlife)</td>
<td>• Pack what you will need for control of hazards.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adverse weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Temperature stresses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• UV hazards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.*
### Equipment

<table>
<thead>
<tr>
<th>PPE Level D:</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Hard Hat</td>
<td></td>
</tr>
<tr>
<td>- Safety Glasses</td>
<td></td>
</tr>
<tr>
<td>- Safety-Toed Boots</td>
<td></td>
</tr>
<tr>
<td>- Work Gloves/Chemical resistant gloves</td>
<td></td>
</tr>
<tr>
<td>- ANSI Class 2 reflective warning vests</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Equipment:</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Generator</td>
<td></td>
</tr>
<tr>
<td>- Fire Extinguishers</td>
<td></td>
</tr>
<tr>
<td>- Emergency Eyewash</td>
<td></td>
</tr>
<tr>
<td>- First Aid Kit</td>
<td></td>
</tr>
<tr>
<td>- Insect repellant – DEET</td>
<td></td>
</tr>
<tr>
<td>- Hand tools</td>
<td></td>
</tr>
<tr>
<td>- Spill containment supplies</td>
<td></td>
</tr>
<tr>
<td>- First aid supplies</td>
<td></td>
</tr>
<tr>
<td>- Containers as needed</td>
<td></td>
</tr>
<tr>
<td>- Tarps</td>
<td></td>
</tr>
<tr>
<td>- GFCI</td>
<td></td>
</tr>
<tr>
<td>- Heavy duty extension cords</td>
<td></td>
</tr>
<tr>
<td>- Drinking water</td>
<td></td>
</tr>
<tr>
<td>- Weather radio</td>
<td></td>
</tr>
<tr>
<td>- Heat stress monitoring</td>
<td></td>
</tr>
<tr>
<td>- Sampling equipment as needed: including but not limited to: pumps, pump controllers, water level probe, miscellaneous hand tools</td>
<td></td>
</tr>
</tbody>
</table>

### Inspection

- **Daily inspection (SSHO) _____________________________**
- **Housekeeping (daily)**
  - Fire extinguisher (monthly)
  - Vehicle inspection (daily)
  - Eye Wash
  - Equipment and tools inspection (daily and before use)
  - Survey areas for poisonous plants, insects, and animals (each work area)
  - Check body for ticks (each evening during tick season)
- **Identify closest usable tornado/hurricane shelter that is available (each work area)**

### CP/QP:

- CP/QP: ____________________________
- Alternate CP/SSHO ____________________
- QP/First Aid and CPR __________________

### Training Requirements (as determined by the SSHO):

- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- MD/MEC awareness
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Subcontractor Oversight Activities – General  
**Examples:** DPT drilling; groundwater well drilling; surveying; utility locating; wetland delineation; asbestos building inspection  
**Prepared By:** Mark McGowan CIH, CHMM  
**Revised By:** Brett Brodersen (Project Manager)

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**Job Steps** | **Hazards** | **Actions to Eliminate or Minimize Hazards** | **RAC**
--- | --- | --- | ---
1. Oversight activities | Struck by and crushing injuries | - Keep a distance of 30 feet from moving equipment and buckets.  
- Stand on uphill side of the work area whenever possible.  
- Determine your escape route prior to entering work area.  
- Adhere to instructions given in daily briefings.  
- Know when heavy equipment is or will be in motion. Stop, look and listen for audible warnings.  
- Make eye contact with the equipment operators before approaching or crossing the path of equipment.  
- Avoid entering active soil removal areas.  
- Wear hearing protection when noise exceeds 85 dBAs (i.e., if you cannot be heard within an arms distance when speaking in a normal voice use hearing protection).  
- Do not walk in areas where soils are loose and can become dislodged.  
- Stand back 3 feet from excavations. Select location an observation point away from traffic and moving equipment.  
- Place barricades for work site protection, if necessary.  
- Wear high visibility vest.  
- Stay clear of traffic and equipment. Have all necessary PPE (e.g., hardhat, safety glasses, hearing protection, vest, etc. (Level D minimum)).  
- Discuss active work areas in daily briefings.  
- Respect active work zones.  
- Note that machinery or equipment requiring an operator should not be permitted to run unattended. | M | 

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**Risk Assessment Code Matrix**

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>Frequent</td>
<td>Likely</td>
<td>Occasional</td>
<td>Seldom</td>
</tr>
<tr>
<td>E=Extremely High Risk</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>H=High Risk</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
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<tr>
<td>M=Moderate Risk</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>L=Low Risk</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

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**Overall Risk Assessment Code (RAC):** M
### 2. General site hazards
(if not covered specifically in this AHA, see the General Site Hazards AHA)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Site access control-unwanted entry</td>
<td></td>
<td>See General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td>• Strains, sprains, awkward bending/lifting/positions and ergonomic hazards</td>
<td></td>
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<tr>
<td>• Overhead hazards</td>
<td></td>
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<tr>
<td>• Electrical</td>
<td></td>
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<td></td>
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<tr>
<td>• Traffic/Heavy Equipment</td>
<td></td>
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</tr>
<tr>
<td>• Unhygienic conditions</td>
<td></td>
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<tr>
<td>• Fire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Driving/ walking over soft ground</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Uneven and rough terrain</td>
<td></td>
<td></td>
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<tr>
<td>• Getting lost/Personal safety</td>
<td></td>
<td></td>
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<tr>
<td>• Electric shock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unattended worker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Slip, trip and fall hazards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Soft ground-entrapment or cave in hazards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Flying debris-Eye, head, etc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• UV exposure-Sunburn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Noise-Hearing loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Spills and leaks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hand tools/power tools-cut hazards, jamming, pinch points, struck-by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Contact with equipment-struck by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Heat or cold stress</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Severe weather related hazards (lightning, high winds, snow, rain, sleet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Inhalation of dust, irritants, allergens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Biologica ls: Contact with poisonous plants, allergens, insects and animal kingdom hazards (for example: spiders, hornets, reptiles, snakes, ticks, mosquitoes, bird and rodent droppings, biting and stinging insects, thorny plants)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Chemical exposure or burns during decontamination activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Take home toxics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3. Specific High Hazard activities
For example: hot work, hoisting, work from elevation, scaffolding opening pressurized lines, electrical, mechanical repair, excavation, confined space, unplanned activity

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3.        | Multiple hazards | • Require permit for these activities before beginning work  
• Require CP to evaluate planned activity for its hazards. Written plan/procedure must be prepared for each activity as appropriate.  
• Hot Work  
• Lock out/Tag out procedures  
• CP inspection and sign-off  
• Confined space permit (NO Confined Space Entry will be allowed) | H |

### 4. Completion of work shift
Take home toxis-Contact with potentially contaminated materials

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 4.        | Take home toxis-Contact with potentially contaminated materials | • Note a source of decontamination water on site. Do not bring contaminated PPE or boots into truck.  
• Wear Saranex as necessary and washable or disposable over-boots in order to keep personal clothing clean and free contaminated soils.  
• Store and dispose of contaminated materials IAW regulations.  
• Use liners to prevent contamination of truck.  
• Shower immediately at end of work day.  
• Check body for ticks, bites and signs of irritation or cuts. | M |

### Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
</table>
| All equipment required for site set up | Daily inspection | HAZWOPER  
HAZ COM |

---

Page 3 of 3
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<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site access</td>
<td>Unauthorized entry</td>
<td>• Implement positive site access control prior to site operations.</td>
<td>L</td>
</tr>
<tr>
<td>control</td>
<td></td>
<td>• Maintain a constant watch or surveillance for intrusion of unauthorized personnel.</td>
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<tr>
<td></td>
<td></td>
<td>• Assure that you have an adequate means of communication.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Isolation hazards</td>
<td>• Note all moving equipment in work areas. Wear high visibility vest.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Traffic-Struck by hazards</td>
<td>• Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>avoid tripping hazards.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walking over soft ground, uneven terrain/slip,</td>
<td>• Be aware of rocks, brush, animal boroughs and other hazards. Choose firm ground for walking, if possible.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trip and fall hazards</td>
<td>• Wear thick clothing fabrics and appropriate PPE such as leather gloves when there is a potential for</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cuts and lacerations. Wear safety glasses if there is a potential for dust and flying debris. Ensure</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>eye wash is available.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cuts, lacerations, flying debris from brush/</td>
<td>• Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vegetation</td>
<td>• Institute buddy system.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remote location</td>
<td>• Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Biologica...</td>
<td>• Institute buddy system.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental hazards</td>
<td>See General Site Hazards actions.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Adverse weather</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature stresses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UV hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plants, insects, wildlife</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Overall Risk Assessment Code (RAC): | M |

<table>
<thead>
<tr>
<th>E=Extremely High Risk</th>
<th>H=High Risk</th>
<th>M=Moderate Risk</th>
<th>L=Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>Frequent</td>
<td>Likely</td>
<td>Occasional</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

Date Prepared: 9/13/2013
Project Name: Peck Iron and Metal RIFS
Activity/Work Task: Visual Site Survey
Prepared By: Mark McGowan CIH, CHMM,
Revised By: Brett Brodersen (Project Manager)
<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. Using and lifting equipment | Injury from physical exertion, sprains, sprains, awkward bending/lifts and ergonomic hazards | • Use proper lifting techniques.  
• Assure solid footing.  
• Maintain good personal level of fitness. Be alert to signs and symptoms of overexertion. Know your limitations.  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance or 2 man lift whenever possible  
• Limit repetitive awkward motions.  
• Have water available and first aid supplies. | M |
| | | Hand tools | L |
| 4. General site hazards (if not covered specifically in this AHA, refer to the General Site Hazards AHA) | • Site access control-unwanted entry  
• Strains, sprains, awkward bending/lifting/positions and ergonomic hazards  
• Overhead hazards  
• Electrical  
• Traffic/heavy equipment  
• Unhygienic conditions  
• Fire  
• Driving/walking over soft ground  
• Uneven and rough terrain  
• Getting lost/personal safety  
• Electric shock  
• Unattended worker  
• Slip, trip and fall hazards  
• Soft ground-entrapment or cave in hazards  
• Flying debris – eye, head, etc.  
• UV exposure-Sunburn  
• Noise-Hearing loss.  
• Spills and leaks.  
• Hand tools/power tools-cut hazards, jamming, pinch points, struck-by, etc.  
• Contact with equipment – struck by.  
• Heat or cold stress.  
• Severe weather related hazards (lightning, high winds, snow, rain, sleet).  
• Inhalation of dust, irritants, allergens.  
• Biologicals: contact with poisonous plants, allergens, insects and animal kingdom hazards (for example: spiders, hornets, reptiles, snakes, ticks, mosquitoes, bird and rodent droppings, biting and stinging insects, thorny plants).  
• Chemical exposure or burns during decontamination activities.  
• Take home toxics. | Refer to General Site Hazards AHA. | M |
### AHA – Subcontractor Oversight Activities – General (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Equipment
- **PPE Level D:**
  - Hard Hat
  - Safety Glasses
  - Safety-Toed Boots
  - Work Gloves/Chemical resistant gloves
  - ANSI Class 2 reflective warning vests

- **Other Equipment:**
  - Generator
  - Fire Extinguishers
  - Emergency Eyewash
  - First Aid Kit
  - Insect repellant – DEET
  - Hand tools
  - Survey equipment if used
  - First aid supplies
  - Containers as needed
  - Tarps
  - Drinking water
  - Weather radio
  - Heat stress monitoring
  - MD/MEC survey equipment including Schonstedt wand and downhole magnetometer and handheld global positioning system unit
  - Yellow pin flags

### Inspection
- **Daily inspection (SSHO):**
  - Housekeeping (daily)
    - Fire extinguisher (monthly)
    - Vehicle inspection (daily)
    - Eye wash
    - Equipment and tools inspection (daily and before use)
    - Survey areas for poisonous plants, insects, and animals (each work area)
    - Check body for ticks (each evening during tick season)
  - Identify closest usable tornado/hurricane shelter that is available (each work area)
  - Daily inspection of hand tools
    - Perform daily equipment/instrument function, location, calibration and control point check.

### Training Requirements (as determined by the SSHO):
- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- MD/MEC awareness
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
- Training in survey instruments
- Training in proper inspection, maintenance and use of hand tools
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Date Prepared: 9/13/2013
Project Name: Peck Iron and Metal RIFS
Task: MD/MEC Surface and Subsurface Avoidance
Prepared By: UXO Safety Manager and Mark McGowan CIH, CSP
Revised By: Brett Brodersen (Project Manager)

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site access control</td>
<td>Unauthorized entry</td>
<td>• Implement positive site access control prior to site operations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maintain a constant watch or surveillance for intrusion of unauthorized personnel. Positive site access</td>
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<td>control will be established prior to on-site operations using barricades, signs or other methods to</td>
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<td></td>
<td>ensure unauthorized access during tasks that could cause exposure to MD/MEC or other safety and health</td>
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<tr>
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<td>hazards. The minimum safe distance (MSD)/ EZ of will be established prior to initiation of material</td>
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<tr>
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<td>potentially presenting an explosive hazard (MPPEH) inspection and handling activities. UXO teams will</td>
</tr>
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<td></td>
<td>observe the team separation distance (TSD) when applicable.</td>
</tr>
<tr>
<td>2. Establish of subsurface</td>
<td>MD/MEC hazard/explosion, radiation exposure,</td>
<td>• Deliver daily task specific briefings regarding the hazards associated with the task and procedures</td>
</tr>
<tr>
<td>grid or clearance area.</td>
<td>fire and over pressure</td>
<td>used to control/mitigate the hazards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use required PPE as indicated by the HASP, by all personnel inside the EZ.</td>
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<td>• Require attendance of all HGL and subcontractors at the site specific hazards and H&amp;S training given</td>
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<td>by the HGL UXO safety officer (UXOSO) and Radiation Protection Manager (or designee).</td>
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<td></td>
<td>• Escort all non-essential UXO personnel by a UXO Technician II or above.</td>
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<td>• Instruct non-UXO personnel not to touch or disturb any potential MD/MEC items. Non-UXO personnel will</td>
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<td></td>
<td>adhere to the instruction of the UXO Technician.</td>
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<td></td>
<td>• Use only trained and qualified UXO Technicians to perform MD/MEC surface and subsurface clearance</td>
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<tr>
<td></td>
<td></td>
<td>activities as specified the training requirement section of this AHA.</td>
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<tr>
<td></td>
<td></td>
<td>• Suspend MD/MEC operations when an electrical storm approaches to within 5 miles of the project</td>
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<td></td>
<td></td>
<td>location.</td>
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<td>• Instruct all non-AVESI crew members not to handle media and/or items identified as potentially</td>
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<td>radioactive by Radiation Protection Manager or designee.</td>
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<td>RAC: M</td>
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</tbody>
</table>

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### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Probability</th>
<th>E=Extremely High Risk</th>
<th>H=High Risk</th>
<th>M=Moderate Risk</th>
<th>L=Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequent</td>
<td>Likely</td>
<td>Occasional</td>
<td>Seldom</td>
<td>Unlikely</td>
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<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
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<tr>
<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
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<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
AHA – Subcontractor Oversight Activities – General (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Conduct mechanical and hand tool subsurface target anomaly investigation to clear MD/MEC.</td>
<td>MD/MEC hazard/explosion, fire and over pressure</td>
<td>Same as above.</td>
<td>M</td>
</tr>
<tr>
<td>4. Conduct point detection magnetometer and gamma detector assisted excavations to investigate subsurface target anomaly.</td>
<td>MD/MEC hazard/explosion, radiation exposure, fire and over pressure</td>
<td>Same as above.</td>
<td>M</td>
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<tr>
<td></td>
<td>Environmental/Biological Hazards such as:</td>
<td>Refer to General Site Hazards AHA.</td>
<td>L</td>
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<tr>
<td></td>
<td>- Adverse weather</td>
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<td></td>
<td>- Temperature stress</td>
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<td></td>
<td>- UV Hazards</td>
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<td></td>
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<td></td>
<td>- Plant, insects and local wildlife</td>
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<tr>
<td>5. General site hazards (if not covered specifically in this AHA, refer to the General Site Hazards AHA)</td>
<td>Site access control – unwanted entry</td>
<td>Refer General Site Hazards AHA.</td>
<td></td>
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<tr>
<td></td>
<td>- Strains, sprains, awkward bending/lifting/positions and ergonomic hazards</td>
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<td></td>
<td>- Overhead hazards</td>
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<td></td>
<td>- Electrical</td>
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<td></td>
<td>- Traffic/heavy equipment</td>
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<td></td>
<td>- Unhygienic conditions</td>
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<td></td>
<td>- Fire</td>
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<td></td>
<td>- Driving/walking over soft ground</td>
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<td></td>
<td>- Uneven and rough terrain</td>
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<td></td>
<td>- Getting lost/personal safety</td>
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<td>- Electric shock</td>
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<td></td>
<td>- Unattended worker</td>
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<td></td>
<td>- Slip, trip and fall hazards</td>
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<td></td>
<td>- Soft ground-entrapment or cave in hazards</td>
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<td>- Flying debris – eye, head, etc</td>
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<td>- UV exposure-Sunburn</td>
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<td>- Noise-hearing loss</td>
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<td></td>
<td>- Spills and leaks</td>
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<td></td>
<td>- Hand tools/power tools-cut hazards, jamming, pinch points, struck-by</td>
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<td>- Contact with equipment-struck-by</td>
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<td></td>
<td>- Heat or cold stress</td>
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<td></td>
<td>- Severe weather related hazards (lightning, high winds, snow, rain, sleet)</td>
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<td></td>
<td>- Inhalation of dust, irritants, allergens</td>
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<td></td>
<td>- Biologicals: contact with poisonous plants, allergens, insects and animal kingdom hazards (for example: spiders, hornets, reptiles, snakes, ticks, mosquitoes, bird and rodent droppings, biting and stinging insects, thorny plants)</td>
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<td></td>
<td>- Chemical exposure or burns during decontamination activities</td>
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<td></td>
<td>- Take home toxics</td>
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<tr>
<td>Job Steps</td>
<td>Hazards</td>
<td>Actions to Eliminate or Minimize Hazards</td>
<td>RAC</td>
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<tr>
<td>5. General Site Hazards (continued)</td>
<td>Adverse weather and lightning</td>
<td>• Monitor warnings or indications of severe weather, conditions and take appropriate precautions to protect personnel and property. Be aware of lightning, use the lightning 30/30 Rule: If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after the storm ends, wait 30 minutes before resuming work activities.</td>
<td>L</td>
</tr>
<tr>
<td>Cave-in of excavated soil, open excavation and permits</td>
<td>• Require that excavated soil be placed two (2) feet away from the edge of the excavation area. A CP will examine and determine if soil type requires protective measures using sloping or benching methods to protect employees from cave-ins. If anomaly is deeper than 4 feet stop excavation and notify the UXOSO. When excavation exceeds a depth of 4 feet sufficient egress measures are required. Excavations shall be backfilled upon completion of anomaly clearance. Excavations not immediately backfilled or covered will be cordoned off to prevent personnel, livestock and wildlife from entering or falling into the excavation. When required, an excavation permit will be obtained by the Project Manager from the appropriate authority.</td>
<td>M</td>
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<tr>
<td>Contact with moving vehicles</td>
<td>• Be aware of vehicle traffic. Stay off of roads.</td>
<td>L</td>
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</tr>
<tr>
<td>Cuts and lacerations</td>
<td>• Wear Level D PPE with leather gloves per the HASP for all tasks with the potential for cuts or lacerations. Personnel will be trained in the proper use and selection of PPE and tools they must use to complete their task and the protection needed for hazards of exposed metal and other cut hazards.</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Eye hazards</td>
<td>• Wear protective eyewear which meets ANZII/ASSE Z81 to protect eyes from hazards associated with MD/MEC operations.</td>
<td>L</td>
<td></td>
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<tr>
<td>Lifting</td>
<td>• Restrict lifting to 50 lbs or less. When lifting in excess of 50 lbs, but no more than 100 lbs, two or more workers are required. Any item weighing more than 100 lbs will only be lifted using mechanical equipment or devices. Personnel will use safe lifting procedures and lift with their legs and not their backs and will be trained in proper lifting techniques.</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Mechanized equipment</td>
<td>• Inspect mechanized equipment prior to it being placed in use on site, by a CP IAW the manufacturer recommendations and requirements of this HASP. All mechanized equipment will be inspected daily (while in use) to promote safe operating conditions. Inspections will be conducted by the operator or a designated CP at the beginning of the day of use. Prior to daily use braking and operating systems will be function checked and all safety devices will be in place. Whenever an unsafe condition or discrepancy is found the equipment will be immediately removed from service and prohibited from use until the unsafe condition is corrected. ONLY qualified operators holding an appropriate certification are permitted to operate mechanized equipment. Equipment operations will be conducted in a manner as to not endanger personnel and IAW with manufacturer’s instructions. Equipment will not be mounted nor dismounted while moving.</td>
<td>M</td>
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</tr>
<tr>
<td>5. General Site Hazards (continued)</td>
<td>Physical injury from mechanized equipment</td>
<td>• Establish a clear safety zone at the maximum radius of the bucket. The safety zone will be clearly marked with orange safety cones or other demarcation. Personnel will remain clear and not enter the safety zone when the excavator is in operation. All personnel working near the safety zone will wear PPE consisting of a high-visibility vest and head, foot and eye protection.</td>
<td>M</td>
</tr>
</tbody>
</table>
### AHA – Subcontractor Oversight Activities – General (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
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<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead hazards</td>
<td>• Wear safety hard hats in those areas with the potential for head injury. All protective head gear shall meet the current requirements of ANSI Z89.1</td>
<td>M</td>
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<tr>
<td>Sprains and strains</td>
<td>• Wear sturdy footwear. Avoid twisting or turning while opening doors and walking with hand-pulled equipment. Personnel will be cautioned about physical strain associated with strenuous activities that may be conducted on site. Personnel will use caution to not over exert themselves of overstrain muscles and joints. Know your limitations.</td>
<td>L</td>
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</tr>
<tr>
<td>Slips, trips and falls</td>
<td>• Wear sturdy footwear, and continually inspect work area for hazards and practice good housekeeping procedures and maintain clear work areas to remove trip hazards. Personnel will also be aware of uneven walking surfaces, animal boroughs, ground surfaces tree roots, small scrubs and the potential for rocks and other trip hazards associated with the work site. Avoid walking near cliffs or on inclined/slopes greater than 30 degrees.</td>
<td>L</td>
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</tr>
</tbody>
</table>

*Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.*
### Equipment

**PPE Level D/C:**
- Hard hat
- Safety glasses
- Safety-toed boots
- Work gloves and boots/chemical resistant gloves and boots
- ANSI Class 2 reflective warning vests
- If dust is generated, air purifying respirator (APR) Half Face Respirator with particulate and organic fume cartridge

**Other Equipment:**
- Generator
- Fire extinguishers
- Emergency eyewash
- First aid kit
- Insect repellent – DEET
- Hand tools
- Survey equipment if used
- First aid supplies
- Containers as needed
- Tarps
- Drinking water
- Weather radio
- Heat stress monitoring
- MD/MEC survey equipment including Schonstedt wand and downhole magnetometer and handheld global positioning system unit
- Yellow pin flags

### Inspection

**Daily inspection (SSHO):**
- Housekeeping (daily)
  - Fire extinguisher (monthly)
  - Vehicle inspection (daily)
  - Eye wash
  - Equipment and tools inspection (daily and before use)
  - Survey areas for poisonous plants, insects, and animals (each work area)
  - Check body for ticks (each evening during tick season)

**Identify closest usable tornado/hurricane shelter that is available (each work area)**

**Daily inspection of hand tools and mechanized equipment IAW manufacturer’s instructions and recommendations.**

Magnetometers will be response tested daily at the test plot to ensure proper operations. All magnetometer tests will be recorded in their respective equipment test log.

### Training

**CP/QP:**
- CP/SSHO
- Alternate CP/SSHO
- QP/First Aid and CPR

**Training Requirements (as determined by the SSHO):**
- HAZWOPER 40 hour and 8 hour HAZWOPER annual refresher, as required
- UXO Technicians shall meet the training/certification requirements of Department of Defense Explosive Safety Board (DDESB) Technical Paper 18
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- MD/MEC awareness
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
- Training in survey instruments
- Training in proper inspection, maintenance and use of hand tools
- Current equipment operator certificate
Date Prepared: 9/13/2013  
Project Name: Peck Iron and Metal RIFS  
Activity/Work Task: Soil and Sediment Sample Processing  
Prepared By: Mark McGowan CIH, CHMM  
Revised By: Brett Brodersen

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Determine location for set up/staging equipment</td>
<td>Traffic-struck by hazards: Select location away from traffic. Place barricades for work site protection, if necessary. Wear high visibility vest.</td>
<td>M</td>
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<td></td>
<td>Driving over soft ground Uneven terrain: Choose location with level and firm soils.</td>
<td>M</td>
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</tr>
<tr>
<td>2. Accept precut tube from driller</td>
<td>Slip, trip and fall hazards: Wear slip resistant footwear. Keep work area picked up and as clean as feasible and free of tripping and fall hazards.</td>
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<td></td>
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<td></td>
<td>Flying debris: Wear safety glasses when near rig or where there is a potential for flying debris. Ensure eyewash is available.</td>
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<tr>
<td></td>
<td>Strains, sprains, awkward bending/lifts and ergonomic hazards: Use proper lifting techniques. Ensure walking pathway is clear. Do not lift greater than 50 lbs. Use mechanical assistance or 2 man lift whenever possible. Limit repetitive awkward motions.</td>
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<td></td>
<td>Noise: Wear hearing protection if noise levels from neighboring equipment exceeds 80 dBAs (if you cannot be heard speaking in a normal voice at arms distance).</td>
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<td></td>
<td>Contact with drilling equipment-struck by: Maintain eye contact with driller when entering zone of operation. Don’t stand too close to rig, honor EZ. Use qualified drillers to operate drilling equipment Conduct real-time monitoring (e.g., PID) when drillers are aware of your presence. Communicate results of monitoring.</td>
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</table>

### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Risk Assessment Code Matrix</th>
<th>Probability</th>
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<tbody>
<tr>
<td>E=Extremely High Risk</td>
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<td>H=High Risk</td>
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<td>M=Moderate Risk</td>
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<td>L=Low Risk</td>
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<td>Frequent</td>
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<td>Negligible</td>
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</tr>
<tr>
<td>Job Steps</td>
<td>Hazards</td>
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</tr>
<tr>
<td>3. Measure with PID for VOCs</td>
<td>Inhalation of contaminants</td>
</tr>
<tr>
<td>4. Cut out sample sections</td>
<td>Inhalation and skin contact hazards</td>
</tr>
<tr>
<td>5. Put sample in preserved jar</td>
<td>Inhalation and skin contact with preservatives: NaOH, HNO₃, HCl Spills</td>
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<tr>
<td>6. Log/label and put sample in cooler</td>
<td>Cut hazards</td>
</tr>
<tr>
<td>7. Observation of drillers: DPT, rotary, mud, etc.</td>
<td>Exposure to site contaminants</td>
</tr>
</tbody>
</table>
| | Hazards associated with drilling: Electrical such as overhead or underground utilities, Rolling spreading or sliding of tools and supplies, Rotating machinery-caught by Fire | **Actions to be taken by drillers:**  
• Require dig permit (utility clearance) before invasive work begins.  
• Mark/locate underground utilities. No drilling within 5 feet of marked underground utilities or within a minimum of 20 feet of overhead high-voltage lines.  
• Maintain adequate clearance for the movement of vehicles and operation of drilling equipment.  
• Use spotters when vision is impaired.  
• Determine safe tool placement to prevent struck by injuries.  
• Inspect all drilling equipment in presence of SSHO.  
• Verify (lead driller) that all safety interlock switches on the drilling equipment operate correctly.  
• Conduct/document weekly drilling inspection in a logbook or checklist.  
• Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO; provide fire watch and suitable fire extinguisher. Use screens to control sparks and UV (welding flash burns to eyes) exposure as necessary | M |
| 8. Wrap up | Take home toxics | • Decontaminate with soap and water or wipes.  
• Remove all contaminated clothing and materials and leave on-site. Use plastic as a barrier for soil, truck bed or foot well contact. | L |
| 9. General site work | Environmental Hazards  
• Biologicales (plants, insects, wild life)  
• Adverse weather  
• Temperature stresses  
• UV hazards | • Refer to General Site Hazards AHA | M |
**AHA – Soil and Sediment Sample Processing (continued)**

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</strong></td>
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<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
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</thead>
<tbody>
<tr>
<td>PPE Level D/C:</td>
<td>Daily inspection (SSHO)</td>
<td>CP/QP: CP/SSHO</td>
</tr>
<tr>
<td>· Hard Hat</td>
<td></td>
<td>Alternate CP/SSHO</td>
</tr>
<tr>
<td>· Safety Glasses</td>
<td></td>
<td>QP/First Aid and CPR</td>
</tr>
<tr>
<td>· Safety-Toed Boots</td>
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<tr>
<td>· Work Gloves and Boots/Chemical resistant gloves and boots</td>
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<tr>
<td>· ANSI Class 2 reflective warning vests</td>
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<tr>
<td>· If dust is generated, APR Half Face Respirator with particulate and organic fume cartridge</td>
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<tr>
<td>Other Equipment:</td>
<td></td>
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<tr>
<td>· Generator, if needed</td>
<td></td>
<td>Training Requirements (as determined by the SSHO):</td>
</tr>
<tr>
<td>· Fire extinguishers</td>
<td></td>
<td>· HAZWOPER 40 hour</td>
</tr>
<tr>
<td>· Emergency eyewash</td>
<td></td>
<td>· Site safety orientation</td>
</tr>
<tr>
<td>· First aid kit</td>
<td></td>
<td>· Tailgate meetings</td>
</tr>
<tr>
<td>· Insect repellent -- DEET</td>
<td></td>
<td>· Emergency procedures</td>
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<tr>
<td>· Hand tools</td>
<td></td>
<td>· HAZ COM</td>
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<tr>
<td>· Spill containment supplies</td>
<td></td>
<td>· Hearing conservation</td>
</tr>
<tr>
<td>· First aid supplies</td>
<td></td>
<td>· MD/MEC awareness</td>
</tr>
<tr>
<td>· Containers as needed</td>
<td></td>
<td>· Applicable AHAs</td>
</tr>
<tr>
<td>· Tarps</td>
<td></td>
<td>· Fire extinguisher use</td>
</tr>
<tr>
<td>· If electrical equipment is required, GFCI</td>
<td></td>
<td>· Biological hazard identification and control</td>
</tr>
<tr>
<td>· Heavy duty extension cords</td>
<td></td>
<td>· Tornado/hurricane shelter location</td>
</tr>
<tr>
<td>· Drinking water</td>
<td></td>
<td>· Lightning safety procedures</td>
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<tr>
<td>· Weather radio</td>
<td></td>
<td>· Heat stress prevention and heat stroke treatment</td>
</tr>
<tr>
<td>· Heat stress monitoring</td>
<td></td>
<td>· Cold stress prevention</td>
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<tr>
<td>· Soil jars/preservatives/coolers</td>
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</tr>
</tbody>
</table>

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**Daily inspection (SSHO)**

- Fire extinguisher (monthly)
- Vehicle inspection (daily)
- Eye wash
- Equipment and tools inspection (daily and before use)
- Survey areas for poisonous plants, insects, and animals (each work area)
- Check body for ticks (each evening during tick season)

**Housekeeping (daily)**

- Identify closest usable tornado/hurricane shelter that is available (each work area)
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## ACTIVITY HAZARD ANALYSIS 44.07

**Overall Risk Assessment Code (RAC): L**

<table>
<thead>
<tr>
<th>Date Prepared: 9/13/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name: Peck Iron and Metal RIFS</td>
</tr>
<tr>
<td>Activity/Work: Excavation and Trenching</td>
</tr>
<tr>
<td>Prepared By: Mark McGowan CIH, CHMM</td>
</tr>
<tr>
<td>Revised By: Brett Brodersen (Project Manager)</td>
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</tbody>
</table>

### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
</tr>
<tr>
<td>Marginal</td>
<td>M</td>
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<tr>
<td>Negligible</td>
<td>M</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E=Extremely High Risk</th>
<th>H=High Risk</th>
<th>M=Moderate Risk</th>
<th>L=Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>Likely</td>
<td>Occasional</td>
<td>Seldom</td>
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</table>

| Activity | Hazard Analysis | 44.07 |

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel on and off project site (vehicular). Arrival of new personnel at site.</td>
<td>Vehicle operation. Newly hired personnel and visitors. Unfamiliarity with: site, general (chemical, physical, environmental) site hazards, project safety rules and hazard control procedures, chain of command, and emergency procedures</td>
<td>Follow the guidelines in the HASP. All personnel shall attend a site safety orientation. After personnel are trained in the contents of the HASP, they shall sign the HASP Acknowledgment Form. All training certifications held by personnel shall also be made available and kept in on-site personnel files. Review emergency procedures and evacuation plans.</td>
<td>L</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>See job steps above.</td>
<td>Medical emergencies Heavy lifting, strains, and sprains</td>
<td>All personnel should complete the Voluntary Allergy/Sensitivity/Medical Questionnaire. Proper lifting techniques shall be used. No individual worker is permitted to lift any object that weighs over 40 lbs. Multiple employees or the use of mechanical lifting devices are required for lifting bulky or overweight objects (i.e., full drums).</td>
<td>L</td>
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</table>

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Fire extinguishers shall be available in work areas. A 4-A:40-B:C fire extinguisher shall be available when refueling at the project site. The SSHO shall establish smoking areas. Smoke only in designated areas. Only discard cigarette butts in proper receptacles – never discard cigarette butts onto the ground. Smoking shall not be permitted within 50 feet of fueling operations.</td>
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<tr>
<td>Job Steps</td>
<td>Hazards</td>
<td>Actions to Eliminate or Minimize Hazards</td>
<td>RAC</td>
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</tr>
<tr>
<td>See job steps above (continued)</td>
<td>Fire (continued)</td>
<td>Use caution when refueling vehicles. All spills will be contained and abated before returning to operations. Use caution with vehicle exhaust systems in grassy areas. Do not run vehicles while parked in grassy areas. Engines shall be shut off before refueling.</td>
<td>L</td>
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<td></td>
<td>Overhead utilities</td>
<td>Power lines shall be assumed to be energized unless verified to be de-energized and visibly grounded. Operation beneath a power line that has not been verified as de-energized and grounded must maintain clearance distances stated above. A high-visibility elevated warning line or barricade shall be erected at the minimum approach distance. Each work crew member shall be trained in the electrocution hazards and emergency procedures associated with energized power lines. Remain aware of overhead power lines – use spotters when necessary. Post overhead hazard warning signs as necessary.</td>
<td>L</td>
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<tr>
<td></td>
<td>Underground utilities</td>
<td>Follow the procedure for intrusive activities in the HASP. Intrusive activities may not proceed until an Intrusive Activities Permit has been issued by the Construction Manager/Field Superintendent and SSHO.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Excavation/Trenching hazards</td>
<td>Follow the Excavation/Trenching Plan All excavations will be inspected and monitored by the excavation CP (at the beginning of the shift, at least twice daily and when conditions change, at a minimum). The inspections are to be documented on the Excavation Inspection form. Soils testing for soil classification are to be documented on the Soils Classification Worksheet. All excavations will be benched, sloped or a combination of the two before allowing personnel to enter. No personnel will enter a test pit/excavation. All benching and sloping design plans will be followed. All excavations greater than 5 feet will be have the proper sloping, benching or a combination of the two. All excavations greater than 4 feet will have at least one egress ladder every 25 feet. The ladder will extend at least 3 feet above the excavation and will follow the 1:4 rule. All excavations deeper than 4 feet will have to be monitored for oxygen content, LEL and VOC content. A PID will be utilized to perform this task. All personnel involved with excavations will be trained in the use of the PID prior to utilization. Soils, equipment, and materials shall be kept至少 2 feet from the face of excavations if personnel will be entering the excavation. All excavations will have a positive barrier encircling the entire excavation to insure that personnel and the public do not enter or fall into the excavation. During lateral and vertical advancement of a test pit/excavation; all soils and items within the soil will be inspected for UXO related items and radiation using field screening instruments specified in the Radiation Protection Plan (RPP) (AVESI, 2014), the Site Management Plan, and this HASP.</td>
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<tr>
<td>Job Steps</td>
<td>Hazards</td>
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<tr>
<td>See job steps above (continued)</td>
<td>Hand injuries</td>
<td>Items to be handled shall be inspected for sharp edges, splinters, burrs, rough surfaces, etc. prior to being handled. Personnel shall wear leather gloves when handling materials with sharp edges, splinters, burrs, rough surfaces, etc. Personnel shall be aware of and avoid pinch point hazards.</td>
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<tr>
<td>Use of mechanical equipment</td>
<td></td>
<td>Only qualified personnel shall be permitted to operate equipment. Mechanical equipment shall be inspected daily. Deficiencies in equipment shall be noted on the inspection form. Equipment found to be unsafe shall be taken out of service. Equipment operators shall wear safety belts and hearing protection (as necessary). All personnel will wear the proper PPE when working on or near mechanical equipment. This includes hard hats, safety toed footwear, leather gloves and eye protection. All equipment shall be operated at safe speeds and in a safe manner. Ground personnel shall not position themselves between equipment and stationary objects (stay out of swing radius). Personnel are only permitted to approach equipment after a signal from the operator.</td>
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<tr>
<td>Dust.</td>
<td></td>
<td>Control dust by maintaining equipment operation rates. Personnel shall stay out of dust and work from upwind when possible. Perform dust monitoring to verify dust control is effective.</td>
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<td>Noise</td>
<td></td>
<td>All personnel shall wear hearing protection when exposed to high noise levels. All personnel shall wear hearing protection when operating powered hand tools or noisy equipment. Personnel working in vicinity of noisy tools or equipment shall wear hearing protection. Noise level and exposure measurements shall be performed to verify hearing protection is adequate when necessary.</td>
<td>L</td>
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<tr>
<td>Struck by and against (vehicles and equipment)</td>
<td></td>
<td>Wear PPE with high visibility vests when walking or working near moving equipment or vehicles. Personnel shall maintain a safe distance from operations. Personnel shall not be permitted in the swing radius of the equipment. Do not assume equipment and vehicle operators have seen you unless operator has made eye contact with you and signaled to you. Use warning signs and signalmen as necessary.</td>
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<tr>
<td>See job steps above (continued)</td>
<td>Slips, trips, and falls</td>
<td>Understand the hazards of slips, trips, and falls – consider the consequences.</td>
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<td>Do not jump from equipment or elevated surfaces.</td>
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<td>Clean-up work areas throughout the day and at the end of each workday. Use three-point contact rule for entering/exiting vehicles, trucks, and equipment.</td>
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<td>Use hand rails and other stationary objects (door frames, steering wheels, etc) to increase stability.</td>
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<td>Use extra caution when walking on wet and muddy surfaces.</td>
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<td>Increase your awareness, keep alert, stay focused, and know your environment.</td>
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<td>Provide warning signs or cordon off areas where necessary. Consider postponing work as necessary and feasible.</td>
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<td>Avoid slippery areas when possible. Slow down - take smaller steps. Stay away from slopes, hills, and grades.</td>
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<td>Be cautious when using vehicle stairs.</td>
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<td>Lower your center of gravity when necessary.</td>
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<td>Fall protection must be provided and used when personnel are exposed to fall hazards greater than 6 feet.</td>
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<td></td>
<td>Injury from use of tools.</td>
<td>Select the proper tool – do not improvise.</td>
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<td>Inspect all power and hand tools before each use (do not use damaged tools).</td>
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<td>Tools shall be appropriate for the task and maintained in good condition. Check your position, footing, and grip before tool use.</td>
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<td>Avoid distraction, keep your focus, and concentrate on the job.</td>
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<td>Personnel shall maintain a steady pace when using tools and take adequate rest periods.</td>
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<td>Proper guards or shields must be installed on all power tools before use. Keep electric cords untangled and out of the way of rotating tools.</td>
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<td>Personnel will not be allowed to utilize any power tools that are not in proper working condition.</td>
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<td>Use double-insulated power tools when possible. Power tools that are not double-insulated must have a ground pin in place.</td>
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<td>Protect electric tools with GFCIs.</td>
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<td>Air must be shut off or the electric cord unplugged before making tool adjustments.</td>
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<td>Air must be “bled down” before tool replacement or disconnection.</td>
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<td>Air compressors must have a relief valve and must be shut down during extended breaks, such as lunch.</td>
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<tr>
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<tr>
<td>See job steps above (continued)</td>
<td>Use of operational chemicals.</td>
<td>Read and follow MSDSs/SDSs for each chemical used. Do not use any chemical that you have not been trained to safely use. Provide ventilation as necessary. Wear proper PPE. Properly label all containers. Spill kits will be utilized in the event of material spillage.</td>
<td>L</td>
</tr>
<tr>
<td>UXO</td>
<td>All personnel will be trained in the hazards of UXO. Only UXO trained Tech II and above will escort Non UXO trained personnel in the Munitions Response Site (MRS). At least one UXO Tech II or above will assist the contractor in characterizing trenches. UXO Tech II will visually sweep the work area for UXO. No one is permitted to handle, move or disturb unidentified ordnance. A minimum of two (2) UXO Tech II’s or above will need to positively identify the UXO condition before taking any actions.</td>
<td>L</td>
<td></td>
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<tr>
<td>Radiation</td>
<td>All personnel will be trained in radiation safety and monitored if onsite for longer than 80 hours over the duration of the entire field event. Only trained radiation specialists will handle potentially radioactive contaminated items or access the radiation waste storage container. At least one trained radiation specialist will be present with each sampling crew.</td>
<td>L</td>
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<tr>
<td>Severe weather.</td>
<td>Follow the guidelines in the HASP.</td>
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<tr>
<td>Heat stress.</td>
<td>Follow the guidelines in the HASP.</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Cold stress.</td>
<td>Follow the guidelines in the HASP.</td>
<td></td>
<td>L</td>
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<tr>
<td>Insect bites and stings.</td>
<td>Follow the guidelines in the HASP.</td>
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<tr>
<td>Asbestos</td>
<td>All personnel will notify the site asbestos supervisor of the presence of asbestos. No field crew members unless receiving training on Asbestos will handle materials potentially containing asbestos.</td>
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<tr>
<td>Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac).</td>
<td>Follow the guidelines in the HASP.</td>
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<tr>
<td>See job steps above (continued)</td>
<td>Use of portable generators.</td>
<td>Review operator manual before use. Check operator’s manual for generator grounding requirements, if any. Keep the generator dry and do not use in rain or wet conditions. Dry your hands (if wet) before touching the generator. Use a heavy duty, outdoor-rated extension cord that is rated (in watts or amps) at least equal to the sum of the connected appliance loads (S, ST, SO, STO, SJ, SJO, SJT, SJOT). Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin. Before refueling the generator, turn it off and let it cool down. Gasoline spilled on hot engine parts could ignite. Do not use portable generators in areas with dry grass unless area has been adequately cleared of the grass. A 4-A:40-B:C fire extinguisher shall be readily available in locations where a generator is being used. Use hearing protection when working near a generator. Use proper lifting procedures when moving portable generators. Do not use indoors or in areas with poor ventilation without performing air monitoring for carbon monoxide. A GFCI circuit protector will always be used between the generator and the power cord.</td>
<td>L</td>
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<tr>
<td>Equipment to Be Used</td>
<td>Training Requirements/Competent or Qualified Personnel Name(s)</td>
<td>Inspection Requirements</td>
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<tr>
<td><strong>PPE Level D/C:</strong></td>
<td>Daily site safety inspection (SSHO) __________________________</td>
<td><strong>CP/QP:</strong></td>
<td></td>
</tr>
<tr>
<td>· Hard hat</td>
<td>Daily site safety inspection</td>
<td><strong>CP/SSHO</strong></td>
<td></td>
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<tr>
<td>· Safety glasses with side shields</td>
<td>• Mechanized equipment (daily)</td>
<td><strong>Alternate CP/SSHO</strong></td>
<td></td>
</tr>
<tr>
<td>· Safety-toed boots</td>
<td>• Overhead utilities (prior to operating equipment in area)</td>
<td><strong>QP/First Aid and CPR</strong></td>
<td></td>
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<tr>
<td>· Work gloves and boots/chemical resistant gloves and boots</td>
<td>• Locate underground utilities (prior to intrusive activities)</td>
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<tr>
<td>· Class 2 high visibility vests</td>
<td>• Excavation inspection (daily)</td>
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<tr>
<td>· If dust is generated, APR Half Face Respirator with particulate and organic fume cartridge</td>
<td>• Housekeeping (daily)</td>
<td></td>
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<tr>
<td>· Hearing protection, as necessary</td>
<td>• Fall protection (before each use)</td>
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<tr>
<td>· Face-shield – disconnecting hoses, when pressure testing pipe, or working with high pressure fluids</td>
<td>• Fire extinguisher (monthly)</td>
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<tr>
<td>· Welding and cutting PPE - refer to SSHP.</td>
<td>• Vehicle inspection (daily)</td>
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<tr>
<td>· Fall protection - working at heights greater than 6 feet Electrical PPE (NFPA 70E, 2012)</td>
<td>• Equipment and tools inspection (daily and before use)</td>
<td></td>
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<tr>
<td><strong>Other Equipment:</strong></td>
<td>• Survey areas for poisonous plants, insects, and animals (each work area)</td>
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<tr>
<td>· Air monitoring instruments</td>
<td>• Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area)</td>
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<tr>
<td>· Noise dosimeter</td>
<td>• UXO sweep (prior to excavation of trenches, prior to moving excavation equipment)</td>
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<tr>
<td>· Fire extinguishers</td>
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<tr>
<td>· First aid kit</td>
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<td>· GFCI</td>
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<tr>
<td>· Heavy duty extension cords (S, ST, SO, STO, SJ, SJO, SJT, SJOT)</td>
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<tr>
<td>· Drinking water</td>
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<td>· Weather radio</td>
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<td>· Caution tape</td>
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<td>· Excavation perimeter protection</td>
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<td>· Tag lines</td>
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<tr>
<td>· Insect repellent with DEET (Deep Woods Off™ or equivalent) Repel Permanone™</td>
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<td>· Soil jars/preservatives/cookers</td>
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<td>· Heat stress monitoring</td>
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<td>· PID</td>
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<td>· Combustible gas meter</td>
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<tr>
<td>· Personal and perimeter dust meters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Schonstedt magnetic wand and downhole magnetometer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Gamma radiation field screening meter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Training Requirements (as determined by the SSHO):</strong></td>
<td><strong>CP/QP:</strong></td>
<td><strong>Alternate CP/SSHO</strong></td>
<td></td>
</tr>
<tr>
<td>· Site safety orientation</td>
<td><strong>CP/SSHO</strong></td>
<td><strong>Alternate CP/SSHO</strong></td>
<td></td>
</tr>
<tr>
<td>· Emergency procedures</td>
<td><strong>QP/First Aid and CPR</strong></td>
<td><strong>QP/First Aid and CPR</strong></td>
<td></td>
</tr>
<tr>
<td>· HAZ COM</td>
<td><strong>QP/First Aid and CPR</strong></td>
<td><strong>QP/First Aid and CPR</strong></td>
<td></td>
</tr>
<tr>
<td>· Hearing conservation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· MD/MEC awareness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Applicable AHAs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Qualified equipment operators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Lifting/back safety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Fall protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Fire extinguisher use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Biological hazard identification and control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Tornado/hurricane shelter location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Lightning safety procedures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Heat stress prevention and heat stroke treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Cold stress prevention</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ACTIVITY HAZARD ANALYSIS 44.08

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Drilling-Sample Processing  
**Prepared By:** Mark McGowan CIH, CSP  
**Revised By:** Brett Brodersen (Project Manager)

#### Overall Risk Assessment Code (RAC): M

**Risk Assessment Code Matrix**

<table>
<thead>
<tr>
<th>Severity</th>
<th>Probability</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E = Extremely High Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical</td>
<td>H = High Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal</td>
<td>M = Moderate Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negligible</td>
<td>L = Low Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Job Steps

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1. | Determine location for set up/staging equipment | Traffic-struck by hazards | • Select location away from traffic  
• Place barricades for work site protection, if necessary  
• Wear high visibility vest | M |
|   |   | Driving over soft ground  
Uneven terrain | • Choose location with level and firm soils | M |
| 2. | Accept precut tube from driller | Slip, trip and fall hazards | • Wear slip resistant footwear  
• Keep work area picked up and as clean as feasible and free of tripping and fall hazards. | M |
|   |   | Flying debris | • Wear safety glasses when near rig or where there is a potential for flying debris  
• Ensure eyewash is available | L |
|   |   | Strains, sprains, awkward bending/lifts and ergonomic hazards | • Use proper lifting techniques  
• Ensure walking pathway is clear  
• Do not lift greater than 50 lbs  
• Use mechanical assistance or 2 man lift whenever possible  
• Limit repetitive awkward motions | M |
|   |   | Noise | • Wear hearing protection if noise levels from neighboring equipment exceeds 80 dBA's (if you cannot be heard speaking in a normal voice at arms distance) | M |
|   |   | Contact with drilling equipment – struck by | • Maintain eye contact with driller when entering zone of operation.  
• Don’t stand too close to rig , honor EZ  
• Use qualified drillers to operate drilling equipment  
• Conduct real-time monitoring (e.g., PID) when drillers are aware of your presence  
• Communicate results of monitoring | L |
| 3. | Measure with PID for VOCs | Inhalation of contaminants | • Follow PPE requirements specified in the HASP based on airborne measurements and action levels | L |
## Job Steps | Hazards | Actions to Eliminate or Minimize Hazards | RAC
--- | --- | --- | ---
4. Cut out sample sections | Inhalation and skin contact hazards | • Wear chemical resistant gloves based on the identified chemicals. Boot covers and splash suit protection if necessary. Follow respirator action level dictates of HASP. | L
5. Put sample in preserved jar | Inhalation and skin contact with preservatives: NaOH, HNO₃, HCl | • Use in well-ventilated area. Wear appropriate PPE (gloves, safety glasses) | L
| Spills | • Use absorbents and containers for spills. |
6. Log/Label and put sample in cooler | Cut hazards | • Set-up stable work area for labeling samples, logging and doing paper work. | L
7. Observation of drillers: DPT, Rotary, Mud, etc. | Exposure to site contaminants | • Instruct drillers of contaminants on site. | L
| Hazards associated with drilling: Electrical such as overhead or underground utilities, Rolling spreading or sliding of tools and supplies, Rotating machinery-caught by Fire | • Media retrieved for sampling will be field screened in accordance with RPP (AVESI, 2014) and SMP (HGL, 2014). |
| **Actions to be taken by drillers:** | • Conduct/document weekly drilling inspection in a logbook or checklist. | M
| • Require dig permit (utility clearance) before invasive work begins. | • Mark/locate underground utilities. No drilling within 5 feet of marked underground utilities or within a minimum of 20 feet of overhead high-voltage lines. |
| • Maintain adequate clearance for the movement of vehicles and operation of drilling equipment. | • Use spotters when vision is impaired. |
| • Determine safe tool placement to prevent struck by injuries. | • Inspect all drilling equipment in presence of SSHO. |
| • Verify (lead driller) that all safety interlock switches on the drilling equipment operate correctly. | • Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO, provide fire watch and suitable fire extinguisher. Use screens to control sparks and UV (welding flash burns to eyes) exposure as necessary. |
8. Wrap up | Take home toxics | • Decontaminate with soap and water or wipes. | L
| • Remove all contaminated clothing and materials and leave on-site. Use plastic as a barrier for soil, truck bed or foot well contact. |
9. General site work | Environmental hazards Biologicals (plants, insects, wild life) Adverse weather Temperature stresses UV hazards | • Refer to General Site Hazards AHA. | M
Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
### Equipment

<table>
<thead>
<tr>
<th>PPE Level D/C:</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Hard hat</td>
</tr>
<tr>
<td>· Safety glasses</td>
</tr>
<tr>
<td>· Safety-toed boots</td>
</tr>
<tr>
<td>· Work gloves and boots/chemical resistant gloves and boots</td>
</tr>
<tr>
<td>· ANSI Class 2 reflective warning vests</td>
</tr>
<tr>
<td>· If dust is generated, APR Half Face Respirator with particulate and organic fume cartridge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Equipment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Generator</td>
</tr>
<tr>
<td>· Fire extinguishers</td>
</tr>
<tr>
<td>· Emergency eyewash</td>
</tr>
<tr>
<td>· First aid kit</td>
</tr>
<tr>
<td>· Insect repellent – DEET</td>
</tr>
<tr>
<td>· Hand tools</td>
</tr>
<tr>
<td>· Spill containment supplies</td>
</tr>
<tr>
<td>· First aid supplies</td>
</tr>
<tr>
<td>· Containers as needed</td>
</tr>
<tr>
<td>· Tarps</td>
</tr>
<tr>
<td>· GFCI</td>
</tr>
<tr>
<td>· Heavy duty extension cords</td>
</tr>
<tr>
<td>· Drinking water</td>
</tr>
<tr>
<td>· Weather radio</td>
</tr>
<tr>
<td>· Heat stress monitoring</td>
</tr>
<tr>
<td>· Sample bottles/ preservatives/ coolers</td>
</tr>
<tr>
<td>· Hand tools</td>
</tr>
<tr>
<td>· Sample bottles and preservatives</td>
</tr>
<tr>
<td>· PID</td>
</tr>
<tr>
<td>· Combustible gas meter</td>
</tr>
<tr>
<td>· Personal and perimeter dust meters</td>
</tr>
<tr>
<td>· Schonstedt magnetic wand and downhole magnetometer</td>
</tr>
<tr>
<td>· Gamma radiation field detector</td>
</tr>
</tbody>
</table>

### Inspection

<table>
<thead>
<tr>
<th>Daily inspection (SSHO) __________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping (daily)</td>
</tr>
<tr>
<td>· Fire extinguisher (monthly)</td>
</tr>
<tr>
<td>· Vehicle inspection (daily)</td>
</tr>
<tr>
<td>· Eye wash</td>
</tr>
<tr>
<td>· Equipment and tools inspection (daily and before use)</td>
</tr>
<tr>
<td>· Survey areas for poisonous plants, insects, and animals (each work area)</td>
</tr>
<tr>
<td>· Check body for ticks (each evening during tick season)</td>
</tr>
</tbody>
</table>

Identify closest usable tornado shelter that is available (each work area)

Pre/post maintenance/calibration per manufacturer’s rec.

Visual prior to use

### Training

<table>
<thead>
<tr>
<th>CP/QP: CP/SSHO __________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternate CP/SSHO __________________</td>
</tr>
<tr>
<td>QP/First Aid and CPR ____________________</td>
</tr>
</tbody>
</table>

Training Requirements (as determined by the SSOH):

- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- MEC awareness
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
**ACTIVITY HAZARD ANALYSIS 44.09**

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Decontamination of Equipment and Personnel  
**Prepared By:** Mark McGowan CIH, CHMM  
**Revised By:** Brett Brodersen (Project Manager)

<table>
<thead>
<tr>
<th>Overall Risk Assessment Code (RAC): M</th>
</tr>
</thead>
</table>

### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Risk Assessment Code Matrix</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>E=Extremely High Risk</td>
<td>Frequent</td>
</tr>
<tr>
<td>H=High Risk</td>
<td>Likely</td>
</tr>
<tr>
<td>M=Moderate Risk</td>
<td>Occasional</td>
</tr>
<tr>
<td>L=Low Risk</td>
<td>Seldom</td>
</tr>
<tr>
<td>Unlikely</td>
<td></td>
</tr>
</tbody>
</table>

#### Severity

<table>
<thead>
<tr>
<th>Catastrophic</th>
<th>E</th>
<th>E</th>
<th>H</th>
<th>H</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

### Job Steps

<table>
<thead>
<tr>
<th>1. Determine location for set up</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
|                                 | Traffic-struck by hazards                                               | • Select location away from traffic  
|                                 |                                                                         | • Place barricades for work site protection, if necessary  
|                                 |                                                                         | • Keep all unnecessary personnel out of the work area and in an upwind location  
|                                 |                                                                         | • Wear high visibility vest  
|                                 | Driving over soft ground                                               | • Choose location with level and firm soils  
|                                 | Uneven terrain                                                         |                                                                                                         | M   |
|                                 | General site hazards - Environmental:                                  | • Refer to General Site Hazards AHA  
|                                 | Biologicals (plants, insects, wild life)                                |                                                                                                         | M   |
|                                 | Adverse weather                                                        |                                                                                                         |     |
|                                 | Temperature stresses                                                   |                                                                                                         |     |
|                                 | UV hazards                                                              |                                                                                                         |     |

<table>
<thead>
<tr>
<th>2. Movement to Decontamination area</th>
<th>Contact with heavy equipment-struck by hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Shut down all machinery or equipment by positive means in order to prevent its operation while decontamination is being done</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lower and block bulldozer and scraper blades, end-loader bucket and similar equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prohibit unattended machinery or equipment that has not been turned off.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prohibit getting off or on any equipment while it is in motion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Require all mobile equipment be equipped with back up alarm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Pressure Washing</th>
<th>Slip, trip and fall hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wear slip resistant footwear</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Keep work area picked up and as clean as feasible and free of tripping and fall hazards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Flying debris-eye hazards | Wear safety glasses or goggles and a face shield | Ensure eyewash is available | M   |
### Pressure Washing (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. Pressure Washing (continued) | Burns-heat/chemical | • Wear rain suits or suits of chemical resistant material to prevent direct contact with hot water or chemicals of concern  
• Prohibit decontamination or washing of PPE, with hot water, while on a person | M |
| | Strains, sprains, awkward bending/lifts and ergonomic hazards | • Use proper lifting techniques.  
• Ensure walking pathway is clear  
• Do not lift greater than 50 lbs  
• Use mechanical assistance or 2 man lift whenever possible  
• Limit repetitive awkward motions | M |
| | Noise | • Wear hearing protection if noise levels from neighboring equipment (pressure washers) exceeds 80 dBAs (if you cannot be heard speaking in a normal voice at arm’s distance). | M |
| | Contact with potentially contaminated materials: Inhalation and skin contact hazards | • Conduct real-time monitoring (e.g., PID, gamma radiation detector).  
• Wear required PPE as indicated in HASP such as: chemical resistant gloves based on the identified chemicals, boot covers and splash suit protection. Follow respirator action level dictates of HASP.  
• Maintain good housekeep to safe guard against cross contamination of surrounding areas and eliminate safety hazards.  
• Practice good personal hygiene.  
• Refer to SSHP for chemical hazard discussion.  
• Require only essential personnel be in the decontamination area. All others will be in an upwind location. | L |
| 4. Measure with PID for VOCs | Inhalation of contaminants | • Follow PPE dictates of HASP based on airborne measurements and action levels. | L |
| 5. Personal decontamination | Take home toxics | • Decontaminate per HASP.  
• Remove all contaminated clothing and materials and leave on-site.  
• Shower as soon as possible | L |
| 6. Containerize water | Spills – environmental damage | • Use absorbents and containers for rinse water | M |

*Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.*
### Equipment

<table>
<thead>
<tr>
<th>PPE Level D:</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Hard hat</td>
<td>Daily inspection (SSHO) _________________________</td>
<td>CP/QP:</td>
</tr>
<tr>
<td>· Safety glasses</td>
<td>Housekeeping (daily)</td>
<td>CP/SSHO</td>
</tr>
<tr>
<td>· Safety-toed boots</td>
<td>· Fire extinguisher (monthly)</td>
<td>Alternate CP/SSHO</td>
</tr>
<tr>
<td>· Work gloves/chemical resistant gloves</td>
<td>· Vehicle inspection (daily)</td>
<td>QP/First Aid and CPR</td>
</tr>
<tr>
<td>· ANSI Class 2 reflective warning vests</td>
<td>· Equipment and tools inspection (daily and before use)</td>
<td>Training Requirements (as determined by the SSHOTO):</td>
</tr>
<tr>
<td></td>
<td>· Survey areas for poisonous plants, insects, and animals (each work area)</td>
<td>· HAZWOPER 40 hour</td>
</tr>
<tr>
<td></td>
<td>· Check body for ticks (each evening during tick season)</td>
<td>· Site safety orientation</td>
</tr>
<tr>
<td></td>
<td>Identify closest usable tornado shelter that is available (each work area)</td>
<td>· Tailgate meetings</td>
</tr>
</tbody>
</table>

### Other Equipment:

| · Generator           | | |
| · Fire extinguishers  | | |
| · Emergency eyewash   | | |
| · First aid kit       | | |
| · Insect repellant – DEET | | |
| · Hand tools          | | |
| · Spill containment supplies | | |
| · First aid supplies  | | |
| · Containers as needed | | |
| · Tarps               | | |
| · GFCI                | | |
| · Heavy duty ext. cords | | |
| · Drinking water      | | |
| · Weather radio       | | |
| · Heat stress monitoring | | |
| · Wind sock           | | |
| · Steam cleaner       | | |
| · Alconox/cleaning brushes/buckets/as needed | | |
| · Gamma radiation detector | | |

### CP/QP: CP/SSHO

Alternate CP/SSHO

QP/First Aid and CPR

Training Requirements (as determined by the SSHOTO):

- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
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## ACTIVITY HAZARD ANALYSIS 44.10

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Stream Surface Water Sampling from Shore  
**Activity Location(s):** Portsmouth, VA  
**Prepared By:** Misty Kauffman  
**Revised By:** Brett Brodersen (Project Manager)

### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
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<td></td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment Code Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>E=Extremely High Risk</td>
</tr>
<tr>
<td>H=High Risk</td>
</tr>
<tr>
<td>M=Moderate Risk</td>
</tr>
<tr>
<td>L=Low Risk</td>
</tr>
</tbody>
</table>

- **Probability:**  
  - **Frequent:** Catastrophic (E), Likely (H), Occasional (M), Seldom (L), Unlikely (L)  

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Determine location for set up/staging equipment-load and unload       | Struck by hazards                            | • Select location away from traffic.  
• Place barricades for work site protection, if necessary.  
• Wear high visibility vest.  
|                                                                           | Driving over soft ground                      | • Choose location with level and firm soils.  
• Add gravel or use mud ramps on soft ground.  
|                                                                           | Uneven terrain                                | • Determine best access route before transporting equipment.  
• Wear slip resistant footwear.  
• Look before you step in order to ensure safe and secure footing.  
• Use Personal Floatation Devices (PFDs) when working within 6 feet of water and/or entering shallow waters. Do not enter waters greater than knee depth.  
• Keep work area picked up and as clean as feasible and free of tripping and fall hazards.  
|                                                                           | Slip, trip and fall hazards                   | • Use proper lifting techniques.  
• Ensure walking pathway is clear.  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance or 2 man lift whenever possible and/or when equipment is or exceeds 100 lbs.  
• Limit repetitive awkward motions and twisting.  
|                                                                           | Heavy lifting – strains, sprains,             | • Wear safety glasses when there is a potential for flying debris or splash hazards.  
awkward bending/lifts and ergonomic hazards |                                                                            |                                                                            |     |
|                                                                           | Eye hazards – flying debris/splash and UV     | • Wear glasses with UV protection.  
and UV hazards                           |                                                                            |                                                                            | L    |
### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 2. Weather Evaluation | Severe weather and cold and/or heat stresses and water temperature hazards | • Monitor weather forecasts for predicted inclement weather.  
• Review heat and cold stress recognition and prevention instructions.  
• Drink small amounts (4 ounce) of liquids for rehydration during breaks, per the work rest regimen required based on temperature, workload and acclimatization.  
• Conduct work during the warmer/cooler part of the day if feasible.  
• Wear sunscreen.  
• Suspend work at winds above 25 miles per hour, rough water, freezing rain, or lightning/thunder or extreme temperatures.  
• Check that communication devices function.  
• Use insulated waders during cold weather/water work. Since prolonged exposure to cold air, or to immersion in cold water at temperatures well above freezing, can lead to dangerous hypothermia, protection in the form of insulated waders must be provided. Adequate insulating clothing to maintain core temperatures above 36°C (96.8°F) will be provided to workers. | M   |
| 3. Sample collection | Water hazards                                                          | • Always work in pairs.  
• USCG approved PFDs if samples will be collected in water above knee height.  
• Wear waders with non-slip soles.  
• When possible try to collect samples from shore utilizing a pond dipper to eliminate the need to enter the water.  
• Take caution of tripping and slipping hazards when entering and maneuvering within the stream.  
• Avoid entering streams during high flow conditions.  
• Stay within visual and audible distance with shore personnel. | M   |
|                    | Inhalation and skin contact hazards of chemicals of concern             | • Conduct real-time monitoring (i.e., PID and gamma radiation detection) before and during sampling activities if contaminate of concern concentrations in media warrant sampling.  
• Follow PPE requirements specified in the HASP based on airborne measurements and action levels.  
• Wear chemical resistant gloves as specified in the HASP. Boot covers and splash suit protection if necessary. Follow respirator action level dictates of HASP.  
• Follow good hygiene practices. | L   |
|                    | Take home toxics                                                       | • Decontaminate with soap and water.  
• Remove all contaminated clothing and materials and leave on-site. Use plastic as a barrier for soil, truck bed or foot well contact.  
• Shower as soon as possible. | L   |
|                    | Environmental hazards                                                 | • See General Site Hazards AHA. | M   |
|                    | Biologicals – plants, insects, wildlife                                | • Use the “buddy system.” | M   |
|                    | Adverse weather                                                       | • Use absorbents and containers for spills. | L   |
|                    | Temperature stresses                                                  | • Use absorbents and containers for spills. | L   |
|                    | UV hazards                                                             | • Use absorbents and containers for spills. | L   |
### AHA – Stream Surface Water Sampling from Shore (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 4. Label and put sample in cooler             | Cut hazards                                                            | • Set-up stable work area for labeling samples.  
• Label all containers as to contents.  
• Wear adequate hand protection.  
• Use care when handling glassware.   | L   |
|                                               | Heavy lifting – strains, sprains, awkward bending/lifts and ergonomic hazards | • Use proper lifting techniques.  
• Ensure walking pathway is clear.  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance or 2 man lift whenever possible.  
• Limit repetitive awkward motions and twisting motions. | L   |

### Equipment

<table>
<thead>
<tr>
<th>PPE Level D:</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Safety glasses</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Safety-toed boots</td>
<td></td>
<td></td>
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<tr>
<td>• Work gloves and boots/chemical resistant gloves and boots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ANSI Class 2 reflective warning vests</td>
<td></td>
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<tr>
<td>Other Equipment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fire extinguishers</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Emergency eyewash</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• First aid kit</td>
<td></td>
<td></td>
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<tr>
<td>• Insect repellent- DEET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hand tools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Spill containment supplies</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• First aid supplies</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>• Containers as needed</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Tarps</td>
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<tr>
<td>• If electrical equipment is required, GFCI</td>
<td></td>
<td></td>
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<tr>
<td>• Heavy duty extension cords</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Drinking water</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• Weather radio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Heat stress monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sample containers/preservatives/coolers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Waders (insulated if needed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PFDs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Gamma radiation detector</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Inspection

| Daily inspection (SSHO)                        |                                                                          |                                                                                             |     |
| Daily inspection (SSHO)                        |                                                                          |                                                                                              |     |
| Housekeeping (daily)                          |                                                                         |                                                                                              |     |
| • Fire extinguisher (monthly)                  |                                                                         |                                                                                              |     |
| • Vehicle inspection (daily)                   |                                                                         |                                                                                              |     |
| • Eye wash                                    |                                                                         |                                                                                              |     |
| • Equipment and tools inspection (daily and before use) |                                                                         |                                                                                              |     |
| • Survey areas for poisonous plants, insects, and animals (each work area) | |                                                                                              |     |
| • Check body for ticks (each evening during tick season) | |                                                                                              |     |

Identify closest usable tornado/hurricane shelter that is available (each work area)

### Training

| CP/QP:                                        |                                                                          |                                                                                             |     |
| CP/SSHO                                      |                                                                         |                                                                                              |     |
| Alternate CP/SSHO                            |                                                                         |                                                                                              |     |
| QP/First Aid and CPR                         |                                                                         |                                                                                              |     |

Training Requirements (as determined by the SSO):

- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/ hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
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ACTIVITY HAZARD ANALYSIS 44.11

Date Prepared: 9/13/2013
Project Name: Peck Iron and Metal RIFS
Activity/Work Task: Stream Sampling by Boat
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Mark A McGowan, CSP, CIH

### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Risk Assessment Code Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Severity</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Catastrophic</td>
</tr>
<tr>
<td>Critical</td>
</tr>
<tr>
<td>Marginal</td>
</tr>
<tr>
<td>Negligible</td>
</tr>
</tbody>
</table>

### Risk Assessment Code Matrix

- **E**=Extremely High Risk
- **H**=High Risk
- **M**=Moderate Risk
- **L**=Low Risk

<table>
<thead>
<tr>
<th>Severity</th>
<th>Probability</th>
<th>Frequency</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
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</tbody>
</table>

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Determine location for set up/staging equipment-load and unload | Struck by hazards | • Select location away from traffic  
• Place barricades for work site protection, if necessary  
• Wear high visibility vest | L |
|           | Driving over soft ground Uneven terrain | | |
|           | Slip, trip and fall hazards | • Determine best access route before transporting equipment  
• Wear slip resistant footwear  
• Look before you step in order to ensure safe and secure footing  
• Use PFDs when working within 6 feet of water and/or entering shallow waters. Do not enter waters greater than knee depth  
• Keep work area picked up and as clean as feasible and free of tripping and fall hazards | M |
|           | Heavy lifting – strains, sprains, awkward bending/lifts and ergonomic hazards | • Use proper lifting techniques.  
• Ensure walking pathway is clear  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance or 2 man lift whenever possible  
• Limit repetitive awkward motions and twisting | M |
|           | Eye hazards – flying debris/splash and UV hazards | • Wear safety glasses when there is a potential for flying debris or splash hazards  
• Wear glasses with UV protection  
• Ensure eyewash is available | L |
### 2. Weather Evaluation

**Hazard:** Severe weather and cold and/or heat stresses and water temperature hazards

- Monitor weather forecasts for predicted inclement weather
- Review heat and cold stress recognition and prevention instructions
- Monitor heat stress index, air temperature, humidity and wind. Follow ACGIH guidelines for work-rest regimens, as necessary. (Free smartphone OSHA app for monitoring heat index download to smartphone [www.osha.gov/SLTC/heatillness/heatindex/heatapp.html](http://www.osha.gov/SLTC/heatillness/heatindex/heatapp.html)
- Drink small amounts (4 ounce.) of liquids for rehydration during breaks, per the work rest regimen required based on temperature and workload.
- Conduct work during the warmer/cooler part of the day if feasible
- Wear sunscreen
- Suspend work at winds above 25 miles per hour, rough water, freezing rain, or lightning/thunder or extreme temperatures
- Check that communication devices function
- Use “Emersion Suits” during cold weather/water work from water craft (water temperature less than 50°F). Since prolonged exposure to cold air, or to immersion in cold water at temperatures well above freezing, can lead to dangerous hypothermia, whole body protection in the form of “Emersion Suits” must be provided. Adequate insulating clothing to maintain core temperatures above 36°C (96.8°F) will be provided to workers

### 3. Water craft operation

**Hazard:** Hazards of boat operation

- Familiarize yourself with any movement of boat traffic on the stream or river
- Review boating safety (boating safety course)
- Obtain information about water temperature, depths and be familiar with locations of rocks, ledges, and manmade surface obstructions noted within the study area.
- Observe all boating regulations
- Tie down equipment when necessary if there issues of boat instability
- Acquire USCG approved lighting and signaling devices as required
- Acquire Marine Emergency and Rescue Equipment

### 4. Sample collection

**Hazard:** Water hazards – falling overboard and or stranding

- Remain seated except when working
- Wear USCG approved PFDs
- Wear non-slip work shoes
- Properly secure, guard and maintain the boat access and walking areas to be free of tripping and slipping hazards
- Maintain an adequate number of USCG throw rings
- Do not exceed maximum weight capacity for watercraft
- Do not use watercraft without shore support personnel
- Maintain radio contact with shore personnel
### AHA – Stream Sampling by Boat (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Sample collection (continued)</td>
<td>Water hazards – falling overboard and or stranding (continued)</td>
<td>• Review float plan with shore personnel so they can track whereabouts&lt;br&gt;• Review training for man overboard emergencies and conduct drills to verify personnel are aware of their responsibilities.&lt;br&gt;• Follow water safety rules&lt;br&gt;• Use PFD at all times when on a boat&lt;br&gt;• Refer to Work Over Water or Adjacent to Water, U.S. Army Corps of Engineers Safety and Health Requirements Manual Engineer Manual (EM) 385-1-1, Sections 19 and 30, and any applicable TVA requirements or USCG regulations. For more extensive information on working on or around water, refer to the Marine Operations Requirements&lt;br&gt;• Review the prepared plan for marine emergencies such as fire, sinking, flooding, severe weather, man overboard, etc.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Inhalation and skin contact hazards of chemicals of concern</td>
<td>• Conduct real-time monitoring (i.e., PID and gamma radiation monitoring) when samples are brought to shore before and during sampling activities if COCs concentrations in media warrant sampling.&lt;br&gt;• Follow PPE as specified in the HASP based on airborne measurements and action levels.&lt;br&gt;• Wear chemical resistant gloves based on the identified chemicals. Boot covers and splash suit protection if necessary. Follow respirator action level dictates HASP.&lt;br&gt;• Follow good hygiene practices.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Take home toxics</td>
<td>• Decon with soap and water.&lt;br&gt;• Remove all contaminated clothing and materials and leave on-site. Use plastic as a barrier for soil, truck bed or foot well contact.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Environmental hazards&lt;br&gt;Biologicals- Plants, insects, wildlife&lt;br&gt;Adverse Weather&lt;br&gt;Temperature Stresses&lt;br&gt;UV Hazards</td>
<td>• See General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Unattended worker</td>
<td>• Use the “buddy system.”&lt;br&gt;• Maintain visual contact with the sampling technician during sampling activities.”</td>
<td>M</td>
</tr>
<tr>
<td>5. Put sample in preserved jar</td>
<td>Inhalation and skin contact with preservatives such as: methanol and hexane</td>
<td>• Use in well-ventilated area. Wear appropriate PPE (e.g., gloves, safety glasses).&lt;br&gt;• Obtain MSDSs/SDSs for materials being used.&lt;br&gt;• Follow safe handling procedures.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Spills</td>
<td>• Use absorbents and containers for spills.</td>
<td></td>
</tr>
<tr>
<td>6. Label and put sample in cooler</td>
<td>Cut hazards</td>
<td>• Set-up stable work area for labeling samples.&lt;br&gt;• Label all containers as to contents.&lt;br&gt;• Wear adequate hand protection.&lt;br&gt;• Use care when handling glassware.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Heavy lifting – strains, sprains, awkward bending/lifts and ergonomic hazards</td>
<td>• Use proper lifting techniques.&lt;br&gt;• Ensure walking pathway is clear.&lt;br&gt;• Do not lift greater than 50 lbs.&lt;br&gt;• Use mechanical assistance or 2 man lift whenever possible and/or when equipment weighs or exceeds 100 lbs.&lt;br&gt;• Limit repetitive awkward motions and twisting motions.</td>
<td>L</td>
</tr>
</tbody>
</table>
AHA – Stream Sampling by Boat (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
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<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Boat Refueling (if required)</td>
<td>Fire, fuel spills</td>
<td>• Store fuel in an area free of vegetation and debris with proper signage.</td>
<td>L</td>
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<tr>
<td></td>
<td></td>
<td>• Transport all flammable liquids in UL/FM approved containers.</td>
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<tr>
<td></td>
<td></td>
<td>• Prohibit smoking while refueling.</td>
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<td></td>
<td></td>
<td>• Turn motor off before refueling.</td>
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<tr>
<td></td>
<td></td>
<td>• Maintain a fully charged fire extinguisher that is readily accessible.</td>
<td></td>
</tr>
</tbody>
</table>

### Equipment

**PPE Level D:**
- Safety glasses
- Safety-toed boots
- Work gloves and boots/chemical resistant gloves and boots
- ANSI Class 2 reflective warning vests
- PFDs

**Other Equipment:**
- Fire extinguishers
- Emergency eyewash
- First aid kit
- Insect repellant – DEET
- Hand tools
- Spill containment supplies
- First aid supplies
- Containers as needed
- Tarps
- If electrical equipment is required, GFCI
- Heavy duty extension cords
- Drinking water
- Weather radio
- Heat stress monitoring
- Sample containers/preservatives/coolers
- Boat
- Waders (insulated if needed)
- Gamma radiation detector

### Inspection

- Daily inspection (SSHO) ______________________________
- Housekeeping (daily)
  - Fire extinguisher (monthly)
  - Vehicle inspection (daily)
  - Eye wash
  - Equipment and tools inspection (daily and before use)
  - Survey areas for poisonous plants, insects, and animals (each work area)
  - Check body for ticks (each evening during tick season)

**Identify closest usable tornado/hurricane shelter that is available (each work area)**

### Training

- CP/QP: CP/SSHO ______________________________
- Alternate CP/SSHO ______________________________
- QP/First Aid and CPR ______________________________

Training Requirements (as determined by the SSHO):
- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- Boat safety and licensing training
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
Date Prepared: 9/13/2013
Project Name: Peck Iron and Metal RIFS
Activity/Work Task: Boat Use for Site Access
Prepared By: Mark McGowan CIH, CSP
Revised By: Brett Brodersen, PM

**Overall Risk Assessment Code (RAC): M**

### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Probability</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
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</tbody>
</table>

### Job Steps

<table>
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<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Struck by hazards</td>
<td>• Select location away from traffic. • Place barricades for work site protection, if necessary. • Wear high visibility vest.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Driving over soft ground Uneven terrain</td>
<td>• Choose location with level and firm soils. • Add gravel or use mud ramps on soft ground.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Slip, trip and fall hazards</td>
<td>• Determine best access route before transporting equipment. • Wear slip resistant footwear. • Look before you step in order to ensure safe and secure footing. • Use PFDs when working within 6 feet of water and/or entering shallow waters. Do not enter waters greater than knee depth. • Keep work area picked up and as clean as feasible and free of tripping and fall hazards.</td>
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</tr>
<tr>
<td></td>
<td>Heavy lifting – strains, sprains, awkward bending/lifts and ergonomic hazards</td>
<td>• Use proper lifting techniques. • Ensure walking pathway is clear. • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible and/or when equipment weighs or exceeds lbs. • Limit repetitive awkward motions and twisting</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Eye hazards – flying debris/splash and UV hazards</td>
<td>• Wear safety glasses when there is a potential for flying debris or splash hazards. • Wear glasses with UV protection. • Ensure eyewash is available.</td>
<td>L</td>
</tr>
</tbody>
</table>
## Weather Evaluation

### Severe weather and cold and/or heat stresses and water temperature hazards

- Monitor weather forecasts for predicted inclement weather. Check weather prior to departure and reschedule if severe weather is forecasted. File the Float Plan with onshore staff. If a high winds small craft warning is issued the boat will not depart shore and/or return to shore. Lightning within 10 miles, personnel will depart water.
- Review heat and cold stress recognition and prevention instructions.
- Monitor heat stress index, air temperature, humidity and wind. Follow ACGIH guidelines for work-rest regimens, as necessary. (Free smart phone OSHA app for monitoring heat index - [www.osha.gov/SLTC/heatillness/heatindex/heatapp.html](http://www.osha.gov/SLTC/heatillness/heatindex/heatapp.html))
- Drink small amounts (4 ounces) of liquids for rehydration during breaks, per the work rest regimen required based on temperature, workload and acclimatization.
- Conduct work during the warmer/cooler part of the day if feasible.
- Wear sunscreen.
- Suspend work at winds above 25 miles per hour (mph), rough water, freezing rain, or lightning/thunder or extreme mph.
- Check that communication devices function.
- Use “Emersion Suits” during cold weather/water work from water craft. Since prolonged exposure to cold air, or to immersion in cold water at temperatures well above freezing, can lead to dangerous hypothermia, whole body protection in the form of “Emersion Suits” must be provided. Adequate insulating clothing to maintain core temperatures above 36°C (96.8°F) will be provided to workers.
- Refer to General Site Hazards AHA for actions not listed here.

## Water craft operation

### Hazards of boat operation

- Familiarize yourself with any movement of boat traffic on the body of water.
- Boat operator(s) must meet all education and licensing requirements of the State in which the boat will be operated. Attach license.
- Obtain information about water temperature, depths and be familiar with locations of rocks, ledges, and manmade surface obstructions noted within the study area.
- Observe all boating regulations.
- Tie down equipment when necessary if there are issues of boat instability.
- Acquire USCG approved lighting and signaling devices as required.
- Acquire Marine Emergency and Rescue Equipment.
- Ensure function of communication equipment.
<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 4. Float plan   | Drowning                          | • Generate a FLOAT PLAN prior to each trip requiring use of a boat) using the following format:  
|                 |                                   | Date.  
|                 |                                   | Project Name.  
|                 |                                   | Boat Operator.  
|                 |                                   | Company.  
|                 |                                   | Destination.  
|                 |                                   | Weather Forecast.  
|                 |                                   | 1. VESSEL INFORMATION (e.g., make/model or local identifier).  
|                 |                                   | 2. MEANS OF COMMUNICATION (e.g., adequate means of communication shall be provided including phone numbers).  
|                 |                                   | 3. EXPECTED TIME OF DEPARTURE, ROUTE, AND TIME OF RETURN.  
|                 |                                   | 3. DISCUSSION OF ACTIVITIES/ PRE-LAUNCH SAFETY DEMONSTRATION (Attended by all on-board personnel listed below).  
|                 |                                   | 4. PERSONNEL ON-BOARD (Print Name).  
|                 |                                   | • Remain seated except when working.  
|                 |                                   | • Wear USCG approved PFDs if working near (less than or equal to 6 feet) or over water deeper than 4 feet (EM 385-1-1 05.J). All personnel will wear PFDs (Type 2 or 3).  
|                 |                                   | • Require that boat operator be trained and experienced, per EM 385 1-1 19.F. Boat operator must complete a Float Plan prior to each trip including a safety demonstration for all passengers. Motor kill switch and throw ring or cushion present on boat. One fire extinguisher with a rating of 1-A:10-B:C in a boat less than 26 feet; two fire extinguishers required for a boat greater than 26 feet. Cellular phones in areas that provide service and radios capable of reaching the National Park Service (NPS) office. CPR and First Aid training for at least two on-site personnel.  
|                 |                                   | • Wear non-slip work shoes.  
|                 |                                   | • Properly secure, guard and maintain the boat access and walking areas to be free of tripping and slipping hazards.  
|                 |                                   | • Maintain an adequate number of USCG throw rings.  
|                 |                                   | • Do not exceed maximum weight capacity for watercraft.  
|                 |                                   | • Do not use water craft without shore support personnel.  
|                 |                                   | • Maintain radio contact with shore personnel.  
|                 |                                   | • Review float plan with shore personnel so they can track whereabouts.  
|                 |                                   | • Review training for man overboard emergencies and conduct drills to verify personnel are aware of their responsibilities.  
|                 |                                   | • Follow water safety rules.  
|                 |                                   | • Use PFD at all times when on a boat.  
|                 |                                   | • Refer to Work Over Water or Adjacent to Water, U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1, Sections 19 and 30, and any applicable TVA requirements or USCG regulations. For more extensive information on working on or around water, refer to the Marine Operations Requirements.  
|                 |                                   | • Review the prepared plan for marine emergencies such as fire, sinking, flooding, severe weather, man overboard, etc.  
|                 |                                   | • Keep adequate First Aid Kit and supplies.  
| 5. Boat transportation | Water hazards-Falling overboard and or stranding Drowning | • Maintain an adequate number of USCG throw rings.  
|                 |                                   | • Do not exceed maximum weight capacity for watercraft.  
|                 |                                   | • Do not use water craft without shore support personnel.  
|                 |                                   | • Maintain radio contact with shore personnel.  
|                 |                                   | • Review float plan with shore personnel so they can track whereabouts.  
|                 |                                   | • Review training for man overboard emergencies and conduct drills to verify personnel are aware of their responsibilities.  
|                 |                                   | • Follow water safety rules.  
|                 |                                   | • Use PFD at all times when on a boat.  
|                 |                                   | • Refer to Work Over Water or Adjacent to Water, U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1, Sections 19 and 30, and any applicable TVA requirements or USCG regulations. For more extensive information on working on or around water, refer to the Marine Operations Requirements.  
|                 |                                   | • Review the prepared plan for marine emergencies such as fire, sinking, flooding, severe weather, man overboard, etc.  
|                 |                                   | • Keep adequate First Aid Kit and supplies.  

Page 3 of 5
### AHA – Boat Use for Site Access (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Boat transportation (continued)</td>
<td>Environmental hazards</td>
<td>• See General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Biologicals – plants, insects, wildlife</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adverse weather</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Temperature stresses</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>UV hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Landing</td>
<td>Unattended worker</td>
<td>• Use the “buddy system.”</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Slips and falls</td>
<td>• Maintain visual contact with staff during all activities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maintain communication with the boat.</td>
<td></td>
</tr>
<tr>
<td>7. Boat Refueling (if required)</td>
<td>Fire, fuel spills</td>
<td>• Store fuel in an area free of vegetation and debris with proper signage.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Transport all flammable liquids in UL/FM approved containers.</td>
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<td></td>
<td></td>
<td>• Prohibit smoking while refueling.</td>
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<td></td>
<td></td>
<td>• Turn motor off before refueling.</td>
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<tr>
<td></td>
<td></td>
<td>• Maintain a fully charged fire extinguisher that is readily accessible.</td>
<td></td>
</tr>
</tbody>
</table>

*Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.*
## Equipment

<table>
<thead>
<tr>
<th>PPE Level D:</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hard hat</td>
<td>Daily inspection (SSHO) ___________________________</td>
<td>CP/QP:</td>
</tr>
<tr>
<td>• Safety glasses</td>
<td>Housekeeping (daily)</td>
<td>CP/SSHO</td>
</tr>
<tr>
<td>• Safety-toed boots</td>
<td>• Fire extinguisher (monthly)</td>
<td>Alternate CP/SSHO _____________________________________________________</td>
</tr>
<tr>
<td>• Work gloves/chemical resistant gloves</td>
<td>• Vehicle inspection (daily)</td>
<td>QP/First Aid and CPR ________________________</td>
</tr>
<tr>
<td>• ANSI Class 2 reflective warning vests</td>
<td>• Eye wash</td>
<td>Training Requirements (as determined by the SSHO):</td>
</tr>
<tr>
<td></td>
<td>• Equipment and tools inspection (daily and before use)</td>
<td>• HAZWOPER 40</td>
</tr>
<tr>
<td></td>
<td>• Survey areas for poisonous plants, insects, and animals (each work area)</td>
<td>• Site safety orientation</td>
</tr>
<tr>
<td></td>
<td>• Check body for ticks (each evening during tick season)</td>
<td>• Tailgate meetings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Emergency procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HAZ COM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hearing conservation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Applicable AHAs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fire extinguisher use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Biological hazard identification and control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tornado shelter location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lightning safety procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heat stress shelter location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Heat stress prevention and heat stroke treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cold stress prevention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Boat safety and licensing training for the operator</td>
</tr>
</tbody>
</table>

- **Other Equipment:**
  - Generator
  - Fire extinguishers
  - Emergency eyewash
  - First aid kit
  - Insect repellant – DEET
  - Hand tools
  - Spill containment supplies
  - First aid supplies
  - Containers as needed
  - Tarps
  - GFIC
  - Heavy duty ext. cords
  - Drinking water
  - Weather radio
  - Heat stress monitoring

- **Identify closest usable tornado shelter that is available (each work area)**
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Date Prepared: 9/13/2013  
Project Name: Peck Iron and Metal  
Activity/Work Task: Monitoring Well Installation  
Activity Location(s):  
Prepared By: Brett Brodersen, PM  
Reviewed By: Mark McGowan, CIH, CSP

### ACTIVITY HAZARD ANALYSIS 44.13

**Overall Risk Assessment Code (RAC):** M

<table>
<thead>
<tr>
<th>Probability</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
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<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
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<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
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<tr>
<td>Negligible</td>
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<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
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</table>

### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Risk</th>
<th>Probability</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Catastrophic</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>Critical</td>
<td>M</td>
</tr>
<tr>
<td>M</td>
<td>Marginal</td>
<td>L</td>
</tr>
<tr>
<td>L</td>
<td>Negligible</td>
<td>E</td>
</tr>
</tbody>
</table>

---

### Job Steps

#### 1. Determine location for set up/staging equipment

- **Traffic—Struck by hazards**
  - Select location away from traffic.
  - Place barricades for work site protection, if necessary.
  - Wear high visibility vest.
  - Note all moving equipment in work areas.

- **Driving and walking over soft ground Uneven terrain**
  - Choose location with level and firm soils.
  - Be aware of rocks, brush, animal boroughs and other hazards.
  - Choose firm ground for walking as much as possible.

- **Slip, trip and fall hazards**
  - Wear slip resistant footwear.
  - Keep work area picked up and as clean as feasible and free of tripping and fall hazards.
  - Use railings barrier with gated access around underground vault openings.

---

#### 2. Drum waste, sealing drums and transporting drums

- **Cut/crush/skin absorption hazards-Hand and Foot**
  - Wear leather steel-toed /ceramic toed boots when there is heavy material being handled.
  - Check bung lids to be sure they are tight to prevent leak.
  - Use mechanical aid (drum dolly) for relocating drums.
  - Wear appropriate chemical resistant PPE as specified in the HASP.
  - Wear thick clothing when there is a potential for lacerations. Wear abrasion resistant hand protection.

- **Inhalation and skin contact hazards with chemicals of concern (COC), etc.**
  - Follow PPE dictates of HASP based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP.
  - Obtain or review chemical information on COCs and/or review MSDSs/ SDSs.
  - Wear chemical resistant gloves based on the identified chemicals. Boot covers and splash suit protection if necessary.
  - Label all IDW containers as to contents.
  - Follow good hygiene practices: no eating, drinking or smoking until decontaminated and out of EZ.
  - IDW transport and disposal activities shall be IAW applicable local, municipal, county, state, and Federal rules and regulations.
  - All media leaving well boreholes/wells shall be field screened with a PID, magnetometer, and gamma radiation detector prior to handling. Items expressing radiation two times above background will not be handled by field sampling crews but will be collected and handled only by radiation subcontractor personnel.
<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Drum waste, sealing drums and transporting drums (continued)</td>
<td>Flying debris-eye</td>
<td>• Wear safety glasses when there is potential for flying debris or splash hazard. • Ensure eyewash is available.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Strains, sprains, awkward bending/lifts and ergonomic hazards. Injury from physical exertion.</td>
<td>• Use proper lifting techniques. • Avoid twisting/turning while moving drums, pulling tools, etc. • Ensure walking pathway is clear. • Do not lift greater than 50 lbs. • Use mechanical assistance. • Limit repetitive awkward motion. • Assure solid footing. • Maintain good personal level of fitness. • Be alert to signs and symptoms of overexertion. • Have water and first aid supplies available. • Assure all tools are in good condition and used for their intended purpose.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td>• Wear hearing protection if noise levels from neighboring equipment exceeds 85 decibels (if you cannot be heard speaking in a normal voice at arms distance).</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Electric shock</td>
<td>• Require a GFCl for any electrical equipment powered by a generator.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Environmental protection/spills</td>
<td>• Place plastic over the area to sample to keep sampling equipment clean and protect environment. • Containerize all purge water and waste. • Use absorbents and containers for spills.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Remote location</td>
<td>• Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Environment and biological hazards • Adverse weather • Temperature Stress • UV Hazards • Plants, insects and local wildlife</td>
<td>• See General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Take home toxics</td>
<td>• Decontaminate with soap and water. • Remove all contaminated clothing and materials and leave on-site. • Use plastic as a barrier for soil, truck bed or foot well contact.</td>
<td>L</td>
</tr>
<tr>
<td>3. IDW waste characterization and management</td>
<td>Inhalation of contaminants</td>
<td>• Follow PPE dictates of HASP based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP. • Obtain or review chemical information on COCs and/or review MSDSs/SDSs. • Open each well for a brief period before work is conducted to allow any vapors to clear. • Follow respirator action level dictates of HASP. • See steps 6-9 for sample handling necessary for characterization.</td>
<td>L</td>
</tr>
<tr>
<td>4. Drum placement</td>
<td>Crushing injuries</td>
<td>• Transport drums properly and keep on level ground.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>• Transport/store all flammable liquids in UL/FM approved containers. • Prohibit smoking and all other sources of ignition during refueling operation. • Keep fully charged ABC fire extinguisher in vehicle. Inspect weekly. • Use in well-ventilated area.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Malfunctioning equipment</td>
<td>• Inspect generators and support equipment (pumps, water meters, transducers, and related equipment) daily and document.</td>
<td>L</td>
</tr>
</tbody>
</table>
## AHA – Monitoring Well Installation (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 5. IDW collection                      | Chemical spills                                                         | • Never leave open chemicals unattended.  
• Know location of nearest eyewash station.  
• Wear proper PPE (nitrile gloves, safety glasses, acid apron).  
• Keep prep and pack area well ventilated (open window).  
• Know location of MSDSs/SDSs, absorbent spill cloth and hazmat spill kit.  
• Make sure all caps are secure. | L   |
| 6. Receiving pre-preserved bottles     | Cuts to hands or acid burns from acid leaks- broken glass containers    | • Use caution when opening package.  
• Wear appropriate PPE (e.g., nitrile gloves, safety glasses). | L   |
| 7. Receiving coolers from the field   | Heavy lifting/back injury                                               | • Bend at knees, ask for assistance.  
• Use hand truck when necessary. | L   |
|                                        | Insects lurking in coolers                                              | • Use caution when taking contents out of cooler (insect potential inside coolers). | L   |
| 8. Preparing coolers for delivery     | Tripping over unrolled tape/strapping machine                          | • Make sure strapping machine is properly rolled. | L   |
|                                        | Cuts to hands/tape guns                                                | • Use caution, be aware of cutting edge; to the extent possible, break tape by pushing tape gun away from you; ensure hands and legs are not in the path of the tape gun. | L   |
|                                        | Heavy lifting/back injury                                               | • Bend at knees, ask for assistance.  
• Use hand truck when necessary. | M   |
| 9. Neutralizing sampling containers    | Chemical spills                                                         | • Wear proper PPE (nitrile gloves, glasses, acid apron, and absorbent cloth).  
• Follow proper procedures for neutralizing samples. | L   |
| 10. Label, move and ship samples and waste | Cut hazards                                                            | • Set-up stable work area for labeling samples. Use care when handling glassware.  
• Dispose of glass waste in IDM box.  
• Wear appropriate PPE (e.g., gloves, safety glasses). | L   |
|                                        | Heavy lifting                                                           | • Size of lift. Use proper technique.  
• Bend at knees, ask for assistance.  
• Use hand truck when necessary. | L   |
| 11. Observation of monitoring well installation | Exposure to site contaminants                                          | • Instruct drillers of contaminants on site. | L   |

### Hazards associated with drilling wells:
- Electrical such as overhead or underground utilities,
- Rolling spreading or sliding of tools and supplies,
- Rotating machinery-caught by Fire

### Actions to be taken by drillers:
- Require dig permit before invasive work begins.
- Mark/locate underground utilities. No drilling within 5 feet. of marked underground utilities or within a minimum of 20 feet. of overhead high-voltage lines.
- Maintain adequate clearance for the movement of vehicles and operation of drilling equipment.
- Determine safe tool placement to prevent struck by injuries.
- Inspect all drilling equipment in presence of SSHO.
- Verify (lead driller) that all safety interlock switches on the drilling equipment operates correctly.
- Conduct/document weekly drilling inspection in a logbook or checklist.
- Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO; provide fire watch and suitable fire extinguisher. Use screens to control sparks and UV exposure as necessary.
## AHA – Monitoring Well Installation (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12. Decontamination using a steam cleaner</strong></td>
<td>Noise-hearing loss</td>
<td>• Wear hearing protection during steam cleaning.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>• Turn off steam cleaner/generator and allow it to cool before refueling.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prohibit smoking during refueling.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical</td>
<td>• Use a GFCI if steam cleaner is powered by a generator.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Splash</td>
<td>• Wear safety goggles during steam cleaning and splash protection as appropriate (aprons, PPE, etc).</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Hand injury and chemical absorption</td>
<td>• Assure guarding on all rotating shafts, belts, and pulleys.</td>
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<tr>
<td></td>
<td></td>
<td>• Wear nitrile gloves while operating the steam cleaner.</td>
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<tr>
<td></td>
<td></td>
<td>• Keep hands clear of water spray.</td>
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</tr>
<tr>
<td></td>
<td>Environmental protection</td>
<td>• Dispose of all liquids and materials used for decontamination IAW Federal, State and local regulation.</td>
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<tr>
<td></td>
<td></td>
<td>Contain spills with absorbents/plastic/containers.</td>
<td></td>
</tr>
<tr>
<td><strong>13. Decontamination by hand</strong></td>
<td>Splash</td>
<td>• Wear safety goggles during steam cleaning and splash protection as appropriate (aprons, PPE, etc.).</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Hand injury and chemical absorption</td>
<td>• Wear nitrile gloves during decontamination.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Chemical exposure</td>
<td>• Change gloves frequently to avoid skin contact with chemicals.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Spray isopropanol in well-ventilated areas to avoid inhalation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contain spills and use proper procedures to clean and dispose of chemicals.</td>
<td></td>
</tr>
</tbody>
</table>

*Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.*
### Equipment

**PPE Level D/C:**
- Hard Hat
- Safety Glasses with side shields
- Safety-Toed Boots
- Work Gloves and Boots/Chemical resistant gloves and boots
- Class 2 high visibility vests
- If dust is generated, APR Half Face Respirator with particulate and organic fume cartridge
- Hearing protection, as necessary
- Face-shield – disconnecting hoses, when pressure testing pipe, or working with high pressure fluids
- Welding and cutting PPE - refer to SSHP.
- Fall protection - working at heights greater than 6 feet Electrical PPE (NFPA 70E, 2012)

### Other Equipment:
- Air monitoring instruments
- Noise dosimeter
- Fire Extinguishers
- First Aid Kit
- GFCI, if electrical equipment needed
- Heavy duty extension cords (S, ST, SO, STO, SJ, SJO, SJT, SJOT)
- Drinking water
- Weather radio Caution tape
- Excavation perimeter protection
- Tag lines
- Insect repellant with DEET (Deep Woods Off™ or equivalent) Repel Permanone™
- Soil jars/preservatives/coolers
- Heat stress monitoring
- PID
- Combustible Gas meter
- Personal and perimeter dust meters
- Schonstedt magnetic wand and downhole magnetometer
- Gamma radiation detector

### Inspection

**Daily SSHO**

- Daily site safety inspection
  - Mechanized equipment (daily)
  - Overhead utilities (prior to operating equipment in area) Locate underground utilities (prior to intrusive activities)
  - Excavation inspection (daily)
  - Housekeeping (daily)
  - Fall protection (before each use)
  - Fire extinguisher (monthly)
  - Vehicle inspection (daily)
  - Equipment and tools inspection (daily and before use)
  - Survey areas for poisonous plants, insects, and animals (each work area)
  - Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area)
  - UXO sweep (prior to excavation of trenches, prior to moving excavation equipment)

### Training

**Training Requirements (as determined by the SSHO):**
- Site safety orientation
- Emergency procedures
- HAZ COM
- Hearing conservation
- MD/ MEC awareness
- Applicable AHAs
- Qualified equipment operators Lifting/back safety
- Fall protection
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
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### ACTIVITY HAZARD ANALYSIS 44.14

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Groundwater Well Development and Sampling  
**Prepared By:** Mark McGowan CIH CHMM  
**Revised By:** Brett Brodersen

---

**Overall Risk Assessment Code (RAC):** M

#### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>E</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>E=Extremely High Risk</td>
<td>H=High Risk</td>
<td>M=Moderate Risk</td>
<td>L=Low Risk</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1.        | Determine location for set up/staging equipment | Traffic-Struck by hazards  
Select location away from traffic.  
Place barricades for work site protection, if necessary.  
Wear high visibility vest.  
Note all moving equipment in work areas.  
Driving and walking over soft ground  
Uneven terrain  
Choose location with level and firm soils.  
Be aware of rocks, brush, animal boroughs and other hazards.  
Choose firm ground for walking as much as possible.  
Slip, trip and fall hazards  
Wear slip resistant footwear.  
Keep work area picked up and as clean as feasible and free of tripping and fall hazards.  
Use railings barrier with gated access around underground vault openings. | M |
| 2.        | Sample collection, Well purging, Well pumping  
Measuring field parameters (pH, temperature, conductivity, turbidity, dissolved oxygen, etc.) | Cut/crush/skin absorption hazards-Hand and Foot  
Wear leather steel-toed /ceramic toed boots if there is heavy material being handled.  
Wear appropriate chemical resistant PPE as specified in the HASP.  
Wear thick clothing when there is a potential for lacerations. Wear abrasion resistant hand protection.  
Inhalation and skin contact hazards with COC, etc.  
Follow PPE dictates of HASP based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP.  
Obtain or review chemical information on COCs and/or review MSDSs/SDSs.  
Wear chemical resistant gloves based on the identified chemicals. Boot covers and splash suit protection if necessary.  
Label all containers as to contents.  
Follow good hygiene practices: no eating, drinking or smoking until decontaminated and out of EZ.  
Communicate monitoring results.  
All media leaving well boreholes/wells shall be field screened with a PID and gamma radiation detector prior to handling. Items expressing radiation two times above background will not be handled by field sampling crews but will be collected and handled only by radiation subcontractor personnel. | M |
### AHA – Groundwater Well Development and Sampling (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 2. Sample collection, Well purging, Well pumping Measuring field parameters (pH, temperature, conductivity, turbidity, dissolved oxygen, etc.) (continued) | Flying debris-eye | • Wear safety glasses when there is potential for flying debris or splash hazard.  
• Ensure eyewash is available. | L |
| | Strains, sprains, awkward bending/lifts and ergonomic hazards. Injury from physical exertion. | • Use proper lifting techniques.  
• Avoid twisting/turning while pulling tools, grates, manway covers, etc.  
• Ensure walking pathway is clear.  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance or 2 man lift whenever possible.  
• Limit repetitive awkward motions.  
• Assure solid footing.  
• Maintain good personal level of fitness.  
• Be alert to signs and symptoms of overexertion.  
• Have water and first aid supplies available. | M |
| | Noise | • Wear hearing protection if noise levels from neighboring equipment exceeds 80 dBAs (if you cannot be heard speaking in a normal voice at arms distance). | M |
| | Electric shock | • Require a GFCI for any electrical equipment powered by a generator. | L |
| | Environmental protection/spills | • Place plastic over the area to sampled to keep sampling equipment clean and protect environment.  
• Containerize all purge water.  
• Use absorbents and containers for spills. | L |
| | Remote location | • Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system. | L |
| | Environment and biological hazards  
• Adverse weather  
• Temperature Stress  
• UV Hazards  
• Plants, insects and local wildlife | • See General Site Hazards AHA. | M |
| | Take home toxics | • Decon with soap and water.  
• Remove all contaminated clothing and materials and leave on-site.  
• Use plastic as a barrier for soil, truck bed or foot well contact. | L |
| 3. Measure with PID for VOCs | Inhalation of contaminants | • Follow PPE dictates of HASP based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP.  
• Obtain or review chemical information on COCs and/or review MSDSs.  
• Open each well for a brief period before work is conducted to allow any vapors to clear.  
• Follow respirator action level dictates of HASP.  
• Communicate results. | L |
**AHA – Groundwater Well Development and Sampling (continued)**

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Generator placement</td>
<td>Crushing injuries</td>
<td>• Transport generator properly and keep on level ground while in use.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>• Operate generator in a clear area away from vehicles.</td>
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<td></td>
<td></td>
<td>• Transport/store all flammable liquids in UL/FM approved containers.</td>
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<td>• Turn of generators and allow cooling before refueling.</td>
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<td></td>
<td></td>
<td>• Prohibit smoking and all other sources of ignition during refueling operation.</td>
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<td></td>
<td>• Keep fully charged ABC fire extinguisher in vehicle. Inspect weekly.</td>
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<td>• Use in well-ventilated area.</td>
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<td></td>
<td>Malfunctioning equipment</td>
<td>• Inspect generators and support equipment (pumps, water meters, transducers, and related equipment) daily and document.</td>
<td>L</td>
</tr>
<tr>
<td>5. Preparation of sample containers</td>
<td>Chemical spills</td>
<td>• Never leave open chemicals unattended.</td>
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<tr>
<td></td>
<td></td>
<td>• Know location of nearest eyewash station.</td>
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<td></td>
<td>• Wear proper PPE (nitrile gloves, safety glasses, acid apron).</td>
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<td></td>
<td>• Keep prep and pack area well ventilated (open window).</td>
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<td>• Know location of MSDS, absorbent spill cloth and hazmat spill kit.</td>
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<td>• Make sure all caps are secure.</td>
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<tr>
<td>6. Receiving pre-preserved bottles</td>
<td>Cuts to hands or acid burns from acid leaks-broken glass containers</td>
<td>• Use caution when opening package.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wear appropriate PPE (e.g., nitrile gloves, safety glasses).</td>
<td></td>
</tr>
<tr>
<td>7. Receiving coolers from the field</td>
<td>Heavy lifting/back injury</td>
<td>• Size up the load.</td>
<td>M</td>
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<tr>
<td></td>
<td></td>
<td>• Bend at knees, ask for assistance.</td>
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<td></td>
<td></td>
<td>• Use hand truck when necessary.</td>
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<td></td>
<td>Insects lurking in coolers</td>
<td>• Use caution when taking contents out of cooler (insect potential inside coolers).</td>
<td>L</td>
</tr>
<tr>
<td>8. Preparing coolers for delivery</td>
<td>Tripping over unrolled tape/strapping machine</td>
<td>• Make sure strapping machine is properly rolled.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Cuts to hands/tape guns</td>
<td>• Use caution, be aware of cutting edge; to the extent possible, break tape by pushing tape gun away from you; ensure hands and legs are not in the path of the tape gun.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Heavy lifting/back injury</td>
<td>• Bend at knees, ask for assistance.</td>
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<td></td>
<td></td>
<td>• Use hand truck when necessary.</td>
<td></td>
</tr>
<tr>
<td>9. Neutralizing sampling containers</td>
<td>Chemical spills</td>
<td>• Wear proper PPE (e.g., nitrile gloves, glasses, acid apron, and absorbent cloth.</td>
<td>L</td>
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<tr>
<td></td>
<td></td>
<td>• Follow proper procedures for neutralizing samples.</td>
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<td></td>
<td></td>
<td>• Provide spill clean-up kit and absorbents.</td>
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<tr>
<td>10. Label, move and ship samples</td>
<td>Cut hazards</td>
<td>• Set-up stable work area for labeling samples. Use care when handling glassware.</td>
<td>L</td>
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<tr>
<td></td>
<td></td>
<td>• Dispose of glass waste in IDM box.</td>
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<td></td>
<td></td>
<td>• Wear appropriate PPE (gloves, safety glasses).</td>
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<tr>
<td></td>
<td>Heavy lifting</td>
<td>• Size of lift. Use proper technique.</td>
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<tr>
<td></td>
<td></td>
<td>• Bend at knees, ask for assistance.</td>
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<td></td>
<td></td>
<td>• Use hand truck when necessary.</td>
<td></td>
</tr>
<tr>
<td>Job Steps</td>
<td>Hazards</td>
<td>Actions to Eliminate or Minimize Hazards</td>
<td>RAC</td>
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<td>-----------------------------------------------</td>
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<td>----------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>11. Observation of monitoring well installation</td>
<td>Exposure to site contaminants</td>
<td>• Instruct drillers of contaminants on site.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Hazards associated with drilling wells:</td>
<td><strong>Actions to be taken by drillers:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical such as overhead or underground utilities</td>
<td>• Require dig permit before invasive work begins.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>Rolling spreading or sliding of tools and supplies,</td>
<td>• Mark/locate underground utilities. No drilling within 5 feet. of marked underground utilities or within a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rotating machinery-caught by Fire</td>
<td>minimum of 20 feet of overhead high-voltage lines.</td>
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</tr>
<tr>
<td></td>
<td>Fire</td>
<td>• Maintain adequate clearance for the movement of vehicles and operation of drilling equipment.</td>
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<tr>
<td></td>
<td></td>
<td>• Determine safe tool placement to prevent struck by injuries.</td>
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<td></td>
<td>• Inspect all drilling equipment in presence of SSHO.</td>
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<td>• Verify (lead driller) that all safety interlock switches on the drilling equipment operates correctly.</td>
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<td>• Conduct/document weekly drilling inspection in a logbook or checklist.</td>
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<td></td>
<td>• Conduct repairs that require HOT WORK under a HOT WORK PERMIT. Inform SSHO; provide fire watch and</td>
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<td></td>
<td></td>
<td>suitable fire extinguisher. Use screens to control sparks and UV exposure as necessary.</td>
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<tr>
<td></td>
<td>Noise-hearing loss</td>
<td>• Wear hearing protection during steam cleaning if there is potential for noise levels in excess of 80</td>
<td>L</td>
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<td></td>
<td>Fire</td>
<td>dBA.</td>
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</tr>
<tr>
<td></td>
<td>Electrical</td>
<td>• Turn off steam cleaner/generator and allow it to cool before refueling.</td>
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<tr>
<td></td>
<td></td>
<td>• Prohibit smoking during refueling.</td>
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<td></td>
<td>Electrical</td>
<td>• Use a GFCI if steam cleaner is powered by a generator.</td>
<td>L</td>
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<tr>
<td></td>
<td>Splash</td>
<td>• Wear safety goggles during steam cleaning and splash protection as appropriate (e.g., aprons, PPE,</td>
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<td></td>
<td></td>
<td>etc.).</td>
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<tr>
<td></td>
<td>Hand injury and chemical absorption</td>
<td>• Assure guarding on all rotating shafts, belts, and pulleys.</td>
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<tr>
<td></td>
<td></td>
<td>• Wear nitrile gloves while operating the steam cleaner.</td>
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<tr>
<td></td>
<td></td>
<td>• Keep hands clear of water spray.</td>
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<tr>
<td></td>
<td>Environmental protection</td>
<td>• Dispose of all liquids and materials used for decontamination IAW Federal, State and local regulation.</td>
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<tr>
<td></td>
<td></td>
<td>Contain spills with absorbents/plastic/containers.</td>
<td></td>
</tr>
<tr>
<td>12. Decontamination using a steam cleaner</td>
<td>Splash</td>
<td>• Wear safety goggles during steam cleaning and splash protection as appropriate (e.g., aprons, PPE,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>etc.).</td>
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<tr>
<td></td>
<td>Hand injury and chemical absorption</td>
<td>• Wear nitrile gloves during decontamination.</td>
<td>M</td>
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<tr>
<td></td>
<td>Chemical exposure</td>
<td>• Change gloves frequently to avoid skin contact with chemicals.</td>
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<tr>
<td></td>
<td></td>
<td>• Spray isopropanol (if used) in well-ventilated areas to avoid inhalation.</td>
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<td></td>
<td></td>
<td>• Contain spills and use proper procedures to clean and dispose of chemicals.</td>
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</tbody>
</table>
AHA – Groundwater Well Development and Sampling (continued)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPE Level D:</td>
<td>Daily inspection (SSHO) _____________________</td>
<td>CP/QP: CP/SSHO _____________________</td>
</tr>
<tr>
<td>· Hard Hat</td>
<td>Housekeeping (daily)</td>
<td>Alternate CP/SSHO _____________________</td>
</tr>
<tr>
<td>· Safety Glasses</td>
<td>· Fire extinguisher (monthly)</td>
<td>QP/First Aid and CPR _____________________</td>
</tr>
<tr>
<td>· Safety-Toed Boots</td>
<td>· Vehicle inspection (daily)</td>
<td>Training Requirements (as determined by the SSHO):</td>
</tr>
<tr>
<td>· Work Gloves and Boots/Chemical resistant gloves and boots</td>
<td>· Eye Wash</td>
<td>· HAZWOPER 40 hour</td>
</tr>
<tr>
<td>· ANSI Class 2 reflective warning vests</td>
<td>· Equipment and tools inspection (daily and before use)</td>
<td>· Site safety orientation</td>
</tr>
<tr>
<td>Other Equipment:</td>
<td>· Survey areas for poisonous plants, insects, and animals (each work area)</td>
<td>· Tailgate meetings</td>
</tr>
<tr>
<td>· Generator, if needed</td>
<td>· Check body for ticks (each evening during tick season)</td>
<td>· Emergency procedures</td>
</tr>
<tr>
<td>· Fire Extinguishers</td>
<td>Identify closest usable tornado shelter that is available (each work area)</td>
<td>· HAZ COM</td>
</tr>
<tr>
<td>· Emergency Eyewash</td>
<td>Pre/post maintenance/calibration per manufacturer’s rec.</td>
<td>· Hearing conservation</td>
</tr>
<tr>
<td>· First Aid Kit</td>
<td>Visual prior to use</td>
<td>· MD/ MEC awareness</td>
</tr>
<tr>
<td>· Insect repellant- DEET</td>
<td></td>
<td>· Applicable AHA’s</td>
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<tr>
<td>· Hand tools</td>
<td></td>
<td>· Fire extinguisher use</td>
</tr>
<tr>
<td>· Spill containment supplies</td>
<td></td>
<td>· Biological hazard identification and control</td>
</tr>
<tr>
<td>· First aid supplies</td>
<td></td>
<td>· Tornado/hurricane shelter location</td>
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<tr>
<td>· Containers as needed</td>
<td></td>
<td>· Lightning safety procedures</td>
</tr>
<tr>
<td>· Tarps</td>
<td></td>
<td>· Heat stress prevention and heat stroke treatment</td>
</tr>
<tr>
<td>· GFCI if electrical equipment utilized</td>
<td></td>
<td>· Cold stress prevention</td>
</tr>
<tr>
<td>· Heavy duty ext. cords</td>
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<td>· Drinking water</td>
<td></td>
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<td>· Weather radio</td>
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<tr>
<td>· Heat stress monitoring</td>
<td></td>
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<tr>
<td>· Sample bottles/ preservatives/ coolers</td>
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<tr>
<td>· Hand tools</td>
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<tr>
<td>· PPE</td>
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<tr>
<td>· Sample bottles and preservatives</td>
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<td>· Photoionization detection</td>
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<tr>
<td>· Combustible gas meter</td>
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<td>· Gamma radiation detector</td>
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### ACTIVITY HAZARD ANALYSIS 44.15

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Well and Borehole Abandonment  
**Prepared By:** Mark McGowan, CIH, CSP  
**Revised By:** Brett Brodersen, PM

#### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
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<td>H</td>
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<td>L</td>
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</table>

#### Overall Risk Assessment Code (RAC): M

<table>
<thead>
<tr>
<th>Probability</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
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</thead>
<tbody>
<tr>
<td><strong>Risk Assessment Code Matrix</strong></td>
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<tr>
<td></td>
<td>E=E</td>
<td>Extremely High Risk</td>
<td>H=High Risk</td>
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</tr>
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#### Job Steps • Hazards • Actions to Eliminate or Minimize Hazards

<table>
<thead>
<tr>
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<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Determine location for set up/staging equipment | Traffic  
Struck by hazards  
Driving over soft ground/uneven terrain | • Select location away from traffic.  
• Place barricades for work site protection, if necessary and wear high visibility vest.  
• Choose location with firm soils for set up and driving as much as possible. | M |
| 2. Well abandonment | Bentonite dust  
Heavy lifting  
Work on uneven surfaces  
Contact with potential contaminated materials such as VOCs  
Flammable or hazardous atmosphere  
Welding and cutting hazards  
Exposure to bacteria  
Struck by hand tools  
Exposure to treatment chemicals  
General site Hazards Environmental Hazards:  
- Biologicals (plants, insects, wild life)  
- Adverse weather  
- Temperature stresses  
- UV hazards  
- Noise | • Require air purifying (P100 or N100) respirator if dusty conditions exist.  
• Use proper lifting technique. Use mechanical means or the buddy system if weight is greater than 50 lbs.  
• Watch set up and footing in order avoid tripping or equipment toppling.  
• Follow HASP directives for appropriate PPE and air monitoring equipment.  
• Monitor atmosphere with LEL/Oxygen direct reading instrumentation as indicated by site contaminants.  
• Obtain hot work permit for torching and welding.  
• Follow PPE requirements as specified in the HASP and H&S Manual.  
• Use tools for their intended purpose and inspect tools daily for uneven wear and damage.  
• Review MSDS/SDSs, follow directions of use, assure all chemicals are labeled, wear appropriate PPE.  
• See general site hazards AHA. | M |
## AHA – Well and Borehole Abandonment (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| **3. Wrap up**| **Take home toxics** | • Decontaminate with soap and water or wipes.  
• Remove all contaminated clothing and materials and leave on-site. Use plastic as a barrier for soil, truck bed or foot well contact. | L   |

### Add Additional Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.

### Equipment Inspection Training

<table>
<thead>
<tr>
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<th>Training</th>
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<tbody>
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<td>CP / QP:</td>
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<tr>
<td>• Hard Hat</td>
<td>Pre and post maintenance and calibration</td>
<td>CP/SSH0</td>
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<td>• Safety Glasses</td>
<td>Housekeeping (daily)</td>
<td>Alternate CP/SSH0</td>
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<td>• Safety-Toed Boots</td>
<td>• Fire extinguisher (monthly)</td>
<td>QP/First Aid and CPR</td>
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<tr>
<td>• Work Gloves/Chemical resistant gloves</td>
<td>• Vehicle inspection (daily)</td>
<td>Training Requirements (as determined by the SSHO):</td>
</tr>
<tr>
<td>• ANSI Class 2 reflective warning vests</td>
<td>• Eye Wash</td>
<td>• HAZWOPER 40</td>
</tr>
<tr>
<td>• APR when using bentonite if dusty conditions exist.</td>
<td>• Equipment and tools inspection (daily and before use)</td>
<td>• Site safety orientation</td>
</tr>
<tr>
<td><strong>Other Equipment:</strong></td>
<td>• Survey areas for poisonous plants, insects, and animals(each work area)</td>
<td>• Tailgate meetings</td>
</tr>
<tr>
<td>• Fire Extinguishers</td>
<td>• Check body for ticks (each evening during tick season)</td>
<td>• Emergency procedures</td>
</tr>
<tr>
<td>• Emergency Eyewash</td>
<td></td>
<td>• HAZ COM</td>
</tr>
<tr>
<td>• First Aid Kit</td>
<td></td>
<td>• Hearing conservation</td>
</tr>
<tr>
<td>• Insect repellant- DEET</td>
<td></td>
<td>• MD/MEC awareness</td>
</tr>
<tr>
<td>• Hand tools</td>
<td></td>
<td>• Applicable AHAs</td>
</tr>
<tr>
<td>• Spill containment supplies</td>
<td></td>
<td>• Fire extinguisher use</td>
</tr>
<tr>
<td>• First aid supplies</td>
<td></td>
<td>• Biological hazard identification and control</td>
</tr>
<tr>
<td>• Containers as needed</td>
<td></td>
<td>• Tornado shelter location</td>
</tr>
<tr>
<td>• Tarps</td>
<td></td>
<td>• Lightning safety procedures</td>
</tr>
<tr>
<td>• GFCI</td>
<td></td>
<td>• Heat stress prevention and heat stroke treatment</td>
</tr>
<tr>
<td>• Heavy duty ext. cords</td>
<td></td>
<td>• Cold stress prevention</td>
</tr>
<tr>
<td>• Drinking water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weather radio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Heat stress monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Wind sock</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ACTIVITY HAZARD ANALYSIS 44.16

**Date Prepared:** 9/13/2013  
**Project Name:** Peck Iron and Metal RIFS  
**Activity/Work Task:** Sampling and Analysis  
**Prepared By:** Mark McGowan, CIH, CHMM  
**Revised By:** Brett Brodersen, PM

**Overall Risk Assessment Code (RAC): L**

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Controls</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1. Pre-job set up | Emergency Response | • Review MSDSs/SDSs if applicable.  
• Identify air monitoring equipment and usage.  
• Identify PPE requirements as specified in the HASP.  
• Identify rallying points.  
• Notification of proper authorities in event of an emergency. | L |
|  | Job site hazards/ security | • Prior to start of work, inspect site for any hazardous conditions and correct before work starts.  
• Make sure work area is properly secured to safely perform work at hand. | L |
|  | Equipment inspection and physical hazards | • Ensure personnel are trained on specific tools.  
• Inspect tools before each use.  
• Use correct tool for the job.  
• Make use of all safety devices and ensure they are functioning. | L |
| 2. Mobilization & set up of equipment | Biological (i.e., Plants, Insects, Snake, and Infectious Material) | • Tuck pants into socks.  
• Wear long sleeves.  
• Use insect repellent.  
• Avoid contact by always looking ahead to where walking; standing; sitting; leaning; grabbing; lifting; or reaching-in-to.  
• Check for signs of insect/spider bites, such as redness, swelling, and flu-like symptoms.  
• Remove ticks immediately with fine tipped tweezers by grasping the tick as close to your skin as possible and gently pulling straight out. Do not squeeze the tick’s body as this may inject fluids into you.  
• Wash the bite area of skin and apply antiseptic. | L |

**Risk Assessment Code Matrix**

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Frequent</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Likely</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Occasional</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Seldom</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Unlikely</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
## AHA – Sampling and Analysis (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Controls</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Mobilization &amp; set up of equipment (continued)</td>
<td><strong>Severe Weather</strong>&lt;br&gt;• Stop outdoor work during electrical storms and other extreme weather conditions such as extreme heat or cold temperatures.&lt;br&gt;• Take cover indoors or in vehicle.&lt;br&gt;• Listen to local forecasts for warnings about specific weather hazards such as tornadoes, hurricanes, and flash floods.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Walking/Working surface</strong>&lt;br&gt;• Good housekeeping practices.&lt;br&gt;• Keep walkways and work areas clear of hoses, cords, and clutter.&lt;br&gt;• Restrict site to essential personnel.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Handling heavy objects/material</strong>&lt;br&gt;• Use proper lifting techniques.&lt;br&gt;• Utilize proper hoisting/material handling techniques and/or equipment.&lt;br&gt;• Use buddy system for heavy, awkward loads and/or if weight of the load equals or exceeds 100 lbs.&lt;br&gt;• Distribute loads evenly.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Hand injuries from pinch points</strong>&lt;br&gt;• Ensure site personnel utilize appropriate hand protection.&lt;br&gt;• Avoid placing hands in tight spaces while moving materials.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Heat Stress</strong>&lt;br&gt;• Increase water intake while working.&lt;br&gt;• Minimize and/or avoid alcohol intake the night before working in heat stress situations. Increase number of rest breaks and/or rotate workers in shorter work shifts; take breaks in shaded areas.&lt;br&gt;• Watch for signs and symptoms of heat exhaustion and fatigue.&lt;br&gt;• Plan work for early morning or evening during hot months.&lt;br&gt;• Use ice vests when necessary.&lt;br&gt;• Rest in cool, dry areas.&lt;br&gt;• In the event of heat stroke, bring the victim to a cool environment ad initiate first aid procedures.&lt;br&gt;• Follow ACGIH Heat Stress Guidelines for Monitoring and establishing a work/rest regimen.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Cold Stress</strong>&lt;br&gt;• Take breaks in heated shelters when working in extremely cold temperatures.&lt;br&gt;• Remove the outer layer of clothing and loosen other layers to promote evaporation of perspiration, upon entering the shelter.&lt;br&gt;• Be aware of cold stress symptoms such as shivering, numbness in the extremities, and sluggishness.&lt;br&gt;• Drink warm liquids to reduce the susceptibility to cold stress.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Insects – Outdoor Work, if Required</strong>&lt;br&gt;• See Job Task 2, Hazard 1, Biological.</td>
<td>L</td>
</tr>
<tr>
<td>3.</td>
<td>Sampling</td>
<td><strong>Chemical spill</strong>&lt;br&gt;• Good housekeeping practices.&lt;br&gt;• Maintain spill response equipment on site.&lt;br&gt;• Practice spill prevention at all times.&lt;br&gt;• Proper chemical storage.&lt;br&gt;• Spill control and countermeasures plan in place for spills encountered during work activities.&lt;br&gt;• Turn off equipment when fuelling. Report all spills to the SSHO.&lt;br&gt;• Subcontractors to supply MSDSs for chemicals to be used.</td>
<td>L</td>
</tr>
</tbody>
</table>
### AHA – Sampling and Analysis (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Controls</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. Sampling (continued) | Contact with sharp objects/material | • Ensure personnel are trained on specific tools.  
• Use correct tool for the job.  
• Make use of all safety devices and ensure they are functioning.  
• Use care with utility knives, replace dull blades, store properly.  
• Wear appropriate PPE (i.e., gloves, long-sleeved shirts and long pants) to avoid scratches.  
• Be aware of body positioning, and ensure that tools are handled correctly.  
• Take care to cut in a direction away from the body.  
• Avoid placing hands in tight places while moving materials. Inspect tools before each use.  
• If tool is not fit for use, report the condition to SSHO, so that it will be taken out of service.  
• If unsure about use of any tool ask SSHO before attempting to utilize tool or equipment. | M |
| Biological (i.e., Plants, Insects, Snake, and Infectious Material) | See Job Step 2, Hazard 1. Biological. | L |
| Severe Weather | See Job Step 2, Hazard 2. Severe Weather. | L |
| Flying Debris | Ensure guards are installed and working on tools/equipment. Wear appropriate PPE (i.e., Safety glasses/goggles/face shield). | L |
| Inhalation/contact with hazardous material | Ensure site personnel have the appropriate HAZWOPER, medical clearance and Site Specific training.  
• Follow decontamination procedures. Follow emergency contingency procedures.  
• Implement site control areas.  
• Perform real time air monitoring.  
• Wear appropriate PPE for task/activity performed. | L |
| Walking/Working surface | See Job Step 2, Hazard 3. Walking/Working surface. | L |
| Handling heavy objects/material | See Job Step 2, Hazard 4. Handling heavy objects/material. | M |
| Electrical Hazards | Keep heavy equipment at least 10 feet from overhead power lines.  
• Area may have unmarked/unknown underground conduit; when an unknown hazard has been encountered, stop work until hazards and controls are identified and in place.  
• Ensure all electric power tools are energized through a GFCI. Inspect equipment daily before use. | L |
| Hand injuries from pinch points | See Job Step 2, Hazard 5. Hand injuries from pinch points. | L |
| Hand/Power tools | Ensure personnel are trained on specific tools.  
• Inspect tools before each use.  
• Use correct tool for the job.  
• Make use of all safety devices and ensure they are functioning. | L |
| Heat Stress | See Job Step 2, Hazard 6. Heat Stress. | L |
| Cold Stress | See Job Step 2, Hazard 7. Cold Stress. | L |
### AHA – Sampling and Analysis (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Controls</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. Sampling (continued) | Chemical Splashing during sampling | • Wear Modified Level D PPE to avoid skin, eye, and inhalation contact with contaminated groundwater and/or soil.  
• Stand upwind when conducting tasks and minimize possible inhalation exposure; especially when first opening monitoring wells.  
• Conduct air monitoring to determine level of respiratory protection.  
• Utilize engineering controls such as portable venturi air movers to draw away or blow away chemical vapors. | L |
| | Static Electricity | • Use grounding clip on interface probe. | L |
| | Contact with corrosive chemicals used as sample preservatives contained in sampling bottles. | • Wear appropriate gloves and eye protection to avoid contact with corrosive chemicals in sampling containers. | M |
| 4. Demobilization of Equipment | Biological (i.e., Plants, Insects, Snake, and Infectious Material)  
Severe Weather  
Walking/Working surface  
Handling heavy objects/material  
Hand injuries from pinch points  
Heat Stress  
Cold Stress | • See Job Step 2 for hazard controls | |
| 5. Decontamination of Equipment | Equipment Decontamination | • Wear modified Level D protection, including a face shield and safety goggles.  
• Ensure that other personnel are out of the area prior to decontamination.  
• Secure the area around the decontamination pad with cones, caution tape, or barricades.  
• Ensure that safe work practices and precautions are taken to minimize the potential for physical injury.  
• Ensure that area is clean after equipment is decontaminated. Barricades, cones, or caution tape must be left in place and secured at all times.  
• Avoid skin and eye contact with isopropyl alcohol, Alconox, or other cleaning materials.  
• Stand upwind to minimize any potential inhalation exposure.  
• Dispose of spent cleaning solutions and rinses accordingly. | L |
### Equipment

<table>
<thead>
<tr>
<th>PPE Level D/C:</th>
<th>Daily SSHO __________________________</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Hat</td>
<td>Mechanized equipment (daily)</td>
<td>CP / QP:</td>
</tr>
<tr>
<td>Safety Glasses with side shields</td>
<td>Overhead utilities (prior to operating equipment in area) Locate underground utilities (prior to intrusive activities)</td>
<td>CP/SSHO __________________________</td>
</tr>
<tr>
<td>Safety-Toed Boots</td>
<td>Excavation inspection (daily)</td>
<td>Alternate CP/SSHO __________________________</td>
</tr>
<tr>
<td>Work Gloves and Boots/Chemical resistant gloves and boots</td>
<td>Housekeeping (daily)</td>
<td>QP/First Aid and CPR __________________________</td>
</tr>
<tr>
<td>Class 2 high visibility vests</td>
<td>Fall protection (before each use)</td>
<td>QP/First Aid and CPR __________________________</td>
</tr>
<tr>
<td>If dust is generated, APR Half Face Respirator with particulate and organic fume cartridge</td>
<td>Fire extinguisher (monthly)</td>
<td>Training Requirements (as determined by the SSO):</td>
</tr>
<tr>
<td>Hearing protection, as necessary</td>
<td>Vehicle inspection (daily)</td>
<td>- Site safety orientation</td>
</tr>
<tr>
<td>Face-shield – disconnecting hoses, when pressure testing pipe, or working with high pressure fluids</td>
<td>Equipment and tools inspection (daily and before use)</td>
<td>- Emergency procedures</td>
</tr>
<tr>
<td>Welding and cutting PPE - refer to SSHP.</td>
<td>Survey areas for poisonous plants, insects, and animals (each work area)</td>
<td>- HAZ COM</td>
</tr>
<tr>
<td>Fall protection - working at heights greater than 6 feet Electrical PPE (NFPA 70E, 2012)</td>
<td>Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area)</td>
<td>- Hearing conservation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- MD/ MEC awareness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Applicable AHA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Qualified equipment operators Lifting/back safety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fall protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fire extinguisher use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Biological hazard identification and control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tornado/hurricane shelter location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Lightning safety procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heat stress prevention and heat stroke treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cold stress prevention</td>
</tr>
</tbody>
</table>

### Other Equipment:

- Air monitoring instruments
- Noise dosimeter
- Fire Extinguishers
- First Aid Kit
- GFCl
- Heavy duty extension cords (S, ST, SO, STO, SJ, SJO, SJT, SJT)
- Drinking water
- Weather radio Caution tape
- Excavation perimeter protection
- Tag lines
- Insect repellant with DEET (Deep Woods Off™ or equivalent) Repel Permanone™
- Soil jars/preservatives/cookers
- Heat stress monitoring
- PID
- Combustible Gas meter
- Personal and perimeter dust meters
- Schönstedt magnetic wand and downhole magnetometer
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Date Prepared: 9/13/2013  
Project Name: Peck Iron and Metal RIFS  
Activity/Work Task: Investigation Derived Waste (IDW) Management  
Prepared By: Mark McGowan CIH, CHMM  
Revised By: Brett Brodersen

### Overall Risk Assessment Code (RAC): M

#### Risk Assessment Code Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>Frequent</td>
<td>Likely</td>
<td>Occasional</td>
<td>Seldom</td>
</tr>
<tr>
<td>E = Extremely High Risk</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>H = High Risk</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>M = Moderate Risk</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>L = Low Risk</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

### ACTIVITY HAZARD ANALYSIS 44.17

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 1.        | Determine location for set up/staging equipment                         | • Select location away from traffic.  
• Place barricades for work site protection, if necessary.  
• Wear high visibility vest.  
• Note all moving equipment in work areas. |
|           | Traffic-Struck by hazards                                               |                                                                                                          | M   |
|           | Driving and walking over soft ground- Uneven terrain                    | • Choose location with level and firm soils.  
• Be aware of rocks, brush, animal boroughs and other hazards.  
• Choose firm ground for walking. | M   |
|           | Slip, trip and fall hazards                                              | • Wear slip resistant footwear.  
• Keep work area picked up and as clean as feasible and free of tripping and fall hazards.  
• Use railings and barrier with gated access around underground openings. |     |
| 2.        | Drum waste, sealing drums and transporting drums                        | • Wear leather steel-toed/ ceramic toed boots when there is heavy material being handled.  
• Check bung lids to be sure they are tight to prevent leaks.  
• Use mechanical aid (drum dolly) for relocating drums.  
• Wear appropriate chemical resistant PPE as specified in the HASP.  
• Wear thick clothing when there is a potential for lacerations.  
• Wear abrasion resistant hand protection. |
|           | Cut/crush/skin absorption hazards-Hand and Foot                         |                                                                                                          | M   |
|           | Inhalation, skin contact and ingestion hazards with COC, etc.           | • Follow PPE specifications in the HASP. Follow upgrades in PPE based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP.  
• Communicate air sampling results.  
• Review hazards of COCs and review MSDSs/SDSs of chemicals brought to site. | M   |
<table>
<thead>
<tr>
<th>Job Steps</th>
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<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 2. Drum waste, sealing drums and transporting drums (continued)          | Inhalation, skin contact and ingestion hazards with COC, etc. (continued) | • Wear chemical resistant gloves based on the identified chemicals. Boot covers and splash suit protection if necessary.  
• Label all IDW containers as to contents.  
• Follow good hygiene practices: no eating, drinking or smoking until decontaminated and out of EZ.  
• IDW transport and disposal activities shall be IAW applicable local, municipal, county, state, and Federal rules and regulations. |     |
|                                                                          |                                                                        | **Flying debris-eye**                                                                                   | L   |
|                                                                          |                                                                        | • Wear safety glasses when there is potential for flying debris or splash hazard.  
• Ensure eyewash is available. |     |
|                                                                          |                                                                        | **Strains, sprains, awkward bending/lifts and ergonomic hazards. Injury from physical exertion.**          |     |
|                                                                          |                                                                        | • Use proper lifting techniques.  
• Avoid twisting/turning while moving drums, pulling tools, etc.  
• Ensure walking pathway is clear.  
• Do not lift greater than 50 lbs.  
• Use mechanical assistance if the weight of the equipment/supplies is greater than or equal to 100 lbs.  
• Limit repetitive awkward motions.  
• Assure solid footing.  
• Maintain good personal level of fitness.  
• Be alert to signs and symptoms of overexertion.  
• Have water and first aid supplies available.  
• Assure all tools are in good condition and used for their intended purpose.  
• Discuss and caution personnel about knowing their limitations. |     |
|                                                                          |                                                                        | **Noise**                                                                                               | L   |
|                                                                          |                                                                        | • Wear hearing protection if noise levels from neighboring equipment exceeds 80 dBAs (if you cannot be heard speaking in a normal voice at arms distance). |     |
|                                                                          |                                                                        | **Electric shock**                                                                                      | L   |
|                                                                          |                                                                        | • Require a GFCI for any electrical equipment powered by a generator.                                   |     |
|                                                                          |                                                                        | **Environmental protection/spills**                                                                     | L   |
|                                                                          |                                                                        | • Place plastic where it is needed, to protect environment.  
• Containerize all purge water and waste.  
• Use absorbents and containers for spills. |     |
|                                                                          |                                                                        | **Remote location**                                                                                     | L   |
|                                                                          |                                                                        | • Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system. |     |
|                                                                          |                                                                        | **Environment and biological hazards**                                                                  | M   |
|                                                                          |                                                                        | • Adverse weather  
• Temperature Stress  
• UV Hazards  
• Plants, insects and local wildlife  
• Radiation |     |
|                                                                          |                                                                        | • See General Site Hazards AHA.  
• IDW waste shall be handled in accordance with the RPP (AVESI, 2014) |     |
|                                                                          |                                                                        | **Take home toxics**                                                                                     | L   |
|                                                                          |                                                                        | • Decontaminate with soap and water.  
• Remove all contaminated clothing and materials and leave on-site.  
• Use plastic as a barrier for soil, truck bed or foot well contact.  
• Check for ticks on body and remove within 24 hours to prevent transmittal of infection (lymes disease precaution). |     |
### AHA – IDW Management (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
</table>
| 3. IDW waste characterization and management | Inhalation, skin contact, ingestion of contaminants                      | - Follow PPE dictates of HASP. Follow upgrades in PPE based on airborne measurements and action levels. Conduct real-time air monitoring as required by HASP.  
- Communicate results of monitoring.  
- Obtain or review chemical information on COCs.  
- Follow respirator action level dictates of HASP.  
- Remain upwind whenever possible. | L   |
| 4. Drum placement                  | Crushing injuries                                                      | - Transport drums properly and keep on level ground.  | L   |
|                                    | Fire                                                                   | - Transport/store all flammable liquids in UL/FM approved containers.  
- Prohibit smoking and all other sources of ignition during refueling operation.  
- Keep fully charged ABC fire extinguisher in vehicle. Inspect weekly.  
- Use in well-ventilated area.                                               | L   |
|                                    | Malfunctioning equipment                                              | - Inspect generators and support equipment (pumps, water meters, transducers, and related equipment) daily and document.                                                                                                                  | L   |
| 5. IDW collection                  | Chemical spills and chemical contact with skin and eyes.                | - Never leave open chemicals unattended.  
- Know location of nearest eyewash station.  
- Wear proper PPE as specified in HASP (for example: nitrile gloves, safety glasses, acid apron).  
- Keep prep and pack area well ventilated (open window).  
- Know location of MSDSs/ SDSs, absorbent spill cloth and hazmat spill kit.  
- Make sure all caps are secure.                                            | L   |

Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.
### Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPE Level D:</td>
<td>Daily inspection (SSHO)</td>
<td>CP / QP: CP/SSHO</td>
</tr>
<tr>
<td>· Hard Hat</td>
<td></td>
<td>Alternate CP/SSHO</td>
</tr>
<tr>
<td>· Safety Glasses</td>
<td></td>
<td>QP/First Aid and CPR</td>
</tr>
<tr>
<td>· Safety-Toed Boots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Work Gloves/Chemical resistant gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· ANSI Class 2 reflective warning vests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Fire Extinguishers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Emergency Eyewash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· First Aid Kit</td>
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<td></td>
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<tr>
<td>· Insect repellant- DEET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Hand tools</td>
<td></td>
<td></td>
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<tr>
<td>· Spill containment supplies</td>
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<td></td>
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<tr>
<td>· First aid supplies</td>
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<tr>
<td>· Containers as needed</td>
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<td></td>
</tr>
<tr>
<td>· Tarps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· GFCI if electrical equipment utilized</td>
<td></td>
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<tr>
<td>· Heavy duty extension cords</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Drinking water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Weather radio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>· Heat stress monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Housekeeping (daily)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Fire extinguisher (monthly)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Vehicle inspection (daily)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Eye Wash</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Equipment and tools inspection (daily and before use)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Survey areas for poisonous plants, insects, and animals (each work area)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>· Check body for ticks (each evening during tick season)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify closest usable tornado/hurricane shelter that is available (each work area)</td>
<td></td>
</tr>
</tbody>
</table>

Training Requirements (as determined by the SSHO):
- HAZWOPER 40 hour
- Site safety orientation
- Tailgate meetings
- Emergency procedures
- HAZ COM
- Hearing conservation
- MD/ MEC awareness
- Applicable AHAs
- Fire extinguisher use
- Biological hazard identification and control
- Tornado/hurricane shelter location
- Lightning safety procedures
- Heat stress prevention and heat stroke treatment
- Cold stress prevention
## ACTIVITY HAZARD ANALYSIS

<table>
<thead>
<tr>
<th>Overall Risk Assessment Code (RAC) (Use highest code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
</tr>
</tbody>
</table>

### Risk Assessment Code (RAC) Matrix

<table>
<thead>
<tr>
<th>Severity</th>
<th>Frequent</th>
<th>Likely</th>
<th>Occasional</th>
<th>Seldom</th>
<th>Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>E</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>Critical</td>
<td>E</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Marginal</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Negligible</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

**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

### Job Steps

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct Building Inspection</td>
<td>Slips, Trips, Falls</td>
<td>Maintain good housekeeping. Wear slip resistant footwear. Remove obstructions to provide a clear pathway to observation point. Inspect the work area for slip, trip and fall hazards on a continuous basis. Establish a walkway on floors that are structurally sound and cleared of debris. Wear slip resistant footwear. Keep work area picked up and as clean as feasible and free of tripping and fall hazards. Exercise caution and avoid walking in areas which can give way. Continually inspect the work area for slip, trip and fall hazards. Note that egress routes are as clear and unobstructed as possible. Use extra caution when working on uneven ground.</td>
<td>M</td>
</tr>
<tr>
<td>Job Steps</td>
<td>Hazards</td>
<td>Actions to Eliminate or Minimize Hazards</td>
<td>RAC</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Conduct Building Inspection</td>
<td>Stairways that may be in disrepair thus causing fall hazards</td>
<td>Inspect stairways prior to use. Only the stairways that are approved for use will be used (Western and Central stairs). Eastern stairways will be taped off. Install lights in the stairways, if necessary, and use headlamps when in the stairways.</td>
<td>M</td>
</tr>
<tr>
<td>Falling Objects</td>
<td>Wear hardhat and steel-toed boots.</td>
<td>Stay alert and stay clear of materials suspended overhead.</td>
<td>M</td>
</tr>
<tr>
<td>Flying debris, dirt, dust, etc.</td>
<td>Wear the appropriate respiratory protection when dirt, dust, animal feces and debris are a concern. Wear eye protection when dust and debris may become airborne. Have a wash eye station readily available. Do not disturb dry or friable asbestos insulation, plaster, ceiling and floor tiles that may be present. Do not disturb lead paint that may be present. Avoid creating or breathing dust.</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Inadequate lighting</td>
<td>Use conductive headlamps and flashlights as necessary. Have spare batteries, light sources, and bulbs on hand.</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Ladders</td>
<td>Use an A-frame ladder and inspect before each use. Keep the ladder fully opened when in use, and a second person will hold the ladder when in use. Do not use the top rung of the ladder as a step.</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Weakened structural elements</td>
<td>Inspect weight bearing structural elements from below prior to walking or climbing on them. Use a screw driver to test strength of wooden members and a ballpein hammer to test metal components.</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Falls from height</td>
<td>Stay 5 feet away from the roof parapet (assuming the roof is secure.). Inspection team members will stay and one person will be the designated observer to make sure this happens.</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Exposure to highly contaminated materials</td>
<td>Avoid the materials that have been segregated and tarped.</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Unhygienic conditions</td>
<td>Use restroom facilities, if installed on site. Restrooms will be adequately provided and maintained. Maintain hand disinfectant, wipes, wash stations.</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Fire</td>
<td>Maintain at least one dry chemical fire extinguisher having a minimum UL rating of 1A5BC on site.</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Job Steps</td>
<td>Hazards</td>
<td>Actions to Eliminate or Minimize Hazards</td>
<td>RAC</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Conduct Building Inspection</td>
<td>Personal safety</td>
<td>Do not travel alone.</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If you must work alone employ a “check-in” system and/or the buddy system. Maintain adequate gear and equipment for possible emergencies.</td>
<td></td>
</tr>
<tr>
<td>Biologics: Contact with</td>
<td>poisonous plants, allergens, insects and animal kingdom hazards</td>
<td>Follow General Site Hazards AHA.</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>(for example: spiders, hornets, reptiles, snakes, ticks, mosquitoes,</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>bird and rodent droppings, biting and stinging insects)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand tools/power tools-cut</td>
<td>hazards, jamming, pinch points, struck-by</td>
<td>Assure that hand tools are in good repair and used correctly. The right tool for the right job. Inspect tools daily prior to use and remove defective tools from service immediately. Wear PPE with eye protection and leather gloves per the SSHP for all tasks with potential for cuts or lacerations.</td>
<td>M</td>
</tr>
<tr>
<td>Poor air quality – Dust/low</td>
<td>oxygen environments</td>
<td>Where appropriate PPE (e.g., ½ face respirators with particulate filters, hard hats, Saranex (or equivalent) coveralls and boot covers). Utilize 4 gas meters to monitor oxygen, methane, carbon monoxide, and low level explosive concentrations. Do not enter confined spaces without appropriate permits.</td>
<td>M</td>
</tr>
<tr>
<td>Completion of work shift</td>
<td>Take home toxics-Contact with potentially contaminated materials</td>
<td>Note a source of Decon water on site or use wipes as necessary. Do not bring contaminated PPE or boots into truck. Wear Tyvek as necessary and washable or disposable over-boots in order to keep personal clothing clean and free of contaminated soils. Store and dispose of contaminated materials in accordance with regulations. Use liners to prevent contamination of truck. Shower immediately at end of work day. Check body for ticks, bites and signs of irritation or cuts.</td>
<td>M</td>
</tr>
</tbody>
</table>
AHA – Building Inspection (continued)

<table>
<thead>
<tr>
<th>Job Steps</th>
<th>Hazards</th>
<th>Actions to Eliminate or Minimize Hazards</th>
<th>RAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Inspection</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal Protective Equipment:</strong></td>
<td>Daily site safety inspection (SSHO)</td>
<td>Competent Person (CP) / Qualified Person (QP):</td>
</tr>
<tr>
<td>PPE Level D:</td>
<td></td>
<td>CP/SSHO</td>
</tr>
<tr>
<td>Hard hat (if there are overhead hazards)</td>
<td></td>
<td>Alternate CP/SSHO</td>
</tr>
<tr>
<td>Safety glasses</td>
<td></td>
<td>QP/First Aid and CPR</td>
</tr>
<tr>
<td>Safety-toed boots</td>
<td></td>
<td>QP/First Aid and CPR</td>
</tr>
<tr>
<td>Work gloves/chemical resistant gloves</td>
<td></td>
<td></td>
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<tr>
<td>½ face respirator with particulate filter</td>
<td></td>
<td></td>
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<tr>
<td>Head lamps</td>
<td></td>
<td></td>
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<tr>
<td>Saranex</td>
<td></td>
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<tr>
<td><strong>Other Equipment:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 gas meters, oxygen meter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All equipment required for site set up: Ladders, hand tools, lights</td>
<td></td>
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</tbody>
</table>

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Page 4 of 4
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ATTACHMENT 3
LEAD COMPLIANCE PLAN
LEAD COMPLIANCE PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PECK IRON AND METAL
PORTSMOUTH COUNTY, VIRGINIA

Prepared for:

U.S. Environmental Protection Agency Region 3
1650 Arch Street
Philadelphia, PA 19103

Prepared by:

HydroGeoLogic, Inc
1835 Market Street, Suite 1210
Philadelphia, PA 19103

November 2011
LEAD COMPLIANCE PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PECK IRON AND METAL, PORTSMOUTH, VIRGINIA

1.0 INTRODUCTION

In accordance with 40 Code of Federal Regulations (CFR) 1926.62, this Lead Compliance Plan (Compliance Plan) has been developed to minimize and/or prevent accidental lead exposure from occurring during Remedial Investigation (RI) sampling activities at the Peck Iron and Metal Superfund site (site), in Norfolk County, Virginia. This Compliance Plan supplements the health and safety requirements presented in the site-specific Health and Safety Plan (HASP). The RI is being executed by HydroGeoLogic, Inc. (HGL) under U.S. Environmental Protection Agency (EPA) Region 3 Response Action Contract (RAC) II, Work Assignment No. 044RICOA3Z4.

2.0 PLANNED REMEDIAL INVESTIGATION SAMPLING ACTIVITIES

Site-specific background information has been provided in the HASP (HGL, 2011a) and the Site Management Plan (SMP) (HGL, 2011b). Former waste management practices, contaminant transport pathways, and the results of previous investigation are also provided in the SMP (HGL, 2011b). RI field activities that will be conducted and that may result in lead exposure include the following:

- X-ray fluorescent (XRF) soil sample preparation (i.e., drying and collecting measurements);
- Munitions and explosives of concern (MEC) visual surface inspection and subsurface avoidance activities;
- Soil and sediment sampling of the wetland and Paradise Creek area;
- Drilling activities, including soil augering, sonic borehole drilling, and temporary and permanent monitoring well installations;
- Redevelopment of existing groundwater monitoring wells;
- Sampling of site groundwater monitoring wells; and
- Sample point surveying.

Multiple subcontractors will be performing activities at the site in support of the RI. All subcontractors will responsible for their own health and safety, and they will be notified in writing during the subcontractor procurement bidding process of the lead concentrations associated with the site and be provided with previously collected analytical site data. Each awarded subcontractor will be required follow the HGL HASP. In addition, the awarded
subcontractors shall submit activity hazard analyses (AHAs) that will be in compliance with applicable Occupational Safety and Health Administration (OSHA) regulations to minimize potential lead exposures for their personnel. During the field event, all subcontractor employees will be in compliance with their respective AHAs; those employees not in compliance with their AHAs or HGLs HASP will be required to leave the site.

3.0 PROJECT-SPECIFIC LEAD COMPLIANCE PROGRAM

3.1 EXPOSURE MONITORING

Prior to conducting work, background screening will be conducted to determine the action level (AL) for dust monitoring. One background location will be utilized to collect readings and will be located in an area upwind of the anticipated field sampling activities. The AL will be determined by adding 150 micrograms per cubic meter (µg/m³) to the background readings. Dust monitoring will be conducted continuously during activities that generate dust. If dust levels are above the AL (i.e., 150 µg/m³ above background dust concentrations) wet misting will be used to reduce or eliminate the dust.

Exposure dust monitoring will be conducted during all surface and subsurface soil investigation activities. Dust monitors will be set at least 20 feet from the location being sampled, along the downwind and upwind perimeters of the investigation area for that field event.

In addition to the use of dust monitors, personal dust monitoring will be conducted under the direction of a person trained by a certified industrial hygienist (CIH). The dust monitoring will be conducted on two people working in both uncontaminated (if possible) and highly contaminated areas over a period of 3 days in each environment. MCE cassettes will be utilized with the personal air sampling pumps. Air will be drawn through closed-top cassettes at 2 liters per minute for 480 minutes. One cassette will be opened and closed and used as a field blank. Samples will be submitted to an American Industrial Hygiene Association accredited industrial hygiene laboratory for analysis for elemental lead using National Institute for Occupational Safety and Health Method 7300. Results will be normalized to an 8-hour exposure time and compared against the OSHA lead action level of 0.03 milligrams per cubic meter (mg/m³) and the Permissible Exposure Limit (PEL) of 0.05 mg/m³.

If dust concentrations are higher than the PEL, air monitoring activities will be conducted in accordance with CFR 1926.62 as presented in the Lead Awareness Training Program (HGL, 2011c). If dust levels exceed the AL (i.e., 150 µg/m³, above background dust concentrations) wet misting will be used to reduce or eliminate the dust.

3.2 COMPETENT PERSON

The HGL field team leader (FTL) during field activities will be HGL’s on-site competent person for this project. The HGL FTL will be in direct contact with HGL’s CIH (Mark McGowan) during monitoring activities.
3.3 MEDICAL SURVEILLANCE AND REMOVAL

3.3.1 Blood Testing

As exposure concentrations will be unknown prior to monitoring and sampling activities, HGL will, as a precautionary measure, implement a mandatory medical monitoring program at the start of the project. Follow-up medical physicals and tests will be determined after samples and monitoring results have been evaluated. Pre-RI blood testing will be conducted to evaluate the blood lead results that will be collected after the completion of the field event. The pre-RI blood testing will also be used to ensure that personnel conducting field sampling activities do not have pre-existing elevated blood lead concentrations.

The majority of RI field work is anticipated to be completed within a 5-month period with additional field sampling activities anticipated to occur a year later. At the end of the RI field work, all field personnel who sampled in elevated lead concentrations areas will undergo post-RI blood testing. Based on the results, follow-up blood testing may be required. The schedule for follow-up blood testing will be determined by the HGL Corporate Health and Safety Manager.

3.3.2 Medical Removal Protection Program

Elevated doses of lead in the body increases the risk for adverse health effects, especially if lead exposures continue. Therefore, the medical monitoring protection program will temporarily remove the effected individual from the project if:

- Blood testing indicates that lead levels are at or above recommended limits, or
- A physician has detected a medical condition that may increase the risk of health problems because of lead exposure.

3.4 CONTROLS/MEASURES TO BE IMPLEMENTED TO MINIMIZE LEAD EXPOSURES

3.4.1 Engineering Controls

The following engineering controls will be utilized during the RI field sampling event.

- Portable decontamination/hand and face-washing stations;
- Hotel showers;
- Portable water misters;
- Bucket lids for carrying generated purged water;
- Shoe scrapers at the entrance to the office trailer/storage unit
- Personnel protective equipment (PPE)

PPE requirements are discussed in the HASP (HGL, 2011a). If respirators are required, additional training will be needed prior to conducting further investigation activities.
3.4.2 Administrative Controls

The following administrative controls will be utilized to direct, restrict, or modify field crew behavior in an effort to prevent or minimize lead exposure:

- Plans, procedures, and permits;
- Safe work practices;
- Housekeeping;
- Postings;
- Access controls; and
- Training.

3.4.2.1 Plans, Procedures, and Permits

Plans, procedures, and permits define the operating conditions that field personnel may encounter and the special precautionary measures for personnel to undertake to minimize workplace lead exposure. When there is a potential for lead to become airborne in a manner that potentially increases a person’s risk of exposure, an AHA or a hazard control plan will identify the hazard and specify controls.

3.4.2.2 Safe Work Practices and Housekeeping

Field personnel must employ the following safe work practices and housekeeping tips to minimize or prevent exposure to lead.

- Wash your hands and face before eating, drinking, smoking, chewing gum, chewing tobacco, or applying cosmetics.
- No eating, drinking, smoking, chewing guy, chewing tobacco, or applying cosmetics will occur during activities that have the potential to generate dust or within 25 feet of any equipment that may have release dust to the atmosphere.
- Do not enter lunchrooms/offices unless you have removed your field work clothes.
- Maintain all surfaces as free as practicable of accumulations of lead dust.
- At the end of each work day, shower prior to conducting any other activity.
- Do not dry-sweep in areas where lead may be present.
- Wash your work clothes separately from your street clothes.

The importance of personal hygiene cannot be understated when occupational exposure to lead is possible. For controls such as hand washing facilities, clean changing areas, and showers to remain effective, workers must use them routinely and correctly. When shortcuts that reduce the effectiveness of these controls are taken, contamination of co-workers and family is possible.
4.0 REFERENCES


ATTACHMENT 4
LEAD AWARENESS TRAINING PROGRAM
LEAD AWARENESS TRAINING PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PECK IRON AND METAL
PORTSMOUTH COUNTY, VIRGINIA

Prepared for:

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Prepared by:

HydroGeoLogic, Inc
1835 Market Street, Suite 1210
Philadelphia, PA 19103

November 2011
1.0 INTRODUCTION

In accordance with 40 Code of Federal Regulations (CFR) 1926.62, this Lead Awareness Training Program (Training Program) has been designed to minimize and/or prevent accidental lead exposure from occurring during Remedial Investigation (RI) sampling activities to be conducted at the Peck Iron and Metal Superfund Site (Site), in Portsmouth, Virginia. A lead awareness training program is required if exposure to lead will occur at or above the action level (AL), 30 micrograms per cubic meter (µg/m³) averaged over an 8-hour period, or if skin or eye irritation from lead could occur.

This training program is to be used in conjunction with the project-specific health and safety plan (HSP) (HydroGeoLogic, Inc. [HGL], 2011a) and the HGL Lead Compliance Plan (HGL, 2011b). Site-specific background information and proposed field sampling activities are presented in the HSP and in the Site Management Plan (HGL, 2011c). Lead exposure may occur during multimedia sampling activities at the site.

2.0 LEAD PROPERTIES AND USES

Since the early 1900s, lead has been used as a pigment in paints and varnishes (many of the yellows, reds, and oranges contain lead), as a protective coating (rust retardant and primer) for metals, as a glaze for ceramics, and as an alloy in bronze, brass and steel. Many of these products are still in place today, and maintenance or construction projects that disturb paints, coatings, and fixtures have the potential to generate airborne lead. Besides the potential for occupational lead exposures, non-occupational exposures can contribute to the amount of lead within a body. Examples of non-occupational activities that may result in lead exposure include, but are not limited to, furniture refinishing, home renovation, jewelry and ceramics/pottery making, model making, and shooting at indoor firing ranges.

2.1 LEAD EXPOSURE ROUTES

Lead can enter the body via inhalation (breathing), ingestion (eating and/or drinking), and absorption (through the skin). Inhalation of airborne lead is the most common means by which lead can enter the body in the workplace. Inhalation can occur when lead is scattered in the air as a dust, fume, or mist. Inhaling small particles of lead allows the material to travel into the lungs, where it can be absorbed into the bloodstream. Ingestion is the second most common way that lead can enter into the body. Ingestion is nearly always a result of poor hygiene practices. Lead can be ingested by handling food, using cigarettes or chewing tobacco, or applying cosmetics with hands contaminated with lead. Absorption of lead through the skin is rare, but can occur if the skin is exposed to certain organic forms of lead or if certain chemicals capable of transporting heavy metals through the skin are present. Exposure to lead
through inhalation or ingestion can cause serious health effects in a variety of body systems. Such health effects may arise from acute (short-term) or chronic (long-term) exposures. The severity of an exposure depends upon the amount, or dose, of lead that enters the system.

### 2.2 ACUTE HEALTH EFFECTS

A short-term, high-dose lead exposure can cause kidney, nerve, and brain damage that may lead to seizures, coma, and death within a matter of days. Workplace exposures of this type are extremely rare, but not impossible. Signs and symptoms of acute lead exposure are similar to many common ailments and, as a result, may not be immediately recognized. Signs and symptoms of acute lead exposure may include the following:

- Blood in the urine or stool,
- Paralysis,
- Coughing,
- Restlessness,
- Digestive disorders,
- Skin or eye irritation,
- Disorientation,
- Sleeplessness,
- Drooling,
- Sweating,
- Fever and chills,
- Thirst,
- Frequent urination,
- Tingling sensation,
- Headache,
- Vomiting,
- Loss of memory,
- Weakness,
- Metallic taste,
- Yellowing of the skin and eyes (jaundice), and
- Muscle pain.

#### 2.2.1.1 Chronic Health Effects

Long-term exposures to lead can damage the following:

- Blood-forming system, impairing the replenishment of blood cells and the blood’s ability to carry oxygen,
- Central nervous system and the brain,
- Kidneys, to the extent that kidney dialysis may be needed, and
- Reproductive system in both men and women.
Signs and symptoms of chronic lead exposure can include the following:

- Anemia,
- Lack of coordination,
- Blue-black lines on the gums,
- Twitching,
- High blood pressure,
- Visual disturbances,
- Loss of appetite, and
- Weight loss.

3.0 REGULATORY BACKGROUND FOR LEAD EXPOSURE

In 1992 Congress passed the Residential Lead-Based Paint Hazard Reduction Act, also known as Title X, because of concern with low level lead poisoning in children due primarily from the ingestion of household dust and paint containing lead from deteriorating lead-based paint. The Act was comprehensive and addressed lead poisoning in housing, in public structures, and in workers involved with lead removal. It mandated the U.S. Department of Housing and Urban Development to reduce lead exposures in public and Indian housing and to develop public awareness materials. It required the U.S. Environmental Protection Agency to promulgate regulations governing lead based paint activities under the Toxic Substances Control Act (TSCA). The Act also mandated that the Occupational Safety and Health Administration (OSHA) issue a revised lead standard covering the construction industry.

OSHA’s Lead Standard for the Construction Industry was initially issued in 1971 and was subsequently revised on June 3, 1993. This OSHA standard (29 CFR 1926.62) applies to cleanup, storage, and disposal of lead contaminated materials and, therefore, applies to the Site requirements.

3.1 OVERVIEW OF OSHA REGULATIONS

The OSHA standards regarding lead exposure are as follows:

- 29 CFR 1910.1025, Occupational Safety and Health Standards, Section 1025, the lead standard for general industry (online at www.osha-sic.gov/OshStd_data/1910_1025.html)
- 29 CFR 1926.62, Safety and Health Regulations for Construction, Section 62, the lead standard for construction (online at www.osha-slc.gov/OshStd_data/1926_0062.html)

Both standards require employers to inform their workers about exposure risks, control measures, monitoring, medical programs, record keeping, and training. The OSHA construction standards for lead apply to all “construction work” where an employee may be exposed to lead.
“Construction work” is defined as work for construction, alteration, and/or repair, including painting and decorating. Construction work in both the lead and cadmium standards includes, but is not limited to, the following:

- Demolition or salvage of structures where lead/cadmium or materials containing lead/cadmium may be present,
- Removal or encapsulation of materials containing lead/cadmium,
- Installation of products containing lead/cadmium,
- Performance of maintenance operations,
- Construction, alteration, repair or renovation of structures or substrates that contain lead or materials that contain lead and/or cadmium,
- Cleanup of lead and/or cadmium contamination emergencies,
- Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed, and
- Maintenance operations associated with the construction activities described in this paragraph.

3.2 REQUIREMENTS OF THE OSHA STANDARDS

3.2.1 Exposure Limits

HGL monitors workers closely if their work results in airborne levels of lead that approach the Permissible Exposure Limit (PEL). The recommended limit for airborne lead is 50 µg/m³ of air averaged over an 8-hour period. Because exceeding the PEL results in the possibility of adverse health effects, there is also an AL, which is set at a level below the PEL. The AL for lead is 30 µg/m³ averaged over an 8-hour period. If the AL is reached, air monitoring, medical monitoring, medical surveillance, and training are required to reduce the risk of exceeding the PEL.

3.2.2 Exposure Monitoring

Workplace exposure assessments using air sampling pumps are conducted to determine airborne lead concentrations. The results of the initial exposure assessment determine when and how often subsequent monitoring will take place. If the initial exposure assessment reveals airborne levels above the AL or the PEL, routine monitoring must take place at required intervals until two consecutive measurements, taken at least 7 days apart, reveal reduced levels. The frequency of the monitoring is then adjusted to match the new level.
The table below lists the frequency of monitoring based on the air concentration.

<table>
<thead>
<tr>
<th>Lead Concentration in Air</th>
<th>Monitoring Frequency within Area of Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead concentration exceeds the PEL (50 µg/m³)</td>
<td>Monitoring will be conducted every 3 months for the duration of the entire field event.</td>
</tr>
<tr>
<td>Lead concentration exceeds the AL (30 µg/m³) but is less than the PEL (50 µg/m³)</td>
<td>Monitoring will be conducted 6 months for the duration of the entire field event.</td>
</tr>
<tr>
<td>Lead concentration is below the AL (30 µg/m³)</td>
<td>Monitoring will not be required unless there is a new activity or change in the process, equipment reducing airborne lead exposure, or personnel that may cause increased lead exposure.</td>
</tr>
</tbody>
</table>

3.3 COMPETENT PERSON

The lead standards require that a “competent person” monitor and have overall authority on abatement projects. The HGL competent person for this project will be Mark McGowan, HGL’s Corporate Health and Safety Manager. Mr. McGowan can be reached at (703)-736-4561. The field investigation field team leader (FTL) will act as the on-site competent person and will be in direct contact with Mr. McGowan during monitoring activities.

3.4 MEDICAL SURVEILLANCE AND REMOVAL

There are established limits for the maximum amount of lead that workers can safely accumulate in their blood, measured as a lead blood (PbB) level. The first and required goal sets a maximum PbB level at or below 40 micrograms per lead per deciliter of blood (µg/dL). This goal was established to prevent adverse health effects from exposures to lead throughout a working lifetime. A second goal, suggested for male and female workers planning to have children, is a PbB level below 30 µg/dL.

Medical surveillance (blood lead tests, urinalysis, and physicals) must be provided for employees who may be exposed to levels at or above the AL for lead for more than 30 days in 12 consecutive months. Employees who are exposed for 30 days or more in any 12 consecutive months to levels either at or above the AL for cadmium or are exposed while performing certain tasks with cadmium (e.g., electrical grounding with cadmium welding; cutting, brazing, burning, grinding, or welding on surfaces painted with cadmium containing paint or on cadmium coated steel, etc.) must be offered medical surveillance. Provisions must be made for periodic reassessment and/or removal of employees whose lead and cadmium physical results meet certain requirements (for example, excessive blood lead levels or urine cadmium levels).

3.5 EMERGENCY EXPOSURE TREATMENT

Most of the lead that enters the body is naturally excreted in the urine in about 1 to 9 weeks if no further exposures occur during that period of time. Therefore, treatment is often unnecessary unless the PbB level is greater than 80 µg/dL of whole blood or if symptoms occur. General symptoms of lead poisoning are presented under Section 2.2 of this document. If treatment is necessary, chelating agents, substances that attach to lead to help remove it
from the body, may be utilized. Chelating agents are much more effective in removing lead from the bloodstream than lead that is stored in other parts of the body. Unfortunately, chelating agents bond to other metals in the body; this can deplete some metals that are necessary to normal body functions.

3.6 MEDICAL REMOVAL PROTECTION PROGRAM

Elevated doses of lead in the body increase the risk for adverse health effects, especially if lead exposures continue. Therefore, the medical monitoring protection program will temporarily remove the effected individual from the project if the following occur:

- Periodic blood testing indicates a PbB level at or above recommended limits, or
- A physician has detected a medical condition that may increase the risk of health problems because of lead exposure.

3.7 NOTIFICATION AND RECORD KEEPING

HGL will notify workers, individually and in writing, within 5 days after the receipt of sampling results. All monitoring records must be kept for 30 years in accordance with the construction standard (CFR 1926.62). These records will include the worker’s name, job classification, details of sampling and analytical techniques, sampling results, and type of respiratory protection utilized (if any). As required by 1926.62, HGL will provide a copy of an individual’s monitoring record upon request.

3.8 EXPOSURE REPORTING

If at any time an employee believes that he or she has been exposed to elevated or unexpected levels of lead or if the employee believes that he or she is showing signs or symptoms of lead exposure, then the employee must notify the FTL and/or Site Safety Officer (SSO) immediately followed by the HGL Project Manager, and the Corporate Health and Safety Manager in accordance with the HSP. If the effected employee is unable to notify the HGL Project Manager and Corporate Health and Safety Manager, then the FTL conduct the notifications. The FTL and SSO will most likely vary between field events, but they will be designated by HGL prior to the beginning of each field event. The HGL Project Manager for this work assignment is Brett Brodersen. He can be reached by telephone at 703-736-4526 or via email at bbrodersen@hgl.com. The Corporate Health and Safety Manager is Mark McGowan. He can be reach via telephone at 703-736-4561.

3.9 CONTROLS/MEASURES TO BE IMPLEMENTED TO MINIMIZE LEAD EXPOSURES

To minimize the potential for lead exposure, controls/measures will be utilized during RI sampling activities. Controls and measures to be utilized include engineering controls, administrative controls, and use of personal protective equipment (PPE). Engineering controls include hotel showers, portable water misters, bucket lids, shoe scrapers, glove boxes, and
face-washing stations. Administrative controls include good housekeeping, signage, access controls, training (this document), and safe work practices.

3.9.1 Training

Training is required by OSHA for all personnel who are subject to lead exposure at or above the AL or for whom the possibility of lead-induced skin or eye irritation exists. Lead training includes the following:

- Introductory lead awareness training (this course) intended for field personnel who will conduct field sampling activities at the site,
- Review of the site-specific HSP, and
- Annual training if the project-related field event lasts longer than a year.

3.9.2 Personal Protective Equipment

PPE is secondary protection that is used when other control measures are not feasible or not sufficiently effective at reducing exposures to lead. Proper use of PPE can reduce an individual’s exposure to lead and prevent the unwanted transfer of lead contamination from the workplace. HGL employees working at the site will be furnished with the appropriate PPE for the site and activities. Specific PPE requirements are specified in the HSP (HGL, 2011).

3.9.3 Respiratory Protection

Working with or around lead may require the use of a respirator, depending on the airborne levels of lead. The use of respirators for this project is specified in the HSP (HGL, 2011a). However, even with the use of respirators, other controls/measures must be implemented to limited/inhibit lead exposure.

4.0 REFERENCES


ATTACHMENT 5
MUNITIONS AND EXPLOSIVES OF CONCERN
ANOMALY AVOIDANCE SUPPORT
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1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the procedures for performing munitions and explosives of concern (MEC) anomaly avoidance support during field operations on environmental projects where there is a potential for encountering MEC hazards. Site-specific deviations from the methods presented herein must be approved by the assigned project manager and the HydroGeoLogic, Inc. (HGL) Quality Assurance/Quality Control Manager and the Unexploded Ordnance (UXO) Safety Manager.

2.0 SCOPE AND APPLICATIONS

This SOP discusses surface and subsurface anomaly avoidance procedures and techniques to be used while conducting hazardous, toxic, radioactive waste (HTRW)-related activities during investigative, design, and remedial actions. These procedures were developed using the Department of Defense (DoD) Manual 6055.09-M DoD Ammunition and Explosive Safety Standard, DoD Explosive Safety Board (DDESB) Technical Paper (TP) 18 Minimum Qualifications for UXO Technicians and Personnel, United States Army Corps of Engineers (USACE) EM 385-1-97 Explosives Safety and Health Manual, USACE EP 75-1-2 Munitions and Explosives of Concern Support During HTRW and Construction Activities, USACE ER 385-1-92 Safety and Occupational Health Requirements for HTRW Activities and USACE ER 385-1-95 Safety and Health Requirements for MEC Operations. These procedures will be performed and adhered to by all HGL and subcontractor personnel during HTRW field activities. HGL and its subcontractors will work closely together to ensure a safe working environment and to ensure the equipment, supplies, and other resources needed to provide MEC anomaly avoidance support are present on-site.

No intrusive work will be allowed during investigative phases where there is no physical contact is intended [e.g., Preliminary Assessments/Site Inspections (PA/SI)] or when a determination is made that the probability of encountering MEC is moderate to high (current or previous land use leads to a determination that MEC was employed or disposed of in the parcel of concern [e.g., open burn and open detonation areas, impact areas, maneuver areas, etc.]). Intrusive anomaly investigation and/or MEC removal is not authorized unless stated in the current Performance Work Statement (PWS) or Scope of Work (SOW). If a MEC removal action is authorized at a later date, the policies and procedures for a MEC removal action will be contained in a separate MEC Removal Action Work Plan (WP) and when in support of HTRW remedial action phase (construction) the HGL SOP 15.13 MEC Construction Support Standard Operating Procedures will be implemented.
3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must document evidence to the site manager/Senior Unexploded Ordnance Supervisor and the Unexploded Ordnance Quality Control Specialist (UXOQCS) that they have read and understand this procedure by completing the SOP acknowledgement form (Attachment 1). This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS

Anomaly Avoidance: Techniques employed on property known or suspected to contain MEC, other munitions that may have experienced abnormal environments (e.g., Discarded Military Munitions (DMM)), Munitions Constituents (MC) in high enough concentrations to pose an explosive hazard, or chemical agent (CA), regardless of configuration, to avoid contact with potential surface or subsurface explosives or CA hazards, to allow entry into the area for the performance of the required operations. Anomaly avoidance techniques are implemented to avoid any potential surface MEC or MPPEH and any subsurface anomalies. MEC anomaly avoidance techniques are primarily implemented during Hazardous, Toxic, and Radioactive Waste (HTRW) project activities, for example, in support of soil sampling or well installation activities where the specific site of the activity can be moved to another location.

Hazardous, Toxic, and Radioactive Waste Activities (HTRW): HTRW activities include those activities undertaken for the Environmental Protection Agency’s (EPA) Superfund Program, the Defense Environmental Restoration Program (DERP), including Formerly Used Defense Sites (FUDS) and Installation Restoration Program (IRP) sites act active DoD facilities, HTRW actions associated with Civil Works projects, and any other mission or non-mission work done for others at HTRW sites. For the purposes of MEC support, HTRW actions during investigative/design phase of a HTRW project on a site with known UXO or unknown fillers requires anomaly avoidance procedures. HTRW activities during the remedial action phase (construction) of a HTRW project on a site with known or UXO with unknown fillers may require either standby support or subsurface removal.
**Material Potentially Presenting an Explosives Hazard (MPPEH):** Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or final disposition; and range-related debris); or material potentially containing a high enough concentration of explosives that the material presents and explosive hazard.

**Military Munitions:** All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, except that the term does include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed [10 U.S.C. 2710(e)(3)(A)].

**Munitions and Explosives of Concern:** This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) UXO, as defined in 10 U.S.C. 101(e)(5)(A) through (C); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

**Munitions Constituents (MC):** Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710).

**Munitions Debris:** Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or final disposition. Inert munitions-related material recovered during an MEC removal.

**Recovered Chemical Warfare Materiel (RCWM):** Non-stockpile CWM that was previously discarded, buried, or fired and discovered either unexpectedly or during planned environmental restoration operations.
Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. For the purpose of this project, the definition of UXO is limited to items larger than 50-caliber.

UXO-Qualified Personnel: Personnel who meet the training requirements for UXO Technician and Personnel and have performed successfully in military EOD positions or are qualified to perform in the following service contract act contractor positions: UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and Senior UXO Supervisor (SUXOS). Refer to DDESB TP 18 for detailed information for approved contract titles and qualifications.

4.2 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>DDESB</td>
<td>Department of Defense Explosive Safety Board</td>
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<tr>
<td>DoD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DPT</td>
<td>direct push technology</td>
</tr>
<tr>
<td>FSP</td>
<td>Field Sampling Plan</td>
</tr>
<tr>
<td>FUDS</td>
<td>Formerly Used Defense Site</td>
</tr>
<tr>
<td>GPS</td>
<td>global positioning system</td>
</tr>
<tr>
<td>HTRW</td>
<td>hazardous, toxic and radiological waste</td>
</tr>
<tr>
<td>IDW</td>
<td>investigated derived waste</td>
</tr>
<tr>
<td>IRP</td>
<td>Installation Restoration Program</td>
</tr>
<tr>
<td>MC</td>
<td>munitions constituents</td>
</tr>
<tr>
<td>MEC</td>
<td>Munitions and Explosives of Concern</td>
</tr>
<tr>
<td>PPE</td>
<td>personal protective equipment</td>
</tr>
<tr>
<td>SSHP</td>
<td>Site Safety and Health Plan</td>
</tr>
<tr>
<td>SOP</td>
<td>standard operating procedure</td>
</tr>
<tr>
<td>SSO</td>
<td>site safety officer</td>
</tr>
<tr>
<td>SUXSO</td>
<td>Senior Unexploded Ordnance Supervisor</td>
</tr>
<tr>
<td>USACE</td>
<td>United State Army Corps of Engineers</td>
</tr>
<tr>
<td>UXO</td>
<td>Unexploded Ordnance</td>
</tr>
<tr>
<td>UXOQCS</td>
<td>Unexploded Ordnance Quality Control Specialist</td>
</tr>
<tr>
<td>UXOSO</td>
<td>Unexploded Ordnance Safety Officer</td>
</tr>
<tr>
<td>UXO TL</td>
<td>Unexploded Ordnance Team Leader</td>
</tr>
<tr>
<td>WP</td>
<td>work plan</td>
</tr>
</tbody>
</table>
5.0 RESPONSIBILITIES

5.1 PROCEDURE RESPONSIBILITY

The HGL Senior UXO Operations Manager is responsible for ensuring that this SOP is reviewed annually for completeness, accuracy, and conformance to industry standards. The HGL UXO Safety Manager is responsible for the maintenance, management, and annual review of this SOP for procedural, quality control and safety issues. All questions, comments, or recommendations regarding this SOP should be directed to the UXO Safety Manager.

5.2 PROJECT RESPONSIBILITY

HGL employees performing the activities addressed by this SOP are responsible for meeting the requirements detailed herein. HGL employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

The Senior UXO Technician assigned is responsible for ensuring that the activities addressed by this SOP are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation that the requirements of this SOP have been met. Such documentation shall be retained with the project record files.

6.0 PROCEDURES

6.1 UXO TEAM

The senior UXO-qualified person will serve as the UXO Team Leader (TL) and has ultimate responsibility for ensuring all MEC anomaly avoidance support activities are performed in accordance with this SOP, the WP and/or the SSHP. The UXO TL will direct all MEC anomaly avoidance support during field operations.

1. The UXO Team will:

- Review any archival information available on the area where MEC anomaly avoidance is required in an effort to determine the probable of types of MEC that may be encountered and identify specific hazards and precautions.
- Provide MEC recognition, location, and safety function for the prime contractor during construction support and HTRW activities.
- Conduct MEC safety briefing for all site personnel and visitors.
- Conduct a surface access survey to locate all surface and near-surface anomalies.
- The UXO Technician on the point position will conduct the initial surface sweep.
Munitions and Explosives of Concern
Anomaly Avoidance Support

- Establish and delineate surface MEC or subsurface anomaly-free ingress/egress lanes and work areas.
- Reporting of all MEC encountered to the appropriate authority, and coordinate final disposition as directed by the Project Manager.
- Work closely with the USACE personnel on all MEC-related matters.
- Document all MEC discoveries following these procedures.
- Coordinating and reporting MEC discoveries to the appropriate authority.

2. Non UXO-qualified personnel responsibilities include:

- Being trained to recognizing the potential hazards impose by MEC, which are fire, fragmentation and blast overpressure.
- Remain with the UXO Technician all times unless otherwise cleared to proceed on your own.
- In the event of an accident, follow the instructions given by the UXO Technician.
- If you see something suspicious please notify the UXO Technician immediately.
- Always be careful where you walk and do as the UXO Technician directs.
- The buddy-system will be observed at all times on the work site.
- If you see something suspicious notify the UXO Technician immediately.

6.2 ANOMALY AVOIDANCE

Anomaly avoidance procedures will be utilized during HTRW-related field investigation activities whenever there is a potential for encountering MEC. These activities include, but are not limited to:

- site access and MEC clearance survey;
- clearing and grubbing;
- land surveying and mapping;
- geophysical surveying; and
- environmental and natural resource assessments:  
  - surface soil sampling,
  - subsurface soil sampling,
  - boring and drilling,
  - ground water monitoring, and
  - test pits and trenches excavations; and
- Preliminary Assessments (PA) and Site Inspection (SI) on Formerly Used Defense (FUDS) and Base Realignment and Closure Sites (BRAC).

The purpose of MEC anomaly avoidance is to avoid any potential surface and subsurface MEC hazards during these activities. For anomaly avoidance on an HTRW site with potential MEC,
HGL will provide an UXO Team consisting of a minimum of two personnel, one of whom must be a UXO Technician II or above.

6.2.1 Site Access and MEC Clearance Surveying

1. In HTRW areas with known or suspected MEC the UXO Team will:
   
   - Use geophysical instrumentation capable of detecting the smallest known or anticipated MEC will be used to locate anomalies just below the surface that may be encountered through erosion from rain or continual foot or vehicular traffic.
   - The subsurface surveys (to a depth of 4 feet below ground surface [bgs]) need only be conducted when the use of motor vehicles is anticipated.
   - Conduct a geophysical instrument-assisted surface clearance access survey and/or a subsurface survey for anomalies before any activities (e.g., site visits, field investigations or PA/SI) commence, including footpath and/or vehicular traffic routes.
   - The access route both approaching and leaving shall be at least twice as wide as the widest vehicle that will use the route. The route shall be clearly marked with flagging or stakes for future entry control.
   - If only foot traffic is required, then a surface clearance and access survey (to a depth of 2 feet bgs) will suffice.
   - Non-UXO qualified HTRW field personnel must be escorted by UXO-qualified personnel at all times in areas where there is any potential for encountering MEC hazards until the UXO Team has completed the access surveys and the cleared areas are visibly marked.
   - Non UXO-qualified will follow behind the UXO Technician.
   - If MEC hazards are detected, the UXO Technician will halt the escorted personnel in place, select a course around the hazard, and instruct escorted personnel to follow behind.
   - No personnel will be allowed outside of the surveyed and cleared areas.

2. Access Survey:

   - Complete an access survey of an area around the proposed investigation site that is large enough to support all planned operations.
   - The size of the surveyed area will be project-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment, etc.), parking of support vehicles, and establishment of decontamination stations.
   - At a minimum, the surveyed area should have a dimension in all directions equal to twice the length of the longest vehicle or piece of equipment to be brought on-site and clearly delineated with flagging or stakes.
3. **MEC Hazards:**

- In the event that anomalies or surface MEC hazards are encountered, they will be marked with flagging and the investigation area will be relocated to avoid contact with the hazards.
- The UXO team will clearly mark the boundaries of the surveyed area using survey flagging and non-metallic pin flags.
- The team will establish a system of flagging colors that will distinguish anomalies, surface MEC, and route boundaries from each other as well as from any utility markings used at the site.
- Attempt to identify the hazard and will inform the appropriate project management personnel. Under no circumstances will the team disturb the hazard in anyway.
- The UXO TL is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards.

6.2.2 **Clearing and Grubbing**

Initial clearing and grubbing operations may be required for specific projects prior to HTRW field activities. The objective of clearing and grubbing is to allow for unhindered access by the HTRW field teams. In areas with potential MEC hazards, the UXO Team must:

1. **Access Survey:**

   - Conduct an access survey of the routes to and from the proposed clearing and grubbing area. The UXO Team will conduct a geophysical instrument-assisted clearance survey for the entire area to be grubbed to a depth of 4 feet. Once this has been accomplished, the clearing and grubbing operation may commence.
   - A accompany grubbing teams at all times. At least one UXO Technician will accompany every grubbing team of six personnel. For every piece of mechanical grubbing equipment used, one UXO Technician will supervise the use of that equipment at all times.
   - If mechanical grubbing equipment is used, the lowest part of the cutting deck will remain at least 6 inches above ground level to ensure that any possible surface MEC hazard that may have been missed during the surface sweep is not contacted by the cutting blades of the equipment.

2. **MEC Hazards:**

   - If a potential MEC hazard is encountered, all clearing and grubbing operations will cease. The clearing and grubbing team will immediately notify the accompanying UXO Technician. No further action shall be taken until the UXO Technician has
made all notifications and the appropriate safety concerns are addressed, in accordance with the SSHP.

- Under no circumstances will the team disturb the hazard in anyway. The UXO TL is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards. After final disposition of the MEC hazard has been completed, clearing and grubbing operations may continue.
- If the item is not MEC, clearing and grubbing activities may resume with the concurrence of the UXOSO when assigned.

6.2.3 Land Surveying and Mapping

During land surveying activities in areas with potential MEC, the survey team will have a minimum of one UXO Technician II or above assigned to perform MEC anomaly avoidance.

1. The UXO Technician will:

   - Conduct an access clearance survey of the routes to and from the proposed survey site as well as an area around the site.
   - Visually survey the surface of each proposed survey point for any indication of MEC or MEC-related contamination.
   - Use a Schonstedt GA-52Cx magnetometer (or equivalent) to assess the presence or absence of buried metallic anomalies at the locations where survey points/stakes will be installed. If magnetometer responses indicate a buried metallic anomaly, no survey point/stake will be installed at that specific location. An alternate location will be selected.

2. MEC Hazards:

   - For location surveying in areas with suspected non-conventional MEC (e.g., micro-gravel mines), GPS will be used for location surveying. Additionally, no intrusive survey markers will be used, only traffic cones and paint will be used to mark locations.

6.2.4 Geophysical Surveying

Geophysical survey methods will consist of several progressive procedures to ensure the safe collection of quality data that can be used to relocate and investigate any anomalies detected. Once an area has been identified and selected for geophysical surveying, UXO sweep personnel will:
1. **Surface Clearance:**

   - Conduct a geophysical instrument-assisted surface clearance of the area to aid in the location of surface metal that may be obscured by vegetation.
   - The surface clearance will be managed using a search system based on transects. To accomplish this surface clearance, UXO sweep personnel will line up side by side, forming a sweep line, and walk each geophysical survey area in an orderly manner.
   - The geophysical survey area may be divided into grids. An automated line-marking system or physical lines will be used to ensure complete coverage within each geophysical survey area or grid.
   - The geophysical instrument-aided surface clearance will determine the presence or absence of surface MEC and provide increased safety to site personnel.
   - During the surface clearance, surface debris will be removed to support subsequent geophysical mapping. Non-MEC metallic debris, which may interfere with the subsurface geophysical survey, will be removed from the surface of the work area, to the maximum extent possible, and consolidated for later disposition.

2. **MEC Hazards:**

   - If a potential MEC item is encountered by the geophysical mapping team, all geophysical survey operations will cease.
   - The geophysical survey team will immediately notify the UXO TL.
   - **Under no circumstances** will the team disturb the item in any way.
   - No further action shall be taken until the UXO TL has made all notifications and the appropriate safety concerns are addressed, in accordance with the SSHP.
   - The UXO TL is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards.
   - If the item is not MEC, geophysical survey activities may resume with the concurrence of the UXOSO when assigned.

6.2.5 **Sampling and Drilling**

6.2.5.1 **Surface Soil Sampling**

The following paragraphs describe anomaly avoidance procedures for surface soil sampling (between 0 and 12 inches bgs) in areas with potential MEC. Soil sampling at depths greater than 12 inches bgs will follow the procedures in Section 6.2.5.2. The UXO Team will:

   - Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
• Visually survey the surface of each proposed surface soil sampling site for any indication of MEC or MEC-related contamination.
• Conduct a survey of the proposed sample locations using hand-held geophysical instruments capable of detecting the smallest known or anticipated MEC to a depth of 2 feet.
• If anomalies are detected at a proposed sampling location or too many anomalies are detected in a general area of interest, the HTRW personnel will select an alternate location for collection of surface soil samples.
• Any anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance during HTRW sampling activities.

6.2.5.2 Subsurface Soil Sampling and Monitoring Well Installation

The following paragraphs describe anomaly avoidance procedures for subsurface soil sampling and monitoring well installations in an area with potential MEC. Subsurface soil sampling is defined as the collection of samples below a nominal depth of approximately 12 inches with a split-spoon, Shelby tube, direct push sampler, or bucket auger (i.e., hand auger) soil sampler using drilling techniques. Drilling techniques will also be used to drill larger diameter soil borings (e.g., 4- to 8-inch outer diameter) and install groundwater monitoring wells for HTRW investigations. The UXO Team will:

1. Surface Clearance:
   • Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
   • Complete a hand-held, geophysical instrument-assisted, subsurface survey of the proposed drill-hole location(s) to a depth of 4 feet.

2. MEC Hazards:
   • If an anomaly is detected, sampling personnel will select a new borehole location.
   • Any anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance.
   • If the subsurface sampling depth is greater than the geophysical instrumentation (e.g. hand-held geophysical instrument) detection capabilities, the UXO Team must incrementally complete the down-hole geophysical survey to undisturbed soil depth as outlined below.
6.2.5.3 Underground Utilities

Utility clearance and/or excavation permits, if required, must be obtained prior to the commencement of any incremental subsurface geophysical survey activities by the UXO Team. The UXO TL is responsible for:

- Verifying that all necessary excavation permits are on-site prior to commencing operations.
- Ensuring that the appropriate agencies or companies have marked the location of all subsurface utilities in the investigation areas prior to commencing intrusive work.
- High-visibility paint, nonmetallic pin flags, or other appropriate means will be used to visually delineate their approximate subsurface routing. The color shall not conflict with the colors used in MEC avoidance activities.
- In the event subsurface utilities are suspected in an excavation area, the field sampling team must attempt to verify their location.
- The field sampling team should be aware that not all utility lines will be detectable with geophysical instrument equipment; not all utility lines are constructed of ferrous material.
- Utility clearance procedures and contact numbers should be listed in the Field Sampling Plan (FSP).

6.2.5.4 Pilot-Hole and Incremental Geophysical Survey for Conventional MEC Clearance

For intrusive sampling (i.e., subsurface sampling and well drilling) in areas with incremental suspected conventional (metallic) MEC, pilot holes and geophysical surveying will be completed. Once an access survey has been completed, the team will install a pilot hole to undisturbed soil depth at each proposed drill-hole location.

1. Installation of Pilot Hole:
   - During installation of the pilot hole non-essential personnel will withdraw to a distance of not less than the exclusion zone (EZ) or fragmentation distance of the munition with the greatest fragmentation distance (MGFD) established for the site.
   - The pilot-hole may be installed using manual or mechanical means. During installation of the pilot hole, a geophysical instrument configured for down-hole utilization will be used to inspect for anomalies every 2 feet or unless otherwise specified by the WP or SSHP.

2. MEC hazards:
   - If an anomaly is detected, the pilot-hole will be backfilled in accordance with project-specific procedures, and HTRW sampling personnel will select a new drill-hole location.
Any anomalies detected will be prominently marked on the surface with survey flagging or non-metallic pin flags for avoidance.

When no anomalies are detected, the pilot hole will be advanced to the maximum reach of the auger or to the maximum depth of the proposed drill hole, whichever is less.

The pilot hole will also be inspected upon reaching the final depth, providing a total clearance depth equal to the pilot-hole depth plus 2 feet.

If no anomalies are detected to the total depth of the proposed drill hole, the drill rig may be brought on-site and utilized.

1. **Incremental Screening for Anomalies:**

   - In cases where the pilot hole does not reach the full depth of the proposed boring (e.g., the proposed depth of the drill hole is more than the maximum depth of the auger or the team cannot penetrate the soils using the auger), the drill rig may be brought on-site and advanced in 2-foot increments beyond the clearance depth of the pilot hole.
   
   - At the end of each 2-foot increment, the drill rig augers must be withdrawn from the hole so that the UXO Team may screen for anomalies as described previously. As necessary with loose soils, a polyvinyl chloride (PVC) pipe (minimum 3 inches inner diameter) may be inserted to keep the hole open and to allow for incremental geophysical instrument screening.
   
   - Incremental screening may be discontinued once the drilling has extended to depths greater than the maximum estimated depth of MEC presence (as described in the WP), based upon the maximum depth of fill materials and maximum depth of MEC penetration.
   
   - All pilot holes will be backfilled in accordance with project-specific procedures.

### 6.2.5.5 Test Pits for Non-Conventional MEC Clearance

For intrusive sampling (subsurface and well drilling) in areas with suspected non-conventional MEC (e.g., non-metallic micro-gravel mines), MEC avoidance and location clearance activities will also include test pits.

1. **The test pits will:**

   - Be dug by an armored remote-controlled excavator to undisturbed soil depths as MEC clearance for each intrusive sampling location.
2. The procedure for test pit non-conventional MEC clearance will be as follows:

- A geophysical instrument-assisted subsurface survey of the proposed boring location will be completed to a depth of 4 feet to clear for metallic anomalies. If an anomaly is detected, a new location will be selected.
- All non-essential personnel will withdraw to a distance not less than the MGFD established for the site.
- An armored, remote-controlled excavator will be used to excavate a small area around the proposed soil boring down to 2 feet. UXO Technicians will inspect the excavation and excavated soil for non-conventional MEC. This process will continue at 2-foot intervals until undisturbed soil is reached.
- Once undisturbed soil is reached, the test pit excavation will be stopped. HTRW sampling personnel and equipment may be mobilized to the site, and intrusive soil sampling may begin.

6.2.5.6 Soil Sampling with Direct Push Technology

The following describes MEC anomaly avoidance procedures for soil sampling and use of direct push technology (DPT) in areas where a potential MEC hazard exits. Soil sampling with DPT typically involves manual or mechanical penetration at the desired location, followed by withdrawal and collection of a soil sample.

1. Surface Clearance:

- The UXO Team will conduct a surface clearance and access clearance survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
- Soil sampling and DPT installations will follow the same anomaly-avoidance procedures as described previously for subsurface soil sampling and monitoring well installations (i.e., incremental down-hole geophysical survey for metallic anomalies and remote-dig test pits for non-conventional MEC). However, the actual sampling and geophysical instrument screening will occur through the DPT borehole. Following collection of the soil samples, the sampling location will be backfilled in accordance with project-specific procedures.

6.2.6 Test Pit and Trench Excavating

Test pits and trench excavations may be used to identify and characterize large subsurface HTRW areas of concern. The following paragraphs describe MEC anomaly avoidance procedures for test pit and trench excavations on a HTRW site with potential MEC. The UXO Team will:
1. **Surface Clearance:**

   - Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site.
   - Complete a subsurface geophysical survey of the proposed excavation locations.

2. **MEC Hazards:**

   - If an anomaly is detected, HTRW sampling personnel will select a new excavation location nearby.
   - Anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance.
   - Proposed excavation depths greater than the geophysical instrumentation detection capabilities will undergo MEC anomaly avoidance by conducting incremental geophysical survey to screening for potential MEC as outlined in the procedures below.

### 6.2.6.1 Test Pits and Trenches MEC Anomaly Avoidance

1. **Access Survey:**

   - Once an access survey has been completed, HTRW personnel may begin excavation in 2-foot increments. During excavation, personnel not directly involved in the excavation activities should withdraw to a distance of not less than the fragmentation distance of the MGFD established for the site.
   - At the end of each 2-foot increment, the UXO team will screen for anomalies. If an anomaly is detected, HTRW sampling personnel will modify the excavation locations to avoid the anomaly.
   - Any anomalies detected will be prominently marked on the surface with survey flagging or non-metallic pin flags for avoidance.

2. **MEC Hazards:**

   - If a potential MEC hazard is uncovered in an excavation, all operations will cease. The UXO Team will attempt to identify the hazard.
   - The UXO team will address the appropriate safety concerns in accordance the SSHP and Section 8.
   - Under no circumstances will the team disturb the hazard in anyway.
   - After final disposition of the MEC hazard has been completed, the excavation may continue.
3. Non-MEC Hazards:

- For test pits and trenches in areas with suspected non-MEC (e.g., non-metallic micro-gravel mines), excavations will be completed using an armored, remote-controlled excavator.
- The procedures for test pits and trenches in areas with suspected non-conventional MEC will be the same as previously described, except that the excavations will be completed using an armored, remote-controlled excavator, and
- The UXO team will visually inspect 100 percent of the material excavated, as well as the excavation, for non-conventional MEC.

6.2.6.2 Waste and/or Other Materials Encountered

In the event potentially hazardous waste, debris, or drums are encountered during test pit or trenching operations, excavation activities will cease. The HTRW SSO will:

- Assess the situation and may direct a change to the personal protective equipment (PPE) for site workers.
- Notify the appropriate personnel in accordance with the WP or SSHP.
- Wastes will be handled in accordance with the Derived Waste (IDW) Management, Transportation, and Disposal Plan (IDW Plan).

6.2.7 Groundwater Monitoring

Groundwater monitoring activities include measurement of groundwater elevations, measurement of free product thickness, and collection of analytical samples. Unless a path is clearly marked, the HTRW sampling personnel must be escorted by UXO-qualified personnel providing MEC anomaly avoidance during groundwater monitoring/aquifer characterization activities in areas with potential MEC.

6.2.8 Preliminary Assessment (PA) and Site Inspection (SI)

Whenever HGL employees conduct PA/SI work on in areas where MEC may be encountered UXO-qualified personnel will provide MEC anomaly avoidance measures to prevent non UXO-qualified personnel from coming into contact with an MEC hazard. Specific notification and reporting procedure for MEC hazards encountered on FUDS or BRAC sites are discussed in Section 6.2.
6.3 MUNITIONS AND EXPLOSIVES OF CONCERN

6.3.1 ENCOUNTER

If MEC/UXO is encountered, the UXO Technician on point will direct the team to stop, point out the hazard and mark the hazard with a high-visibility pin flag, paint, or surveyors tape. The UXO Technician discovering the MEC hazard will inform the UXO TL who then will notify the Site Supervisor of the hazard and its location. The UXO TL shall:

- Visually examined the MEC hazard for markings and other external features such as shape, size and external fittings.
- Record the MEC hazard item(s) GPS coordinates in the UXO team logbook.
- Record the MEC hazard as outlined by Section 9.0.
- Take a digital photograph of the hazard and record the photo number using the MEC Investigation Field Log Form (HGL MR Form 15.01) and UXO TL logbook.
- After notifying the Site Supervisor and all other authorities of the MEC hazard(s), and collecting the necessary data, the team may proceed with their activities.

6.3.2 DISPOSITION

The disposition of MEC hazards will be implemented as specified by the applicable site WP, SSHP or when applicable the Memorandum of Agreement (MOA). The senior UXO-qualified person has the responsibility for coordinating with the proper authorities for the final disposition of all MEC hazard(s) discoveries. Specific procedures for reporting MEC discoveries during a PA/SI are covered by USACE Military Munitions Center of Expertise (MM CX) Interim Guidance Document 06-05.

7.0 QUALITY CONTROL

The HGL Senior UXO Operation Manager is responsible for ensuring this SOP is reviewed annually for completeness, accuracy and safety. The HGL UXO Safety Manager is responsible for the maintenance, management and annual review of this SOP for procedural, quality control and safety issues. All questions, comments or recommendations regarding this SOP should be directed to the UXO Safety Manager.

Project Managers and supervisors are responsible for ensuring all site personnel read, understand, and follow this SOP. If any discrepancies are found with procedural steps or safety issues pertaining to this, it will be brought to the attention of the responsible supervisor for corrective action. Anytime there is a potential for encountering MEC during HTRW related activities a UXO Team will be assigned to provide anomaly avoidance support.
7.1 AUTHORITY

The senior UXO-qualified person on site has final on-site authority on all munitions and MEC procedures and safety issues. This individual will have direct reporting and communications responsibility with and as direct by the HGL Project Manager with all responsible authorities.

7.2 CERTIFICATIONS

HGL will provide UXO-qualified personnel that meet the certification levels specified by DDESB TP 18 and USACE EP 75-1-2. The UXO Team will:

- Consist of a minimum of two personnel for anomaly avoidance, one of whom must be a UXO Technician II or above.
- Be on-call during all investigative/design HTRW activities where there is a potential for encountering MEC.
- Conduct access clearance surveying activities:
  - The second person can be a designated UXO Sweep Person in accordance with DDESB TP 18 requirements.
  - UXO Sweep Personnel are required to have undergone site specific training on the potential hazards present.

The UXO Team may include additional UXO-qualified personnel depending on project-specific and task-specific conditions and requirements. Additional personnel requirements, including certificates of training and medical monitoring guidelines listed in the Site Safety and Health Plan (SSHP).

7.3 EQUIPMENT

Project equipment for MEC anomaly avoidance and construction support will come from HGL sources, subcontractors, and local vendors offering equipment for lease or purchase. All equipment, regardless of source, will be inspected and function checked to ensure completeness and operational readiness. Any equipment found damaged or defective will be repaired or returned for replacement. All instruments and equipment that require routine maintenance and/or calibration will be inspected initially upon arrival and then periodically as required in the manufacturer’s equipment manual. Equipment required for daily usage shall be calibrated twice daily (start and finish). This system of checks ensures that the equipment on-site is functioning properly. If an equipment function check indicates that any piece of equipment is not operating correctly and field repair cannot immediately be accomplished, the equipment will be removed from service until it can be repaired. Alternately, the equipment may be replaced with a like model or an approved substitute. Replacement equipment will meet the same specifications for accuracy and precision as the equipment removed from service.
7.3.1 Geophysical Equipment

The use of geophysical sweep equipment (magnetometers) will depend on the local area of the sweep and the intended work to be conducted in that area. If the area is to be investigated only on foot, it may suffice to conduct only a detector-aided visual search of the area. If vehicular traffic is expected, the site will require a geophysical sweep for shallow subsurface anomalies (to a depth of 4 feet). For the purpose of anomaly avoidance, the following geophysical equipment will be utilized:

- For a geophysical sweep of an area, either the Schonstedt GA-52Cx or GA-72Cd or the Subsurface ML-1 or ML-1M will be utilized. These units can be expected to detect subsurface ferrous anomalies to a depth of 4 feet.
- Additionally, the White’s Spectrum XLT all-metals detector may be utilized. This unit can be expected to detect subsurface ferrous and non-ferrous anomalies to a depth of 18 to 24 inches.
- For down-hole surveillance, the Subsurface BHG-1, Schonstedt MG 220/230, MAGEX 120 LW or the MK26 Forrester will be utilized. The down-hole geophysical instrument used will depend on the diameter of the borehole. If direct push technology (DPT) is used, then the MAGEX 120 LW, Subsurface BHG-1 or Schonstedt MG 220/230 w will be used. The MK 26 will not fit inside the typical direct push borehole (e.g., 1 to 1.5 inches outer diameter).

Additional equipment items that may be required for marking hazards are:

- Non-metallic shaft pin flags (as required)
- Brightly colored surveyors tape (as required)
- High visibility, biodegradable spray paint (as required)

7.3.2 Equipment Function Checks

A daily equipment function check will be performed on all geophysical instruments and global position systems (GPS). The check will consist of using the geophysical instrument in the demarcated function check area and verifying its response on a known designated target anomaly. A record of the geophysical equipment/serial number function check will be logged using the Instrument Maintenance and Calibration Log (HGL MR Form 15.16) following each functionality test describing the performance results.

7.4 TRAINING

As part of the anomaly avoidance support process, the senior UXO-qualified person or UXOSO, as assigned will perform project-specific training for all on-site personnel assigned to these activities. The purpose of this training is to ensure that all on-site personnel fully understand the
operational procedures and methods to be used, including individual duties and responsibilities and all safety and environmental concerns during investigation and excavation activities. Any personnel arriving at the site after this initial training session will have to complete the training before being allowed to work. On-site training will include the following topics:

- Field equipment operation, including safety precautions and safety equipment, field inspection of equipment, and maintenance procedures that will be used
- Procedures, guidelines, and requirements in relevant sections of the WP and the SSHP, as they relate to the task being performed
- Site- and task-specific hazards, including physical, biological and chemical hazards
- Specific ordnance materials (e.g., MEC, munitions constituents [MC], explosive soil) potentially found on-site and hazards awareness
- Public relations, including encounters with press and public
- Environmental concerns and sensitivities, including endangered/threatened species and historic, archaeological, and cultural resources on-site
- Emergency procedures and contact information

8.0 SAFETY

If MEC is encountered during any phase of work the HGL Project Manager, and when assigned the Site Safety Officer or UXOSO will be immediately notified. In general, the following MEC safety precautions and protocols will be followed:

- Always remain alert at all times for MEC, UXO and related scrap or MPPEH hazards.
- The cardinal principle to be observed involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials is to limit the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation.
- Always assume MEC hazards contain a live charge until determined otherwise.
- Death or injury can occur from MEC/UXO and explosive related accidents.
- The age or condition of a MEC hazard does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.
- DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances will any MEC be handled during avoidance activities or moved in an attempt to make a positive identification.
- DO NOT touch, pickup up, kick or move anything that is unfamiliar or unknown.
• DO NOT roll the item over or scrap the item to identify markings.
• DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
• DO NOT transmit radios or cellular phones in the vicinity of suspect MEC hazards.
• DO Not walk across an area that the ground surface cannot be seen that has not been cleared of MEC hazards by the UXO Technician.
• DO NOT rely on color codes for positive identification of ordnance items nor their contents.
• DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
• DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
• DO Not misled by markings on the MEC item stating “practice bomb,” “dummy,” or “inert.” Practice ordnance can have explosive charges that are used to mark and/or spot the point of impact; or the item could be marked incorrectly.
• The location of any ordnance item found anomaly avoidance activities will be clearly marked so it can be easily located and avoided.
• Follow the procedures of the WP and SSHP; and upon locating any MEC hazards immediately notify the UXO Technician so appropriate measures can be taken.

— WARNING —

REMOVING OR TAKING ANY MUNITIONS, EXPLOSIVE OR UNEXPLODED ORNANCE OR MUNITIONS RELATED DEBRIS FROM THE SITE BY ANY EMPLOYEE IS STRICTLY PROHIBITED,

8.1 DAILY TAILGATE SAFETY MEETING

Prior to entering an area requiring MEC anomaly avoidance, the UXO TL must conduct a safety brief covering emergency procedures, operations, MEC hazards and anomaly avoidance procedures.

9.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained utilizing the following forms:

• HGL MEC Form 15.01 MEC Investigation Field Log
• HGL MEC Form 15.16 Instrument Maintenance and Calibration Log
• HGL MEC Form 15.19 Daily Tailgate Meeting Log
10.0 REFERENCES


US Army Corps of Engineers, 2004 Engineer Pamphlet 75-1-2 Munitions and Explosives of Concern Support during Hazardous, Toxic and Radioactive Waste (HTRW) and Construction Activities, August;


US Army Corps of Engineers, 2007, Engineer Regulation 385-1-95 Safety and Health Requirements for Munitions and Explosives of Concern Operations, March;

US Army Corps of Engineers, 2006, Memorandum, Procedures for PA/SI Teams that Encounter UXO While Gathering Non-UXO Field Data, Military Munitions Center of Expertise (MMECX) Interim Guidance Document 06-05, March;


HydroGeoLogic, Inc., Site Specific Work Plan.

HydroGeoLogic, Inc., Site Specific Accident Prevention Plan and Site Safety and Health Plan.
# Standard Operating Procedure Acknowledgement

I have read, understand and agree to abide by the provisions as detailed in this standard operating procedure (SOP) prepared by HGL. By signing below, I certify that I have had the opportunity to read and ask questions about this SOP, and that I understand the procedures, equipment and restrictions, and agree to abide by them. Failure to comply with this SOP may lead to disciplinary action and/or my dismissal from the work site and termination of employment.

Prior to the commencement of any work task associated with these SOPs, the Senior Unexploded Ordnance Supervisor (SUXOS) or Senior Unexploded Ordnance Technician assigned to the project will discuss additional procedures to be implemented, or any other site-specific conditions that may arise. All on-site personnel of HydroGeoLogic, Inc. must sign this Acknowledgment Form before performing the task covered by these SOPs.

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ATTACHMENT 6
RADIATION PROTECTION PLAN
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Appendix A. AVESI Health Physics Procedures
LIST OF ACRONYMS

AHA Activity Hazard Analysis
ALARA As Low As Reasonably Achievable
AVESI American Veteran Environmental Services, Inc.
Bi-210 Busmuth-210
Bi-214 Bismuth-214
BZ Breathing Zone Air Sampler (Lapel)
CFR Code of Federal Regulations
DAC Derived Air Concentration
DOE Department of Energy
DOT Department of Transportation
EPA Environmental Protection Agency
FOM Field Operations Manager
FS Feasibility Study
GA General Air Sampler
HGL HydroGeoLogic, Inc.
HP Health Physics
IDW Investigation Derived Waste
LQ Limited Quantity
mL Milliliter
mrem Millirem
NIST National Institute of Standards and Technology
NRC Nuclear Regulatory Commission
NUREG Nuclear Regulatory Guide
NVLAP National Volunteer Laboratory Accreditation Program
Pb-210 Lead-210
Pb-214 Lead-214
PPE Personal Protective Equipment
Ra-226 Radium-226
RAM Radioactive Material
RMSA Radioactive Materials Storage Area
RPM Radiation Protection Manager
RPP Radiation Protection Plan
RWT Radiation Worker Training
RI Remedial Investigation
Sr/Y Strontium/Yttrium
STC Strong Tight Container
TEDE Total Effective Dose Equivalent
Th-230 Thorium 230
TLD Thermo Luminescent Dosimeter
μCi Microcurie
y Year
1. INTRODUCTION

HydroGeoLogic, Inc. (HGL) has been tasked by the U.S. Environmental Protection Agency (EPA) Region 3 to conduct a Remedial Investigation (RI) and Feasibility Study (FS) of the Peck Iron and Metal Superfund Site (Site) located in Portsmouth, Virginia.

Previous gamma scan surveys have shown that radioactive contamination is present and is primarily contained (i.e., fixed contamination) in specific objects. However some of these objects have decayed or eroded and have allowed the radioactive material to become easily transferrable (i.e., removable contamination). An initial gamma scan survey covered 25% of the property surface (excluding 100% coverage around identified anomalies) identifying Ra-226 as a radionuclide of concern. Since only 25% of the property has been gamma scan surveyed it would be premature to conclude that Ra-226 is the only radionuclide present while the status of 75% of the property remains relatively unknown.

Recent sampling has identified objects and possible soil contaminated with Radium 226 (Ra-226) in the top six inches of soil at the Site. No subsurface investigations for Ra-226 have been conducted to date. To complete the RI, HGL subcontracted American Veteran Environmental Services, Inc. (AVESI) to generate and implement a Radiation Protection Plan (RPP) for the protection of on-site crews; implement and conduct a dosimetry program for the duration of the field portion of the RI in compliance with the Radiation Protection Plan, and provide on-site support for gamma radiation scanning of excavated soils as well as scanning all equipment, materials, supplies, and samples sent off-site to ensure no items leaving the Site are emitting radiation above background levels.

The primary objectives applicable to the project include:

- Review existing Site analytical and field screening data.
- Implement and manage a personnel radiation dosimetry program for all on-site HGL crew members and HGL subcontractors, estimated to be 50 persons, in accordance with this Radiation Protection Plan.
- Provide on-site support including labor, equipment, and supplies, for gamma radiation field screening activities of excavated soils and collected samples, as well as field screening of sample coolers, equipment, supplies, and materials leaving the Site to ensure that those items (and others) are not released with radiological contamination.

1.1 RADIATION PROTECTION PLAN IMPLEMENTATION

AVESI Health Physics (HP) personnel will work with HGL to implement the RPP at the Peck Iron and Metal Site in Portsmouth, Virginia. AVESI will provide a Radiation Protection Manager (RPM) and other health physics staff to manage the personnel radiation dosimetry program and provide on-site health physics support. The primary steps for implementing the RPP consist of, but are not limited to:

- All personnel expected to be on-site 80 hours or more per year will participate in a personnel radiation dosimetry monitoring program and be required to wear radiation dosimetry while on-site. The selection of 80 hours on-site per year is an action limit designed to keep personal doses As Low As Reasonably Achievable (ALARA). NOTE: The dose limit to members of the public is 100 millirem per year (mrem/yr). On-site personnel would have to spend over 650 hours in an area with a dose rate of 0.15 mrem/hr (maximum whole body dose identified during gamma spectroscopy survey) to exceed this limit.
• The RPM will review potential soil sampling and excavation areas, compare them with previous survey data, and perform a follow on gamma scan survey to minimize the potential for disturbing radioactive contamination during these activities. The RPM may suggest relocation of sample locations and excavations based on survey results, if possible.

• Controlled work zones will be set up around sampling and excavation activities. Health physics personnel will conduct radiological surveys of personnel and equipment to ensure radioactive contamination above limits is not removed from the work zone into the uncontrolled area. Equipment to be surveyed will be cleaned prior to survey (i.e., visible soil shall be removed, etc.).

• Air monitoring will be conducted at each work zone: downwind general area (GA) at the work zone perimeter. It is unlikely that airborne exposure will exceed 500 mrem per year. During intrusive activities dust suppression (misting) and respirators will be required for non-radiological contaminants therefore, breathing zone (BZ) sampling for 1 in 4 workers within the work zone is sufficient. NOTE: Soil sampling tasks may be of too short a duration to provide good statistical results. In these cases, the RPM may allow the samplers to wear the same BZ sampler for an extended period of time (e.g., a whole day of sampling, etc.).

• Although radiological decontamination of materials and equipment is not expected due to proactively selecting soil sample and excavation areas that do not contain radioactive contamination on the surface, it may be required. Materials and equipment are expected to be free of soil prior to survey. Decontamination of materials and equipment after survey should consist of minor wiping or scrubbing with a brush and a detergent.

• Investigative Derived Waste (IDW) generated during the sampling/excavation activities may include decontamination towels and fluids, soiled sampling containers, smears, air sample filters, and personal protective equipment (PPE). IDW is not expected to contain radioactive contamination above release limits. HGL will manage IDW on the Site.

The RPP presents procedures and requirements associated with radiological protection, monitoring, and the release of equipment and materials from the Site. HP technicians will implement the provisions of this RPP under the direction of the Site RPM, in accordance with the following AVESI procedures:
HP technicians performing work in support of this RPP will be qualified on this plan, as well as, the referenced health physics procedures. Qualification of health physics technicians will include successful completion of applicable Task Evaluation Standards in accordance with HP-16.
2. RADIOLOGICAL HAZARDS

This Radiation Protection Plan (RPP) describes the procedures that provide for the radiological safety of the HGL and AVESI personnel during RI/FS sampling, excavation and characterization activities at the Peck Iron and Metal Superfund Site (Site) located in Portsmouth, Virginia.

From a radiological perspective, consideration of the hazards associated with radium (plus progeny), and other potential radionuclides present at the Peck Iron and Metal Site largely focuses on the potential for uptake into the body, but external exposure and skin contamination hazards are also considered in this RPP. This plan has been designed to comply with the following direct and referenced radiation safety regulations:

- 10 Code of Federal Regulations (CFR) 20, Standards for Protection Against Radiation.
- 10 CFR 19, Notices, Instructions, and Reports to Workers.

The radiological conditions on accessible areas at the Site have been documented, and the Site does not have fixed or removable contamination levels that pose a hazard to workers during non-intrusive activities. However, IDW generated during intrusive investigations has the potential to cause the following adverse radiological conditions: personnel or equipment contamination, localized land contamination of the immediate sampling/excavation area, an external radiation exposure hazard, or an airborne radioactive contamination inhalation area hazard.

The following radiological Activity Hazard Analysis (AHA) tables have been prepared for planned project tasks:

- Radiation Protection Support for Media Sampling and Excavation Activities (Table 2-1).

Monitoring requirements, action levels, and Site release limits for radiological hazards are presented in Section 6 of this RPP and are summarized in Table 6-1.

Access to the Work Zones during intrusive sampling/excavation activities will be physically controlled by HP technicians. Once sampling activities begin, posting of individual sample locations as Controlled Areas in accordance with HP-24 will not be required due to the short duration of the discrete sampling activities. However excavation areas will be posted in accordance with HP-24 if radioactive contamination above limits are discovered. The HP technicians will use HGL’s Work Zone boundary as the radiological boundary. Postings will be upgraded as necessary according to the radiological conditions. Access in and out of the area will be controlled by HP technicians, the field manager, and Site safety. This RPP will address the health physics controls necessary to mitigate the listed adverse conditions during each activity.
3. RADIOLOGICAL CONTROLS

The HGL Team makes the following commitment regarding radiation exposure: Individual and collective radiation exposures to workers and individual members of the public will be kept below regulatory limits and As Low as Reasonably Achievable (ALARA). The following sections detail the radiological controls that will be in place during RI/FS sampling, excavation and characterization activities at the Site.

Radiological controls will be implemented to ensure compliance with applicable dose limits. Radiological controls include: training, monitoring for ionizing radiation, monitoring for radioactive contamination, sampling for and measurement of airborne activity, waste minimization, job coverage (i.e. HP support for all activities that have potential of workers to come into contact with radioactive materials), contamination control, posting, labeling, and source control. An RPM will be on-site during all work activities to ensure radiological controls are being implemented in accordance with this RPP and referenced health physics procedures.
4. TRAINING

4.1 RADIOLOGICAL SITE ORIENTATION TRAINING

All personnel subject to this RPP will receive radiological orientation training as an element of Site orientation training. The objective of this orientation will be to familiarize personnel with Site-specific radiation safety hazards and procedures.

4.2 RADIATION WORKER TRAINING

Personnel who have the potential to receive 100 mrem, total effective dose equivalent (TEDE) in a year must receive training as specified in 10 CFR 19. Although we do not expect personnel to receive exposures exceeding 100 mrem, given that the potential for such exposures exists, each Site worker expecting to be on-Site 80 or more hours per year will receive radiation worker training (RWT). A participant will successfully complete RWT with a score of at least 70% on a written test administered after the training. When available, documentation of successful completion of current Site-specific (annual) RWT fulfills this requirement.

The RWT will include at a minimum, instruction in the following aspects of radiological safety: health effects of ionizing radiation, exposure limits (including those for declared pregnant workers), use of dosimetry and instruments, effects of radiation on the embryo/fetus, employee rights and responsibilities, Site contaminants and probability of exposure, required monitoring, and exposure control methods.
5. DOSIMETRY

5.1 RADIOLOGICAL AIR SAMPLING

Breathing zone (lapel) particulate air sampling will be conducted to verify that internal dose monitoring is not required. Air sampling will be conducted on individuals with the highest potential of inhaling airborne radioactive contamination, when the potential exists (as determined by the RPM). Contamination levels encountered during work will be evaluated to determine the potential to generate airborne radioactive contamination.

Air sampling will be conducted in accordance with the guidance provided in HP-21. Air samples will be analyzed for gross alpha and gross beta/gamma using a Ludlum 2929/43-10-1, or equivalent. Air samples may exhibit activity from short-lived radionuclides such as radon and progeny. If elevated activity is indicated after the first air sample screening, the sample may be screened again (e.g., after about an hour) to determine if in fact short-lived radionuclides are present. If this is the case, then the final count (for the purpose of assigning occupational dose) may be done as late as 10-14 days after collection for accurate indication of actual air concentrations without radon and radon progeny interference. In order to determine occupational dose, alpha air sample activity will be compared against the Derived Air Concentration (DAC) value of radium-226 listed in 10 CFR 20, Appendix B (i.e., 3E-10 $\mu$Ci/ml). The same will be done with beta results using the most conservative beta DAC of lead-210 (Pb-210) (i.e., 1E-10 $\mu$Ci/ml). The basis for this beta DAC is that Pb-210 is a beta emitter at the end of the Uranium decay chain with a long half-life (22 y).

Although not expected, bioassay sampling will be performed to validate air sample results if an individual has the potential to exceed the required monitoring level, as determined by air sampling. U. S. Nuclear Regulatory Commission (NRC) Regulatory Guide 8.7 state that bioassay is required if an individual has a potential to receive an internal dose greater that 0.5 rem (i.e., 200 DAC-hours) per year. In addition, NRC Regulatory Guide 8.7 states that previous dose received at other facilities during the year need not be considered. Based on previous surveys and sampling activities conducted at the Site, exceeding the required monitoring is not anticipated for any workers during the planned on-site activities.

5.2 RADIATION EXPOSURE VERIFICATION

A general area Site radiation survey will be performed in the areas where gamma scan surveys have indicated the presence of radioactive contamination (i.e., gamma scan results are 2 or more times background) and sampling tasks are to be performed. The general area Site radiation survey will be performed using a Bicron micro-rem meter (or equivalent) in accordance with HP-21.

Each radiation worker subject to this RPP and expecting to be on-site 80 or more hours per year will wear a thermo luminescent dosimeter (TLD) between the waist and neck while on-site, except while in designated office and assembly areas. TLDs will be issued in accordance with HP-12. Dosimetry records will comply with 10 CFR 20, Subpart L – Records. TLDs will only be used for dose verification; therefore, an estimate of current year exposure will be accepted as a dose history. When not in use, dosimetry will be stored with a control badge in a designated dosimetry receptacle. A National Voluntary Laboratory Accreditation Program (NVLAP) accredited processor will evaluate dosimetry every 3 months or at the completion of the waste characterization field activities.
6. MONITORING

The following sections describe requirements associated with radiological monitoring of on-site personnel and the release of equipment and materials. Monitoring requirements, action levels, and Site release limits are summarized in Table 6-1.

6.1 PERSONNEL CONTAMINATION MONITORING

All on-site workers who have the potential to handle radioactive material will be monitored for total contamination upon exiting areas where intrusive activities have been performed (i.e., Work Zones). Personnel monitoring will be performed with a Geiger Mueller pancake probe under the direct supervision of an HP technician. Personnel monitoring will take place after doffing PPE. Personnel will be considered contaminated if total activity at ¼ inch from the skin or clothing is greater than background (at a frisk rate not to exceed 2 inches per second).

If personnel contamination is detected on the skin, the affected area will be decontaminated with soap and lukewarm water under the direct supervision of an HP technician. The nature and extent of the contamination event will be documented on Attachment 1 of HP- 27. Contamination of personnel will be reported to the RPM immediately.

6.2 EQUIPMENT CONTAMINATION MONITORING

Prior to release from Work Zones, equipment contamination surveys will be conducted on sampling equipment, and other surfaces as directed by the RPM. Only equipment that meets the radiological requirements of an unconditional release as specified in Nuclear Regulatory Guide (RG) 1.86 will be released from the Site. Any incoming equipment that does not meet the radiological requirements for unconditional release will be refused entry onto the Site.

Direct contamination surveys will be performed with an instrument of sufficient sensitivity to the type and level of contamination that will be encountered on-site. The minimum detectable activity will also be evaluated for each instrument used to perform unconditional release surveys to ensure that required standards as specified in RG 1.86 are achieved. Each instrument will have a current annual calibration and will be response checked each day prior to use with a radioactive check source(s). Instrument response checks will be performed in accordance with HP-31.

Smears and air samples will be counted with a dual alpha-beta/gamma scintillation detector coupled with a scaler (Ludlum 2929/43-10-1 or equivalent). The bench counter will have a current annual calibration and will be source checked each day prior to use with a National Institute of Standards and Technology (NIST) traceable Th-230 and Sr/Y-90 source. Given the range of beta energies for Ra-226 decay products, the Sr/Y-90 beta source will be used to determine instrument efficiencies. The beta energy of Y-90 (2280 keV) is consistent with that of Bi-214 which emits a wide range of beta energies, but most abundantly in the range of 1507 to 3272 keV. This is consistent with the Y-90 beta energy and Bi-214 will also be in equilibrium with and act as a surrogate for its parent Pb-214. Pb-210 and Bi-210 are not likely to be encountered at significant levels due to the longer half-life of Pb-210 (22 y). Source checks will be performed in accordance with HP-31.

Direct frisk (fixed + removable) and smear (removable) surficial contamination surveys will be performed in accordance with the provisions of HP-21. Release limits established in RG 1.86 Table 1 “Acceptable Surface Contamination Levels” or DOE Order 458.1 Figure IV-1 will be enforced.
Any tools or equipment with contamination exceeding the acceptable surface contamination limits will be managed as contaminated material. Contaminated material and equipment will be either decontaminated or containerized for disposal, under the direct supervision of an HP technician.

NOTE: Although radiological decontamination of materials and equipment is not expected due to proactively selecting soil sample and excavation areas that do not contain radioactive contamination on the surface, it may be required. Materials and equipment are expected to be free of soil prior to survey. Decontamination of materials and equipment after survey should consist of minor wiping or scrubbing with a brush and a detergent.
7. INVESTIGATIVE DERIVED WASTE

Investigative Derived Waste (IDW) generated during the sampling/excavation activities may include decontamination towels and fluids, soiled sampling containers, smears, air sample filters, and personal protective equipment (PPE). IDW is not expected to contain radioactive waste above release limits.

If radioactive IDW is generated, AVESI will assist HGL in the storage and labelling of radioactive IDW on the Peck Iron and Metal Site in accordance with AVESI HP-28. At no time will AVESI assume possession of any radioactive wastel or IDW.
8. SHIPMENT OF SAMPLES

Per Department of Transportation (DOT) regulations, sample shipments will be shipped in compliance with 49 CFR 171 – 178 “Transportation” and also in accordance with the AVESI health physics procedures 41, 61, 62, 63 and 65. Samples will be shipped based on previous analytical results that are representative of existing materials.

Sample containers and shipment packages will be surveyed for contamination/dose control purposes. Each sample container and cooler (shipping package) will be surveyed for removable contamination. Only containers that are less than Site removable contamination limits will be released for shipment. In addition, a dose rate will be obtained from the surface of each cooler. Only coolers less than 0.5 mrem/hour on contact will be released for shipment. Shipping containers must be strong, tight containers (STC) when shipping Limited Quantity (LQ) radioactive material. Additionally, personnel performing sample shipment must be trained to the DOT standards listed in 49 CFR 172 Subpart H “Training”.

9. RADIOACTIVE SOURCE ACCOUNTABILITY AND CONTROL

Radioactive sources will be received and shipped in accordance with 49 CFR 173. Only exempt-quantity (per 10 CFR 30.18) radioactive check sources will be used at the Site. Radioactive sources will be kept in a locked container inside the project trailer. The source container will be labeled with a “Radioactive Material” label. Each source will be accounted for during daily instrument check-in/response-check activities. In the event of a missing source, the Field Operations Manager (FOM) and the RPM will be notified.
10. POSTING AND LABELING

Work Zones will be radiologically posted when radioactive contamination is discovered that requires the Work Zone to be posted. The Work Zone barrier (i.e., yellow/magenta rope) will be used to establish and identify radiologically controlled areas. Health physics technicians will prevent unauthorized entry into the radiologically controlled area during sampling/excavation activities.

All containers that potentially contain radioactive material (RAM) will be labeled as “Radioactive Materials”. A “Radioactive Materials Storage Area” (RMSA) will be designated to store containerized RAM. The RMSA will be defined using yellow and magenta rope, with signs that include the words “CAUTION – RADIOACTIVE MATERIAL”. NOTE: Although not expected, some soil samples may contain radioactive contamination above limits. These containers would be controlled as RAM.

As approved by the EPA, radiological areas will be posted in accordance with the provisions of 10 CFR 20, Subpart J, and HP-21. Signs and symbols will conform to those described in 10 CFR 20.1901.
11. CONTAMINATED INJURY PROTOCOLS

As long as the performance of radiological surveys does not adversely impact the medical status of the injured person, personnel with minor injuries will be frisked prior to leaving the site. Contaminated personnel will be decontaminated prior to release. In the event of a serious or life-threatening injury, personnel will be frisked prior to departure from the Site if possible. In no case will frisking or decontamination delay medical care.

In the event of a potentially contaminated person with life threatening injuries, the hospital will be notified that a potentially radioactively contaminated person is being sent, and that a radiation protection expert will arrive with him/her. Efforts to prevent/minimize the spread of contamination which do not jeopardize the workers health will be taken. HGL will be contacted as soon as possible.
12. REFERENCES


10 CFR 20, Standards for Protection Against Radiation.

10 CFR 71, Packaging and Transportation of Radioactive Material.


Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86, Termination of Operating Licenses from Nuclear Reactors.
### RADIATION PROTECTION SUPPORT FOR MEDIA (SOIL, WATER, SEDIMENT, ETC.) SAMPLING ACTIVITIES

Mobilization and demobilization to and from the Site, traversing the Site, periodic and equipment radiological surveys.

<table>
<thead>
<tr>
<th>Radiological Safety Hazards</th>
<th>Probability/Severity</th>
<th>Controls</th>
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<tr>
<td>Radiation Hazards</td>
<td>Very Low/ Very Low</td>
<td>General area measurements will be made to verify work area exposure rates when gamma scan survey results are 2 or more times background. When gamma scan survey results indicate area exposure rates in areas exceeding two times the gamma scan survey background level, work zones will be moved to areas of lower radiation, if possible. TLDs will be worn by personnel expected to spend 80 or more hours on-site per year to verify individual exposures. Although not expected based on previous surveys, areas will be defined and posted as a “Radiation Area” at 5 mrem/hour. All posted areas will be reviewed in radiological orientation training. The action level for radiation hazards will be the sodium iodide rate meter exceeding the highest scale (999,999 cpm). The action associated with this level is to move away to an area of lower activity, identify the area, and notify the RPM and HGL. Designated background areas will be established in each survey unit near the non-impacted access road.</td>
</tr>
<tr>
<td>Contamination Hazards</td>
<td>Very Low/ Very Low</td>
<td>Personal protective equipment: Boot covers and saranex coveralls for walking on-site. Contamination monitoring of equipment and personnel prior to egress. No eating, drinking, smoking, chewing, or application of cosmetics in investigation areas.</td>
</tr>
<tr>
<td>Airborne Hazards</td>
<td>Very Low/ Very Low</td>
<td>One in four personnel working in a work zone will wear a BZ. General area air monitoring will be conducted downwind just outside of work zones.</td>
</tr>
</tbody>
</table>

Note: AHAs for the control of non-radiological hazards are included in HGL Health and Safety Plan for the Remedial Investigation/Feasibility Study of Peck Iron and Metal in Norfolk County, Virginia.
### Table 6-1. Radiological Survey Action Levels and Site Release Limits

<table>
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<tr>
<th>Hazard or Measured Parameter</th>
<th>Area</th>
<th>Interval</th>
<th>Limit</th>
<th>Action</th>
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<td>Radiological total surface contamination with beta sensitive survey instrument.</td>
<td>Work Zone equipment and materials, general areas, and personnel.</td>
<td>All equipment and materials – Site release, at Work Zone exit. Personnel- Upon exit from Work Zone.</td>
<td>Equipment and items – 5,000 dpm/100 cm² beta. Personnel – background</td>
<td>Equipment and items – control as radioactive material or decontaminate. Personnel- decontamination and re-evaluate PPE requirements.</td>
</tr>
<tr>
<td>Removable surface contamination determined by smearing 100cm² surface area per swipe. Surface may be more than 100cm².</td>
<td>Work Zone equipment and materials, general areas, and shipment surveys.</td>
<td>All equipment prior to Site release and following decontamination. General areas upon Site arrival. Shipment surveys prior to shipment and upon receipt of RAM.</td>
<td>1,000 dpm/100cm² beta.</td>
<td>Equipment and items - Remove by decontamination or control as radioactive material.</td>
</tr>
<tr>
<td>Sampling for airborne radioactive particulates.</td>
<td>Breathing zone of the employee with the highest potential of inhaling radioactive material. General Area sample downwind at the perimeter of excavation Work Zones. (Not required for soil sampling outside of test pit areas.)</td>
<td>Continuous during sampling/excavation activities, and as directed by the RPM.</td>
<td>Alpha DAC = 3x10⁻¹⁰ μCi/mL (Ra-226) Beta DAC = 1x10⁻¹⁰ μCi/ml (Pb-210) 12 DAC-hours/week 200 accumulated DAC-hours</td>
<td>Review engineering controls and respiratory protection requirements if &gt;0.25 DAC on air sample. Notify Field Operations Manager and RPM if 12 DAC-hours/week is accumulated by any individual. Conduct bioassay if &gt; 200 DAC-hours accumulated.</td>
</tr>
<tr>
<td>Radiation exposure with exposure meter.</td>
<td>General areas of the Site, shipment surveys.</td>
<td>Areas exceeding twice the gamma scan survey background level, and intermittently as determined by the RPM.</td>
<td>Exceeding the highest scale on the sodium iodide rate meter (999,999 cpm) 5 mrem/hour general areas. 0.5 mrem/hour contact on shipment surveys for “Limited Quantity” materials.</td>
<td>Post as a radiation area (5 mrem/hour general areas), notify Field Manager, RSO, HGL and RPM</td>
</tr>
</tbody>
</table>
APPENDIX A

AVESI Health Physics Procedures
RADIATION PROTECTION PROGRAM

AVESI HP-01

APPROVED BY: _________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

The American Veteran Environmental Services (AVESI) Radiation Protection (RP) Program, as defined within this procedure (AVESI HP-01) and its supporting procedures, is developed to ensure work activities involving potential exposure to ionizing radiation, where the activities are conducted under this program, are performed in accordance with applicable regulatory requirements. This program contains the basic concepts and criteria of a radiation protection program and is implemented through procedures addressing specific categories of radiation safety and regulatory compliance. The program provides for the following commitments:

1.1 radiological safety of occupationally exposed personnel, the public and the environment,
1.2 monitoring of radiation and radioactive materials,
1.3 controlling distribution and releases of radioactive materials, and
1.4 maintaining occupational radiation exposure to individuals within federal limits, and at levels as low as reasonably achievable (ALARA).

2.0 Scope

2.1 This procedure and its supporting procedures apply to all AVESI or subcontractor personnel at sites or locations working under this AVESI radiation protection program. This program is designed to ensure regulatory compliance through the implementation of procedures, personnel training, and development of technical work records that document a specific method of compliance. The radiation protection program provides the following commitments:

2.1.1 Each individual is responsible for integrating the information contained in Radiological Work Permits, Radiation Worker Training (RWT), and additional site specific radiation safety training into all applicable work activities.

2.1.2 Each individual working under this radiation protection program must understand and accept the responsibility to follow all procedures and maintain his or her radiation exposure ALARA.

2.1.3 AVESI shall comply strictly with regulatory requirements, radiation exposure limits, and limits regarding release of radioactive materials.

2.1.4 AVESI shall maintain a comprehensive radiation protection program to keep individual and collective radiation exposures to workers and the public below regulatory limits and ALARA.
2.2 This radiation protection program and its supporting procedures are based on the requirements set forth in Title 10 Code of Federal Regulations (CFR) Part 20 (10 CFR 20), “Standards for Protection Against Radiation”. Sites where this program is implemented other than those regulated by the Nuclear Regulatory Commission (NRC) (i.e., Department of Energy (DOE), U.S. Army Corps of Engineers (USACE), etc.) may require establishment of guidelines and requirements differing from those set forth in this procedure. The AVESI Radiation Protection Manager (RPM) will document these differences and establish guidelines and requirements in the Site Safety and Health Plan (SSHP) for that site (or in other appropriate documents), as applicable.

3.0 References

3.1 10 CFR 19, “Notices, Instructions and Reports to Workers: Inspection and Investigations”

3.2 10 CFR 20, “Standards for Protection Against Radiation”


3.5 10 CFR 71, “Packaging and Transportation of Radioactive Material”

3.6 10 CFR 835 “Occupational Radiation Protection”

3.7 29 CFR 1910.132, “Personal Protective Equipment”


3.10 49 CFR, “Transportation”

3.11 40 CFR, Part 240 through 281, "Resource Conservation and Recovery Act"


3.20 APHA Method 7110 - American Public Health Association, Method 7110, "Gross Alpha and Gross Beta Radioactivity (Total, Suspended, and Dissolved)”, Standard Methods for the Examination of Water and Wastewater.

3.21 Department of Energy, “Emergency Response Guidebook”


3.23 Disposal site acceptance criteria.


3.43 QAAP 17.1, “Records Management”
3.44 AVESI EH&S Manual, Section 9, “Respiratory Protection Program”
3.45 AVESI EH&S Procedure 19, “Radiation Protection”
3.46 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”
3.47 NUREG/BR-0204, “Instructions for Completing NRC’S Uniform Low-Level Radioactive Waste Manifest,” NRC
3.48 NUREG-1507, “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions”
3.49 NUREG-1608, “Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects”, NRC

4.0 Definitions

This procedure uses the standard definitions contained in 10 CFR 20. These and additional definitions are given below.

4.1 **Access Control Point (ACP)** – an area established to maintain contamination control and access control of Restricted Areas. ACPs are not a requirement, but are a good HP practice and are established at the discretion of the RPM.

4.2 **Airborne Radioactivity Area** – a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

   4.2.1 In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20, or
4.2.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.3 **Conditional Release** – The release of an item from the Restricted Area which externally meets the requirements of “Unconditional Release”, but may have areas inaccessible for surveying. Conditionally released items shall not leave the site Controlled Area without the approval of the RPM and concurrence with the appropriate client representative.

4.4 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site specific contamination limits as documented on Attachment 2 of AVESI HP-11, “Radiological Limits” or other site specific documentation (i.e., Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), etc.).

4.5 **Contamination (Radioactive)** – Deposition of radioactive material in any place not desirable. The presence of unwanted radioactive material on tools, equipment, surfaces, clothing, personnel, and etc.

4.6 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

4.7 **Decontamination** – The removal of radioactive contamination from surfaces, people or equipment.

4.8 **Dosimeter** – A device that is used to measure cumulative radiation dose, such as a self-reading pocket dosimeter, TLD or electronic dosimeter.

4.9 **Exposure Extension** – An authorization to increase a worker’s allowable exposure to radiation within AVESI exposure guidelines.

4.10 **Extremity** – Hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

4.11 **Frisk** – The term used to describe the method and requirements for monitoring of contamination on personal clothing and/or body, either by using a portable radiation detection instrument, or a portal monitor.
4.12 **Radiological Work Permit (RWP)** – A permit issued by HP personnel to communicate work area radiological hazards to personnel and specify controls and protective equipment necessary for worker protection.

4.13 **High Radiation Area** – Any area accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

4.14 **Ionizing Radiation** – Any radiation which either directly or indirectly causes ionization.

4.15 **Continuous Radiological Coverage** – A level of radiation safety provided for a work activity that is determined by the RPM to involve significant radiological hazards which implies continuous HP coverage while the job is in progress.

4.16 **Protective Clothing** – Special clothing worn by a radiological worker to prevent bodily or personal clothing contamination.

4.17 **Qualified Personnel** – A person who has demonstrated and documented proficiency in performing a task as specified in HP procedures and training documents.

4.18 **Radiation Area** – Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or any surface that the radiation penetrates.

4.19 **Radiological Worker Level I (RWI)** – an individual that has successfully completed RWT. A RWI is referred to in this document as a radiological worker who has successfully completed radiological worker training.

4.20 **Radiological Worker Level II (RWII)** – an individual meeting Radiological Worker Level I requirements and qualified to perform HP tasks by satisfactorily completing specific training requirements, as approved by the RPM. A RWII is referred to in this document as a HPT.
4.21 **Radioactive Material Area (RMA)** – an area or room in which there is used or stored an amount of radioactive material exceeding 10 times the quantity of such material specified in Appendix C to 10 CFR 20.

4.22 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.

4.23 **Respiratory Protection Factor** – A measure of the degree of protection afforded by a respirator.

4.24 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.25 **Intermittent Radiological Coverage** – Refers to a level of HP protection provided for work involving radiological conditions that do not require continuous HP coverage.

4.26 **Self-Reading Dosimeter (SRD)** – Pocket ionization chamber used to monitor X-ray or gamma radiation.

4.27 **Self-Contained Breathing Apparatus (SCBA)** - An atmosphere-supplying respirator in which the source of breathing air independent of the ambient atmosphere is designed to be carried by the user.

4.28 **Thermo-luminescent Dosimeter (TLD)** – A dosimeter that measures radiation exposure by radiation interaction with a crystalline structure. TLDs are typically the primary method to measure and quantify personnel exposure from external radiation fields.

4.29 **Unrestricted Use (Unconditional Release)** – Classification of tools, equipment, or components that may be released from or used on site without the imposition of radiological controls, restrictions, or requirements.

4.30 **Very High Radiation Area** – Area accessible to individuals in which the radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter (m) from the source or any surface that the radiation penetrates.

4.31 **Whole Body Count** – An analysis performed external to the body to determine the amount of gamma-emitting radioactivity deposited in a person’s body.

5.0 Responsibilities

5.1 The Radiation Safety Officer (RSO) is responsible for:

5.1.1 Developing radiation safety standards and controls.

5.1.2 Ensuring compliance with the requirements delineated in 10 CFR 20, and other applicable federal and state regulations.

5.1.3 Making the appropriate notifications in accordance with AVESI EH&S Procedure 19.

5.1.4 Ensuring site activities conducted under this radiation protection program are performed in accordance with this manual and supporting procedures.
5.1.5 Posting a current copy of NRC Form 3, “Notice to Employees” for personnel examination at NRC regulated sites.

5.1.6 Performing an annual audit of the radiation protection program to identify and address program quality and compliance.

5.1.7 Reviewing personnel exposures upon availability of monitoring results.

5.1.8 Supporting and enforcing radiation safety standards and controls outlined in this procedure.

5.1.9 Assigning a site RPM for each client site working under this radiation protection program.

5.2 The Site Radiation Protection Manager (RPM) is responsible for:

5.2.1 Assuming the roles and responsibilities of the RSO at a specific client site, other than the RSO responsibilities listed in AVESI HP-16, “Qualifications and Training” which shall not be delegated.
5.3 HPTs are responsible for:

5.3.1 Implementation of the RPP and supporting procedures under the direction of the RPM.

5.3.2 Reporting non-conformance with HP procedures and policies.

5.3.3 Stopping work or ordering an area evacuated when, in their judgment, the radiological conditions warrant such an action and such actions are consistent with site and personnel safety.

5.4 Each radiological worker is responsible for:

5.4.1 Integrating the information contained in Radiological Work Permits, RWT, and additional site-specific radiation safety training and instructions into all applicable work activities to maintain their exposure ALARA.

6.0 Procedure

6.1 General

6.1.1 HP activities should be governed by written procedures, which are available for review and audit.

6.1.2 The HP organization is illustrated graphically in Attachment 1, or equivalent.

6.1.3 Responsibilities of personnel performing HP tasks are communicated through the training qualifications associated with specified tasks and as directed by the RPM.

6.1.4 The Site RPM may delegate responsibilities described in HP procedures to qualified HPTs when specified by this RPP and its implementing procedures (i.e., RPM or designee).

6.1.5 Contractor personnel performing radiation safety-related activities on-site shall be verified to have the training and experience to perform their assigned duties.

6.1.6 HPTs are responsible for providing support for job coverage (i.e., HP oversight).

6.1.7 The RPM shall be notified of any radiological incidents or emergencies that may involve the contamination of personnel or the loss of control of radioactive material. Additionally, the RPM shall be notified of any radiological occurrence as described in AVESI HP-22, “Radiological Reporting”.

6.1.8 In HP procedures, the word “shall” is to be understood as a requirement, and the word “should” is to be understood as a recommendation.

6.1.9 Exemptions to HP procedures shall be permitted pursuant to the written authorization of the RSO, as site-specific conditions warrant. Procedural exemption authorization shall not be delegated.
6.1.10 In addition to HP procedures, HP instructions may be implemented to standardize guidance for program areas that are not related to safety. HP instructions need only be approved by the RPM.

6.1.11 Procedure attachment (forms) equivalents may be implemented as specific conditions warrant, as approved by the RPM. The information recorded in procedural attachments may also be recorded by electronic means, as approved by the RPM.

6.2 HP Training and Qualification

6.2.1 The training and qualification program for site personnel is designed to provide an adequate level of radiation safety training commensurate with the duties of each worker.

6.2.2 The RSO will have a minimum of four years of applied radiation safety experience, a Bachelor of Science in Health Physics or other related educational field, and 2 years of management experience.

6.2.3 A site RPM will have a minimum of four years of applied radiation safety experience and one year of management experience. The site RPM shall act as the designated alternate to the RSO at client sites where the RSO is not assigned.

6.2.4 Senior HPTs will have a minimum of a high school diploma, three years of applied radiation safety experience, and be qualified on the performance of specific tasks. Additional education and training may be substituted for up to one (1) year of experience.

6.2.5 The RPM is responsible for ensuring training for the HP organization meets the requirements to provide adequate protection of occupationally exposed personnel, public, and environment.

6.2.6 The RPM shall review and approve the content of lesson plans, handout material and examination question banks for HP training programs, as applicable.

6.2.7 Prior to allowing unescorted access into the Restricted Area, personnel are required to successfully complete Site Orientation Training (SOT) and Radiological worker Training (RWT). The RPM may permit access into the Restricted Area without completing SOT and RWT provided the personnel are accompanied by an individual who has satisfactorily completed SOT and RWT.

6.2.8 AVESI HP-16, “Qualifications and Training” outlines the minimum training and qualifications for site personnel.

6.2.9 Radiological Worker Training (RWT)

Site employees who frequently enter the Restricted Area and work in radiological areas shall complete initial RWT.

6.2.9.1 The RPM shall approve all material presented in RWT and the qualifications of instructors who present the material.
6.2.9.2 RWT shall meet the requirements of 10 CFR 19.

6.2.9.3 Successful completion of the training provides the necessary knowledge to safely work in radiological areas of the facility and meets the requirements to become a Radiological Worker.

6.2.9.4 Specialized training for radiological workers is conducted on an “as needed” basis. This type of training includes use of containment devices, operation of special decontamination equipment, special controls for unusual radiological conditions, and other topics, as required.

6.2.9.5 AVESI HP-16, “Qualifications and Training” outlines the content and requirements for successful completion of initial RWT.

6.2.10 Respiratory Protection Training

6.2.10.1 The Respiratory Protection Training Program has been developed consistent with 10 CFR 20 and 29 CFR 1910.134.

6.2.10.2 Personnel who are expected to enter an Airborne Radioactive Material Area using respiratory protection equipment must have Respiratory Protection Training. This includes contractors and vendors as well as permanent site personnel.

6.2.10.3 Personnel must successfully complete a refresher training class and undergo a fit test and physical examination annually to maintain respiratory protection qualification.

6.2.10.4 Detailed requirements for training, qualification, and use of respiratory protection equipment are contained in AVESI HP-15, “Respiratory Protection”.

6.2.11 HP Training

6.2.11.1 HP Training is designed to train and qualify HP personnel (HPTs, Health Physicists, etc.) in the tasks necessary to maintain site radiation safety. Current industry standards and practices are also incorporated into the training material, which serves as the basis for developing competent professionals in the radiation safety field.

6.2.11.2 Contractors or temporary personnel working in the HP organization are required to complete appropriate HP training prior to assuming responsibility for radiation safety activities. Training consists of reviewing site-specific procedures and equipment. Examination material, an evaluation of past experience, or formal on-the-job training may be utilized to verify qualifications for performing given tasks.

6.2.11.3 Details on HP training requirements are contained in AVESI HP-16, “Qualifications and Training”.

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6.3 Exposure Control

Control of radiation exposure received is achieved through a program using the ALARA program, RWPs, administrative exposure limits, and exposure reports. Exposures are monitored using TLDs, electronic dosimeters (EDs), SRDs, portable survey instruments, air sampling, and bioassay samples.

6.3.1 Administrative Exposure Limits

6.3.1.1 Personnel receive an initial administrative limit on the annual TEDE (Total Effective Dose Equivalent) as an ALARA Awareness Limit. The purpose of this limit is to stress each individual’s personal awareness of ALARA, radiation exposure accumulation and their responsibility for maintaining their exposure ALARA.

6.3.1.2 Personnel may be allowed to receive an addition to the initial administrative limit with a formal request for extension, at the discretion of the RSO. It is the responsibility of project management to make every effort to maintain collective radiation exposure ALARA and distribute such exposure to the extent practical.

6.3.1.3 An administrative cumulative lifetime exposure limit on the TEDE (rem), equal to an employee’s age in years, is established to comply with NCRP-91. This limit will be evaluated only when exposure extensions are requested. Exceeding this limit requires the approval of the RSO.

6.3.1.4 The dose to an embryo/fetus during the entire gestation period, due to occupational exposure of a declared pregnant female worker, shall not exceed 500 mrem TEDE. Efforts to minimize substantial variation above a uniform exposure rate of 50 mrem TEDE/month to a declared pregnant female worker will be implemented. If the dose to an embryo/fetus is found to have exceeded 500 mrem TEDE, or is within 50 mrem of this limit when the female worker declares her pregnancy, then AVESI shall be deemed to be in compliance with the limit if the dose to the embryo/fetus does not exceed 50 mrem TEDE during the remainder of the gestation period.

6.3.1.5 For high radiation exposure jobs where individual radiation exposures are anticipated to exceed the initial administrative exposure limit, exposure extensions may be processed prior to start of work.
6.3.1.6 Provisions for planned special exposures are not expected to be used; however, if planned special exposures become necessary the activity will be conducted in accordance with the guidance contained in NRC Regulatory Guide 8.35, “Planned Special Exposures”.

6.3.2 Radiological Work Permits

The Radiological Work Permit (RWP) is the primary tool for ensuring ALARA objectives are incorporated into daily activities. The major emphasis of the program is toward proper planning of activities. This is accomplished by specifying radiological conditions and HP requirements such as engineering controls, respiratory protection, protective clothing, and dosimetry based upon current conditions, job scope and historical information. The ALARA objectives incorporated in the RWP are listed below.

6.3.2.1 Job Planning – Issuance of an RWP requires adequate time to review the radiological hazards at the site and recommend the appropriate protective measures.

6.3.2.2 Pre-job Estimates – The collective total effective dose equivalent estimate involved with each RWP is conducted when required by AVESI HP-13, “ALARA Program”. Estimates are based on actual or expected radiation levels, stay times, and/or past experience. Subsequent pre-job actions are based on the estimated exposure.

6.3.2.3 Post-job Recommendations – ALARA recommendations for future and similar jobs may be documented on the RWP. Recommendations are reviewed by the RPM for implementation feasibility. Feedback is provided to originators of ALARA recommendations.

6.3.3 HP Job Reviews

6.3.3.1 Jobs that involve a collective radiation exposure in excess of 1 person-rem, will be reviewed by the RPM to ensure proper radiological controls are utilized and exposures received are ALARA. Job reviews are scheduled to maintain an ongoing review of major activities with the following objectives:

(a) Develop or review training guidelines for performing HP job coverage for specific tasks and/or job categories.

(b) Review associated site activities to identify and incorporate radiation safety requirements and controls.

(c) Identify any improvements such as equipment changes, procedure changes, shielding applications, or design modifications that may economically reduce exposure or the spread of contamination.
6.3.3.2 Modifications to work activities involving radiation exposure are incorporated into the RWP, as applicable.

6.3.4 Monitoring for Whole Body External Exposure to Gamma Radiation

Monitoring of radiological workers and calculation of occupational exposure from external sources of radiation will be conducted in accordance with the guidance in NRC Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses”, or other appropriate guidance documents.

6.3.4.1 Monitoring for whole body external exposure to gamma radiation may be accomplished using thermo-luminescent dosimeters (TLDs), electronic dosimeters (EDs), or Self Reading Dosimeters (SRDs).

6.3.4.2 Personnel should wear dosimetry on the chest to assure a representative measurement of whole body radiation exposure, unless otherwise directed by the RPM.

6.3.4.3 HP personnel should direct placement of the dosimetry on that portion of the whole body expected to receive the largest exposure during work.

6.3.4.4 Multiple dosimeters are utilized, when necessary, to determine which portion of the whole body receives the highest radiation exposure.

6.3.4.5 Personnel shall immediately stop work and notify an HPT if dosimetry is lost, an off-scale SRD reading is noted, or if an ED alarm occurs.

6.3.4.6 The HPT or RPM, as applicable, will investigate and initiate a Personnel Monitoring Incident Report for a lost dosimeter, or an elevated monitoring result in accordance with AVESI HP-22, “Radiological Reporting”.

6.3.4.7 Short-term visitor exposure is normally limited to 50 mrem TEDE and they must have a qualified escort (i.e., qualified radiological worker who has successfully completed the RWT Program and Site Orientation Training).

6.3.4.8 Personnel dosimetry may not be required if the RPM determines that personnel entering the Restricted Area are not likely to exceed 500 mrem per year deep dose equivalent (DDE).

6.3.5 Monitoring for Extremity Exposure

6.3.5.1 Monitoring to determine shallow dose equivalent to extremities is required for tasks where an individual’s extremity dose is likely to exceed 5 rem/yr.

6.3.5.2 Extremity monitoring is typically conducted with TLDs.
6.3.5.3 Extremity dose should be recorded and reported as shallow dose equivalent.

6.3.5.4 Actions to preclude or minimize beta and/or gamma radiation exposure to extremities include the use of protective clothing, shielding, and minimizing exposure time.

6.3.6 Monitoring For External Beta Exposure

6.3.6.1 Monitoring to determine shallow dose equivalent to the skin is required for tasks where an individual’s skin dose is likely to exceed 5 rem/yr.

6.3.6.2 Monitoring to determine dose equivalent to the lens of the eye is required for tasks where an individual’s dose to the lens of the eye is likely to exceed 1.5 rem/yr. Radiation exposure to the skin of the whole body from beta radiation is primarily monitored with TLDs.

6.3.6.3 Radiation exposure due to skin contamination should be calculated, recorded, and reported if any portion of the skin receives greater than 1000 mrem due to a skin or personal clothing contamination incident.

6.3.6.4 Actions to preclude or minimize beta radiation exposure to the skin of the whole body and the lens of the eye include use of protective clothing, safety glasses, shielding, and/or minimizing exposure time.

6.3.7 Quality Control of Dosimetry

6.3.7.1 The TLD processing program shall be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for the energies and types of radiation expected to be encountered at a site.

6.3.8 Monitoring and Control of Surface Contamination

6.3.8.1 Contaminated surfaces of structures or land areas within the Restricted Area are controlled and posted if alpha or beta/gamma emitting removable surface contamination levels are greater than site “removable” contamination limits. Engineering, preventative, and administrative controls are utilized to the extent practical to minimize the spread of contamination.

6.3.8.2 Fixed surface contamination is predominately a direct radiation hazard. As such, a contact survey limit of 2.0 mrem/hr is applied to fixed surface contamination on items (i.e., tools, equipment, etc.) used in a Restricted Area.
6.3.8.3 Monitoring of personnel and equipment for surface contamination shall be conducted in accordance with AVESI HP-21, “Radiological Monitoring”. Routine surveillance surveys for surface contamination shall be conducted in accordance with AVESI HP-23, “Health Physics Oversight”.

6.3.9 Monitoring and Control of Airborne Radioactive Material

6.3.9.1 Monitoring radiological workers to determine dose from internally deposited radionuclides is required for individuals likely to receive an intake of 10 percent of the applicable ALI(s) in Table 1, Columns 1 & 2 of Appendix B to 10 CFR 20.

6.3.9.2 The primary methods of monitoring for internal radiation exposure should be air sampling, whole body monitoring, and/or bioassay, as applicable. The RPM is responsible for determining the most appropriate monitoring method. Monitoring for airborne radioactivity shall be conducted in accordance with AVESI HP-21, “Radiological Monitoring”.

6.3.9.3 Site areas shall be posted as Airborne Radioactivity Areas in accordance with the requirements of 10 CFR 20 and AVESI HP-24, “Radiological Posting and Labeling”.

6.3.9.4 If monitoring is required, DAC-hours are calculated and documented in dose record files for any individual who, considering respiratory protection, is estimated to have received 0.4 DAC-hours (i.e., 1 mrem).

6.3.9.5 Process and engineering controls, such as temporary ventilation and containment, are utilized when practical to minimize the need for respiratory protection equipment. Routine use of respiratory protection equipment to control internal exposures is strongly discouraged. The use of respiratory protection equipment is normally limited to non-routine evolutions where process and engineering controls are not practical or in emergency situations.

6.3.9.6 When process or engineering controls are not practical to eliminate exposure to airborne radioactive materials and/or radiation, ALARA assessments should consider exposure and total risks with and without respiratory protection equipment. The goal is to minimize the workers total risk (radiological, industrial, and environmental factors). Respirators should not be used if the assessment indicates that the total radiation dose or total risk would be increased. In addition, ALARA assessments are performed whenever respiratory protection is used that has a protection factor less than the peak number of DACs (i.e, the concentration inside the respirator is assumed to
be greater than 1 DAC even after considering the respirator protection factor).

6.3.9.7 The RWP identifies when the potential exists for airborne radioactive material and specifies the controls used to limit exposure. HP personnel are trained in the proper use of air sampling equipment and DAC-hour calculation methods. The RPM is responsible for specifying when the use of respiratory protection equipment is required.

6.3.9.8 When the use of respiratory protection equipment is necessary, only those devices which are National Institute of Occupational Safety and Health (NIOSH) approved are used. Selection of such devices for a particular application is based upon protection factors specified in site procedures and 10 CFR 20 Appendix A. The protection factor for the type of respiratory protection device selected should reduce the inhaled concentration to less than 1 DAC, whenever practical.

6.3.9.9 The following requirements shall apply to the use of respiratory protective equipment:

(a) Personnel are fully respirator qualified when all three of the following criteria are satisfactorily completed.
   1. Personnel are medically qualified to wear respiratory protection equipment.
   2. Personnel have successfully completed either an initial respiratory training class or an annual re-qualification class.
   3. Personnel have been successfully fitted for the respirator to be used within one year of use.

(b) Personnel designated to maintain respirator qualification are required to undergo medical evaluation on an annual basis.

(c) Respirator qualification requires that annually, during the respirator fit tests, facial hair around the sealing periphery of the respirator mask must be shaved so that facial hair does not interfere with the form, fit or function of the respirator mask.
(d) Most personnel who receive occupational radiation exposure on a routine basis may also be expected to work in airborne radioactive material areas when such conditions exist. Project managers are responsible for ensuring that the number and skills of respirator-qualified personnel are adequate for supporting normal site operations, periods of increased work-load, and emergency conditions.

(e) Personnel who have medical limitations or cannot obtain a satisfactory seal due to facial dimensions are not qualified to wear respiratory protection equipment.

6.3.10 Radiological Posting and Labeling

6.3.10.1 Areas within the Restricted Area are posted as a Radiation Area if general area levels are equal to or greater than 5 mrem/hr and as a High Radiation Area if general area levels are equal to or greater than 100 mrem/hr. General area measurements are made at twelve (12) inches (30 centimeters) from any relevant component or source.

6.3.10.2 High Radiation Areas are conspicuously posted and barricaded in accordance with 10 CFR 20.

6.3.10.3 Entryways to HRAs should be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into a HRA.

6.3.10.4 When conditions are impractical for barricading or locking, such as limited evolution jobs or temporary storage, flashing lights (normally red) are utilized with the high radiation area posting to alert the individual to potential entry into a High Radiation Area. Direct surveillance, to prevent unauthorized entry, may be substituted for locked areas or flashing lights for temporary High Radiation Areas.

6.3.10.5 Any individual or group of individuals entering a High Radiation Area shall be provided with, or accompanied by, one or more of the following:

(a) A radiation monitoring device which continuously indicates the radiation levels in the area.

(b) A radiation monitoring device which continuously integrates the radiation dose rate in the area and alarms when a preset integrated dose is received. Entry into such areas with such a device may be made after the radiation levels in the area are known.
(c) A Senior HPT with a radiation exposure rate monitoring device, who is responsible for providing positive control over the activities within the area.

6.3.10.6 Areas are posted as Very High Radiation Areas if dose rates could exceed 500 rads in 1 hour at 1 meter from any source.

6.3.10.7 VHRAs are subject to all controls established for High Radiation Areas.

6.3.10.8 VHRAs shall require special posting in accordance with 10 CFR 20, must be locked when not open for access, and require primary HP coverage for each small group entering when open for access. When unlocked, a guard will be posted to prevent unauthorized access.

6.3.10.9 The RPM shall institute the controls necessary (in addition to the controls above) to ensure that an individual is not able to gain unauthorized access to VHRAs in which radiation levels could be encountered at 500 rads or more in one hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

6.3.10.10 Restricted Areas are posted and controlled to ensure that personnel in unrestricted areas will not receive greater than 2 mrem in any one (1) hour or 100 mrem total effective dose equivalent in one (1) year.

6.3.10.11 Client sites working under the AVESI radiation protection program shall be posted in accordance with AVESI HP-24, “Radiological Posting Labeling”.

6.4 Radioactive Material Control

The HP organization is responsible for identification, surveillance, and accountability of radioactive material as conditions warrant.

6.4.1 Control of Radioactive Material within the Restricted Area

6.4.1.1 Radioactive material is maintained within the Restricted Area of the site or in a RMSA unless otherwise approved by the RPM, or designated Senior HPT.

6.4.1.2 Labeling is not required if any one of the exceptions delineated in 10 CFR 20 apply.

6.4.1.3 The RPM, with the assistance of HPTs, shall control radioactive sources in accordance with AVESI HP-25, “Radioactive Source Control”.

6.4.1.4 Good housekeeping is necessary to ensure material used by workers is decontaminated and/or stored in a controlled manner once work is completed. This includes proper packaging and prompt survey upon removal of items from a contaminated area.
6.4.1.5 Movement and storage of radioactive material is monitored by the HP organization when the potential exists for unnecessary or inadvertent radiation exposure. Surveys are routinely performed in RMSAs and non-posted areas to ensure compliance with HP procedures and policies.

6.4.1.6 Designated radioactive material storage areas are posted and controlled in accordance with 10 CFR 20.

6.4.2 Control of Radioactive Material Outside the Restricted Area

6.4.2.1 The RPM, or Senior HPTs, may designate RMSAs outside of the Restricted Areas, but within the Controlled Area of the site.

6.4.2.2 Materials with the potential to be volumetrically contaminated shall be evaluated on a case by case basis and unconditional release approved by the RPM.

6.4.3 Control of Radioactive Material Receipt and Shipment

6.4.3.1 Receipt and shipment of radioactive material is performed in accordance with Department of Transportation (DOT) regulations contained in 49 CFR and AVESI HP-41, “Radioactive Material Shipping.”

6.4.3.2 For NRC licensed material, controls for shipments include package determination and a quality assurance program in accordance with 10 CFR 71.

6.4.3.3 HPTs are responsible for performing radiation and contamination surveys on trucks and radioactive material payloads upon arrival at, and departure from, the site, as well as preparation and review of shipment documents and verification of recorded radiation and contamination levels.

6.4.3.4 Radioactive materials are promptly surveyed and normally stored within the Restricted Area or approved RMSAs after receipt.

6.4.3.5 AVESI HP-41, “Radioactive Material Shipping”, establishes criteria for radiation and contamination surveys on radioactive shipments, specifies when surveys are required, the types of surveys required, the extent of surveys and documentation required.

6.5 Radiological Surveillance

Radiological surveillance is established to ensure compliance with applicable regulations while ensuring that radiation exposures are maintained ALARA. Specific requirements are contained in AVESI HP-21, “Radiological Monitoring” and AVESI HP-23, “Health Physics Oversight”. 
6.5.1 Routine Surveillance

6.5.1.1 HPTs are responsible for performing routine surveys (radiation, contamination, and/or airborne radioactive material) in specified areas of the site. Survey frequencies are established to adequately assess trends within the Restricted Area and ensure adequate controls are being maintained to prevent contamination of areas outside the Restricted Area.

6.5.1.2 Routine surveys within the Restricted Area shall be sufficient to assess significant changes in radiological conditions, to provide a method for establishing controls, and to ensure proper controls already established are adequate.

6.5.1.3 In areas outside the Restricted Areas of the site (controlled and/or uncontrolled areas), surveys are routinely performed in areas used frequently by personnel who extensively work in the Restricted Area, as appropriate.

6.5.1.4 Surveys, both routine and non-routine, will be appropriately documented to serve as a useful tool in job planning and establishing a radiological history for future reference. AVESI HP-21, “Radiological Monitoring” and AVESI HP-23, “Health Physics Oversight” specify the types of surveys to be documented.

6.5.1.5 Any survey which reveals results which are out of the ordinary shall be investigated to determine the cause of the abnormal results and the method for returning the area back to normal. The RPM is informed of abnormal survey results.

6.5.2 Radiation Surveys

Surveys performed to determine radiation levels throughout the site are conducted with survey instruments calibrated for the types and ranges expected or actually present. Area radiation surveys are performed to determine general area radiation levels and to identify components that are significant contributors to the general area levels.

6.5.3 Contamination Surveys

6.5.3.1 Surveys for surface contamination are usually performed using a smear technique or by direct measurement. Instrumentation used to analyze smears taken outside the Restricted Area or smears taken to unconditionally release equipment or clear contaminated areas should be capable of detecting contamination levels at or below the applicable release limit.
6.5.3.2 Contamination surveys are performed in controlled and uncontrolled areas of the site in order to evaluate the effectiveness of contamination control methods and to adequately assess personnel protection requirements. Prior to issuing a RWP, contamination levels in a work area are determined, or an evaluation is performed and used to establish protective clothing requirements.

6.5.3.3 Personnel monitoring for contamination is accomplished using friskers or stationary monitors. The frisker is considered the primary type of instrumentation to be used by personnel exiting contaminated areas.

6.5.4 Airborne Radioactive Material Surveys

6.5.4.1 Concentrations of airborne radioactive material are assessed on a routine basis at a frequency dictated by site conditions in accordance with AVESI HP-21, “Radiological Monitoring”. These assessments are performed using equipment and techniques appropriate for the types of radioactive material present at the sampling locations.

6.5.4.2 Air sampling data, or an evaluation of potential conditions, are used as the basis for establishing respiratory protection requirements for RWPs. Periodic air samples are also collected when work is being performed when a reasonable potential for airborne radioactive material exists, to ensure that respiratory protection specified is adequate and that radiological conditions have not deteriorated.

6.5.4.3 Air sampling should be accomplished in accordance with Regulatory Guide 8.25 and HP-21, “Radiological Monitoring”.

6.6 Instrumentation

6.6.1 Instrumentation is available to properly detect and measure encountered types of radiation over a wide range of exposure rates and energies.

6.6.2 Calibration guidance in Regulatory Guide 8.25 and ANSI N323A-1997 is referenced in order to maintain an industry standard calibration program.

6.6.3 AVESI HP-31, “Radiological Instrumentation” defines instrument calibration requirements, the determination of quality control acceptance criteria, and instrument efficiency determinations.

6.6.4 Quality Control of radiation survey instruments is established and maintained in accordance with AVESI HP-31, “Radiological Instrumentation”.

6.7 Quality Control

6.7.1 Administration of the internal program for maintaining a high level of quality is accomplished through the organization described in Section 6.1. The RPM ensures proper evaluation of procedures and reported results.
6.7.2 Procedures delineate the requirement that data analysis and review are conducted in a timely manner by qualified personnel to ensure consistency and accuracy of results.

6.7.3 Periodic audits performed on the radiological monitoring quality assurance program are described in Section 6.8.

6.8 Oversight

6.8.1 Oversight is performed to ensure the effectiveness of the radiation protection program through the following measures.

6.8.1.1 Identify non-compliance with federal, state, and procedural requirements.

6.8.1.2 Identify work practices that could be improved, particularly those which could result in unnecessary exposure.

6.8.1.3 Evaluate the effectiveness of HP training.

6.8.1.4 Identify radiological control problems and potential problems.

6.8.1.5 The RPM, or other qualified health physicist shall annually review the performance of the radiation protection program.

6.8.2 The RPM and/or HPTs are responsible for reviewing activities in the Restricted Area. These reviews consist of reviewing RWP requirements, survey records and periodic observation of selected activities. Reviews are performed to assure procedural compliance, proper work practices, proper postings, and adequate HP surveillance.

6.8.3 HP training programs are reviewed annually by the RPM, or designee, to identify areas for improvement. Experience gained through past problems and occurrences are considered during such reviews.

6.9 Radiological and Personnel Monitoring Incident Reporting

6.9.1 AVESI HP-22, “Radiological Reporting” defines the criteria and methods for reporting and tracking radiological and personnel monitoring incidents. Proper emphasis is placed on the correction of reported items to prevent their recurrence.

6.9.2 The report objectives are to identify generic problems and adverse trends and recommend actions that may reduce the frequency of repeated problems.

6.9.3 Instrument Deficiency reports are used to report problems or deficiencies with portable radiation detection and measurement equipment, in accordance with AVESI HP-31, “Radiological Instrumentation”.

7.0 Records

7.1 Records of the radiation protection program shall be maintained, including:

7.1.1 The provision of the program, and

7.1.2 Audits and other reviews of program content and implementation.
7.2 Records of audits and reviews of the radiation protection program shall be maintained on file for 3 years. Records of the provisions of the radiation protection program shall be kept on file until the NRC terminates the NRC license (if applicable).

7.3 The units of curie, rad, rem, including multiples and subdivisions shall be used to clearly indicate the units of all quantities on records required by 10 CFR 20. SI units may be used in conjunction with the units specified above (in parenthesis following the specified unit).

7.4 Information recorded on shipping manifests must be recorded in SI units or in SI units and units specified in Section 7.3.

7.5 All records generated, as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
AVESI HP ORGANIZATION

RSO/Project Manager

Site RPM

- Rad Engineering/ALARA
- Training Emergency Response
- Dosimetry
- Radiological Surveillance
- H.P. Instrument Calibration
- Radioactive Material Shipping
HEALTH PHYSICS PROCEDURE

AVESI HP-11

RADIOLOGICAL LIMITS

APPROVED BY: __________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: __________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

This procedure establishes the guidelines to determine site limits on surface radiological contamination, individual dose, and the concentrations of radioactive material in air.

2.0 Scope

This procedure applies to all AVESI and subcontractor personnel at sites working under this AVESI radiation safety program.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.3 DOE Order 458.1, “Radiation Protection of the Public and the Environment”
3.4 AVESI HP-01, “Radiation Protection Program”
3.5 AVESI HP-21, “Radiological Monitoring”
3.6 NRC Regulatory Guide 1.86, “Termination of Operating Licenses from Nuclear Reactors”
3.7 NUREG-1640, “Radiological Assessments for Unrestricted Release of Equipment and Materials from Nuclear Facilities” (Draft)
3.8 U.S. Army Corps of Engineers Manual No. EM 385-1-1, Section 06.E, “Ionizing Radiation”
3.9 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”

4.0 Definitions

4.1 Administrative Exposure Limit – A limit established in order to stress individual responsibility for maintaining exposures as low as reasonably achievable (ALARA) and to assist in the prevention of any individual exceeding regulatory exposure limits.

4.2 Committed Dose Equivalent (CDE) – the dose equivalent to organs or other tissues that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

4.3 Committed Effective Dose Equivalent (CEDE) – the dose equivalent to the whole body that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

4.4 Contamination - The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site’s release limits. Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable". Total contamination refers to fixed plus removable contamination.
4.5 **Derived Air Concentration (DAC)** - The concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 m³ per hour) results in an intake of one Annual Limit on Intake (ALI).

4.6 **Declared Pregnant Woman** – a woman who has voluntarily informed the RPM, in writing, of her pregnancy and the estimated date of conception.

4.7 **Deep Dose Equivalent (DDE)** – external whole body dose equivalent at a tissue depth of 1 cm (1000 mg/cm²).

4.8 **Dose** – a generic term meaning absorbed dose, effective dose equivalent, committed effective dose equivalent (CEDE), total effective dose equivalent (TEDE), etc. as used in this procedure.

4.9 **Extremity** - Hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

4.10 **Lens (Eye) Dose Equivalent** – external exposure to the lens of the eye taken as the dose equivalent at a tissue depth of 0.3 cm (300 mg/cm²).

4.11 **Exposure** – being exposed to ionizing radiation or to radioactive materials.

4.12 **Minimum Detectable Activity (MDA)** - The smallest amount of radioactivity that can be detected given the conditions of a specific sample.

4.13 **Shallow Dose Equivalent** – the dose equivalent at a tissue depth of .007 centimeter averaged over an area of 1 square centimeter when applied to the external exposure of the skin or an extremity.

4.14 **Total Effective Dose Equivalent (TEDE)** – the sum of the DDE and the CEDE.

4.15 **Total Organ Dose Equivalent (TODE)** – the sum of the DDE and CDE.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Calculate or approve existing administrative and/or project limits, and document the limits on Attachment 2, or equivalent.

5.1.2 Post Attachment 2 (or equivalent) in an appropriate project work area as directed by the site RPM.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Evaluate survey results against the project/site limits of Attachment 2, or equivalent.

6.0 Procedure

6.1 General Requirements

6.1.1 The following limits are project and site specific: administrative dose, surface contamination, airborne DAC values, and personnel release. The RPM should use this procedure as a guideline to establish these limits.
6.1.2 Prior to the start of work, the RPM, or designee shall establish and/or calculate all applicable limits for a project or site, and document the limits on Attachment 2, “Site Limits”, or equivalent. The RPM shall approve all site limits.

6.1.3 Supporting information, such as source term and calculations, shall be attached, and filed in health physics files.

6.1.4 Attachment 2 (or equivalent) shall be revised during the project when determined necessary by the RPM. A copy of the most current Attachment 2 (or equivalent) should be posted at the site in an appropriate project work area as determined by the RPM.

6.1.5 Alternatively, previously established limits may be adopted for use at client sites when; the limits are contained in an approved document, and the limits are approved by the RPM.

6.2 Dose Limits

6.2.1 Regulatory Dose Limits

6.2.1.1 Individual doses for occupational workers shall not exceed 5 rem TEDE or 50 rem TODE per calendar year, excluding medical and background radiation exposures.

6.2.1.2 Individual doses for visitors and members of the general public shall not exceed 0.1 rem TEDE per calendar year.

6.2.1.3 The total radiation dose to the unborn child of a declared pregnant female shall not exceed 0.5 rem TEDE for the duration of pregnancy.

6.2.1.4 Doses to the skin, lens of the eye and the extremities shall not exceed 50 rem, 15 rem, and 50 rem, respectively.

6.2.2 Administrative Dose Limits

6.2.2.1 Unless otherwise documented for the site, individual doses for visitors or the general public should not exceed 0.05 rem TEDE per calendar year from site activities.

6.2.2.2 Unless otherwise documented for the site on Attachment 2 (or equivalent), the more limiting of the following administrative dose limits shall apply to individual doses for radiological workers:

6.2.2.2.1 TEDE limited to 0.5 rem/yr.

6.2.2.2.2 TODE limited to 5.0 rem/yr.

6.2.2.2.3 Eye Dose Equivalent limited to 1.5 rem/yr.

6.2.2.2.4 Shallow Dose Equivalent limited to 5 rem/yr.

6.2.2.2.5 Extremity Dose limited to 5 rem/yr.
6.2.2.6 Declared pregnant employees – 500 mrem for the entire gestation period. Declared pregnant females should be limited to exposure rates less than 50 mrem per month unless otherwise approved by the RPM.

6.2.2.7 Cumulative Lifetime Exposure Limit limited to 1 rem per year of age.

6.2.3 Approval by the RSO is required for any employee to exceed an administrative dose limit, and shall be documented in the employee’s exposure record.

6.2.4 Alternate site specific administrative dose limits may be established by the RPM with written approval from the RSO, as documented on Attachment 2, or equivalent.

6.3 Surface Contamination Limits

6.3.1 The RPM shall provide HPTs with project or site-specific surface contamination limits on Attachment 2, or equivalent.

6.3.2 Using site characterization data, surface contamination limits may be derived using Regulatory Guide 1.86 guidance or DOE Order 458.1, as presented in Attachment 1, “Regulatory Guide 1.86 and DOE Order 458.1 Surface Contamination Limits” (or equivalent). Column 1 (Average) values should be used for total activity. Column 3 “Removable” values should be used for removable activity.

6.3.3 Surface contamination limits may be derived by using the most conservative radionuclide present, or by weighting the radionuclides using the following equation:

\[
\text{Weighted Limit (dpm/100cm}^2) = \frac{1}{\frac{F_1}{\text{Limit}_1} + \frac{F_2}{\text{Limit}_2} + \frac{F_3}{\text{Limit}_3}}
\]

Where:

F = The fractional abundance of the radionuclide (≥1% abundance)

Limit = The radionuclide surface contamination limit.

6.3.4 Alternate means of deriving project or site surface contamination limit may be established by the RPM.

6.4 Derived Air Concentration and Air Effluent Values

6.4.1 The RPM shall provide HPTs with project or site-specific DAC values on Attachment 2, or equivalent.

6.4.2 Using site characterization data, effective DAC values may be derived using the DAC values specified in 10 CFR 20 Appendix B, Table 1, Column 3.
6.4.3 Using site characterization data, effective air effluent concentration (AE) values may be derived using the AE values specified in 10 CFR 20 Appendix B, Table 2, Column 1.

6.4.4 DAC or AE values may be derived by using the most conservative radionuclide present, or by weighting the radionuclides using the following equation:

\[
\text{Weighted DAC or AE (µCi/ml) = } \frac{1}{\frac{F_1}{\text{DAC}_1} + \frac{F_2}{\text{DAC}_2} + \frac{F_3}{\text{DAC}_3}}
\]

Where:
F = The fractional abundance of the radionuclide (≥1% abundance)
DAC = The radionuclide 10 CFR 20 Appendix B DAC or AE value

6.4.5 Alternate means of deriving site DAC or AE values may be established by the RPM, as documented in the SSHP, technical work record (TWR), or equivalent document.

6.4.6 In conjunction with establishing site-specific DAC & AE values, the RPM, or designee, shall provide site-specific minimum air sample volumes on Attachment 2 that are based on the established DAC & AE values.

6.5 Personnel Release Limits

6.5.1 The RPM shall provide HPTs with site-specific total (direct frisk) personnel contamination limits on Attachment 2, or equivalent.

6.5.2 Personnel contamination release criteria should be calculated from the MDA of personnel release detection equipment, in accordance with AVESI HP-21, “Radiological Monitoring” Attachment 2 “Radiological Survey Calculation” (or equivalent).

6.5.3 Personnel contamination scanning techniques and detection equipment shall be of sufficient sensitivity to detect less than 5000 dpm/100cm² beta or 100 dpm/100cm² alpha.

6.6 Additional Guidance

6.6.1 The RPM may use the reference listed in Section 3.0 of this procedure (as appropriate) as additional guidance for determination or derivation of site radiological limits. The use or derivation of site radiological limits other than those specified in this procedure should be coordinated with the project client.

7.0 Records

All records generated as a result of this procedure shall be maintained by RPM until transmitted to the appropriate Central Records Facility.
### Regulatory Guide 1.86 and DOE Order 458.1 Surface Contamination Limits

<table>
<thead>
<tr>
<th>Nuclide*</th>
<th>Average(^{b,c})</th>
<th>Maximum(^{b,d})</th>
<th>Removable(^{b,e})</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-nat, U-235, U-238, and associated decay products</td>
<td>5,000 dpm (\alpha/100 \text{ cm}^2)</td>
<td>15,000 dpm (\alpha/100 \text{ cm}^2)</td>
<td>1,000 dpm (\alpha/100 \text{ cm}^2)</td>
</tr>
<tr>
<td>Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129</td>
<td>100 dpm/100 cm(^2)</td>
<td>300 dpm/100 cm(^2)</td>
<td>20 dpm/100 cm(^2)</td>
</tr>
<tr>
<td>Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133</td>
<td>1,000 dpm/100 cm(^2)</td>
<td>3,000 dpm/100 cm(^2)</td>
<td>200 dpm/100 cm(^2)</td>
</tr>
<tr>
<td>Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above</td>
<td>5,000 dpm (\beta-\gamma/100 \text{ cm}^2)</td>
<td>15,000 dpm (\beta-\gamma/100 \text{ cm}^2)</td>
<td>1,000 dpm (\beta-\gamma/100 \text{ cm}^2)</td>
</tr>
</tbody>
</table>

---

\(^{a}\) Where surface contamination by both alpha and beta-gamma-emitting nuclides exist, the limits established for alpha and beta-gamma-emitting nuclides should apply 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.

\(^{c}\) Measurements of average contaminant should not be averaged over more than 1 m\(^2\). For objects of less surface area, the average should be derived for each such object.

\(^{d}\) The maximum contamination level applies to an area of not more than 100 cm\(^2\).

\(^{e}\) The amount of removable radioactive material per 100 cm\(^2\) of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination of objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.
## Site Limits

**Project/Site:** ________________

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational administrative dose</td>
<td></td>
<td>Rem TEDE</td>
</tr>
<tr>
<td>Total alpha surface contamination</td>
<td></td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Total beta surface contamination</td>
<td></td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Removable alpha surface contamination</td>
<td></td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Removable beta surface contamination</td>
<td></td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Occupational alpha DAC value</td>
<td></td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Occupational beta DAC value</td>
<td></td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Minimum Occupational Air Sample Volume</td>
<td></td>
<td>Liters</td>
</tr>
<tr>
<td>Non-occupational alpha AE value</td>
<td></td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Non-occupational beta AE value</td>
<td></td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Minimum Non-occupational Air Sample Volume</td>
<td></td>
<td>Liters</td>
</tr>
<tr>
<td>Personnel release (alpha)</td>
<td></td>
<td>cpm/probe area</td>
</tr>
<tr>
<td>Personnel release (beta)</td>
<td></td>
<td>cpm/probe area</td>
</tr>
</tbody>
</table>

**Notes:**
1) Attach supporting information, such as source term and calculations.
2) Dose limits not listed are equivalent to the dose limits contained within the procedure, unless specified.
3) If a limit does not apply to the project/site, place an “N/A” in the “Value” column.
4) Any volumetric release limits applicable to release of material/equipment at the site should be specified.

Approved By (RPM): ________________ Date: ___________
HEALTH PHYSICS PROCEDURE

AVESI HP-12

PERSONNEL RADIATION EXPOSURE MONITORING

APPROVED BY: ___________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ___________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

The purpose of this procedure is to provide the requirements and guidelines for monitoring employee occupational exposure to ionizing radiation.

2.0 Scope

This procedure applies to all personnel working in Radiological Areas under this AVESI radiation safety program. Planned special exposures are not within the scope of this procedure.

3.0 References

3.1 10 CFR 19, “Notices, Instructions and Reports to Workers Inspections and Investigations”
3.2 10 CFR 20, “Standards for Protection Against Radiation”
3.3 ANSI N322-1977, “Inspection and Test Specifications for Direct and Indirect Reading Quarts Fiber Pocket Dosimeters”
3.5 AVESI HP-01, “Radiation Protection Program”
3.6 AVESI HP-11, “Radiological Limits”
3.7 AVESI HP-21, “Radiological Monitoring”
3.8 AVESI HP-23, “Health Physics Oversight”
3.9 AVESI HP-24, “Radiological Posting and Labeling”
3.10 AVESI HP-22, “Radiological Reporting”
3.15 NRC Regulatory Guide 8.4, February 1973, “Direct Reading and Indirect Reading Pocket Dosimeters”
3.28 NRC. Regulatory Guide 8.11, “Applications of Bioassay for Uranium” June 1974

4.0 Definitions

4.1 Administrative Exposure Limit – A limit established to stress responsibility for maintaining exposures As Low As Reasonably Achievable (ALARA) and to assist in the prevention of exceeding the limits specified in 10 CFR 20.

4.2 Airborne Radioactivity Area – A room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.2.1 In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20, or

4.2.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.3 Background Radiation - The ambient radiation field to which we are exposed daily, originating from cosmic rays, naturally-occurring radionuclides (\(^{40}\text{K}\), etc.) and human endeavors (fallout, fuel cycle, etc.).

4.4 Baseline monitoring - Monitoring performed prior to the start of work in a Radiological Area.

4.5 Committed Dose Equivalent (CDE) – the dose equivalent to organs or other tissues that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

4.6 Committed Effective Dose Equivalent (CEDE) – the dose equivalent to the whole body that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
4.7 **Confirmatory monitoring** - Monitoring carried out in situations where workers are unlikely to be exposed to significant intakes, in order to demonstrate satisfactory work conditions.

4.8 **Declared Pregnant Worker** – A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

4.9 **Deep Dose Equivalent (DDE)** – external whole body dose equivalent at a tissue depth of 1 cm (1000 mg/cm²).

4.10 **Direct Bioassay** - In vivo measurements to estimate the quantity of radioactive material in the human body using instrumentation that detects radiation emitted from within the body. For purposes of this procedure, “direct bioassay” will be referred to as “body count”.

4.11 **Indirect Bioassay** – Determination of kinds, quantities, or concentrations of radioactive material in the human body by analysis and evaluation of materials excreted from the body. For purposes of this procedure, “indirect bioassay” will be referred to as “bioassay”, and consists of performing laboratory analysis of a urine sample.

4.11.1 A full 24-hour bioassay sample is defined as all voids collected within a 24-hour period.

4.11.2 A simulated 24-hour bioassay sample is defined as the voids collected just before retiring at night and all the voids until and including the first void after rising in the morning, on two successive days.

4.11.3 A spot bioassay sample is defined as any single void collected.

4.12 **Lens (Eye) Dose Equivalent** – external exposure to the lens of the eye taken as the dose equivalent at a tissue depth of 0.3 cm (300 mg/cm²).

4.13 **Monitoring** - The measurement of radioactivity in the whole body, in a region of the body, in material eliminated from the body or in the air for purposes of estimating the intake of radioactive material. The term monitoring also includes interpretation of the measurements. It may consist of the use of personnel dosimetry devices for measurement of deep dose equivalent from external sources, air sampling and/or bioassay services for measurement of committed effective dose equivalent.

4.14 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.15 **Routine monitoring** - Monitoring carried out at regular intervals during normal operations.

4.16 **Shallow Dose Equivalent** – the dose equivalent at a tissue depth of .007 centimeter averaged over an area of 1 square centimeter when applied to the external exposure of the skin or extremity.

4.17 **Special monitoring** - Monitoring carried out in actual or suspected abnormal conditions.
4.18 **Termination monitoring** - Monitoring carried out shortly after all work in a Radiological Area ceases.

4.19 **Thermo-luminescent dosimeter (TLD)** – A dosimeter that measures radiation exposure by radiation interaction with a crystalline structure. The TLD is the primary means of measuring external personnel exposure to beta and gamma radiation.

4.20 **Total Effective Dose Equivalent (TEDE)** - The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

4.21 **Total Organ Dose Equivalent (TODE)** – the sum of the DDE and CDE.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Administer industry-standard internal and external radiation exposure monitoring programs.

5.1.2 Determine if internal and/or external monitoring is required pursuant to 10 CFR 20, or perform monitoring, as appropriate.

5.1.3 Review monitoring results from the internal and external radiation exposure monitoring programs.

5.1.4 Review the results of all unusual exposure incidents and make notifications as required by AVESI HP-22, “Radiological Reporting”.

5.1.5 Note any special dosimetry requirements (i.e., extremity dosimeters) on Radiological Work Permits (RWPs).

5.1.6 Identify individuals whose dose records indicate they are near administrative dose levels, re-assign them to non-RAM work while a re-evaluation of their work practices is completed.

5.2 Monitored Personnel shall:

5.2.1 Comply with the requirements of this procedure while participating in the internal and external radiation exposure monitoring programs, as applicable.

5.2.2 Provide baseline, confirmatory routine, special and termination bioassays as directed by the RPM.

5.2.3 Provide past exposure history for employee exposure history files.

5.2.4 Notify the RPM, or designee immediately upon arrival at the workplace following administration of a radiopharmaceutical.

5.2.5 Plan and perform work involving radioactive materials in a fashion that minimizes the radiation exposures received.

5.2.6 Control their own exposure to radiation hazards such that their annual dose remains below the administrative limits and are ALARA.
5.2.7 Notify the RPM, or designee of any unusual conditions that may cause an unexpected intake of radioactive material or external exposure, such as spills, facial contamination, or higher than expected removable contamination levels or air particulate concentrations.

5.2.8 Use dosimetry in accordance with this procedure and RWP requirements.

5.2.9 Report missing dosimetry to the RPM, or designee.

6.0 Procedure

6.1 General Requirements

6.1.1 Refer to AVESI HP-11, “Radiological Limits” for federal and administrative exposure limits.

6.1.2 No one under the age of 18 will be allowed access to a Restricted Area if work being performed is at a U.S. Army Corps of Engineers (USACE) site.

6.1.3 Declared pregnant workers may not be allowed access to certain areas of the Restricted Area in order to maintain the administrative limit of $< 50 \text{ mrem \ TEDE/month}$.

6.1.4 Upon notification of medical administration of a radioisotope, the RPM shall remove the affected individual’s dosimetry from use until such time as the activity retained in the individual’s body is not detectable utilizing a personnel contamination monitor.

6.1.5 If monitoring is required, air sampling and/or urine bioassay sampling shall be the primary means of monitoring for internal radiation exposure (e.g., CEDE, and CDE), as determined appropriate by the RPM.

6.1.6 Other methods for monitoring internal radiation exposure (i.e., whole body monitoring, fecal bioassay sampling, etc.) may be implemented at the discretion of the RPM.

6.1.7 If monitoring is required, monitoring with TLDs shall be the primary means of monitoring for external radiation exposure (e.g., DDE), as determined appropriate by the RPM.

6.1.8 If required to monitor for both internal and external radiation exposure in accordance with 10 CFR 20.1501(a) and (b), compliance with dose limits (e.g., TEDE, TODE) shall be demonstrated by summing external and internal doses in accordance with the requirements of 10 CFR 20.1202.

6.2 Internal Radiation Monitoring

6.2.1 General

6.2.1.1 If internal monitoring is required, individuals shall participate in the bioassay and/or air monitoring programs as directed by the RPM.
6.2.1.2 If internal exposure monitoring is not required, breathing zone air sampling may be performed solely to confirm that monitoring is not required in accordance with the routine surveillance schedule documented on Attachment 2 (or equivalent) of AVESI HP-23, “Health Physics Oversight”.

6.2.1.3 Air monitoring shall be conducted in accordance with AVESI HP-21, “Radiological Monitoring”.

6.2.2 Bioassay Monitoring

6.2.2.1 Bioassay may be used for routine, confirmatory or special monitoring of personnel to determine if an intake of radionuclides has occurred, as determined by the RPM.

6.2.2.2 An analytical laboratory that has been pre-approved by the RPM shall perform analysis of the radionuclide content of bioassay samples. The RPM shall ensure that the bioassay analytical laboratory:

6.2.2.2.1 Meets the performance specifications for indirect bioassay recommended in ANSI N13.30.

6.2.2.2.2 Has written procedures that document the laboratory's analytical capabilities and a QA/QC program which assures the validity of the analytical results.

6.2.3 Bioassay Sampling (Urine bioassay)

6.2.3.1 Bioassay samples shall be either 24 hour samples or simulated 24-hr samples as defined in Section 4.0 of this procedure.

6.2.3.2 The RPM, or designee shall issue sample containers, and Attachment 1 (or equivalent), “Bioassay Instructions/COC”, to the monitored employee.

6.2.3.3 The monitored employee shall collect the specified urine sample and return the containers and completed bioassay instructions/chain-of-custody to the RPM, or designee.

6.2.3.4 Upon receipt, the RPM, or designee, shall complete and secure the container labels, affix a tamper-evident seal to the container, complete a chain of custody form (see below), and forward the sample to the analytical laboratory.

6.2.3.5 Each bioassay sample chain-of-custody form should provide the following sample information:

6.2.3.5.1 Monitored individuals name

6.2.3.5.2 Date and time of voids

6.2.3.5.3 Required analysis

6.2.3.5.4 Reason for sample (baseline, routine, special, exit)
6.2.4 Monitoring Frequency

6.2.4.1 Baseline bioassays for monitored employees shall be performed at the start of employment, unless waived by the RPM on Attachment 3 (or equivalent).

6.2.4.2 Routine bioassay monitoring should be performed at a frequency specified by the RPM, as appropriate.

6.2.4.3 If monitoring is required, routine air sampling shall be conducted daily when radionuclides are being used or handled, as determined appropriate by the RPM.

6.2.4.4 If monitoring is not required, routine air sampling shall follow the routine surveillance schedule set by the RPM in accordance with AVESI HP-23, “Health Physics Oversight”.

6.2.4.5 Special or non-routine bioassays should be performed, at the discretion of the RPM:

6.2.4.5.1 After detection of facial contamination or positive nasal smear results.

6.2.4.5.2 Following acute exposure to airborne radioactivity without respiratory protection in place.

6.2.4.5.3 When it is suspected that an individual may have incurred an intake in excess of 10% of the ALI for any radionuclide.

6.2.5 Assessment of Internal Dose

6.2.5.1 Radioactive material intakes shall be determined by correcting reported bioassay measurement results using the methodology described in NUREG/CR-4884 or other appropriate methods as determined by the RPM.

6.2.5.2 Committed effective dose equivalent (CEDE) and/or committed dose equivalent (CDE) for radionuclide intakes detected through bioassay and/or air monitoring should be calculated using methodologies contained in NRC Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses”, or other appropriate methods as determined by the RPM.

6.2.5.3 If sufficient data to determine a worker’s intake is available from both air sampling and bioassay measurements and the results are significantly different, the worker’s intake estimate should be based on the data considered to be most accurate as determined by the RPM.
6.3 External Radiation Monitoring

6.3.1 General

6.3.1.1 TLDs are used to measure external occupational radiation exposure. TLD results are considered the official record of deep dose equivalent (DDE) for occupational radiation dose received from external radiation sources.

6.3.1.2 TLDs should normally be processed in quarterly monitoring periods unless determined otherwise by the RPM.

6.3.1.3 TLDs storage area exposure rates shall not be distinguishable from background.

6.3.1.4 TLDs in storage or transit shall be accompanied with a control TLD to monitor accumulated dose while in storage or transit.

6.3.1.5 TLDs should be sent to a processing facility within two weeks from the end of a monitoring period. TLDs of terminating personnel may be stored until the end of a monitoring period and sent with the other TLDs from that monitoring period.

6.3.2 Monitoring for Extremity Exposure

6.3.2.1 Radiological workers likely to exceed 5 Rem/yr to the extremities shall wear extremity dosimeters (ring badges) to evaluate the dose to extremities, as determined by the RPM.

6.3.2.2 When ring badges are required, each hand shall be provided with a dosimetry device unless an alternate approach is justified and documented.

6.3.2.3 Monitored personnel shall place ring badges such that they are as close as possible to the radiation source during work operations without restricting the use of the extremity (i.e., facing the palm of the hand).

6.3.3 Monitoring for Skin Exposure

6.3.3.1 Radiological workers likely to exceed 5 Rem/yr to the skin shall be monitored for shallow dose equivalent.

6.3.3.2 The RPM, or designee should control skin dose rates primarily by using appropriate protective equipment (shielding and protective clothing such as gloves) and decontamination.

6.3.3.3 Dose to the skin of the extremities shall be considered to be an extremity dose rather than a dose to the skin of the whole body.
6.3.3.4 The RPM, or designee shall calculate the skin dose (e.g., shallow dose equivalent) if it is suspected that a worker may have received greater than 5,000 mrem shallow dose equivalent from skin contamination or if detectable skin contamination cannot be removed by decontamination pursuant to AVESI HP-27, “Personnel and Equipment Decontamination”.

6.3.4 Monitoring for exposure to the Lens of the Eye.

6.3.4.1 Radiological workers likely to exceed 1,500 mrem/yr lens (eye) dose equivalent shall be monitored.

6.3.4.2 The RPM, or designee should control dose to the lens of the eye primarily by using protective equipment (shielding and protective clothing such as safety glasses), as appropriate.

6.3.4.3 The RPM, or designee shall calculate lens (eye) dose equivalent if it is suspected that a worker may have received greater than 1,500 mrem to the lens of the eye.

6.3.5 Equipment Specifications

6.3.5.1 Dosimetry services shall be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

6.3.5.2 The RPM shall ensure that dosimeter issuance, retrieval, handling, storage, and processing practices; personnel training and qualifications; quality assurance; documentation; calibration; and record keeping practices meet the minimum conditions for accreditation by NVLAP and the requirements of ANSI N13.11.

6.3.6 Estimating External Dose

6.3.6.1 When a dosimeter is reported lost or missing, the RPM, or designee shall estimate the dose of the individual through the use of:

6.3.6.1.1 Secondary dosimeter totals (if worn).

6.3.6.1.2 Workplace conditions and stay times.

6.3.6.1.3 Dose assessments from co-workers.

6.3.6.1.4 Dose assessments from similar jobs/tasks.

6.3.6.1.5 A combination of the above methods.

6.3.6.2 Dose estimates for DDE and/or shallow dose equivalent shall be documented on Attachment 8 (or equivalent), “External Dose Estimation”.
6.3.7 External Dose Assessment

6.3.7.1 The dose of record for DDE, shallow dose equivalent and extremity dose is that recorded from processing of the TLD, unless determined otherwise by the RPM.

6.3.7.2 The results of a dose estimate or assessment shall be included in the individual's radiation dose totals, in accordance with the requirements of this procedure.

6.4 Short Term Visitor Access Requirements

6.4.1 Short Term Visitors are administratively limited to 50 mrem TED E, and are normally limited to escorted touring inside of a Restricted Area.

6.4.2 Short Term Visitors are not considered monitored employees.

6.4.3 Short Term Visitors shall not enter Contamination Areas, Radiation Areas, High Radiation Areas, Very High Radiation Areas, or Airborne Radioactivity Areas unless escorted by a Senior Health Physics Technician (HPT). Entry requirements in other Restricted Areas shall be determined by the site RPM, as appropriate.

6.4.4 Short Term Visitors and Escorts shall read, understand, and sign Attachment 1 (or equivalent), “Visitor Log”.

6.5 Employee Radiation Exposure Monitoring Participation

6.5.1 In order to determine monitoring requirements, the RPM, or designee should anticipate individual exposure using dose modeling, historical monitoring data, and/or professional judgment. Anticipated exposure should be evaluated using one, or a combination of the following factors:

6.5.1.1 Expected duration within the Restricted Area for a given activity.

6.5.1.2 Expected dose rates in work areas for the radionuclide of concern.

6.5.1.3 Expected or historical air particulate concentrations in the work areas.

6.5.1.4 Historical exposure performing similar work.

6.5.2 A radiological worker shall participate in the radiation monitoring program if they are likely to incur greater than 10% of a regulatory dose limit from internal or external sources of radiation (i.e., DDE or CEDE).

6.5.3 A declared pregnant worker shall participate in a radiation monitoring program if they are likely to incur more than 100 millirem DDE or CEDE during the period of gestation. The RPM may require monitoring of declared pregnant workers regardless of the exposure potential.

6.5.4 A minor shall participate in the radiation monitoring program if they are performing work on a non-USACE site and are likely to receive 100
mrem/yr DDE, a lens dose equivalent of 150 mrem/yr, a shallow dose equivalent of 500 mrem/yr, or 500 mrem/yr CEDE.

6.5.5 The RPM may elect to conduct monitoring in lieu of performing an assessment to determine monitoring requirements.

6.6 Monitored Employee Processing Requirements

6.6.1 Each Monitored Employee shall:

6.6.1.1 Provide documentation indicating successful completion of RWT.

6.6.1.2 Complete applicable sections of Attachment 3 (or equivalent), “Monitored Employee Information”.

6.6.1.3 Provide an initial bioassay sample. The RPM shall specify the type of bioassay (i.e., 24-hour, simulated 24-hour, or spot sample) and instruct personnel how to complete the bioassay. The bioassay along with a chain-of-custody shall be sent to the laboratory for analysis. This requirement may be waived or postponed by the RPM by completing the waiver section of Attachment 3 (or equivalent).

6.6.1.4 Be issued a TLD and extremity dosimeter (if required), unless waived by the RPM.

6.6.2 Each Monitored Employee previously monitored for radiation exposure shall:

6.6.2.1 Provide a completed NRC Form 4, or equivalent.

6.6.2.2 Provide a signed Attachment 2 (or equivalent), “Request for Radiation Exposure Records”.

6.6.3 The RPM, or designee, shall review all of the initial paperwork provided by the employee, and complete the remainder of Attachment 3 (or equivalent), “Monitored Employee Information”.

6.6.4 If the individual is expected to exceed 10% of any applicable federal limit, and the current year exposure is estimated, then the RPM, or designee shall attempt to verify the estimated current year dose information provided using Attachment 2 (or equivalent), “Request for Radiation Exposure Records”. Copies of all dose verification requests shall be kept in the individuals dosimetry file.

6.6.5 If the individuals available dose balance is insufficient for the exposure anticipated, then the individual shall be denied access to the RA.

6.6.6 The RPM, or designee shall enter the individual into the monitoring program by completing Attachment 4 (or equivalent), “Monitored Employee Log”.

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6.7 Termination of Monitoring

6.7.1 Personnel terminating work on site shall return their dosimetry and submit an exit bioassay sample to the RPM, or designee (unless waived by the RPM). The exit bioassay shall be accompanied by a chain-of-custody.

6.7.2 The RPM, or designee, shall complete appropriate sections of Attachment 3 (or equivalent), “Monitored Employee Information”, and Attachment 4 (or equivalent), “Monitored Employee Log” to terminate an individual from the monitoring program.

6.8 Radiation Exposure Reports

6.8.1 Within thirty days of receipt of dosimetry and bioassay results, employee radiation exposure should be assessed.

6.8.2 The results of annual radiation exposure monitoring shall be documented on Attachment 5 (or equivalent), “NRC Form 5” and forwarded to the monitored individual.

6.8.3 The RPM should utilize the guidance contained in Reference 3.9 for recording and reporting occupational radiation exposure data.

6.9 Additional Guidance

6.9.1 The RPM may use the references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for implementation of the personnel monitoring program and for calculation of occupational radiation exposure.

7.0 Records

7.1 Records of radiation dose assigned to individuals shall make a clear distinction among the dosimetric quantities entered on the records (e.g., TEDE, CEDE, CDE, DDE, shallow dose equivalent, lens dose equivalent).

7.2 Records of the results of surveys, measurements and calculations shall be maintained until the NRC terminates the license (if applicable) requiring the record if used to determine:

7.2.1 External dose (i.e., DDE, shallow dose equivalent, lens (eye) dose equivalent, dose to extremities, etc.) from radiation sources external to the body; and

7.2.2 Internal dose (i.e., CEDE or CDE) from the intake of radioactive materials.

7.3 Records of individual monitoring results shall be reported to individuals and maintained for each individual for whom monitoring was required in accordance with this radiation safety program.

7.4 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
## VISITOR LOG

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<th>DATE</th>
<th>VISITOR SIGNATURE*</th>
<th>SSN</th>
<th>COMPANY</th>
<th>ESCORT SIGNATURE*</th>
<th>TIME IN</th>
<th>TIME OUT</th>
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*Signature indicates that you have read, understand, and will comply with the information presented below.

### VISITOR RESPONSIBILITIES
- If not currently radworker trained, read and understand USNRC Regulatory Guide 8.29, “Instruction Concerning Risk from Occupational Radiation Exposure”.
- If entering an RWP area, read, understand, and comply with the requirements of the RWP, and place a “V” next to your name on the entry log (if required to sign in).
- Stay with, and obey all instructions given by your escort at all times.

### ESCORT RESPONSIBILITIES
- The escort is responsible for the radiological and industrial safety of the visitor(s) being escorted by them.
- The escort may accompany up to 5 visitors simultaneously.
- Ensure the visitor does NOT enter an Airborne Radioactivity Area.
- Should an emergency develop during escort of a visitor, accompany the visitor(s) to the Site assembly area.

Note the anticipated external dose in the table above.
- The visitor (admin) exposure limit for the whole body is 50 mrem unless otherwise approved by the RPM.
American Veteran Environmental Services, Inc.
Attn: Radiation Safety Officer
1246 Illini Dr.
O'Fallon, IL 62269

Subject: Request for Radiation Exposure Records

Exposure Records Department:

Please send copies of your records of occupational radiation exposure for the person listed below to the above address:

Name: __________________________
SSN: __________________________

Monitored Dates: _________________

Authorization: I authorize by a copy of an original signed request, release of my occupational radiation exposure records to American Veteran Environmental Services, Inc.

Under the provisions of the Privacy Act of 1974.

_________________________    _____________
SIGNATURE                  DATE
# MONITORED EMPLOYEE INFORMATION

**HPID: ___________ (Page 1 of 3)**

## EMPLOYEE

Name (print): ___________________________  SSN: ___________________________  Date: ___________

Date of Birth: ___________  Job Title: ___________________________

Email: ___________________________  Work Phone: ___________

Permanent Home Address:  

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## Have you ever been monitored for occupational radiation exposure?  
☐ YES  ☐ NO

- If yes, your estimated lifetime dose is: __________ Rem

## Have you been monitored for occupational radiation exposure this calendar year?  
☐ YES  ☐ NO

- If yes, complete this table:

| Period of Time Monitored During the Current Year | Name/Address of Facility or Site where monitored | Exposure Estimate / Record (mRem)  
Include: DDE/LDE/SDE, WB/SDE, ME/CEDE/CDE/TEDE/TODE, as available |
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MONITORED EMPLOYEE INFORMATION
HPID: ___________ (Page 2 of 3)

EMPLOYEE COMPLETE

It is my responsibility to:

- Provide the RPM, or designee with correct occupational exposure information (when estimated, information that is to the best of your knowledge).
- Read, understand and comply with the protective requirements of the RWP prior to entry into the Restricted Area (if applicable).
- Comply with RPM verbal instructions.
- Inform the RPM before it becomes necessary to change either the scope of work, or the method in which work will be accomplished (previously agreed on by the RPM).
- Notify the RPM, or designee immediately upon arrival at work following the use of a radiopharmaceutical.
- Notify the RPM, or designee of any open cut or wound.
- Notify the RPM, or designee immediately if my dosimeter is missing.
- Return my dosimetry and provide an exit bioassay sample with chain of custody information (as applicable) at the completion of work at this project.

______________________________  ______________________________
Individuals Signature                        Date

Sex: ☐ Male ☐ Female  (If female, please read and sign the following statement)

USNRC Regulatory Guide 8.13 requires that female workers authorized to receive occupational radiation exposure, and their supervisors, be given special instructions about prenatal radiation exposure risks to the developing embryo/fetus. The instruction also explains that during the entire gestation period a declared pregnant female worker will be limited to less than 500 mrem for the entire gestation period to minimize risks from radiation exposure to the embryo/fetus.

I have both read and received instruction in Regulatory Guide 8.13. I am aware of the radiation exposure risks for an embryo/fetus and further understand that any decision to provide special protection from such risk, through a written declaration of pregnancy, is voluntary.

______________________________  ______________________________
Individuals Signature                        Date
MONITORED EMPLOYEE INFORMATION

HPID: ___________ (Page 3 of 3)

RPM, or designee COMPLETE

Monitoring Prerequisites:

☐ Current radworker training on file  ☐ Initial bioassay submitted
☐ Dosimeter issued

If any of the above is not checked, indicate the reason for the waiver:

Current year available federal exposure: ___________ mrem TEDE
(Reduce 5 rem by 1.25 rems for each monitored quarter in which written records/estimates are not available)

Site administrative exposure limit: ___________ mrem TEDE

Current year whole body exposure: ___________ mrem TEDE
(Add all current year whole body exposure, including estimates)

Current year available administrative exposure: ___________ mrem TEDE
(Admin. limit - current year whole body exposure, use 100 mrem if admin. limit is 100mrem)

Individual entered on Attachment 4 (or equivalent), “Monitored Employee Log”?
☐ Yes  ☐ No

Monitoring start date: _________________

__________________________________   ___________________
RPM Signature                                                Date

Monitoring Termination:

☐ Exit bioassay submitted with chain-of-custody information  ☐ Dosimeter retrieved

If either of the above is not checked, indicate the reason for the waiver:

Monitoring stop date: _________________

__________________________________   ___________________
RPM (or designee) Signature                                  Date
## MONITORED EMPLOYEE LOG

**Year:** ____________  **Page #:_____**

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<th>SSN (Last 4 digits are HPID)</th>
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<th>DOSIMETER DATE</th>
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</table>

18 of 24
### OCCUPATIONAL EXPOSURE RECORD
FOR A MONITORING PERIOD

<table>
<thead>
<tr>
<th>Block</th>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>1.</td>
<td>NAME (LAST, FIRST, MIDDLE INITIAL)</td>
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</tr>
<tr>
<td>2.</td>
<td>IDENTIFICATION NUMBER</td>
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<td>3.</td>
<td>ID TYPE</td>
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<td>FEMALE</td>
</tr>
<tr>
<td>4.</td>
<td>SEX</td>
<td>MALE</td>
<td>FEMALE</td>
</tr>
<tr>
<td>5.</td>
<td>DATE OF BIRTH</td>
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</tr>
<tr>
<td>6.</td>
<td>MONITORING PERIOD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>LICENSEE OR REGISTRANT NAME</td>
<td>TO</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>LICENSE OR REGISTRATION NUMBERS</td>
<td>9A</td>
<td>9B</td>
</tr>
<tr>
<td>9A</td>
<td>RECORD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9B</td>
<td>ROUTINE</td>
<td></td>
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<tr>
<td>9A</td>
<td>ESTIMATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9B</td>
<td>PSE</td>
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### INTAKES

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<tr>
<td>10A</td>
<td>RADIONUCLIDE</td>
<td>10B. CLASS</td>
<td>10C. MODE</td>
</tr>
<tr>
<td>11.</td>
<td>DEEP DOSE EQUIVALENT</td>
<td>(DDE)</td>
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</tr>
<tr>
<td>12.</td>
<td>EYE DOSE EQUIVALENT TO THE LENS OF THE EYE</td>
<td>(LDE)</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>SHALLOW DOSE EQUIVALENT, WHOLE BODY</td>
<td>(SDE,WB)</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>SHALLOW DOSE EQUIVALENT, MAX EXTREMITY</td>
<td>(SDE,ME)</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>COMMITTED EFFECTIVE DOSE EQUIVALENT</td>
<td>(CEDE)</td>
<td></td>
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<tr>
<td>16.</td>
<td>COMMITTED DOSE EQUIVALENT, MAXIMALLY EXPOSED ORGAN</td>
<td>(CDE)</td>
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</tr>
<tr>
<td>17.</td>
<td>TOTAL EFFECTIVE DOSE EQUIVALENT</td>
<td>(TEDE)</td>
<td></td>
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<tr>
<td>18.</td>
<td>TOTAL ORGAN DOSE EQUIVALENT, MAX ORGAN</td>
<td>(TODE)</td>
<td></td>
</tr>
</tbody>
</table>

### COMMENTS

This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 CFR 19. You should preserve this report for future reference.

<table>
<thead>
<tr>
<th>Block</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>SIGNATURE - LICENSEE OR REGISTRANT</td>
<td>AVESI Radiation Safety Officer or designee</td>
</tr>
<tr>
<td>20</td>
<td>DATE PREPARED</td>
<td></td>
</tr>
</tbody>
</table>

This report is furnished to you under the provisions of the Nuclear Regulatory Commission regulation 10 CFR 19. You should preserve this report for future reference.
**INSTRUCTIONS AND ADDITIONAL INFORMATION PERTINENT TO THE COMPLETION OF AGENCY FORM NRC 5**  
(All doses should be stated in rems)

1. Type or print the full name of the monitored individual in the order of last name. Include “Jr”, “Sr,” “III,” etc., first name, middle initial (if applicable).
2. Enter the individual’s identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification as a passport or work permit.
3. Enter the individual’s identification used as shown below:

<table>
<thead>
<tr>
<th>CODE</th>
<th>ID TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSN</td>
<td>U.S. Social Security Number</td>
</tr>
<tr>
<td>PPN</td>
<td>Passport Number</td>
</tr>
<tr>
<td>CSI</td>
<td>Canadian Social Insurance Number</td>
</tr>
<tr>
<td>WPN</td>
<td>Work Permit Number</td>
</tr>
<tr>
<td>IND</td>
<td>INDEX Identification Number</td>
</tr>
<tr>
<td>OTH</td>
<td>Other</td>
</tr>
</tbody>
</table>

4. Check the box that denotes the sex of the individual being monitored.
5. Enter the date of birth of the individual being monitored in the format MM/DD/YY.
6. Enter the monitoring period for this report is listed. The format should be MM/DD/YY-MM/DD/YY.
7. Enter the name of the licensee or registrant.
8. Enter the license or registration number or numbers.
9A. Place an “X” in Record or Estimate. Choose “Record” if the dose data listed represent a final determination of the dose received to the best of the licensee’s or registrant’s knowledge. Choose “Estimate” only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that are not yet available.
9B. Place an “X” in either Routine or PSE. Choose “Routine” if the data represent the results of monitoring for routine exposures. Choose “PSE” if the listed dose data represent the results of monitoring of planned special exposures received during the monitoring period if more than one PSE was received in a single year, the licensee or registrant should sum them and report the total of all PSES.
10A Enter the symbol for each radionuclide that resulted in an internal exposure recorded for the individual. Using the format “Xx-$$$x,” for instance, Cs-137 or Tc-99m.
10B Enter the lung clearance class as listed in Schedule RHS 8-30 (D, W, Y, V, or O for other) for all intakes by inhalation.
10C Enter the mode of intake. For inhalation, enter “H.” For absorption through the skin, enter “B.” For oral ingestion, enter “G.” For injection, enter “I.”
10D. Enter the intake of each radionuclide in Ci.
11. Enter the deep dose equivalent (DDE) to the whole body.
12. Enter the eye dose (LDE) recorded for the lens of the eye.
13. Enter the shallow dose equivalent recorded for the skin of the whole body, (SDE, WB).
14. Enter the shallow dose equivalent recorded for the skin of the extremity receiving the maximum dose, (SDE, ME).
15. Enter the committed effective dose equivalent (CEDE) or “NR” for “Not Required” or “NC” for “Not Calculated”.
16. Enter the committed dose equivalent (CDE) recorded for the maximally exposed organ or “NR” for “Not Required” or “NC” for “Not Calculated”.
17. Enter the total effective dose equivalent (TEDE). The TEDE is the sum of items 11 and 15.
18. Enter the total organ dose equivalent (TODE) for the maximally exposed organ. The TODE is the sum of items 11 and 16.
19. Signature of the person designated to represent the licensee or registrant.
20. Enter the date this form was prepared.
21. COMMENTS.

In the space provided enter additional information that might be needed to determine compliance with limits. An example might be to enter the note that the SDE was the result of exposure from a discrete hot particle. Another possibility would be to indicate that an overexposure report has been sent to the Division in reference to the exposure report.
### LIFETIME OCCUPATIONAL EXPOSURE HISTORY

<table>
<thead>
<tr>
<th>1. NAME (LAST, FIRST, MIDDLE INITIAL)</th>
<th>2. IDENTIFICATION NUMBER</th>
<th>3. ID TYPE</th>
<th>4. SEX</th>
<th>5. DATE OF BIRTH</th>
<th>6. MONITORING PERIOD</th>
<th>7. LICENSEE NAME</th>
<th>8. LICENSE NUMBER</th>
<th>9. RECORD ESTIMATE</th>
<th>10. ROUTINE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NO RECORD</td>
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<td></td>
<td>PSE</td>
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<td></td>
</tr>
</tbody>
</table>

|----------|----------|-------------|-------------|----------|---------|----------|---------|

<table>
<thead>
<tr>
<th>19. SIGNATURE OF MONITORED INDIVIDUAL</th>
<th>20. DATE SIGNED</th>
<th>21. CERTIFYING ORGANIZATION</th>
<th>22. SIGNATURE OF DESIGNEE</th>
<th>23. DATE SIGNED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>
# INSTRUCTIONS AND ADDITIONAL INFORMATION PERTINENT TO THE COMPLETION OF NRC FORM 4

### (All doses should be stated in rems)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Type or print the full name of the monitored individual in the order of last name (include “Jr.”, “Sr.”, “III,” etc.), first name, middle initial (if applicable).</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Enter the individual’s identification number, including punctuation. This number should be the 9-digit social security number if at all possible. If the individual has no social security number, enter the number from another official identification such as a passport or work permit.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Enter the code for the type of identification used as shown below:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CODE</td>
<td>ID TYPE</td>
</tr>
<tr>
<td></td>
<td>SSN</td>
<td>U.S. Social Security Number</td>
</tr>
<tr>
<td></td>
<td>PPN</td>
<td>Passport Number</td>
</tr>
<tr>
<td></td>
<td>CSI</td>
<td>Canadian Social Insurance Number</td>
</tr>
<tr>
<td></td>
<td>WPN</td>
<td>Work Permit Number</td>
</tr>
<tr>
<td></td>
<td>IND</td>
<td>INDEX Identification Number</td>
</tr>
<tr>
<td></td>
<td>OTH</td>
<td>Other</td>
</tr>
<tr>
<td>4.</td>
<td>Check the box that denotes the sex of the individual being monitored.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Enter the date of birth of the individual being monitored in the format MM/DD/YY.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Enter the monitoring period for which this report is filed. The format should be MM/DD/YY – MM/DD/YY.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Enter the name of the licensee or facility not licensed by NRC that provided monitoring.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Enter the NRC licensee number or numbers.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Place an “X” in Record, Estimate, or No Record. Choose “Record” if the dose data listed represents a final determination of the dose received to the best of the licensee’s knowledge. Choose “Estimate” only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report. An example of such an instance would be dose data based on self-reading dosimeter results and the licensee intends to assign the record dose on the basis of TLD results that are not yet available.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Place an “X” in either Routine or PSE. Choose “Routine” if the data represents the results of monitoring for routine exposures. Choose “PSE” if the listed dose data represents the results of monitoring of planned special exposures received during the monitoring period. If more than one PSE was received in a single year, the licensee should sum them and report the total of all PSEs.</td>
<td></td>
</tr>
</tbody>
</table>

### PRIVACY ACT STATEMENT

Pursuant to 5 U.S.C. 552a(e)(3), enacted into law by Section 3 of the Privacy Act of 1974 (Public Law 93-579), the following statement is furnished to individuals who supply information to the U.S. Nuclear Regulatory Commission on NRC Form 4. This information is maintained in a system of records designated as NRC-27 and described at 58 Federal Register 36473 (July 7, 1993), or the most recent Federal Register publication of the Nuclear Regulatory Commission’s “Republication of Systems of Records Notices” that is available at the NRC Public Document Room, Gelman Building, Lower Level, 2120 L Street NW, Washington, D.C.

#### 1. AUTHORITY:

Sections 53, 63, 65, 81, 103, 104, 161(b), and 161(o) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201(b), and 2201(o)). Executive Order 9397, November 22, 1943.

#### 2. PRINCIPAL PURPOSE(S):

The information is used by the NRC in its evaluation of the risk of radiation exposure associated with the licensed activity and in exercising its statutory responsibility to monitor and regulate the safety and health practices of its licensees. The data permits a meaningful comparison of both current and long-term exposure experience among types of licenses and among licensees within each type. Data on your exposure to radiation is available to you upon your request.

#### 3. ROUTINE USE(S):

The information may be used to provide data to other Federal and State agencies involved in monitoring and/or evaluating radiation exposure received by individuals employed as radiation workers on a permanent or temporary basis and exposure received by monitored visitors. The information may also be disclosed to an appropriate Federal, State, local, or Foreign agency in the event the information indicates a violation of potential violation of law and in the course of an administrative or judicial proceeding. In addition, this information may be transferred to an appropriate Federal, State, local or Foreign agency to the extent relevant and necessary for an NRC decision about you or to the extent relevant and necessary for that agency’s decision about you. Information from this form may also be disclosed, in the course of discovery under a protective order issued by a court of competent jurisdiction, and in presenting evidence, to a Congressional office to respond to their inquiry made at your request, or to NRC-paid experts, consultants, and others under contract with the NRC, on a need-to-know basis.

#### 4. WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:

It is voluntary that you furnish the requested information, including social security number, however, the licensee must complete NRC Form 5 on each individual for whom personnel monitoring is required under 10 CFR 20.2106. Failure to do so may subject the licensee to enforcement action in accordance with 10 CFR 20.2401. The social security number is used to assure that NRC has an accurate identifier not subject to the coincidence of similar names or birthdates among the large number of persons on whom data is maintained.

#### 5. SYSTEM MANAGER(S) AND ADDRESS:

REIRS Project Manager
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Bioassay Instructions/COC
(EXAMPLE)

This kit is being provided by American Veteran Environmental Services, Inc. for the collection of a 24-hour urine sample that will be used to assess the levels of internal radiological contaminants in your system. It is important to follow the directions below to obtain a valid sample. If you have any questions regarding how to provide the sample, please contact the Radiation Safety Officer.

Instructions:
1. Keep the sample box and containers clean and free of any foreign material.
2. Prior to collecting urine in the bottles, record the DATE and TIME of your LAST UNCOLLECTED VOID below. The sampling period is 24-hours, which begins with the last uncollected void and ends after 24-hours. (It is not necessary to fill both containers to have a valid sample. If both containers are not full after 24-hours note the END TIME below. If both containers are filled before 24-hours, the sampling is complete. Note the END TIME below and complete the following steps.)
3. Between voidings, secure bottle with caps provided. When the bottles are full, tighten the caps securely.
4. Complete the enclosed security labels and place securely on bottles when sampling is complete. SIGN AND DATE THE CHAIN OF CUSTODY BLOCK BELOW IN THE FIRST “RELINQUISHED BY” LINE!
5. Place the sample bottles in the sample kit box.
6. Return the completed sample kit and this sheet to the RPM, or designee.
7. Use a cooler and secure samples if shipping.

Complete the following information:

<table>
<thead>
<tr>
<th>Name:</th>
<th>SSN:</th>
</tr>
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<tbody>
<tr>
<td>Date of last uncollected void:</td>
<td>Time of last uncollected void:</td>
</tr>
<tr>
<td>Sample collection end date:</td>
<td>Sample collection end time:</td>
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</table>

Chain of Custody:

<table>
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<tr>
<th>Relinquished by:</th>
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<th>Received by:</th>
<th>Date</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td>Received by:</td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td>Received by:</td>
<td>Date</td>
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## EXTERNAL DOSE ESTIMATION

<table>
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<th>Employee Name:</th>
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<table>
<thead>
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<table>
<thead>
<tr>
<th>Computed Dose (mrem DDE):</th>
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<table>
<thead>
<tr>
<th>Reason (check):</th>
<th>Basis (check):</th>
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</thead>
<tbody>
<tr>
<td>☐ Lost Dosimeter</td>
<td>☐ Prior exposure history</td>
</tr>
<tr>
<td>☐ Damaged Dosimeter</td>
<td>☐ Comparison with coworkers</td>
</tr>
<tr>
<td>☐ Other (describe):</td>
<td>☐ Ambient exposure rate and stay time analysis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other (describe):</th>
<th>Other (describe):</th>
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</thead>
<tbody>
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<th>Notes and Calculations:</th>
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<table>
<thead>
<tr>
<th>Assessment performed by (name and signature):</th>
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</table>

<table>
<thead>
<tr>
<th>RPM Approval (name and signature):</th>
</tr>
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<tbody>
<tr>
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</tr>
</tbody>
</table>
HEALTH PHYSICS PROCEDURE

AVESI HP-13

ALARA PROGRAM

APPROVED BY: __________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: __________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
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</tr>
<tr>
<td>2.0 Scope</td>
<td>1</td>
</tr>
<tr>
<td>3.0 References</td>
<td>1</td>
</tr>
<tr>
<td>4.0 Definitions</td>
<td>1</td>
</tr>
<tr>
<td>5.0 Responsibilities</td>
<td>1</td>
</tr>
<tr>
<td>6.0 Procedure</td>
<td>2</td>
</tr>
<tr>
<td>6.1 The ALARA Program Elements</td>
<td>2</td>
</tr>
<tr>
<td>6.2 ALARA Policy Statement</td>
<td>2</td>
</tr>
<tr>
<td>6.3 Work Review</td>
<td>2</td>
</tr>
<tr>
<td>6.4 ALARA Suggestion Program</td>
<td>3</td>
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<tr>
<td>7.0 Records</td>
<td>3</td>
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# LIST OF ATTACHMENTS

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>ALARA POLICY STATEMENT</td>
</tr>
<tr>
<td>2</td>
<td>PRE-JOB ALARA REVIEW</td>
</tr>
<tr>
<td>3</td>
<td>POST JOB ALARA REVIEW</td>
</tr>
<tr>
<td>4</td>
<td>ALARA SUGGESTION FORM</td>
</tr>
</tbody>
</table>
1.0 Purpose

This program establishes the policies for maintaining exposures to ionizing radiation As Low As Reasonably Achievable (ALARA). The ALARA Program helps ensure exposure of the general public and facility personnel to radiation and radioactive material is kept as far below site limits as is reasonably achievable.

2.0 Scope

This procedure applies to all AVESI and subcontractor activities that take place involving radioactive material at sites working under this American Veteran Environmental Services, Inc. (AVESI) radiation safety program.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 AVESI HP-01, “Radiation Protection Program”
3.3 AVESI HP-14, “Radiological Work Permits”
3.4 NRC. Regulatory Guide 8.8, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be As Low As Is Reasonably Achievable”
3.5 NRC. Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Exposures As Low As Is Reasonably Achievable”
3.6 U.S. Army Corps of Engineers Manual No. EM 385-1-1, Section 06.E, “Ionizing Radiation”
3.7 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”

4.0 Definitions

4.1 ALARA – an acronym for as low as reasonably achievable. The term means making every reasonable effort to maintain exposures to radiation as far below the dose limits of the site as is practicable. ALARA as a philosophy must be understood to encompass all site activities involving exposure to radiation while taking into consideration cost versus benefit and other factors.

4.2 Reasonably (or Reasonable) – within the bounds of good sense and practicality.

5.0 Responsibilities

5.1 The RPM shall:

5.1.1 Incorporate the ALARA concept into training programs developed for site personnel.
5.1.2 Ensure that the ALARA Program is implemented in accordance with procedural requirements.
5.1.3 Establish an ALARA suggestion program.
5.1.4 Review ALARA suggestions for program incorporation.
5.1.5 Perform pre and post job ALARA reviews, as required by this procedure.
5.2 All site personnel have the responsibility to:

5.2.1 Follow ALARA practices and procedures.

5.2.2 Incorporate the ALARA concept into everyday work habits and activities.

5.2.3 Make ALARA suggestions to the RPM when better methods or equipment could be utilized to reduce exposure to ionizing radiation.

6.0 Procedure

6.1 The ALARA Program Elements

6.1.1 Development of an ALARA Policy Statement.

6.1.2 Posting the ALARA Policy Statement so it is accessible to all employees that work with radioactive materials or ionizing radiation.

6.1.3 Development of procedural requirements to ensure the completion of pre- and post-job ALARA reviews and application of the ALARA concept in site design changes, work activity changes and/or work practices, as applicable.

6.1.4 Establishment of lines of communication between the site management (AVESI and client) and site personnel such that information concerning the radiological hazards of site activities can be readily accessed by site personnel and clients.

6.1.5 Assessment of ALARA performance indicators, such as: radiological incident reports, personnel contamination events, and cumulative dose reports.

6.1.6 Reviewing ALARA suggestions for potential dose reduction, assigning responsibility for implementation, and following up each accepted suggestion to ensure incorporation into the program.

6.2 ALARA Policy Statement

6.2.1 The ALARA Policy Statement is contained in Attachment 1 or equivalent to this procedure.

6.2.2 The policy statement is used to clearly delineate the responsibilities for the successful implementation of the ALARA Program. It contains the description of the ALARA Program and its elements.

6.2.3 The policy statement should be provided to all employees during Radiation Worker Training (RWT).

6.3 Work Review

6.3.1 Pre- and Post-Job ALARA Reviews

6.3.1.1 Pre- and post-job ALARA reviews should be documented using Attachments 2 and 3 (or equivalent), respectively.
6.3.1.2 Any work activity that is likely to cause radiation exposures in excess of monitoring thresholds (i.e., 10% of 10 CFR 20 exposure limits for radiological workers) should have a pre-job ALARA review, and ALARA pre-job briefing conducted by the RPM, or designee in accordance with AVESI HP-14, “Radiological Work Permits”.

6.3.1.3 A post-job ALARA review will be conducted for all work activities that require a pre-job review. All post-job reviews will be completed within 3 months of job completion or closure of the RWP.

6.3.1.4 Pre and post-job ALARA reviews, upon completion, will be retained in the project files.

6.3.2 ALARA Goals

Due to changing radiological hazards and concentrations of radionuclides in the material handled at each site, the approach to ALARA goals is necessarily unique. The primary focus of ALARA goal setting will be through pre- and post-job reviews. All goals determined through pre-job reviews should be achievable and realistic.

6.4 ALARA Suggestion Program

6.4.1 Any site employee may make suggestions for the improvement of activities, facilities and procedures to help reduce exposure to radiation or radioactive materials. Documentation of the suggestion should be performed by completing Attachment 4 (or equivalent) and submitting it to the RPM.

6.4.2 The RPM should indicate approval or disapproval on the ALARA Suggestion form, then transmit the form to the Project Manager for further evaluation.

6.4.3 All suggestions should undergo a complete review cycle as listed on Attachment 4 (or equivalent), regardless of any previous reviewer’s rejection. Suggestions approved by the site RPM should be implemented into the appropriate facility programs as soon as practicable.

6.5 References (Section 3.0) used to establish this ALARA program may be used, at the discretion of the RPM, as additional guidance for ALARA implementation.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
AVESI ALARA POLICY STATEMENT

The goal of the AVESI ALARA program is to provide for the radiological safety of the general public and occupationally exposed personnel by limiting all exposures to ionizing radiation whether occupational or non-occupational, individual or collective, to the lowest reasonably achievable level.

AVESI Management has a strong commitment to the reduction of radiation exposure, including the review of initial design of site work practices with the goal of having the ALARA concept incorporated to the maximum extent practicable.

AVESI Management provides an opportunity for all site personnel to participate in the ALARA Program by making ALARA suggestions. The individuals in the decision making process for tasks involving occupational exposure are encouraged to make ALARA suggestions. Routine responsibilities for all site personnel include compliance with requirements of work permits, procedures and training, and participation in Pre- and Post-Job Reviews.

AVESI Management acknowledges its responsibility to incorporate the ALARA concept in all phases of site and employee activities.

The ALARA Program contains the following elements:

Pre and Post Job Reviews
Tracking and Trending of Occupational Exposures
Review of Radiological Incident Reports
Development of ALARA Procedures
ALARA Suggestions
Pre-Job ALARA Review

RWP No: ____ ____ - ____ . ____ ____ Date: __________________________

Client/Location/Site: _________________________________________________

Material Type: _______________________________________________________

Job Description: _____________________________________________________

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

Personnel Performing Review: __________________________________________

_____________________________________________________________________

_____________________________________________________________________

Estimated Person-Hours: __________________

Estimated Average General Area Dose Rate: __________________

Estimated Average Derived Air Concentration: __________________

Calculated External Exposure: __________________

(Person hours * dose rate)

Calculated Internal Exposure: __________________

(Person hours * DAC * 2.5 mrem/DAC-hr)

Initial Person-Rem Estimate: ____________ Goal: ________________

Job Classification:  ○ Routine

○ Non-routine
Pre-Job ALARA Review

**NOTE:**
Prior to performing the ALARA pre-job review the RPM, or designee, should review previous job histories and/or interview personnel experienced in the task, as appropriate.

**PRE-JOB REVIEW GUIDELINES**

<table>
<thead>
<tr>
<th>Item</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
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<tbody>
<tr>
<td>RWP prepared</td>
<td></td>
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<td></td>
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<tr>
<td>all equipment is operable and in good repair</td>
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<td></td>
<td></td>
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<tr>
<td>dry runs or walkthroughs performed</td>
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<tr>
<td>special ventilation required</td>
<td></td>
<td></td>
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<tr>
<td>special dosimetry required</td>
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<tr>
<td>overall safety aspects of the job discussed</td>
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<tr>
<td>housekeeping responsibilities established</td>
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</table>

**SPECIAL CONTROLS and / or COMMENTS:**

(Attach additional pages as necessary)

**REVIEW PERFORMED BY:**

Job estimate: > 500 mrem/yr internal and external exposure.

RPM ___________________________ Date ____________

Project Manager ___________________ Date ____________
Post Job ALARA Review

Job/Task: __________________________  Date: ________________

RWP No: __________________________

Total Person-Rem: _________________  Estimated Person-Rem: _________________

1. Was the Person-Rem estimate for the work accurate? (±25%)  Yes ☐ No ☐
   If “No” explain _______________________________________________________

2. Were exposure reduction suggestions implemented?  Yes ☐ No ☐
   If “No” explain _______________________________________________________

3. Were exposure reduction methods successful?  Yes ☐ No ☐
   If “No” explain _______________________________________________________

4. Were any Radiation Incident Reports written on this job?  Yes ☐ No ☐
   If “Yes” review and note cause(s) ______________________________________

5. Was new equipment identified during the course of work that could enhance the work, save time or reduce dose?  Yes ☐ No ☐
   If “Yes” – Identify and perform cost/benefit analysis _______________________

6. Did existing equipment perform well?  Yes ☐ No ☐
   If “No” explain _____________________________________________________

______________________________

7 of 9
Post Job ALARA Review

7. Is facility refurbishment necessary? Yes ☐ No ☐
   If “Yes” explain ______________________________________________________

8. Was housekeeping satisfactory for the duration of the job? Yes ☐ No ☐
   If “No” explain ______________________________________________________

9. Were procedures adequate to the task? Yes ☐ No ☐
   If “No” explain ______________________________________________________

RECOMMENDATIONS (derived from post-job review or de-brief with workers):

________________________________________________________________________
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RPM or designee: ___________________________ Date: __________
Project Manager: __________________________ Date: __________
**ALARA SUGGESTION FORM**

Name: ___________________________  
Date: ___________________________

Facility:  

Suggestion:  

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<th>Disapprove</th>
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Project Manager:  

Signature  Date

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<th>Disapprove</th>
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RPM:  

Signature  Date

Comments:  

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HEALTH PHYSICS PROCEDURE

AVESI HP-14

RADIOLOGICAL WORK PERMITS

APPROVED BY: ________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<td>RADILOGICAL WORK PERMIT</td>
</tr>
<tr>
<td>3</td>
<td>PRE-JOB BRIEFING</td>
</tr>
<tr>
<td>4</td>
<td>RWP ENTRY CONTROL LOG</td>
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Error! Bookmark not defined.
1.0 Purpose

The purpose of this procedure is to provide the guidelines and requirements for the generation, implementation, revision, and termination of Radiological Work Permits (RWP) at sites where AVESI is responsible for maintaining radiological safety.

2.0 Scope

This procedure applies to all personnel requiring access to a location covered by an RWP under this AVESI radiation safety program.

3.0 References

3.1 AVESI HP-01, “Radiation Protection Program”
3.2 AVESI HP-14, “ALARA Program”
3.3 10 CFR 20, “Standards for Protection Against Radiation”

4.0 Definitions

4.1 Radiological Work Permit (RWP) – A document used for control of specific work that provides the minimum protective requirements for the performance of that work.

4.2 RWP Package – A compilation of documentation providing the complete record of an RWP from its generation to its closure. The completed RWP Package should contain:

4.2.1 The Pre-Job ALARA review, as applicable;
4.2.2 Pre-Job briefing forms;
4.2.3 RWP and revisions;
4.2.4 Post-Job ALARA review, as applicable; and
4.2.5 Other documentation as determined by the Radiation Protection Manager (RPM).

4.3 Radiological or Industrial Safety Hold - A planned point when work stops due to the potential health and safety consequences of performing the next step.

4.4 Restricted Area – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 Responsibilities

5.1 The RPM shall:

5.1.1 Ensure that RWPs are initiated as required by this procedure.

5.1.2 Determine if a Pre-Job ALARA Review is required and ensure reviews are completed prior to approval of the RWP.

5.1.3 Review and approve all RWPs prior to job commencement.
5.1.4 Conduct a quarterly assessment of active RWPs to confirm that the exposure conditions and training/use requirements reflected on the RWP are current and appropriate.

5.1.5 Maintain copies of terminated RWP's as part of the radiation protection records.

5.1.6 Maintain a log of RWPs that have been established and their status.

5.2 All personnel performing work under an RWP shall:

5.2.1 Read the current version of the RWP and clearly understand the work to be performed;

5.2.2 Comply with the requirements of the RWP;

5.2.3 Complete the RWP Entry Control Log prior to entering and upon exiting the work area, if required by the RWP;

5.2.4 Notify the HPT covering the activity of any unexpected change in conditions in the work area;

5.2.5 Make every effort to minimize the spread of contamination and ensure proper disposition of materials;

5.2.6 Notify the HPT covering the activity when a hold, as specified in the work procedure, work instructions, or on the RWP is encountered, and

5.2.7 Attend a pre-job briefing on the current revision of the RWP.

5.3 Health Physics Technicians (HPTs) shall:

5.3.1 Perform required surveys and monitoring for RWPs;

5.3.2 Perform pre-job briefings for RWPs;

5.3.3 Provide coverage for the job, as applicable;

5.3.4 Periodically review RWP Entry Control Logs at their work area for accuracy and completeness;

5.3.5 Notify the RPM if an RWP revision becomes necessary.

6.0 Procedure

6.1 General

6.1.1 An RWP shall be initiated for any of the following conditions:

6.1.1.1 Work in or entry into a Contamination Area, Radiation Area, High Radiation Area, Very High Radiation Area, or Airborne Radioactivity Area.

6.1.1.2 Transfer of or work with radioactive material as determined by the RPM,

6.1.1.3 Any work as determined by the site RPM.
6.1.2 The RPM shall review scheduled work and assign a Senior HPT to perform the RWP assessment if warranted by the hazard. Otherwise the RPM shall perform the assessment.

6.1.3 The RPM, or designee shall issue the RWP number. This number shall be entered on Attachment 1 or equivalent. The RWP number uses the following format: the year, next sequential number and the revision (e.g., 01-04.02).

6.1.4 The RPM, or designee and work supervisor shall document the Pre-job ALARA Review, if required, in accordance with AVESI HP-13, “ALARA Program”.

6.1.5 Using RWP assessment data and the Pre-job ALARA Review, if completed, the RPM, or designee will complete Attachment 2, “Radiological Work Permit”.

6.1.6 Prior to issue of the RWP:
   6.1.6.1 The RWP shall be reviewed by the RPM, or designee and Local EC & HS Official and approved by the RPM.
   6.1.6.2 The RPM or HPT covering the activity shall conduct a pre-job briefing for all RWPs. The pre-job briefing shall:
      6.1.6.2.1 Include a discussion of the completed Pre-job ALARA Review, as applicable;
      6.1.6.2.2 Consist of a step-by-step overview of the job, as applicable;
      6.1.6.2.3 Consist of a review of the requirements of the RWP; and
      6.1.6.2.4 Be documented on Attachment 3 or equivalent form.

6.1.7 After an RWP number is issued, the RPM, or designee shall establish and maintain an RWP Package, which includes; the RWP, pre-job ALARA review (as applicable), RWP Assessment (as applicable), and pre-job briefing forms.

6.1.8 Only personnel who have attended a pre-job briefing and signed the briefing form shall be authorized to perform work under that RWP. Personnel preparing, reviewing or approving RWPs or giving pre-job briefings are considered authorized on the briefing form by merit of their familiarity with the requirements of the RWP.

6.1.9 All personnel shall complete the Entry Control Log for the RWP under which they are performing work, if required by the RWP.
6.1.10 Dose in, Dose out, and Total Dose sections of the RWP Entry Control Log shall be completed if a direct reading dosimeter is required by the RWP.

6.1.11 Prior to end of shift, the HPT covering the activity should ensure all personnel have logged out of the RWP Entry Control Logs and all log entries are complete.

6.1.12 The RPM or designee shall ensure that supporting documentation outlined in Section 4.2 are placed in the RWP Package.

6.1.13 RWPs shall remain active for the duration of the work, up to a maximum of one year.

6.1.14 The RPM or HPTs shall perform quarterly assessments of all RWPs to verify the RWP requirements are appropriate for the work being performed (i.e. conditions or work to be performed have not changed significantly).

6.1.14.1 The quarterly assessments shall be performed and documented.

6.1.14.2 Verification of the quarterly assessment shall be made by signing and dating the appropriate space on Attachment 2 (or equivalent) and indicating whether a revision is necessary.

6.1.14.3 If necessary, revisions to RWPs shall be made according to this procedure.

6.1.15 Site-specific work plans, radiation protection plans, or health and safety plans may be used in lieu of RWPs to control on-site AVESI activities if approved by the RSO.

6.2 Radiological Holds

6.2.1 Radiological holds shall be identified in the additional requirements section of the RWP or in the appropriate procedure/instruction for work covered by the RWP.

6.2.2 Work shall be stopped and the HPT covering the activity shall be notified when a radiological hold is encountered.

6.2.3 Work shall not resume until the RPM, or designee has evaluated conditions and authorization is given.

6.3 RWP Revision

6.3.1 An RWP shall be revised if any of the following conditions apply:

6.3.1.1 Changes in conditions sufficient to warrant a change in personnel protection or monitoring requirements, (e.g., a change in protective clothing, respiratory protection equipment, or dosimetry).

6.3.1.2 A significant change in the scope of the job as it is described on the RWP.

6.3.1.3 The RPM, or designee determines a revision is necessary.
6.3.2 When an RWP is determined to need revision, the RPM, or designee shall employ a complete revision or a pen and ink change, as necessary. Complete revisions shall be performed as follows:

6.3.2.1 During transition from one revision to another, all work under the RWP shall stop to ensure all personnel actively working on the RWP are notified of the revision and are briefed on the changes and requirements for performing work on the revised RWP. Complete Attachment 3 or equivalent form.

6.3.2.2 Work under the revised RWP may begin after personnel are briefed and appropriate documentation is complete.

6.3.2.3 Remove all copies of the terminated RWP and RWP Entry Control Logs.

6.3.2.4 Sign and date the “Terminated by” blank on the original RWP and provide the reason for the termination.

6.3.2.5 Prepare and issue the revised RWP according to the requirements of this procedure.

NOTE:
All personnel shall be briefed on the changes made under the revised RWP before being authorized to enter the work area governed by that RWP.

6.3.2.6 The revised RWP shall retain the same number as the original RWP except the “Rev” designator, which will be .00 for initial RWPs, shall be changed to .01 for the first revision and .02 for the second, etc.

6.3.3 Pen and ink changes shall be authorized by the RPM, or designee, for minor changes to personal protection or monitoring requirements. Pen and ink changes shall be made as follows:

6.3.3.1 Pen and ink changes shall be made on the original and all copies of the latest revision to the RWP.

6.3.3.2 Deletions to requirements shall be made using a single line strikeover then initialing and dating the revision.

6.3.3.3 Additions to requirements shall be initialed and dated after the addition.

6.3.3.4 The “Additional Requirements” section of the RWP shall be used to clarify any pen and ink changes, if necessary.
6.3.3.5 If numerous pen and ink changes have made the RWP illegible, a complete revision shall be performed. Personnel performing work covered by the revised RWP shall be briefed on the revision and shall document the briefing by resigning the pre-job briefing form (Attachment 3 or equivalent) prior to working under the revised RWP.

6.3.3.6 The RPM, or designee shall ensure that all personnel that were briefed on the previous version of the RWP are contacted and informed of the revision to the RWP, as applicable.

6.4 RWP Termination

6.4.1 RWP shall be terminated for any of the following reasons:

6.4.1.1 Any condition requiring a complete revision to the RWP.
6.4.1.2 Completion of the job.
6.4.1.3 If the time limits are reached.

6.4.2 The RPM or designee shall complete the “Terminated by”, “Reason for Termination”, and revision or RWP termination blanks on the original maintained in the RWP Package.

6.4.3 After RWP termination, the RPM, or designee shall perform the Post-Job ALARA Review, if required, in accordance with AVESI HP-13, “ALARA Program”.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
<table>
<thead>
<tr>
<th>PERMIT NUMBER</th>
<th>JOB DESCRIPTION</th>
<th>DATE AUTHORIZED</th>
<th>DATE TERMINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>
RADIOLOGICAL WORK PERMIT

RWP No: ______-____-____ Date Issued: ______ Expiration Date: ______

Client: ___________________ Location: ___________________ Site: ___________________

Job Description: ________________________________________________________________

<table>
<thead>
<tr>
<th>H/S COVERAGE</th>
<th>DRESS REQUIREMENTS</th>
<th>DOSIMETRY REQUIREMENTS</th>
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<tbody>
<tr>
<td>☐ Continuous</td>
<td>Cotton Coverall</td>
<td>☐ Self Reading Dosimeter</td>
</tr>
<tr>
<td>☐ Intermittent</td>
<td>Paper Coveralls</td>
<td>☐ Whole Body TLD</td>
</tr>
<tr>
<td>☐ Buddy System</td>
<td>Plastic Coveralls</td>
<td>☐ Ring TLD</td>
</tr>
<tr>
<td>☐ Confined Space</td>
<td>Tyvek Coveralls</td>
<td>☐ Electronic Dosimeter</td>
</tr>
<tr>
<td>☐ Entry Permit.</td>
<td>Skull Cap</td>
<td>☐ Multi-Badging</td>
</tr>
<tr>
<td>☐ Notify H/S upon entry to area.</td>
<td>Cloth Gloves</td>
<td></td>
</tr>
<tr>
<td>☐ RWP Entry / Exit Log Required</td>
<td>Rubber Gloves</td>
<td></td>
</tr>
<tr>
<td>☐ HPT perform all personnel frisk surveys</td>
<td>Plastic Booties</td>
<td></td>
</tr>
<tr>
<td>☐ Radiological Workers may perform personnel frisk surveys</td>
<td>Lab Coat</td>
<td>Other</td>
</tr>
<tr>
<td>☐ ☐ Rubber Apron</td>
<td>☐ Surgeon’s gloves</td>
<td>Other</td>
</tr>
<tr>
<td>☐ ☐ Rubber Shoe covers</td>
<td>☐ Other</td>
<td>Other</td>
</tr>
</tbody>
</table>

SAFETY EQUIPMENT

| ☐ Safety Glasses | ☐ Face-Shield | ☐ Other |
| ☐ Steel-toed Shoes | ☐ Leather Apparel | ☐ Other |
| ☐ Goggles | ☐ Hearing Protection | ☐ Other |
| ☐ Hard Hat | ☐ Welding Shield w/ number lens | ☐ Other |

ADDITIONAL REQUIREMENTS (ALARA considerations, Pen and Ink changes, safety, job specific):

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

A PRE-JOB BRIEFING IS REQUIRED PRIOR TO ENTRY ON THE RWP

Reviewed By: ___________________________ Date: ______________

Local EC&HS Representative

Approved By: ___________________________ Date: ______________

Radiation Protection Manager

Collective dose goal: __________ Approved by: __________ Date: __________

Terminated by: ______________ Date: ______________

Revision termination: ______ RWP termination: ______ (check one)

Reason for termination: __________________________________________________________
## RWP CONTINUATION SHEET

### QUARTERLY ASSESSMENT VERIFICATION

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<th>Signature of RPM/HPT</th>
<th>Revision Required</th>
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<tbody>
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*If “Yes”, state the reason a revision is required and whether a pen and ink change or complete revision is necessary:

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Revision approved: _____________________________  Date: ______________

RPM
PRE-JOB BRIEFING

RWP No. ___ ___ - ___ ___ . ___ ___  

Date: __________________

PRE-JOB BRIEFING CHECKLIST

- Discuss Pre-job ALARA review, if applicable
- Review requirements of RWP
- Review the step-by-step aspects of the job, ensuring all personnel are aware of their required actions

Job Description: ____________________________________________________________

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### PERSONNEL ATTENDING PRE-JOB BRIEFING

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<th>Printed Name</th>
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*By signature, personnel certify they have read, understand, and will comply with the requirements of the RWP.*

Signature ________________________________ RPM __________________________ Date ____________
RWP ENTRY CONTROL LOG

RWP No. __________ CLIENT: ___________________ LOCATION: ________________

AREA ___________________ DATE ___________________

A PRE-JOB BRIEFING IS REQUIRED PRIOR TO ENTRY ON THIS RWP

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<th>RESP TYPE</th>
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</table>

RESP. TYPE: FF = FULL FACE; SCBA = SELF CONTAINED BREATHING APPARATUS; AL = AIRLINE

Reviewed by: ______________________________________ Date: ___________
HEALTH PHYSICS PROCEDURE

AVESI HP-15

RESPIRATORY PROTECTION

APPROVED BY: _________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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LIST OF ATTACHMENTS

  1 RESPIRATORY PROTECTION ISSUE LOG.............................................................. 8
1.0 Purpose
This manual contains the basic concepts and criteria for a radiological respiratory protection program.

2.0 Scope
2.1 This manual is to be used as a supplement to AVESI E&HS Manual, Section 9 “Respiratory Protection Program” when implemented for the protection of personnel from airborne radioactive material.

2.2 Dust masks may be used in areas not requiring radiological respiratory protection. Use of dust masks in such circumstances will be for worker comfort and will not be covered by this program.

2.3 The use of atmosphere-supplying respirators, self-contained breathing apparatus, and emergency use respiratory protection equipment is beyond the scope of this procedure.

2.4 This procedure applies to AVESI and subcontractor personnel working under the AVESI radiation protection program.

3.0 References
3.1 10 CFR 20 “Standards for Protection Against Radiation”
3.2 10 CFR 835 “Occupational Radiation Protection”
3.4 AVESI HP-01, “Radiation Protection Program”
3.5 AVESI HP-21, “Radiological Monitoring”
3.6 AVESI HP-12, “Personnel Exposure Monitoring”
3.9 AVESI E&HS Manual, Section 9, “Respiratory Protection Program”
3.10 U.S Army Corps of Engineers Regulation No. EM 385-1-1, Section 05.E, “Respiratory Protection”
3.11 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”

4.0 Definitions
4.1 **Annual Limit on Intake (ALI)** – the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by Reference Man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.
4.2 **Derived Air Concentration (DAC)** – the concentration of a given radionuclide in air that, if breathed by reference man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 m³ of air per hour), results in an intake of one ALI.

4.3 **Protection Factor (PF)** - a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the face-piece under conditions of use.

4.4 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 **Responsibilities**

5.1. The Radiation Protection Manager (RPM) shall ensure that:

5.1.1 The content of the Respiratory Protection Program, when utilized to protect workers from exposure to sources of ionizing radiation, is in compliance with applicable radiological regulations.

5.1.2 To the extent practical, process or other engineering controls (e.g., containment or ventilation) are used to control the concentrations of radioactive material in air.

5.1.3 Respiratory protection is indicated on the RWP when required for radiological purposes.

5.1.4 Radiological air sampling is performed and DAC-hours are tracked as required by AVESI HP-21, “Radiological Monitoring”.

5.1.5 The site bioassay program is implemented in accordance with AVESI HP-12, “Personnel Exposure Monitoring”, to ensure that the respiratory protection program is effective.

5.1.6 For sites regulated by the Nuclear Regulatory Commission (NRC), the Regional administrator of the appropriate NRC Regional office is notified in writing at least 30 days before the date that respiratory protection equipment is used for the purpose of limiting intakes of radioactive material.

5.1.7 The Respiratory Protection Program is implemented, in accordance with reference 3.9, including;

5.1.7.1 Obtaining respiratory protection equipment,

5.1.7.2 Respirator issuance,

5.1.7.3 Respirator maintenance,

5.1.7.4 Respirator selection (when not used for radiological protection),

5.1.7.5 Respirator use,

5.1.7.6 Respirator cleaning and disinfection,
5.1.7.7 Return of respirator equipment,
5.1.7.8 Respiratory training program implementation,
5.1.7.9 Respirator fit testing,
5.1.7.10 Respiratory protection program surveillances and,
5.1.7.11 Medical surveillance.

6.0 Procedure

6.1 General Requirements

6.1.1 Unwarranted use of respiratory protective equipment shall not be permitted and is considered contrary to the ALARA principle due to the increased time to perform individual tasks and the increase in physiological stress.

6.1.2 Process and engineering controls, such as temporary ventilation and containment, are utilized when practical to minimize the need for respiratory protection equipment. The use of respiratory protection equipment is normally limited to non-routine evolutions where process and engineering controls are not practical or in emergency situations.

6.1.3 When process or engineering controls are not practical to eliminate exposure to airborne radioactive materials and radiation dose rates, ALARA assessments should consider exposure and total risks with and without respiratory protection equipment.

6.1.4 During respiratory protection training, each respirator user shall be advised that he or she may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions than might require such relief.

6.2 Hazard Assessment

6.2.1 The RPM shall conduct a hazard assessment of operations that involve the use of radioactive materials to determine the need for radiological respiratory protection. When assessing area(s) and condition(s), the following (as a minimum) shall be taken into consideration for selection of radiological respiratory protection equipment (RPE):

6.2.1.1 Radioactive material sampling results,
6.2.1.2 Removal efficiency of ventilation controls,
6.2.1.3 Smearable contamination levels,
6.2.1.4 Radionuclides,
6.2.1.5 Re-suspension factors,
6.2.1.6 Area dose rates,
6.2.1.7 General conditions, including equipment and materials used and worker activity,
6.2.1.8 10 CFR 20-DAC’s,
6.2.1.9 Feasibility of engineering controls to reduce employee exposure below the exposure limit,
6.2.1.10 The degree of protection provided by the respirator.

6.2.2 Respiratory protection or other appropriate exposure reduction methods shall be considered for any planned work involving removable surface contamination levels exceeding the radionuclide specific levels in Table 1 below. If the radionuclide of concern is not included in Table 1, the RPM shall calculate the action level for that radionuclide. In the event that the action levels are exceeded for work that was not expected to reach the action level, a stop work order shall be initiated so that respiratory protection and other PPE for the activity can be re-evaluated. The RPM may re-initiate site work when PPE for the activity has been re-evaluated and necessary revisions have been made to the RWP.

6.2.3 RWPs for scoping surveys and characterization surveys (i.e., when the magnitude and extent of contaminant levels is not well known) shall use the action levels as a “hold point” for requiring evacuation and re-evaluation of current protection requirements.

6.2.4 The RPM shall consider the use of engineering controls prior to the assignment of respirators for purposes of protecting personnel from airborne loose surface contamination. This does not preclude the use of respiratory protection equipment at contamination levels less than that specified above.

6.2.5 Active processing areas should be decontaminated following any work activity which results in loose surface contamination levels of 10,000 dpm/100 cm² beta-gamma and/or 2,000 dpm/100 cm² alpha. If the alpha activity is known to be natural or depleted uranium, the beta gamma action level of 10,000 dpm/100 cm² may be used at the discretion of the Health Physics Technician for the area.
### Table 1. Removable Contamination Action Levels

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Action Level (dpm/100 cm²)</th>
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<tbody>
<tr>
<td>Am-241</td>
<td>3.1E+04</td>
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<tr>
<td>Co-60</td>
<td>8.7E+06</td>
</tr>
<tr>
<td>Cs-137 + D</td>
<td>3.2E+07</td>
</tr>
<tr>
<td>I-129</td>
<td>4.0E+07</td>
</tr>
<tr>
<td>I-131</td>
<td>4.4E+07</td>
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<tr>
<td>Np-237 + D</td>
<td>2.5E+04</td>
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<tr>
<td>Pu-238</td>
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<tr>
<td>Pu-240</td>
<td>3.2E+04</td>
</tr>
<tr>
<td>Ra-226</td>
<td>1.4E+06</td>
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<tr>
<td>Ra-226 + D</td>
<td>1.3E+06</td>
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<tr>
<td>Ra-228 + D</td>
<td>2.2E+06</td>
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<tr>
<td>Sr-90 + D</td>
<td>4.1E+07</td>
</tr>
<tr>
<td>Th-228 + D</td>
<td>5.4E+04</td>
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<td>Th-230</td>
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<tr>
<td>U-238 + D</td>
<td>1.1E+05</td>
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### 6.3 Fit Testing

6.3.1 A quantitative fit test (QNFT) or qualitative fit test (QLFT) shall be performed if the respirator will be used for the purpose of protecting individuals from airborne radioactive material.

6.3.2 QNFTs shall achieve a protection factor (PF) of at least 1000.

6.3.3 Documentation of QNFT results shall be provided by the QNFT testing vendor.

6.3.4 QLFTs are only authorized for use with negative pressure respirators.
6.3.5 A successful QLFT for a full face negative pressure respirator is assumed to achieve a PF of 100.

6.4 Protection factors

6.4.1 No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

6.4.2 For particulates, the radiological protection factor of a full face negative pressure respirator used with a HEPA filter is 100. PFs for other respirator types (i.e., half face negative pressure, air-line, SCBA, etc.) are located in Appendix A to 10 CFR 20.

6.4.3 The RPM shall select respiratory protection equipment that provides a protection factor greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in 10 CFR 20 appendix B, Table 1, column 3.

6.4.4 If the selection of a respiratory protection device with a protection factor greater than the multiple defined in the preceding sentence is inconsistent with the goal of keeping the total effective dose equivalent ALARA, the RPM may select respiratory protection equipment with a lower protection factor.

6.4.5 The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in air, during each period of uninterrupted use, by the protection factor. If the intake is later found to be greater than estimated (through bioassay or other means), the corrected value shall be used; if the exposure is later found to be less than estimated, the corrected value may be used.

6.5 Respirator Issuance

6.5.1 Respirators may be issued to qualified individuals either long term or on a daily basis, as determined by the RPM and SSHO.

6.5.2 Utilize Attachment 1, “Respiratory Protection Issue Log”, or equivalent to document the issuance of RPE.

6.5.3 After use, respirators shall be surveyed, cleaned, and placed in the appropriate container or designated area. Only qualified individuals may survey a respirator for release from a Restricted Area. Long term issued RPE shall be stored in accordance with the instructions received in training.

6.6 Additional Guidance

6.6.1 The RPM may use references listed in Section 3.0 of this procedure (as appropriate) as additional guidance for implementation of the respiratory protection program.
7.0 Records

All records generated as a result of this procedure shall be maintained by RPM until transmitted to the appropriate Central Records Facility.
# RESPIRATORY PROTECTION ISSUE LOG

## ISSUE INFORMATION

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<tr>
<th>Date</th>
<th>RWP</th>
<th>Person Issued to (Last Name, Int.)</th>
<th>Equipment Type</th>
<th>Filter Type</th>
<th>Issued By</th>
<th>Comments</th>
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*FF = FULL FACE NEGATIVE PRESSURE, DAPR = FULL FACE POWERED AIR POSITIVE PRESSURE, HF = HALF FACE NEGATIVE PRESSURE*

**COMMENTS:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

**REVIEWED BY:**__________________________ **DATE**________________________

________________________________________________________________________
HEALTH PHYSICS PROCEDURE

AVESI HP-16

QUALIFICATIONS AND TRAINING

APPROVED BY: ______________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ______________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<td>5.0 Responsibilities</td>
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<td>6.1 General Requirements</td>
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<td>6.2 Site Orientation Training (SOT)</td>
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<tr>
<td>6.3 Radiation Worker Training (RWT)</td>
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<td>6.4 Qualification of Radiological Workers</td>
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<td>6.5 Qualification of Health Physics Technicians</td>
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<td>6.6 Health Physics Technician Training</td>
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<td>6.7 Qualifications of the Radiation Safety Officer (RSO)</td>
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<td>6.8 Qualifications of the Radiation Protection Manager</td>
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# LIST OF ATTACHMENTS

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<tr>
<td>3</td>
<td>HEALTH PHYSICS REQUIRED READING LOG...................................... 9</td>
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</table>
1.0 Purpose

This procedure describes the qualifications and training that are necessary to ensure that radiological workers and the health physics staff can perform their duties in accordance with this AVESI radiation protection program.

2.0 Scope

This procedure applies to all AVESI and subcontractor personnel working under this AVESI radiation protection program. This procedure does not apply to respiratory protection training or transportation training, which is described in other health physics procedures.

3.0 References

3.1 ANSI 3.1 - 1987, “Selection, Qualification and Training of Personnel for Nuclear Power Plants”
3.2 10 CFR 19, “Notices, Instructions and Reports to Workers: Inspection and Investigations”
3.3 10 CFR 20, “Standards for Protection Against Radiation”
3.4 AVESI HP-01, “Radiation Protection Program”
3.5 U.S. Army Corps of Engineers Manual No. EM 385-1-1, Section 06.E, “Ionizing Radiation”
3.6 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”

4.0 Definitions

4.1 Environmental Compliance Manager (ECM) – an individual who is responsible for containerizing, labeling, and tracking of radioactive waste in storage.

4.2 Health Physics Technicians (HPT) - Personnel who perform work involving radioactive materials, such as shipping/receiving activities, release surveys, area surveys, contamination surveys, leak tests, radiation survey records maintenance, and quality assurance activities as they pertain to radiation surveys.

4.3 Radiation Protection Manager (RPM) – An individual who, by virtue of qualifications and experience, assumes the role and responsibilities of the RSO at a specific client site. The site RPM is delegated the authority to implement the radiation protection program except for the RSO responsibilities listed in Section 6.7.3 of this procedure.

4.4 Radiation Safety Officer (RSO) - An individual who, by virtue of qualifications and experience, has been given the authority to implement the radiation safety program. The RSO is qualified to direct the use of radioactive material in a manner that protects health and minimizes danger to life or property. The RSO is responsible for recognizing potential radiological hazards, developing a radiation
protection program to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation safety operations.

4.5 **Radworker** – An individual, that by virtue of his/her job assignment, is likely to receive a total effective dose equivalent in excess of 100 millirem per year. Radiological workers are required to successfully complete Radiation Worker Training (RWT). Radiological workers are qualified to work with radioactive materials under the direction of health physics staff.

4.6 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.7 **Task Evaluation Standards (TES)** – HPT training standards, which describe the knowledge and requirements necessary to perform an individual health physics task. The HPT trainee is required to discuss knowledge items and perform the task according to the standard, without coaching, in order to successfully qualify on the task. Some tasks may only require discussion or simulation, based on the nature of the task.

4.8 **Transportation Representative** - the individual maintaining training qualifications in accordance with 49 CFR 172, Subpart H, and responsible for the determination and implementation of container and package labeling, shipment placarding, and manifesting of radioactive material offered for transport. Additionally, the individual is responsible for the assessment of incoming radioactive material manifests to ensure compliance with regulatory requirements.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Review the past experience of prospective HPTs to ensure that HPT qualifications meet the requirements of this procedure.

5.1.2 Provide training to meet the requirements of this procedure.

5.1.3 Approve all material presented in health physics procedures, TESs, and RWT.

5.1.4 Approve the qualifications of individuals that present training material.

5.2 The Environmental Compliance Manager (ECM) shall:

5.2.1 Ensure that containerization, labeling, tracking, and management of radioactive waste placed in storage is conducted in compliance with applicable federal and state laws and regulations, the site waste management plan or other appropriate document/plan, and AVESI HP-28, “Storage and Control of Radioactive Waste”.

5.3 The Transportation Representative shall:

5.3.1 Implement the requirements of AVESI HP-41, “Radioactive Material Shipping” in accordance with reference Department of Transportation (DOT) regulations.
5.4 Health Physics Technicians (HPTs) shall:

5.4.1 Successfully qualify on the requirements of this procedure prior to performing health physics tasks.

5.5 Radiological workers shall:

5.5.1 Successfully complete Site Orientation Training (SOT) and annual RWT.

6.0 Procedure

6.1 General Requirements

6.1.1 Prior to allowing unescorted access into a Restricted Area, personnel are required to successfully complete SOT and annual RWT.

6.1.2 Other RWT programs may be accepted in place of AVESI RWT if; certification of successful completion of the training is provided, and the training is determined to be equivalent by the RPM.

6.1.3 The RPM may permit access into the Restricted Area without completing SOT and RWT, provided an individual who has satisfactorily completed SOT and RWT accompanies the person.

6.1.4 The RPM shall log required reading assignments on Attachment 3, or equivalent.

6.2 Site Orientation Training (SOT)

6.2.1 SOT shall be required prior to being allowed unescorted access to Restricted Areas of the site.

6.2.2 SOT shall contain the following information at a minimum:

   6.2.2.1 names of site HP staff and designees,
   6.2.2.2 hazards and symptoms of contaminant exposure including the names of contaminants, exposure limits, required monitoring, and pregnancy concerns,
   6.2.2.3 site and task PPE,
   6.2.2.4 safe work practices to minimize risk,
   6.2.2.5 safe use of engineering controls and equipment,
   6.2.2.6 medical surveillance requirements and employee medical/exposure records access,
   6.2.2.7 site control measures,
   6.2.2.8 reporting requirements,
   6.2.2.9 other safety related information required by SOT in the SSHP.

6.3 Radiation Worker Training (RWT)

6.3.1 RWT shall be required annually.
6.3.2 RWT shall include a test, in which the trainee is required to answer at least 70% of the questions correctly.

6.3.3 RWT is not required for approved RWT instructors by virtue of their knowledge of the subject matter.

6.3.4 RWT shall contain the following information as a minimum:

6.3.4.1 The health protection problems associated with exposure to radiation or radioactive material.

6.3.4.2 The precautions or procedures to minimize internal and external radiation exposure.

6.3.4.3 The purposes and functions of protection devices, including the proper use of dosimetry.

6.3.4.4 The applicable provisions of regulations (and health physics procedures) for the protection of personnel from exposure to radiation or radioactive material.

6.3.4.5 The responsibility to report any condition that may lead to a violation of regulations or unnecessary radiation/radioactive material exposure.

6.3.4.6 The response to warnings made in the event of an unusual occurrence.

6.3.4.7 Being advised that radiation exposure reports may be requested.

6.3.4.8 The health and safety problems associated with exposure to a pregnant female, the fetus, or embryo.

6.4 Qualification of Radiological Workers

6.4.1 A radiological worker shall successfully complete SOT prior to being granted unescorted access to Restricted Areas of the site.

6.4.2 A radiological worker shall successfully complete RWT prior to being granted unescorted access to Restricted Areas of the site, and annually thereafter.

6.5 Qualification of Health Physics Technicians

6.5.1 The RPM shall review HPTs work history, and classify HPTs as Junior (Jr) or Senior (Sr), based on the individuals education and work history. Approval of work history shall be documented on Attachment 1, or equivalent.

6.5.2 A Sr HPT shall possess a high school diploma and three years of applicable health physics experience, as approved by the RPM. Education and training may be substituted for up to one (1) year of experience.

6.5.3 A Jr HPT shall possess a high school diploma. Jr HPTs shall not perform job coverage, equipment or material release surveys, shipping surveys, or
personnel decontamination; unless under the direct supervision of a Sr Technician, or the RPM.

6.6 Health Physics Technician Training

6.6.1 HPT training is designed to train and qualify HPTs on the tasks necessary to maintain site radiation safety.

6.6.2 Initial HPT training shall be documented on Attachment 1 or equivalent, and include:

6.6.2.1 Review of all health physics procedures.

6.6.2.2 Successful completion of Task Evaluation Standards, commensurate with HPT duties, may include, but are not limited to, the following tasks:
   6.6.2.2.1 Operation of radiological monitoring equipment (RME).
   6.6.2.2.2 Quality control checks of RME.
   6.6.2.2.3 Performing a radiation/contamination survey.
   6.6.2.2.4 Obtaining an air sample.
   6.6.2.2.5 Evaluating an air sample on a bench counter.
   6.6.2.2.6 Evaluating a smear on a bench counter.
   6.6.2.2.7 Performance of equipment release surveys.
   6.6.2.2.8 Personnel decontamination techniques.

6.6.3 Continuing HPT training shall include:

6.6.3.1 A review of all health physics procedures every three years.

6.6.3.2 Reviewing health physics procedure revisions, as documented on Attachment 2, or equivalent.

6.6.3.3 A review of applicable changes to regulations, industry events, industry lessons learned, deficiencies identified during the performance of periodic program reviews, and general topics, as provided by the RPM, and documented on Attachment 2, or equivalent.

6.6.3.4 Formal specialized training commensurate with the duties of the Technician, (i.e. instrument calibration) as required by the RPM, and documented on Attachment 1, or equivalent.

6.7 Qualifications of the Radiation Safety Officer (RSO)

6.7.1 The RSO shall have a minimum of four years of applied radiation safety experience, a Bachelor of Science in Health Physics or other related educational field, and 2 years of management experience.
6.7.2 The RSO should participate in refresher training. Refresher training may consist of; attendance at seminars or training courses on radiation protection issues; self development through review of books and literature on radiation protection issues; or attendance at scientific meetings where radiation protection issues are discussed;

6.7.3 The RSO may delegate responsibilities described in health physics procedures to a Site Radiation Protection Manager (RPM), except for; establishing alternate administrative exposure limits, approval to exceed site administrative exposure limits, regulatory agency notification, approval to dispose of radioactive sources, SSHP approval, and Health Physics Procedure approval.

6.8 Qualifications of the Radiation Protection Manager

6.8.1 The Site RPM shall have a minimum of four years of applied radiation safety experience, formal health physics training, and 2 years of management experience.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RSO until transmitted to the appropriate Central Records Facility.
# Health Physics Training Log

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Health Physics Required Reading

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All Sites  □ Site Specific □, Site:___________________

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**Health Physics Required Reading Log**

Staff □ Senior Technicians □ Junior Technicians □

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Required reading should be numbered using the following format: YY-XX (YY = year, XX = sequential number)
HEALTH PHYSICS PROCEDURE

AVESI HP-21

RADIOLOGICAL MONITORING

APPROVED BY: _______________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _______________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

The purpose of this procedure is to provide guidelines for performance and documentation of radiological surveys and sampling.

2.0 Scope

This procedure applies to all areas of a site working under this AVESI radiation protection program, including those areas where radioactive materials are not normally stored or handled.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 AVESI HP-01, “Radiation Protection Program”
3.3 AVESI HP-11, “Radiological Limits”
3.4 AVESI HP-27, “Personnel and Equipment Decontamination”
3.5 AVESI HP-24, “Radiological Posting and Labeling”
3.6 AVESI HP-31, “Radiological Instrumentation”
3.7 AVESI HP-12, “Personnel Radiation Exposure Monitoring”
3.8 NUREG-1507, “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions”
3.9 NRC Regulatory Guide 8.21, "Health Physics Surveys for Byproduct Material at NRC-Licensed Processing and Manufacturing Plants," 1979

4.0 Definitions

4.1 Annual Limit on Intake (ALI) - The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by Reference Man that would result in a committed effective dose equivalent of 5 rem or a committed dose equivalent of 50 rem to any individual organ or tissue. ALI values are given in Table 1, Columns 1 and 2 of Appendix B, 10 CFR 20.1001-2401.

4.2 Airborne Radioactivity Area – a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.2.1 In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20, or
4.2.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.3 **Breathing Zone** - That region in the vicinity of a worker's mouth and nostrils from which air is drawn into the lungs while performing his/her assigned work. Air sampled from this region represents the air the worker breathe while at work, whether standing, sitting, or moving.

4.4 **Chain of Custody** – An unbroken trail of accountability that ensures the physical security of radioactive materials.

4.5 **Contact Exposure Rate** - The exposure rate from a surface or piece of equipment measured with the radiation detector housing positioned a distance of no greater than 0.5 cm (1/4 inch) from the surface or equipment.

4.6 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site specific contamination limits as documented on Attachment 2 of AVESI HP-11, “Radiological Limits” or other site specific documentation (i.e., Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), etc.).

4.7 **Contamination** - The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds the site-specific surficial release limits pursuant to AVESI HP-11, “Radiological Limits”. Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable". Total contamination refers to fixed plus removable contamination.

4.8 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

4.9 **Derived Air Concentration (DAC)** - The concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work (inhalation rate of 1.2 m³ per hour) results in an intake of one Annual Limit on Intake (ALI). DAC values are given in Table 1, Column 3 of Appendix B of 10 CFR 20.

4.10 **General Area Exposure Rate** - An indication of the potential for a human to incur a radiation dose. Ambient (i.e., general area) exposure rates are measured in units of *millirem per hour* or *microroentgen per hour*.

4.11 **Geometry** - The size and type of container used to hold a sample during counting.

4.12 **Intake** - Amount of radioactive material entering the body through the nose, mouth, or skin.

4.13 **Loose surface contamination (Removable)** - Radioactive contamination easily transferred by normal handling and contact.

4.14 **Minimum Detectable Activity (MDA)** - The smallest amount of radioactivity that can be detected given the conditions of a specific sample.
4.15 **Monitoring** - The measurement of radioactivity in the whole body, in a region of the body, in material eliminated from the body or in the air for purposes of estimating the intake of radioactive material. The term monitoring also includes interpretation of the measurements.

4.16 **Radiation Detection Instrument** - A device, consisting of a detector and a ratemeter, which detects ionizing radiation.


4.18 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.

4.19 **Representative** - Faithfully showing the quality and characteristics of the area from which a sample is drawn or a measurement is made.

4.20 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.21 **Sample** – a representative portion of a medium (i.e., air, water, soil, etc.) of interest, or one or more separated constituents from a representative portion of the medium.

4.22 **Scan** – An evaluation technique performed by moving a survey instrument over a surface of an object at a specified speed and distance above the surface of the object to detect radiation.

4.23 **Stop Work Authority** – The authority residing in all management and radiological workers for immediately stopping work for the following reasons:

4.23.1 If conditions develop that were not anticipated which would result in a significant increase in radiological or industrial safety hazards.

4.23.2 The conditions on the job have degraded to the point that the work is not being performed consistent with the ALARA concept.

4.23.3 The potential for deterioration of occupational safety exists if the job is continued.

4.23.4 The work practices may result in violation of regulatory or NRC license requirements or radiation safety procedures.

4.24 **Unrestricted Area** - Any area to which access is neither limited nor controlled.

4.25 **Unrestricted Release** - Equipment, components, materials, land areas (property), and other items that may be used, transferred, sold, or disposed of without regard for their radiological constituents.

5.0 **Responsibilities**

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Assure that all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) are performed pursuant to this procedure.
5.1.2 Verify compliance with this procedure during planned and periodic surveillances of the radiation protection program.

5.1.3 Specify the types and frequency of air sample collection.

5.1.4 Ensure individual DAC-hour dose records are maintained, if internal monitoring is required pursuant to AVESI HP-12, “Personnel Radiation Exposure Monitoring”, in accordance with the requirements of this procedure.

5.1.5 Ensure that radiological monitoring survey documentation is reviewed in accordance with the requirements of this procedure.

5.2 HPTs shall:

5.2.1 Perform all radiological monitoring surveys (i.e., contamination, radiation, airborne concentration, etc.) in accordance with the provisions of this procedure.

5.2.2 Perform air sampling as required by this procedure.

5.2.3 Perform air sample evaluation as required by this procedure.

5.2.4 Conduct routine surveillance surveys in accordance with the provisions of AVESI HP-23, “Health Physics Oversight”.

6.0 Procedure

6.1 General Requirements

6.1.1 Maintain exposures ALARA when conducting radiological monitoring surveys.

6.1.2 Instrumentation referenced in this procedure is to be prepared for use, and used, in accordance with AVESI HP-31, “Radiological Instrumentation”.

6.1.3 Performance requirements for coverage, release, and routine surveillance surveys are defined in AVESI HP-23, “Health Physics Oversight”.

6.1.4 Radiological monitoring surveys shall be performed, as appropriate, to:

6.1.4.1 Establish and maintain RWPs.

6.1.4.2 Determine whether the confinement or radioactive materials is effective.

6.1.4.3 Measure airborne radioactivity concentrations, radioactive contamination and radiation levels in the workplace.

6.1.4.4 Estimate worker intakes and/or exposures to radiation.

6.1.4.5 Determine posting requirements.

6.1.4.6 Determine appropriate protective equipment and measures.

6.1.4.7 Warn of elevated radiation, contamination, and/or airborne radioactivity levels.

6.1.4.8 Investigate emergency situations.
6.1.4.9 Investigate abnormal conditions.
6.1.4.10 Release material or equipment for unrestricted use or disposal.
6.1.4.11 Investigate anticipated or changing radiological conditions.
6.1.4.12 Comply with other radiation safety procedures.
6.1.4.13 Comply with regulations or NRC license requirements.
6.1.4.14 Investigate radiological conditions in accordance with AVESI HP-23, “Health Physics Oversight.”

6.1.5 In addition to surveys required by Section 6.1.3, the following air sample surveys shall be required:

6.1.5.1 To monitor airborne concentrations of radioactive material to uncontrolled areas (for non-occupational exposure to members of the public), as directed by the RPM.

6.1.5.2 To monitor airborne concentrations of radioactive material in work areas where personnel exposure is likely to exceed 500 mrem/yr CEDE, as determined by the RPM.

6.1.5.3 To monitor airborne concentrations of radioactive material in work areas where personnel exposure is not likely to exceed 500 mrem/yr CEDE, as determined by the RPM, for the purpose of routine surveillance in accordance with Section 6.13 of this procedure.

6.1.5.4 During entries into “Airborne Radioactivity Areas”.

6.1.5.5 Whenever respirators are worn for the purpose of protecting individuals from airborne radioactive material exposure.

6.1.5.6 As determined by the RPM.

6.1.6 Each survey shall be planned in regard to:

6.1.6.1 Specific radiation types.

6.1.6.2 Predetermined radiation levels, contamination levels, or airborne concentrations.

6.1.6.3 Locations where the radiation, contamination and/or airborne radioactive material is expected.

6.1.6.4 The minimum detection sensitivity for each survey (i.e., survey instrument MDA or MDC based on survey parameters such as instrument background, scan speed, count time, etc.).

6.1.7 Radiation and contamination surveys shall be documented on Attachment 1, or equivalent.
6.1.8 The RPM, or designee should establish, and make available, minimum air sample volumes and count times for occupational and non-occupational samples based on site specific data, as applicable and available.

6.1.9 Air sample volumes and count times should be of sufficient volume and duration to detect a minimum detectable concentration of 10% of the DAC or 100% of the Air Effluent Concentration (AE), if practical.

6.1.10 Airborne radioactive material surveys shall be documented on Attachment 4, or equivalent.

6.1.11 The RPM shall evaluate the need for personnel radiation exposure monitoring in accordance with AVESI HP-12, “Personnel Radiation Exposure Monitoring”.

6.1.12 Surveys shall be signed by the individual(s) that performed the survey, and reviewed by the RPM, or designee.

6.2 General Area Radiation Surveys

6.2.1 General area surveys shall be performed with a portable radiation survey instrument that is sensitive to gamma, beta, and/or neutron radiations (i.e., microR meter, microrem meter, ionization chamber, remball, etc.), as appropriate.

6.2.2 Hold the instrument detector at waist level, slowly walking over the area of interest. General area surveys are conducted to ascertain the general area dose rate in accessible areas where personnel may be working or standing near surfaces that contribute to whole body exposure.

6.2.3 An increase in the instrument response or in the needle/indicator movement may indicate the presence of radioactivity in excess of background. The instrument shall be held stationary in the locations where the increased response is noted in order to confirm the response.

6.2.4 General area surveys should include normally accessible areas.

6.2.5 Obtain a representative number of general area radiation readings at knee level when the source of radiation is below waist level (i.e., radioactive material storage areas (RMSA)). Note the position of the reading on the radiation survey form (i.e. knee level).

6.2.6 Document radiation levels on Attachment 1. Any comments and notations that may be necessary for interpretation of results should be recorded on the survey form.

6.3 Contact Radiation Surveys

6.3.1 Surveys shall be performed with a portable radiation survey instrument that is sensitive to gamma, beta, and/or neutron radiations (e.g., microrem meter, microR meter, ionization chamber, remball, etc.), as appropriate.

6.3.2 Contact surveys should be taken so the detector housing is within ¼ inch of the item being evaluated. The detector housing should be positioned so
that the active area of the detector is as close to the radiation source as practical.

6.3.3 A general area survey should be performed each time contact dose rates are measured, as appropriate.

6.3.4 Dose rate contributors shall be clearly identified on the survey form (i.e., bags, drums, piping, equipment, etc.).

6.4 Beta Radiation Surveys

6.4.1 Beta dose rate contribution is determined by calculating the open window reading and closed window reading difference, multiplied by the appropriate beta correction factor.

6.4.2 Beta radiation surveys shall be conducted where bulk beta-emitting radioactive materials are being used, handled, or stored as determined necessary by the RPM.

6.4.3 Beta radiation surveys may not be necessary when beta-emitting radioactive materials are present in the matrix of soil contamination, at the discretion of the RPM.

6.5 Removable Contamination (Smear) Surveys

6.5.1 Smear surveys shall be performed to assess removable contamination on vehicles, equipment, structures, bench tops, fume hoods, and other items.

6.5.2 Using moderate pressure, wipe the smear over an area of 100 cm². A 100 cm² area is approximated by a four-inch square or an eighteen-inch “S” shaped wipe.

6.5.3 Ensure sufficient quantities of smears are taken to adequately assess the magnitude and extent of contamination.

6.5.4 The smear should be placed in a sample holder (e.g., smear booklet or glassine envelope) such that individual smears are separated from each other to prevent cross contamination.

6.5.5 Smears shall be evaluated with a radiation detection instrument (i.e., bench scaler, gas flow proportional counter, liquid scintillation counter, etc.) that is sensitive to the type of radiation expected to be encountered.

6.5.6 Smear results (i.e., gross cpm) shall be converted to dpm/100 cm², as applicable, in accordance with the Attachment 3. Items with total surface area < 100 cm² shall be smeared over the entire surface and documented as dpm/item. Smear results shall be recorded on Attachment 1, or equivalent.
6.5.7 Smear results shall be compared with applicable site removable contamination criteria pursuant to AVESI HP-11, “Radiological Limits”. The RPM shall be notified when unexpected removable contamination is encountered.

6.5.8 The RPM shall review survey data and implement appropriate controls (i.e., respiratory protection, protective clothing, area entry restrictions, etc.) as necessary.

6.6 Total Contamination (Direct Frisk) Surveys

6.6.1 Direct frisk surveys shall be performed to measure total (fixed plus removable) surficial contamination on personnel, vehicles, equipment, structures, and other items.

6.6.2 Direct frisk surveys shall be performed with a portable survey instrument (e.g., GM detector, dual-phosphor scintillation detector, gas flow proportional detector, etc) that is sensitive the type of radiation expected to be encountered.

6.6.3 Direct frisk scan surveys shall be conducted by moving the detector at 1-2 inches/second and with the active area of the detector at ¼ inch (alpha) and ½ inch (beta) from the surface of interest, as applicable.

6.6.4 When an increased instrument count rate is detected, the surveyor shall pause to allow the instrument response to stabilize.

6.6.5 Direct frisk activity (dpm/100cm²) shall be calculated in accordance with Attachment 3.

6.6.6 Alternate scan speed and/or distance may be implemented at the discretion of the RPM.

6.6.7 Scan area coverage for release surveys of equipment and materials shall be 100% of accessible areas unless otherwise specified by the RPM.

6.6.8 A fixed-point (stationary) measurement should be performed where elevated activity was noted (and confirmed) during a scan survey.

6.6.9 Survey results shall be recorded on Attachment 1, or equivalent.

6.6.10 The surveyor shall compare survey results with applicable site specific total contamination criteria in accordance with AVESI HP-11, “Radiological Limits”, and notify the RPM when unexpected surficial contamination is encountered.

6.7 Personnel Release Surveys

6.7.1 A radiological survey is required upon exit from any potentially contaminated area as determined by the RPM, or designee.
6.7.2 When scan area coverage (i.e., whole body, hand and foot, etc.) is not specified on a guiding document (SSHP, RWP, etc.), the RPM, or designee should determine scan area coverage by evaluating the level of removable contamination in the work area, and the likelihood of contact with the contamination.

6.7.3 If the survey indicates contamination above background, the initial survey, personnel decontamination, and re-survey shall be performed and documented in accordance with AVESI HP-27, “Personnel and Equipment Decontamination”. Surveys that do not indicate personnel contamination are not required to be documented.

6.8 Release surveys of equipment/materials for unrestricted use

6.8.1 Equipment and materials being surveyed for unrestricted release shall be surveyed in accordance with Sections 6.5 and 6.6 of this procedure (total and removable contamination surveys).

6.8.2 Equipment/material release surveys shall be documented on Attachment 1, or equivalent.

6.8.3 Release surveys shall be conducted by a Senior HPT or under the direction of a Senior HPT.

6.9 Airborne Particulate Sampling

6.9.1 Airborne particulate radioactivity shall be determined using an air pump connected to a filter cartridge.

6.9.2 In order to meet MDA requirements, verify the required minimum air sample volume prior to collecting an air sample and document the minimum air sample volume on Attachment 4 of this procedure.

6.9.3 The flow rate to be used for calculations should be the average of the pre- and post-sampling flow rates.

6.9.4 The filter cartridge should contain a membrane filter, rather than a glass fiber filter, unless specified by the RPM.

6.9.5 Air shall be drawn through the filter for the duration of monitoring, or until visible dust loading or decreased flow is noted.

6.9.6 The following information should be recorded on Attachment 4 (or equivalent); the sample location, sample ID number, sampler ID, sampler calibration due date, sample date, the time at start/stop, the flow rate at start/stop, minimum air sample volume, RWP number (as applicable), monitored workers and whether the sample is occupational/non-occupational.

6.9.7 The filter shall be removed from the cartridge and placed in a sample envelope such that individual filters are separated from each other to prevent cross contamination.
6.10 Air Sample Types

6.10.1 When occupational air sampling is required in the workplace, the RPM shall specify the type of occupational air sample that is required, including:

6.10.1.1 A breathing zone (BZ) sample is obtained within the breathing zone of the worker, i.e., in the vicinity of the nose and mouth. Sampling shall be performed at low flow rates with the intent of collecting a sample representative of what an individual worker is breathing.

6.10.1.2 A general area (GA) sample (or continuous air monitor sample) is collected in a fixed position without regard to the specific work evolution that represents the environment in the room.

6.10.1.3 A work area (WA) sample, which is temporary in nature, and obtained when a sample would be (conservatively) representative of a work crew. The sample should be obtained between the source of airborne exposure and the breathing zone of the individual with the highest likelihood for exposure. For example, an air sample placed near a drilling mast (or in the breathing zone of the individual handling the augers) would provide a conservative estimate of exposure for the entire drilling crew.

6.10.1.4 In situations in which there is a potential for accidents to cause intakes exceeding 40 DAC-hours in one day continuous air monitoring should be conducted. Monitoring may be through the use of BZ, GA, or WA samples, as determined appropriate by the RPM.

6.10.2 Perimeter (non-occupational) air samples shall be used to monitor non-occupational exposure, as required by the RPM. Perimeter air samples shall be placed at the boundary of the unrestricted area at sufficient locations to determine potential exposure to receptors.

6.11 Air Sample Evaluation

6.11.1 Air sample data shall be documented on Attachment 4, “Air Sample Report”, or equivalent. As an alternative, air sample information may be entered into an air sample database, as directed by the RPM.

6.11.2 When the need for gross alpha/beta analysis is not immediate (i.e., internal monitoring is not required pursuant to AVESI HP-12, “Personnel Radiation Exposure Monitoring”), air sample counting and evaluation may be delayed to reduce the interference of radon and thoron components. Air samples should be counted 10-14 days after collection for accurate indication of actual air concentrations without radon and/or thoron interference.
6.11.3 In situations in which there is a potential for intakes to exceed 40 DAC-hours in one week, air samples should be screened on a daily basis (credit may be taken for respiratory protection factors if respirator protection is worn).

6.11.4 Screening air sample results > 1.0 DAC or 1.0 AE requires immediate notification of the RPM. In addition, Attachment 4 shall be reviewed by the RPM, or designee within 24 hours of counting the elevated screening sample.

6.11.5 Formal air sample results (i.e., reported from the laboratory or final count results) shall be reviewed by the RPM or designee within 7 days of receipt of the results.

6.11.6 Air samples may be screened (counted) for gross alpha and/or beta with a bench counter (e.g. dual phosphor scintillator, gas flow proportional counter) using the following method, as appropriate:

6.11.6.1 Place the air sample filter on the count tray, taking care not to disturb the active surface of the filter.

6.11.6.2 Close and lock the count tray,

6.11.6.3 Ensure the sample count time is set correctly to satisfy MDA requirements.

6.11.6.4 Count the sample.

6.11.6.5 Record the results of the count on Attachment 4.

6.11.6.6 Calculate the air sample activity and DAC-hrs in accordance with Attachment 3, Equations 10 and 12, respectively.

6.11.6.7 Document air sample activity and DAC-hours on Attachments 4 and 5, respectively. Equivalent forms may be used at the discretion of the RPM.

6.11.7 Air samples may also be evaluated (counted) by other methods or sent to a qualified vendor as determined appropriate by the RPM.

6.12 DAC-Hour Tracking

6.12.1 The HPTs shall complete Attachment 5, “DAC-hour Tracking” when:

6.12.1.1 Air monitoring (i.e., required internal monitoring) is conducted.

6.12.1.2 DAC-hour tracking is not required for air sampling conducted solely for routine surveillance purposes.

6.12.2 DAC-hours should be calculated using formal air sample results.

6.12.3 All individuals that were in the sampled area during the time frame of the air sample shall be entered on Attachment 5.
6.12.4 If internal monitoring is required, copies of Attachment 5 shall be forwarded to individual dose files when calculated individual DAC-hrs are equal to, or greater than, 0.4 DAC-hrs (1 mrem). As an alternate method, DAC-hr tracking results may be maintained by transferring dose information to an electronic dose-tracking database, as determined by the RPM.

6.13 Routine Surveillance Surveys

6.13.1 Routine surveillance surveys shall be conducted to verify that the radiological controls implemented by this radiation protection program are sufficient to prevent the spread of contamination, generation of airborne radioactivity, or radiation levels >2 mrem/hr outside Controlled Areas.

6.13.2 Routine surveillance surveys shall be conducted by HPTs in accordance with the requirements set forth in AVESI HP-23, “Health Physics Oversight”.

6.14 Walkover Surveys

6.14.1 Walkover surveys shall be performed with a portable survey instrument that is sensitive to gamma radiation (i.e., scintillation detector) in order to find contamination in soil or other media.

6.14.2 Walkover surveys should be conducted by moving the detector at a rate that does not exceed 1.5 feet/second (0.5 meter per second) at 4” (10 cm) from the surface.

6.14.3 An increase in the instrument response or in the needle/indicator movement may indicate the presence of radioactivity above background. The instrument should be held stationary for a time period determined appropriate by the RPM, or designee at locations where the increased response is noted in order to determine if the response is above or below the site investigation level.

6.14.4 Alternate scanning speed, scanning distance, or modes of transport (e.g., ATV) may be implemented, as long as survey data quality objectives are met, at the discretion of the RPM.

6.14.5 Instrument count-rate and other notations that may be necessary for interpretation of results shall be documented on Attachment 1, unless otherwise recorded electronically.

6.15 Radiological Sampling

6.15.1 Samples (i.e., water, soil, etc.) shall be collected in accordance with the provisions of a site-specific sampling plan, or equivalent document.

6.15.2 A chain-of-custody record shall be initiated by the individual collecting or overseeing the collection of samples.

6.15.3 A copy of the chain-of-custody form shall accompany the samples throughout transportation and analyses.
6.15.4 Any break in custody or evidence of tampering shall be documented and may comprise the validity of the sample results.

6.15.5 Sample custody shall be assigned to one individual at a time in order to prevent confusion of responsibility.

6.15.6 Custody is maintained when:
   - 6.15.6.1 The sample is under direct surveillance by the assigned individual.
   - 6.15.6.2 The sample is maintained in a tamper-free or tamper-evident container.
   - 6.15.6.3 The sample is within a controlled-access facility.

6.15.7 Samples that are submitted to a radioanalytical laboratory should be accompanied by a “Request for Analysis” form used by the laboratory, if required.

6.15.8 The radioanalytical laboratory shall have written procedures that document the laboratory’s analytical capabilities for the request analysis and a QA/QC program which assures the validity of the analytical results.

6.16 Additional Guidance
   - 6.16.1 The RPM may use the references contained in Section 3.0 of this procedure as additional guidance to determine appropriate elements of the radiological monitoring program for specific client facilities or sites.

7.0 Records
   - 7.1 The RPM shall maintain records of surveys and calibrations required by this procedure, for three (3) years after the record is made.
   - 7.2 Records of the results of surveys, measurements, and calculations shall be maintained until the NRC terminates the license (if applicable) requiring the record if used to determine:
     - 7.2.1 External dose (i.e., DDE, shallow dose equivalent, lens (eye) dose equivalent, dose to extremities, etc.) from radiation sources external to the body;
     - 7.2.2 Internal dose (i.e., CEDE, CDE) from the intake of radioactive materials;
     - 7.2.3 The release of radioactive effluents to the environment;
     - 7.2.4 Compliance with the dose limit for members of the public.
   - 7.3 All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
## AVESI RADIOLOGICAL SURVEY REPORT

**SURVEY LOCATION:**

**PURPOSE OF SURVEY:**

| Instrument Type(s): (✓ if used) | Detector Area (cm²) | Serial Number: meter detector | Cal. Due Date: meter detector | Background: (CPM) | Efficiency (%)
|-------------------------------|---------------------|-------------------------------|-------------------------------|-------------------|-------------------|
| Ludlum 2221/43-10 ___         | N/A                 |                               |                               | Alpha (α) Beta (βγ) | Alpha (α) Beta (βγ)
| Ludlum 2360/43-89 ___         | 125                 |                               |                               |                   |                   |
| Ludlum 2221/44-9 ___          | 15.5                |                               |                               |                   |                   |
| Micro-R ___                   | N/A                 |                               |                               |                   |                   |

### Contamination Limits: (dpm/100cm²)

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<th>Sample No.</th>
<th>Description/ Location</th>
<th>Removable α</th>
<th>Removable βγ</th>
<th>Total α</th>
<th>Total βγ</th>
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<th>Sample No.</th>
<th>Description/ Location</th>
<th>Removable α</th>
<th>Removable βγ</th>
<th>Total α</th>
<th>Total βγ</th>
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**REMARKS:**

**TECHNICIAN(S) SIGNATURE/DATE:** __________________________ / ________________

**REVIEWER SIGNATURE/DATE:** /
## AVESI RADIOLOGICAL SURVEY REPORT (Supplement)

### SURVEY LOCATION:

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<th>dpm/100cm² α</th>
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<th>dpm/100cm² γ</th>
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### REMARKS:

TECHNICIAN(S) SIGNATURE/DATE: /

REVIEWER SIGNATURE/DATE: /
## AVESI RADIOLOGICAL SURVEY REPORT (Map)

<table>
<thead>
<tr>
<th>SURVEY LOCATION:</th>
<th>RWP:</th>
<th>Page of</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEGEND: (Fill in blank) _____ = Smear Location _____ = G/A Dose Rate □ mR/hr □ μR/hr</td>
<td>DATE:</td>
<td>TIME:</td>
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<tr>
<td>/</td>
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<tr>
<td>Instrument Type(s):</td>
<td>Serial Number:</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>(√ if used)</td>
<td>(meter/detector)</td>
</tr>
<tr>
<td>Ludlum 2221/44-10</td>
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REMARKS:

TECHNICIAN(S) SIGNATURE/DATE: ___________________________ / ________ ___________________________ / ________

REVIEWER SIGNATURE/DATE: ___________________________ / ________
RADIOLOGICAL SURVEY CALCULATIONS

Count-rate (Equation 1)

Net Counts Per Minute (NCPM) = GCPM – BCPM

GCPM = gross counts per minute
BCPM = background counts per minute

Activity (Equation 2)

\[
DPM = \frac{NCPM}{\varepsilon_i}
\]

NCPM = net counts per minute
\(\varepsilon_i\) = instrument efficiency (cd\(^{-1}\))

Activity - Direct Frisk (Equation 3)

\[
dpm/100 \text{ cm}^2 = \frac{NCPM}{\varepsilon_i \times DA} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2}
\]

where:
- Ludlum 43-93 probe area = 126 cm\(^2\)
- Ludlum 44-9 probe area = 15.5 cm\(^2\)
- Ludlum 43-89 probe area = 125 cm\(^2\)
- Ludlum 43-5 probe area = 76 cm\(^2\)

dpm = disintegrations per minute
\(\varepsilon_i\) = instrument efficiency (cd\(^{-1}\))
DA = detector area (cm\(^2\))
NCPM = net counts per minute

Counter Detection Limit (LD) – 95% confidence level, differing count/background count times (Equation 4)

\[
L_D = 3 + 3.29 \sqrt{\left(\frac{R_B}{T_S} + 1 + \frac{T_S}{T_B}\right)}
\]

\(L_D\) = \text{a priori} detection limit [minimum significant activity level]
\(R_B\) = background count rate (cpm)
\(T_B\) = background count time (minutes)
\(T_S\) = sample count time (minutes)

The detection limit, \(L_D\), is the \text{a priori} (before the fact) activity level that an instrument can be expected to detect 95% of the time. It is the smallest amount of activity that can be detected at a 95% confidence level. It should be used to calculate the minimum detection capability of an instrument.
Counter Detection Limit ($L_D$) – 95% confidence level, same count/background count times (Equation 5)

$$L_D = 3 + 4.65 \sqrt{R_B}$$

$L_D$ = *a priori* detection limit [minimum significant activity level]
$R_B$ = background counts

The detection limit, $L_D$, is the *a priori* (before the fact) activity level that an instrument can be expected to detect 95% of the time. It is the smallest amount of activity that can be detected at a 95% confidence level. It should be used to calculate the minimum detection capability of an instrument.

### Portable Counter (time count) Minimum Detectable Activity (MDA) (Equation 6)

$$MDA \text{ (dpm/100 cm}^2\text{)} = \frac{L_D}{DA[\varepsilon_i][\varepsilon_s][T]} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2}$$

$L_D$ = *a priori* detection limit [minimum significant activity level]
$DA$ = detector area (cm$^2$)
$\varepsilon_i$ = instrument efficiency (cd$^{-1}$)
$\varepsilon_s$ = surface efficiency (unitless)
$T$ = count time (minutes)

Notes: Surface efficiency is normally only used during a final status survey and is otherwise set to one (1).

### Bench Counter Smear Minimum Detectable Activity (MDA) (Equation 7)

$$\text{Smear MDA (dpm/100 cm}^2\text{)} = \frac{L_D}{(T)(\varepsilon_i)}$$

$L_D$ = *a priori* detection limit [minimum significant activity level]
$T$ = smear count time (minutes)
$\varepsilon_i$ = instrument efficiency (cd$^{-1}$)

Notes: Smear is assumed to have been wiped over a 100 cm$^2$ area on the item surveyed.
Frisker Scan Minimum Detectable Activity (MDA)  
(Equation 8)

The observable background counts (b) is defined as the number of background counts observed within the observation interval (i). The equation used for calculating b' is as follows:

\[ b = (BCPM) \times (i) \times (1 \text{ min/60 sec}) = \text{counts/interval} \]

BCPM = instrument background (or reference area background count rate for final status surveys)  
i = observation interval (seconds)

The minimum detectable number of net source counts in the interval is given by \( s_i \). Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance (d) as shown below:

\[ s_i = d \sqrt{b} \text{ (counts per observation interval)} \]

The MDCR is defined as the increase above background recognizable during a survey in a given period of time. The variable, d, is defined as the index of sensitivity and is dependent on the selected decision errors for Type I (alpha) and Type II (beta) errors. A true positive error (1-\( \beta \)) of 95% and a false positive error (alpha) of 60% may be selected to be consistent with NUREG 1507. The value of 1.38 was obtained from Table 6.1 in NUREG 1507 (Table 6.5 in MARSSIM).

\[ \text{MDCR (cpm)} = s_i \times (60/i) \]

Finally, the scan MDAs for surfaces may be calculated:

\[ \text{Scan MDA} = \frac{\text{MDCR}}{\sqrt{p} \ v_i \ v_s \ DA} \times \frac{100 \text{ cm}^2}{100 \text{ cm}^2} \]

where:

MCDR = minimum detectable count rate (cpm)  
\( v_i \) = instrument efficiency (cd\(^{-1}\))  
\( v_s \) = surface efficiency (unitless - normally only used for final status surveys)  
p = surveyor efficiency (unitless - normally assumed to be 50% (0.50))  
DA = detector area (cm\(^2\))
Air Sample Minimum Detectable Concentration (MDC)  
(Equation 9)  
\[
\text{Air Sample MDC (\(\mu\text{Ci/ml}\))} = \frac{L_D}{(T)(\epsilon_i)(\epsilon_c)(V)(2.22 \times 10^9)}
\]
where:
- \(L_D\) = \text{a priori detection limit [minimum significant activity level]}
- \(T\) = air sample count time (minutes)
- \(\epsilon_i\) = instrument efficiency (\(\text{cd}^{-1}\))
- \(\epsilon_c\) = collection efficiency (default to 0.99)
- \(V\) = sample volume (ml)
- 2.22E9 = conversion from dpm to \(\mu\text{Ci}\) and L to ml.

Air Sample Activity  
(Equation 10)  
\[
\text{Air Sample Activity (\(\mu\text{Ci/ml}\))} = \frac{(\text{NCPM})}{(\epsilon_i)(\epsilon_c)(V)(2.22 \times 10^9)}
\]
where:
- \(\text{NCPM}\) = Net counts per minute = Gross counts per minute – background counts per minute
- \(\epsilon_i\) = Instrument efficiency (\(\text{cd}^{-1}\))
- \(\epsilon_c\) = Collection efficiency (default value is 0.99)
- \(V\) = Sample volume (liters) [if converting from ft\(^3\), multiply ft\(^3\) by 28.3 to calculate liters]
- 2.22E9 = conversion from dpm to \(\mu\text{Ci}\) and L to ml.

DAC Fraction  
(Equation 11)  
\[
\text{DAC Fraction} = \frac{\text{Air Sample Activity (\(\mu\text{Ci/mL}\))}}{\text{Site (alpha or beta) DAC Value (\(\mu\text{Ci/mL}\))}}
\]
\(\text{DAC} = \text{derived air concentration}\)

DAC-hrs  
(Equation 12)  
\[
\text{DAC-hrs} = (\text{DAC Fraction}) \times (\# \text{hrs in monitored work area})
\]
Dose Equivalent
(Equation 13)

\[
CEDE = DAC - hrs \times 2.5 \frac{\text{mrem}}{DAC - hr}
\]

CEDE = committed effective dose equivalent (mrem)
DAC-hrs = derived air concentration hours
## AIR SAMPLE REPORT

### Section I

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<th>General Area</th>
<th>Work Area</th>
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<th>Sample Information</th>
<th>Time</th>
<th>Flow Rate (lpm)</th>
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</thead>
<tbody>
<tr>
<td>Date</td>
<td></td>
<td></td>
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<tr>
<td>Start</td>
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<tr>
<td>Stop</td>
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<tr>
<td>Total (minutes)</td>
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<th>(lpm) x (minutes) =</th>
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Sent to lab **after** a screen for final count ☐ (Section II required)  
Sent to lab **without** a screen for final count ☐ (Section II NOT required)

### Section II

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<tr>
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<tr>
<td>meter</td>
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| Count Information |

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<th>Units</th>
<th>1st Count</th>
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<th>3rd Count</th>
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<td>Count Time (e.g., noon, 1300, etc.)</td>
<td>Minutes</td>
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<td>Sample Count Time</td>
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<td>Sample Count Rate</td>
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<td>Background Count Rate</td>
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<tr>
<td>Volume of Air (Liters)</td>
<td>(A)</td>
<td>Liters</td>
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<tr>
<td>Net Count Rate (CPM)</td>
<td>(B)</td>
<td>CPM</td>
<td></td>
<td></td>
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<tr>
<td>Counter Efficiency</td>
<td>(C)</td>
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<td>Collection Efficiency</td>
<td>(D)</td>
<td>0.99</td>
<td>0.99</td>
<td>0.99</td>
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<tr>
<td>Efficiency = (C) x (D)</td>
<td>(E)</td>
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<tr>
<td>Activity (DPM) = (B) / (E)</td>
<td>(F)</td>
<td>DPM</td>
<td></td>
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<tr>
<td>Conc. = (F) / (2.22E9 x (A))</td>
<td>(G)</td>
<td>µCi/ml</td>
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<table>
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<tr>
<th>DAC/AE Fraction = (G) / (H)</th>
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<table>
<thead>
<tr>
<th>Final Count?</th>
<th>Yes / No</th>
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**Note:** DAC/AE fractions > 1.0 requires immediate RPM notification.

RPM Notified ☐

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<th>Date</th>
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<table>
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<tr>
<th>Reviewed By</th>
<th>Date</th>
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</table>
**DAC-HR TRACKING**

Site: ________________________  Air Sample Date/Time: ________________________  RWP: ________________________  Sample ID: ________________________

<table>
<thead>
<tr>
<th>NAME</th>
<th>HPID#</th>
<th>WORK AREA</th>
<th>TIME IN</th>
<th>TIME OUT</th>
<th>TOTAL TIME (HR)¹</th>
<th>Sample Results (µCi/mL)</th>
<th>Sample DAC (µCi/mL)</th>
<th>Corrected DAC Fraction²</th>
<th>DAC-hrs³</th>
<th>CEDE⁴ (mrem)</th>
<th>CALCULATED BY (INITIALS)</th>
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1 Total time is to be recorded in hours and fractions of hours (e.g. 1.5).

2 PF = 1 for no respirator; PF = 50 for Full Face Negative Pressure; PF = 2000 for a Supplied Air; PF = 10,000 for SCBA (see 10 CFR 20, Appendix A)
   Corrected DAC-Fraction = Sample Results/Sample DAC/PF

3 Calculate DAC-Hrs by multiplying the total time by the Corrected DAC Fraction.

4 Calculate CEDE by multiplying DAC-hrs by (2.5 mrem per DAC-hr).

Reviewed by RPM: ________________________  DATE: ________________________

If monitoring is required and ≥ 0.4 DAC-hrs calculated (i.e., 1 mrem), dose records updated by: ________________________  Date: ________________________
HEALTH PHYSICS PROCEDURE

AVESI HP-22

RADIOLOGICAL REPORTING

APPROVED BY: ________________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ________________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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LIST OF ATTACHMENTS

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2 PERSONNEL MONITORING INCIDENT REPORT ............................................ 10
3 RADIOLOGICAL INCIDENT AND DOSIMETRY DEFICIENCY REPORT LOG .... 11
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1.0 Purpose

The purpose of this procedure is to provide requirements and guidelines for identifying, documenting, and correcting radiological incidents such that continuous improvements and corrections are made to the radiation protection program.

2.0 Scope

This procedure applies to radiological and personnel monitoring incidents at all sites where work is performed under this AVESI radiation protection program.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”

3.2 49 CFR, “Transportation”

3.3 AVESI HP-01, “Radiation Protection Program”

3.4 AVESI HP-11, “Radiological Limits”

3.5 AVESI HP-31, “Radiological Instrumentation”

4.0 Definitions

4.1 **Radiological Incident** – a condition or occurrence that reduces the radiological safety provided to site personnel or the public, or indicates an adverse trend in radiation protection program performance. The following conditions or occurrences should be considered radiological incidents:

4.1.1 Occupational radiation exposures exceeding administrative exposure limits.

4.1.2 Unplanned intakes of radioactive material in excess of 10 % of an Annual Limit on Intake (ALI).

4.1.3 Unmonitored radiation exposure (i.e., exposure received without appropriate monitoring equipment) estimated to exceed 500 mrem Total Effective Dose Equivalent (TEDE), 1,500 mrem eye dose equivalent, 5,000 mrem Total Organ Dose Equivalent (TODE) or Shallow Dose Equivalent (SDE).

4.1.4 High radiation areas or very high radiation areas not properly controlled, posted, and guarded or locked, as required.

4.1.5 Uncontrolled radioactive material resulting in loose surface contamination exceeding the criteria established in AVESI HP-11, “Radiological Limits”.
4.1.6 Radioactive Spills – The uncontrolled release of radioactivity into the site environment. The material may be in liquid, solid or gaseous form and may vary considerably in volume or activity. The key element in identifying a spill is the “uncontrolled” nature of the release.

4.1.7 Improperly controlled sources of radioactive material outside the Restricted Area (RA), including loss or theft.

4.1.8 An issued “Stop Work Order,” due to unexpected or degrading radiological work conditions or unsafe radiological work practices.

4.1.9 Personnel contamination events resulting in calculated skin exposure exceeding 5,000 mrem.

4.1.10 Any reportable levels of radioactivity (per 10 CFR 20), found in the environment.

4.1.11 Any transportation accident resulting in the release of a Reportable Quantity (RQ) of radioactive material in accordance with 49 CFR 172.101, Table 1.

4.1.12 Any notification, as stated in this document, made to a regulatory agency.

4.1.13 As determined by the RPM, any condition or occurrence that exhibits significant radiological hazards consistent with the definition of radiological incidents, including:

4.1.13.1 Violations of Health and Safety Work Permit requirements, verbal RPM or HPT instructions, or radiation protection postings.

4.1.13.2 Unplanned generation of radioactive wastes or unnecessary contamination of radioactive wastes with other materials that complicates disposal (i.e., unplanned generation of mixed waste).

4.1.13.3 Airborne radioactive material areas, contaminated areas, radioactive material storage areas or radiation areas that are not properly posted and controlled.

4.2 **Immediate Actions** – Those actions taken to halt the progress of a Radiological Incident and recover normal or stable radiological conditions.

4.3 **Root Cause** – Those underlying factors that contribute to the occurrence of a Radiological Incident. This may include factors such as poor equipment or site design, inadequate training, inadequate procedures, failure to follow work instructions, inadequate knowledge or experience, and inadequate supervision.
4.4 **Tracking Log** – Classification of radiological incidents into groups relating to radiation protection program performance areas. Results are used to track program performance and identify program weaknesses.

5.0 Responsibilities

5.1 The RPM shall:

5.1.1 Make timely notifications of radiological incidents in accordance with federal, state, local and client requirements.

5.1.2 Determine causal factors of radiological incidents, and implement corrective actions to prevent reoccurrence.

5.1.3 Notify the Radiation Safety Officer (RSO) of any radiological or personnel monitoring incident reports that are initiated in accordance with this procedure.

5.2 Health Physics Technicians shall:

5.2.1 Notify the RPM of any condition that requires a radiological or monitoring report as described in this procedure.

5.2.2 Take immediate actions to establish safe radiological conditions during a radiological incident.

6.0 Procedure

6.1 Any radiological incident that could have a potentially adverse effect on the site, the health and safety of the staff or public, or require written notification to a regulatory agency must be promptly documented.

6.2 Any radiation monitoring equipment related problems that may render the quality of the equipment or collected data unacceptable or indeterminate must be promptly documented using the guidance provided in AVESI HP-31, “Radiological Instrumentation”.

6.3 Personnel monitoring incidents, including lost dosimeters and unusual or elevated monitoring results, shall be investigated and documented on Attachment 2, “Personnel Monitoring Incident Report”. Each monitoring incident shall have the next RIR number assigned in sequence, and shall be documented on Attachment 3, “Radiological And Dosimetry Incident Tracking Log”.

6.4 When unsafe radiological conditions are identified, HPTs shall take whatever immediate corrective actions are necessary to establish safe radiological conditions. In the course of implementing immediate corrective actions, every effort should be made to collect pertinent information to document and
reconstruct the event. However, restoring safe radiological conditions is the highest priority.

6.5 A Radiological Incident Report (RIR) shall be generated whenever a condition described in Section 4.1 is present.

6.5.1 As soon as practicable after any immediate corrective actions are complete, initiate a RIR by completing Sections I and II of Attachment 1, entering the appropriate information in the log (Attachment 3) and assigning the next RIR number in sequence.

6.5.2 The RPM shall review Attachment 1 to establish whether a formal root cause assessment is necessary and either signify concurrence by signature or make changes and return the report to the appropriate personnel. Once the assessments or actions are determined, assign completion date(s) and responsible individual(s), and document in Section III. Each assigned action shall be transmitted to the assigned individual accompanied by a copy of Attachment 1.

<table>
<thead>
<tr>
<th>NOTE:</th>
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<tbody>
<tr>
<td>“Due Dates” will be determined to allow completion of the Radiological Incident Report within 30 days for reports requiring notification of appropriate authorities or regulatory agencies.</td>
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</tbody>
</table>

6.5.3 When all corrective actions have been satisfactorily completed, the RPM shall review the completed RIR and update Attachments 1, 2, and 3 as appropriate.

6.5.4 RIRs shall be tracked utilizing Attachment 3. The tracking should include an assessment of repetitive incidents, effectiveness of corrective actions, and general trends in the quality of the radiation protection program.

6.6 The RPM shall, upon discovery, immediately report to the Project Manager and RSO any event involving any source of radiation possessed by the site that may have caused or threatens to cause any of the conditions stated in Section 6.6.1 or 6.6.2 of this procedure. The RPM and/or Project Manager shall immediately notify the client representative, and the AVESI Corporate Environmental Health and Safety (EH&S) Manager. Reports to the appropriate authorities and/or regulatory agencies shall remain the responsibility of the client representative. Note that the NRC requires immediate notification for this type of event. Information on the appropriate notifications is contained in Attachment 4.

6.6.1 An individual to receive:

6.6.1.1 A total effective dose equivalent of 25 rems (0.25 Sv) or more;

6.6.1.2 An eye dose equivalent of 75 rems (0.75 Sv) or more; or
6.6.1.3 A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more;

6.6.2 The release of radioactive material so that, if an individual were present for 24 hours, the individual could receive an intake five times the occupational annual limit on intake. This paragraph does not apply to locations where personnel are not normally stationed during routine operations.

6.7 The RPM shall immediately report to the Project Manager and RSO the discovery of any event involving loss of control of a source of radiation possessed by the site that may have caused or threatens to cause any of the conditions stated in Section 6.7.1 or 6.7.2 of this procedure. The RPM and/or Project Manager shall immediately notify the client representative, and the AVESI Corporate EH&S Manager. Reports to the appropriate authority and/or regulatory agencies shall remain the responsibility of the client representative. Note that the NRC requires notification within 24 hours for this type of event.

6.7.1 An individual to receive, in a period of 24 hours:

6.7.1.1 A total effective dose equivalent exceeding 5 rems (0.05 Sv);

6.7.1.2 An eye dose equivalent exceeding 15 rems (0.15 Sv); or

6.7.1.3 A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv).

6.7.2 The release of radioactive material so that if an individual were present for 24 hours, the individual could receive an intake greater than one occupational annual limit on intake. This paragraph does not apply to locations where personnel are not normally stationed during routine operations.

6.8 Reports filed with the appropriate authority or regulatory agency shall list for each individual exposed: the name, Social Security number, and date of birth. The report shall be prepared so that this information is stated in a separate and detachable section.

6.9 Reports of Theft or Loss of Licensed Material

6.9.1 When it becomes known that any lost, stolen or missing radioactive material in an aggregate quantity equal to or greater than 1000 times the quantity specified in Appendix C of 10 CFR 20, and it appears an exposure could result to persons in unrestricted areas; the RPM shall immediately notify the Project Manager and RSO. The RPM and/or Project Manager shall immediately notify the client representative, and the AVESI Corporate EH&S Manager. Reports to the appropriate authority
and/or regulatory agencies shall remain the responsibility of the client representative. Note that the NRC requires immediate telephone notification of this type of event.

6.9.2 When it becomes known that any radioactive material is lost, stolen or missing in a quantity greater than 10 times the quantity specified in Appendix C of 10 CFR 20, the RPM shall report the occurrence to the Project Manager and RSO. The RPM and/or Project Manager shall immediately notify the client representative, and the AVESI Corporate EH&S Manager. Reports to the appropriate authority and/or regulatory agencies shall remain the responsibility of the client representative. Note that the NRC requires telephone notification of this type of event within 30 days.

6.10 Written Reports

6.10.1 Should the RPM be required to make an immediate telephone report, within 30 days the RPM shall make a written report setting forth the following information:

6.10.1.1 A description of the radioactive material involved, including kind, quantity and chemical and physical form;

6.10.1.2 A description of the cause and circumstances under which the loss, theft or misplacement occurred;

6.10.1.3 A statement of disposition, or probable disposition, of the radioactive material involved;

6.10.1.4 Exposures of individuals to radiation and the circumstances under which the exposures occurred;

6.10.1.5 The possible total effective dose equivalent to persons in unrestricted areas;

6.10.1.6 Actions that have been taken, or will be taken, to recover the material including a schedule to achieve conformance with applicable limits, environmental standards, or license conditions; and

6.10.1.7 Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss, theft or misplacement of radioactive material.

6.10.2 If after filing the written report, the RPM learns of additional substantive information, such additional information shall be reported within 30 days.
6.10.3 Each report filed shall list for each individual exposed: the name, Social Security number, and date of birth. The report shall be prepared so that this information is stated in a separate and detachable part.

6.10.4 Additional Reports

6.10.4.1 The RPM shall submit a written report within 30 days after any of the following occurrences:

(a) Any incident for which notification is required or any planned special exposure.

(b) Doses in excess of any of the following:
   1. The occupational dose limits for adults
   2. The occupational dose limits for minors
   3. The limits for an embryo/fetus of a declared pregnant woman
   4. The limits for an individual member of the public; or
   5. Any applicable limit in a license.

(c) Levels of radiation or concentrations of radioactive material in:
   1. A restricted area in excess of any applicable limit in the license or registration; or
   2. An unrestricted area in excess of 10 times any limit set forth in the standard or the license; whether or not there is exposure of any individual in excess of the limits.

(d) Levels of radiation or releases of radioactive material exceeding EPA’s generally applicable environmental standards in 40 CFR 190, or license conditions.

6.10.4.2 Contents of reports.

(a) Each report shall describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:
   1. Estimates of each individual’s dose;
   2. The levels of radiation and concentrations of radioactive material involved;
3. The cause of the elevated exposures, dose rates or concentrations; and

4. Corrective steps taken or planned to ensure against a recurrence. These should include the schedule for achieving compliance with limits, generally applicable environmental standards, and license conditions.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
RADIOLOGICAL INCIDENT REPORT

RIR No.: ______________

SECTION I: INCIDENT IDENTIFICATION  (Attach additional sheets, as required)

Date of Incident: __________ Time of Incident: __________ RWP No.: __________
Client: ______________________ Site: ______________________
Specific Location: ______________________
Personnel Present (Name, HPID No.): ______________________

Description of Incident: ______________________

Initiated by: ______________________ Date: __________ Time: __________
RPM or designee

SECTION II: IMMEDIATE CORRECTIVE ACTION

Description: ______________________

Notification Required: Yes ☐ No ☐
RPM Signature: ______________________ Date: __________

SECTION III: ADDITIONAL CORRECTIVE ACTION

Additional Corrective Action Required:
Yes ☐ No ☐

If Yes, Action Required: ______________________
Signature: ______________________ Date: __________
RPM

Additional Corrective Action Assigned To: Individual ______________________ Date: __________
Additional Corrective Action Complete: Individual ______________________ Date: __________
Completion Verified by: RPM ______________________ Date: __________
Closure: ______________________ Date: __________
RPM
## PERSONNEL MONITORING INCIDENT REPORT

### External
- [ ] Lost dosimeter
- [ ] Unexpected dosimeter result
- [ ] Elevated dosimeter result
- [ ] Other: _______________________________

### Internal
- [ ] Lost bioassay sample
- [ ] Unexpected bioassay result
- [ ] Elevated bioassay result
- [ ] Other: _______________________________

**Initial findings and suspected cause:**

**Actions taken / calculation to verify exposure:**

**Will this result in a change to the permanent exposure record?**
- [ ] yes  _______mrem  [ ] no

**Is this a reportable occurrence?**
- [ ] yes  [ ] no

**Comments:**

**Completed by: _______________________________  Date: _____________**

**Approved By (RPM)_______________________________  Date: _____________**
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<th>CLOSURE DATE</th>
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### AVESI NOTIFICATION INFORMATION

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Telephone Number/Pager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate EH&amp;S Manager</td>
<td>Gary Waggoner</td>
<td>(619) 535-4355</td>
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### NUCLEAR REGULATORY COMMISSION INFORMATION

<table>
<thead>
<tr>
<th>Region</th>
<th>Address</th>
<th>Telephone (24 hour)</th>
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<tr>
<td>Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.</td>
<td>USNRC, Region I, 475 Allendale Road, King of Prussia, PA 19406</td>
<td>(610) 337-5000 (FTS) 346-5000</td>
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<tr>
<td>Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.</td>
<td>USNRC, Region II, Atlanta Federal Center, 61 Forsyth Street, SW., Suite 23T85, Atlanta, GA 30303</td>
<td>(404) 562-4400 (FTS) 841-4503</td>
</tr>
<tr>
<td>Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.</td>
<td>USNRC, Region III, 799 Roosevelt Road, Glen Ellyn, IL 60137</td>
<td>(708) 790-5500 (FTS) 388-5500</td>
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### UNITED STATES ARMY CORPS OF ENGINEERS RADIATION SAFETY POINTS OF CONTACT

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<th>Telephone Number/Pager</th>
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</table>
HEALTH PHYSICS PROCEDURE

AVESI HP-23

HEALTH PHYSICS OVERSIGHT

APPROVED BY: __________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: __________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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# LIST OF ATTACHMENTS

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1.0 Purpose
This procedure establishes guidelines and requirements for health physics (HP) oversight, including: restricted area requirements, job coverage, stop-work, release surveys, and routine surveillance.

2.0 Scope
This procedure applies to HP oversight at sites working under this radiation protection program. At sites controlled by others, the provisions of their HP program may apply.

3.0 References
3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 AVESI HP-01, “Radiation Protection Program”
3.3 AVESI HP-11, “Radiological Limits”
3.4 AVESI HP-15, “Respiratory Protection”
3.5 AVESI HP-27, “Personnel and Equipment Decontamination”
3.6 AVESI HP-21, “Radiological Monitoring”
3.7 AVESI HP-24, “Radiological Posting and Labeling”
3.8 AVESI HP-22, “Radiological Reporting”

4.0 Definitions
4.1 **Airborne Radioactivity Area** – a room, enclosure, or area in which airborne radioactive materials exist in concentrations:
   4.1.1 In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20, or
   4.1.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

4.2 **Contamination** - The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site surficial release limits. Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable". Total Contamination refers to fixed plus removable contamination.

4.3 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site specific contamination limits as documented on Attachment 2 of AVESI HP-11, “Radiological Limits” or other site specific documentation (i.e., Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), etc.).

4.4 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.
4.5 **High Radiation Area** – Any area accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

4.6 **Hot Spot** – A source of radiation emanating from equipment or components that is greater than 50 mrem/hr on contact and of a significantly higher (factor of three) radiation level than the surrounding general area, where it is likely personnel could receive exposure higher than expected while in the area. Post as a “HOT SPOT” with additional information concerning the area and applicable dose rates.

4.7 **HPT Coverage** – The assistance provided by HPTs for the purpose of keeping radiation exposure ALARA, preventing the spread of contamination and airborne radioactive material hazards, and monitoring the general work area.

4.7.1 Continuous Coverage - HPTs providing continuous coverage are in the area to monitor radiological conditions during performance of the task and are available to direct or stop work activities as conditions warrant. Line-of-sight coverage is not required (e.g., HPTs may leave the immediate work area to count smears or air samples).

4.7.2 Intermittent Coverage - The assignment of an HPT to one or more jobs, such that HP coverage is periodic. HPTs providing intermittent coverage are aware of the worker’s presence in the work area, but radiological conditions do not require continuous communication with the workers.

4.8 **Loose surface contamination (Removable)** - Radioactive material easily transferred by normal handling and contact.

4.9 **Radiation Area** – Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or any surface that the radiation penetrates.

4.10 **Radioactive Material Area (RMA)** – an area or room in which there is used or stored an amount of radioactive material exceeding 10 times the quantity of such material specified in Appendix C to 10 CFR 20.

Note: If a combination of materials is present (i.e., a combination of uranium and $^{60}$Co), the following relationship must be used to determine if the area must be posted as an RMA:

$$\frac{\mu C_{iCo}}{10Q_{Co}} + \frac{\mu C_{iU}}{10Q_{U}} \leq 10$$

where $Q$ = the quantity shown in Appendix C of 10 CFR 20.

4.11 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled.
4.12 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.13 **Stop Work Authority** – The authority provided to HPTs and radiological workers to immediately stop work for the following reasons:

4.13.1 If conditions develop that were not anticipated which would result in a significant increase in radiological or industrial safety hazards.

4.13.2 The conditions on the job have degraded to the point that the work is not being performed consistent with the ALARA concept.

4.13.3 The potential for deterioration of occupational safety exists if the job is continued.

4.13.4 The work practices may result in violation of regulatory requirements or HP procedures.

4.14 **Unrestricted Area** - Any area to which access is neither limited nor controlled.

4.15 **Unconditional (Unrestricted) Release** - Equipment, components, materials, land areas (property), and other items that may be used, transferred, sold, or disposed of without regard for their radiological constituents.

4.16 **Very High Radiation Area** – Area accessible to individuals in which the radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter (m) from the source or any surface that the radiation penetrates.

4.17 **Volumetric material** – Material that takes the shape of its container, such as; water, sand, or soil.

5.0 **Responsibilities**

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Verify compliance with this procedure during planned and periodic audits of the radiation protection program.

5.1.2 Shut-down or prevent a task or project from starting if the task/project may violate requirements for radiological protection, and specify the actions that are necessary to continue work and lift the stop-work order.

5.1.3 Specify job coverage requirements on a Site Safety and Health Plan, Work Plan, RWP, or equivalent.

5.1.4 Ensure that radiological workers are trained on restricted area requirements.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Shut-down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.

5.2.2 Perform job coverage, release surveys, and routine surveillance in accordance with the requirements of this procedure.
5.2.3 Initiate stop-work orders in accordance with the provisions of this procedure.

5.3 Radiological workers shall:

5.3.1 Comply with the requirements in Attachment 1, “Radworker Restricted Area Requirements”.

5.3.2 Shut-down or prevent a task from starting if the task may violate regulatory requirements for radiological protection.

6.0 Procedure

6.1 General Requirements

6.1.1 Radiation and contamination surveys shall be performed in accordance with AVESI HP-11, “Radiological Monitoring”.

6.1.2 Airborne radioactivity surveys shall be performed in accordance with AVESI HP-11, “Radiological Monitoring”.

6.1.3 Survey results shall be compared against the criteria specified in AVESI HP-11, “Radiological Limits”.

6.1.4 Respiratory protection shall be considered and used in accordance with the provisions of AVESI HP-15, “Respiratory Protection”.

6.2 Restricted Area Requirements

6.2.1 Prior to allowing unescorted access into the Restricted Area, personnel are required to successfully complete Site Orientation Training and Radiation Worker Training (RWT) in accordance with AVESI HP-16, “Qualifications and Training”. The RPM may permit an individual access to the RESTRICTED AREA without this training, provided the individual is accompanied by a qualified escort and a waiver form has been completed and signed by the RPM, or designee.

6.2.2 No entry is permitted into the Restricted Area without sufficient cause for the entry (i.e., no “sightseeing” in contamination, airborne radioactivity, radiation or high radiation areas).

6.2.3 Individuals with accumulated exposure > 70% of allowable administrative exposure limits will be restricted from entry into High Radiation Areas.

6.2.4 Approval by the RSO and/or an extension of the administrative dose limit is required for individuals with accumulated exposure > 70% of allowable administrative exposure limits.

6.2.5 Individuals shall follow Restricted Area requirements in accordance with Attachment 1, while working in Restricted Areas.

6.3 Job Coverage

6.3.1 Job specific surveys shall be performed as frequently as necessary to document the level of radiological hazards in the work area.
6.3.2 Continuous coverage shall be provided for all entries into High Radiation Areas or Airborne Radioactivity Areas, and for work that may cause a significant change to radiological conditions.

6.3.3 Intermittent coverage shall be provided for entries into Restricted Areas with little, or no potential to change radiological conditions.

6.4 High Radiation Areas (HRA) and Very High Radiation Areas (VHRA)

6.4.1 HRAs and VHRAs shall be conspicuously posted and barricaded in accordance with 10 CFR 20.

6.4.2 Entryways to HRAs and VHRAs should be locked, except during periods when access to the areas is required. Positive controls shall be maintained during each entry into a HRA.

6.4.3 When conditions are impractical for barricading or locking, such as limited evolution jobs or temporary storage, flashing lights (normally red) are utilized with the HRA and VHRA postings to alert the individual to potential entry into a HRA or VHRA.

6.4.4 Direct surveillance, to prevent unauthorized entry, may be substituted for locked areas or flashing lights for temporary HRAs or VHRAs.

6.4.5 Personnel entering a HRA or VHRA shall have one or more of the following:

6.4.5.1 A radiation monitoring device which continuously indicates the radiation exposure rate in the area.

6.4.5.2 A radiation monitoring device which continuously integrates the radiation exposure rate in the area and alarms when a preset integrated dose is received. Entry into such areas with this monitoring device may be made after the exposure rate level in the area has been established and personnel have been made knowledgeable of them.

6.4.5.3 A HPT with a radiation exposure rate monitoring device, and who is responsible for providing positive control over the activities within the area.

6.4.6 In addition to the requirements for entry into HRAs, the following requirements shall apply for entry into VHRA:

6.4.6.1 Areas are posted as Very High Radiation Areas if dose rates could exceed 500 rads in 1 hour at 1 meter from any source.

6.4.6.2 The RPM shall institute the controls necessary (in addition to the controls above) to ensure that an individual is not able to gain unauthorized access to VHRAs in which radiation levels could be encountered at 500 rads or more in one hour at 1 meter from a radiation source or any surface through which the radiation penetrates.
6.5 Stop Work

6.5.1 All HPTs and other radiological workers shall have the responsibility and authority to initiate a stop-work order.

6.5.2 If radiological conditions exceed expected levels to an extent where additional protection measures may be required, HPTs shall initiate a stop-work order and notify the RPM.

6.5.3 Once aware of known or suspected unsafe work conditions, the individual shall assess the situation and, as necessary, issue a stop-work order. The RPM shall be notified immediately.

6.5.4 Specific work activities shall be permitted to proceed to a safe condition after issuance of the stop-work order. The RPM, or designee should supervise specific work activities as they proceed to a safe shut down.

6.5.5 Stop Work orders shall be documented in accordance with AVESI HP-22, “Radiological Reporting”.

6.6 Personnel Release Surveys

6.6.1 A personnel release survey (frisk with a handheld radiological survey instrument) is required upon exit from any potentially contaminated area as determined by the RPM, or designee.

6.6.2 Radiological workers may perform personnel frisks unless otherwise specified on the task specific RWP.

6.6.3 A whole-body frisk should take approximately 2 - 3 minutes, and include the: head, neck, chest, abdomen, shoulders, arms, back, hips, seat of pants, legs, shoe tops, shoe bottoms, personnel dosimetry, and hard-hat, as applicable.

6.6.4 When an increased instrument count rate is detected above the background count rate, the surveyor shall pause over the suspect area for a time sufficient to allow the instrument response to stabilize.

6.6.5 If personnel skin or clothing contamination above background is confirmed, personnel decontamination shall be performed and documented in accordance with AVESI HP-27, “Personnel and Equipment Decontamination”.

6.7 Surficial Material and Equipment Release Surveys

6.7.1 Material and equipment that may be unconditionally released include; sampling equipment, PPE, monitoring equipment, or any other solid item.

6.7.2 When surveying materials, consideration must be made for the chemical hazards associated with the material. If the material is radiologically clean but has a chemical hazard, the site Project Manager must be contacted for correct disposition of the material.

6.7.3 Clients may restrict the release of selected materials, such as PPE. Verify release restrictions in site work plans or safety and health plans prior to releasing an item for unrestricted use.
6.7.4 A surficial total and removable contamination survey must be performed prior to unconditional release.

6.7.5 Only Health Physics personnel may perform material or equipment release surveys.

6.7.6 Surveys should be concentrated on locations most likely to be contaminated. However, the entire item shall be surveyed for total contamination by direct frisk of accessible surfaces, unless documented otherwise by the RPM.

6.7.7 Materials with inaccessible surfaces should be evaluated for release on a case-by-case basis. Factors to be considered are; the removable contamination activity of the work area, the likelihood of internal contamination based on the function of the item, or whether disassembly of the item is practical.

6.7.8 Release survey results shall be compared to the surficial contamination limits provided by the RPM on Attachment 2 of AVESI HP-11, “Radiological Limits”.

6.8 Material Conditional Release Surveys

6.8.1 At no time shall materials/items conditionally released from the Restricted Area be removed from the site without approval of the RPM.

6.8.2 Radioactive materials (i.e., calibration sources, samples, etc.) that do not meet the requirements for unrestricted release may need to be removed from the Restricted Area for use in instrument performance tests, sample analysis, or other program needs. These items may be removed from the Restricted Area in accordance with the following requirements:

6.8.2.1 Radioactive source standards must be under continuous control of HPTs.

6.8.2.2 Radioactive material, other than source standards, shall be placed in closed containers with the exterior of the container meeting the unconditional release limits for removable contamination. The container will also have the appropriate labels or stickers in accordance with 10 CFR 20.

6.8.2.3 Packages of radioactive material offered for transport in accordance with 49 CFR shall meet the removable contamination limits.

6.9 Vehicle Release Surveys

6.9.1 Vehicles shall be surveyed for removable and total contamination prior to release from the RESTRICTED AREA.

6.9.2 Only Health Physics personnel may perform vehicle release surveys.

6.9.3 During the release survey, consideration should be given for surfaces most likely to be contaminated, such as the; wheels/tires, floorboard, steering wheel, or areas where radioactive material may have been transported.
6.9.4 Surfaces shall be reasonably free of material that will prohibit the detection of radioactivity, such as mud.

6.9.5 Vehicle identifying information, such as license plate number, rental agency, or company name, should be noted on the survey form.

6.10 Volumetric Material Release Surveys

6.10.1 A surficial survey may not be representative of volumetric material radioactivity; HPTs shall contact the RPM for release requirements. At no time shall volumetric material (or an item known or suspected to be volumetrically contaminated) be released from the site without approval of the RPM.

6.10.2 Sampling shall be performed to determine volumetric material activity, as directed by the RPM, or designee. The RPM, or designee shall compare the concentration of radionuclides in the material with appropriate volumetric release limits with concurrence of the project client.

6.10.3 An unopened container of volumetric material, such as a bag of sand, may be released using standard survey techniques.

6.10.4 Materials and equipment requiring volumetric release surveys may also require surficial release surveys, as determined by the RPM, or designee.

6.11 Routine Surveillance

6.11.1 At projects/sites controlled by this radiation protection program with an expected duration longer than three months, the RPM shall specify the frequency of routine surveys by completion of Attachment 2, “Routine Surveillance Frequency”.

6.11.2 Routinely accessed Restricted Areas shall be routinely surveyed at the frequencies specified by the RPM. Survey frequencies should be based on the likelihood of changing radiological conditions. Types of routine surveys may include; removable contamination surveys, total contamination surveys, radiation surveys, and/or airborne radioactive material surveys.

6.11.3 HRAs and VHRAs do not require routine surveillance. Surveys in posted HRAs and VHRAs should be conducted as appropriate when access is required into the area to verify the magnitude and extent of potential radiological hazards in the area. Pre-entry surveys should cover areas that are planned to be accessed by personnel, at a minimum.

6.11.4 When performing a routine surveillance survey, the area and type of work in the area should be considered, specifically:

6.11.4.1 Office areas should routinely have desktops and door handles smeared because those and similar areas are the most likely areas where contamination would be spread.
6.11.4.2 Work areas should routinely have hand tools, control panels or other items frequently handled smeared because these areas are most likely to become contaminated.

6.11.4.3 Consideration should be given to all likely areas where contamination may have been spread not just those areas where personnel walk.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
Radworker Restricted Area Requirements

Prior to entry into a Restricted Area:

1. Pick up your TLD and SRD (if required) from the issue point.

2. Log in, if required by the RWP, by filling out the sign-in sheet and proceed to the Restricted Area. If respiratory protection is required, use the code at the bottom of the sheet to indicate the type of respirator you are using. Accurately account for time and radiation exposure in the Restricted Area.

3. Properly don PPE in accordance with training instructions, HPT instructions, or posted instructions, as applicable.

4. Remove all external packaging if bringing materials and equipment into the Restricted Area to minimize generation of radioactive waste.

5. Take only the tools and materials actually needed for the work; limit the amount of materials in the area.

6. Report the presence of treated or open wounds to the HPT covering the activity.

While in the Restricted Area:

7. Utilize the appropriate container for all potentially non-radioactive trash generated outside of a Contaminated Area. Ensure protective clothing, respirators and radwaste are placed in the proper containers.

8. While working in Contamination Areas keep your hands away from your face and use caution not to splash or cause a spill while handling liquids.

9. Do not sweep with standard brooms in a Restricted Area. Masslinn mops are the only approved “sweeping” means. All vacuum cleaners used in the Restricted Area should be HEPA filtered vacuums.

10. Ensure that the HPT covering the activity is contacted before entry is made to any normally inaccessible area.

11. Notify the HPT covering the activity prior to entry into any Airborne Radioactivity Area or HRA.

12. Notify the HPT covering the activity for any changes to the job scope, prior to air tool usage in Contamination Areas and any radiological deficiency (e.g., postings missing or defaced, barriers down or damaged).

13. DO NOT move or remove postings, barriers, shielding or equipment unless directed to do so by a Senior HPT, Health Physicist, or the RPM.
14. Follow all HPT instructions and HP procedures. Promptly obey "stop work" and "evacuate" instructions issued by the HPT covering the activity.

15. DO NOT smoke, chew, eat, or drink or bring smoking, eating, chewing, or drinking materials into the Restricted Area.

16. Properly doff PPE, and perform an appropriate body frisk (as required by the RWP or HPT instruction) when leaving a Contamination Area.

17. Minimize the spread of a known or a potential radioactivity spill, and notify the HPT covering the activity.

18. Avoid unnecessary contact with contaminated surfaces, including your clothing (if contaminated), tools and other equipment.

19. Keep your radiation and hazardous material exposure ALARA, including leaving Radiation Areas or Airborne Radioactivity Areas when not working.

20. Exit the area promptly if a wound occurs, or any injury is received, and notify the HPT covering the activity.

21. Maintain good housekeeping practices to minimize the spread of contamination.

22. If utilizing a self reading dosimeter:
   - And the dosimeter reads greater than 1/2 full scale, have a HPT re-zero the dosimeter prior to entering the Restricted Area.
   - If a dosimeter reads 3/4 full scale or greater while working in the Restricted Area, exit the area and have an HPT document exposure and re-zero the dosimeter.
   - Notify the HPT covering the activity immediately anytime a self-reading dosimeter reads off-scale, is dropped, or is lost.
   - Keep track of your own radiation dose.
   - Notify the HPT covering the activity of any unexpected exposures received (e.g., receiving high exposures in low exposure areas).
   - Do not exceed your remaining allowable exposure.

Upon Exit from the Restricted Area:

23. Perform an appropriate body frisk as required by the RWP, posted instructions, or HPT instructions.

24. Sign out of the RWP (as required), and return your dosimetry to the issue point.
**ROUTINE SURVEILLANCE FREQUENCY**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Location/Description</th>
<th>Radiation Survey(^1)</th>
<th>Contamination Survey(^2)</th>
<th>Air Sample(^3)</th>
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\(^1\) List the requirement such as general area and/or on-contact radiation survey.

\(^2\) List the requirement such as total and/or removable contamination survey.

\(^3\) List the requirement such as breathing zone (occupational), work area (occupational), general area (occupational), and/or perimeter (non-occupational) air samples.
HEALTH PHYSICS PROCEDURE

AVESI HP-24

RADIOLOGICAL POSTING AND LABELING

APPROVED BY: ______________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ______________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose
This procedure establishes guidelines and requirements for radiological postings and labels.

2.0 Scope
This procedure applies to all radiological areas at sites working under this AVESI radiation protection program.

This procedure is based primarily upon the requirements set forth in 10 CFR 20. Sites other than those regulated by the Nuclear Regulatory Commission (NRC) may require establishment of guidelines and requirements for radiological postings differing from those set forth in this procedure (i.e., 10 CFR 835). AVESI will document these differences and establish guidelines and requirements for radiological postings in the Site Safety and Health Plan (SSHP) or other appropriate document for that site, as applicable.

3.0 References
3.1 10 CFR 19, “Notices, Instructions and Reports for Workers; Inspection and Investigations”
3.2 10 CFR 20, “Standards for Protection Against Radiation”
3.3 DOE-STD-1098-2008, “Radiological Control Standard”
3.4 AVESI HP-01, “Radiation Protection Program”
3.5 AVESI HP-11, “Radiological Limits”

4.0 Definitions

4.1 **Airborne Radioactivity Area** – a room, enclosure, or area in which airborne radioactive materials exist in concentrations:

4.1.1 In excess of the derived air concentrations (DACs) specified in Appendix B, to 10 CFR 20, or

4.1.2 To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

Posting requirement: “CAUTION - AIRBORNE RADIOACTIVITY AREA” or “DANGER – AIRBORNE RADIOACTIVITY AREA”.

4.2 **Contamination Area** – Any area with total and/or smearable (removable) contamination levels greater than site specific contamination limits as documented on Attachment 2 of AVESI HP-11, “Radiological Limits” or other site specific documentation (i.e., Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), etc.). Post as: “CONTAMINATION AREA”.

4.3 **Controlled Area** – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.
4.4 **High Radiation Area** – Any area accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates. Posting requirement: “CAUTION – HIGH RADIATION AREA” or “DANGER – HIGH RADIATION AREA”.

4.5 **Hot Spot** – A source of radiation emanating from equipment or components that is greater than 50 mrem/hr on contact and of a significantly higher (factor of three) radiation level than the surrounding general area, where it is likely personnel could receive exposure higher than expected while in the area. Post as a “HOT SPOT” with additional information concerning the area and applicable dose rates.

4.6 **Radiation Area** – Any area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the radiation source or any surface that the radiation penetrates. Posting requirement: “CAUTION – RADIATION AREA”.

4.7 **Radioactive Material Area** – Any area, room or enclosure within a Restricted Area where radioactive material is present, handled or stored in quantities exceeding 10 times the quantity in appendix C of 10 CFR 20. Posting requirement: “CAUTION – RADIOACTIVE MATERIAL(S)” or “DANGER – RADIOACTIVE MATERIAL(S)”.

Note: If a combination of materials is present (i.e., a combination of uranium and \( ^{60}\text{Co} \)), the following relationship must be used to determine if the area must be posted as an RMA:

\[
\frac{\mu Q_{\text{Ci}}}{10Q_{\text{Co}}} + \frac{\mu Q_{\text{U}}}{10Q_{\text{U}}} \leq 10
\]

where \( Q \) = the quantity shown in Appendix C of 10 CFR 20.

4.8 **Radioactive Material Storage Area (RMSA)** – An administratively designated area where radioactive material is stored and controlled. Post as “RADIOACTIVE MATERIAL STORAGE AREA”.

4.9 **Restricted Area** – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Post as: “RESTRICTED AREA”.

4.10 **Very High Radiation Area** – Area accessible to individuals in which the radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter (m) from the source or any surface that the radiation penetrates. Posting requirement: “GRAVE DANGER - VERY HIGH RADIATION AREA”.

5.0 **Responsibilities**

5.1 The Radiation Protection Manager (RPM) shall:
5.1.1 Ensure radiological areas are established based upon current radiological conditions.
5.1.2 Ensure posting requirements are met prior to approval of all Health and Safety Work Permits.
5.1.3 Remove postings and labels used to identify radiation hazards when the conditions that required their use no longer exist.

5.2 Health Physics Technicians (HPTs) shall:
5.2.1 Post areas in accordance with the requirements of this procedure.

6.0 Procedure
6.1 Posting and Labeling Requirements
6.1.1 Radiological area posting/labeling requirements shall be as described in 10 CFR 20, Subpart J.
6.1.2 Any area, room, or enclosure under this programs control that meets the definitions described in Section 4.0 shall be posted as described in the definition.
6.1.3 Areas or containers meeting the exceptions of 10 CFR 20.1903 or 20.1905 are not required to be posted/labeled but may be as an added measure of information and safety.
6.1.4 Each posted area shall be defined and clearly marked with appropriate signs and may include a portion or all of a room, building, area, or vehicle. Areas without clearly defined existing boundaries (e.g., walls, doors or fences) may be defined by the use of magenta/yellow tape, ribbon, or rope.
6.1.5 Any container of radioactive material shall be labeled as “CAUTION – RADIOACTIVE MATERIAL” unless specifically exempted from labeling pursuant to 10 CFR 20.1905. The label shall provide sufficient information to avoid exposure; such as the date, dose rate, and container activity information.
6.1.6 Warning signs, tags, labels, notices and other radiation hazard identification markings shall be removed only by authorization of the RPM, or designee when conditions requiring their use no longer exist.
6.1.7 Form USNRC-3, "Notice to Employees", or equivalent, should be posted in prominent locations within the area if the work being performed is under the jurisdiction of the USNRC.

6.2 Exceptions to Posting Requirements
6.2.1 Areas or rooms containing radioactive materials for periods less than 8 hours are not required to be posted if:
6.2.1.1 The materials are constantly attended and controlled by an individual who takes necessary precautions to prevent exposures in excess of the limits stated in AVESI HP-11, “Radiological Limits”.
6.2.1.2 The area or room is subject to HP staff control.

6.2.2 A room or area is not required to be posted with a caution sign due to the presence of a stated source unless the source creates a “Radiation Area” due to its presence in the area.

6.3 Exemptions to Labeling Requirements

6.3.1 The following are not required to be labeled:

6.3.1.1 Containers holding radioactive materials in concentrations less than the quantities listed in Appendix C to 10 CFR 20.

6.3.1.2 Containers holding radioactive materials in concentrations less than those specified in table 3 of Appendix B to 10 CFR 20.

6.3.1.3 Containers attended by an individual who takes precautions necessary to prevent exposure to individuals in excess of the limits established in AVESI HP-11, “Radiological Limits.”

6.3.1.4 Containers when they are in transport and labeled in accordance with DOT regulations.

6.3.1.5 Containers that are accessible only to individuals authorized to handle or use them.

6.3.1.6 Installed manufacturing or process equipment such as piping and tanks.

6.4 Caution or Danger Signs

6.4.1 Each Caution (or Danger) posting shall depict a magenta (or black) trefoil symbol on a yellow background, as described in 10 CFR 20.1901. Each area, building, or room shall be posted at each entrance point.

6.4.2 Each sign, tag, or label shall be displayed prominently and shall be recognizable from a safe distance, and kept current, reflecting any changes in radiological conditions.

6.4.3 Supplementary notices specifying the requirements for entry to and exit from areas and other special precautions that are to be exercised should be posted in conjunction with radiation warning signs and tags to provide personnel with any required additional instructions or information not given by the signs and tags.

6.4.4 Caution signs may not be necessary in areas/rooms containing radioactive materials for a period of less than eight (8) hours, provided that the materials are attended throughout the temporary storage period by an individual who has been trained in the precautions for radiation exposure of personnel.

7.0 Records

There are no records generated by this procedure.
HEALTH PHYSICS PROCEDURE

AVESI HP-25

RADIOACTIVE SOURCE CONTROL

APPROVED BY: ______________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ______________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<th>ATTACHMENT</th>
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<td>2</td>
<td>RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY</td>
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<td>3</td>
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<td>4</td>
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1.0 Purpose

This procedure establishes the requirements for the control, accountability and leak testing of radioactive sources.

2.0 Scope

This procedure applies to the inventory and leak testing of radioactive sources controlled under this AVESI radiation safety program.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 EM 385-1-80, “Radiation Protection Manual”
3.3 AVESI HP-01, “Radiation Protection Program”
3.4 AVESI HP-21, “Radiological Monitoring”
3.5 AVESI HP-22, “Radiological Reporting”
3.6 QAAP 17.1, “Records Management”

4.0 Definitions

4.1 Controlled Area – An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

4.2 Minimum Detectable Activity (MDA) - The smallest amount of radioactivity that can be detected given the conditions of a specific sample.

4.3 Sealed Source - Any device containing radioactive material that may be used as a source of radiation, and which has been constructed in such a manner as to prevent the escape of radioactive materials.

4.4 Semi-annual - A time period that consists of six (6) months.

4.5 Source Housing - Device designed to support, shield and/or contain a sealed radiation source.

4.6 Restricted Area – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.7 Unrestricted Area – An area to which access is neither limited nor controlled by the responsible party.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Secure radioactive sources that are stored in Controlled or Restricted Areas from unauthorized access.

5.1.2 Authorize source purchases.

5.1.3 Verify that leak tests are performed at the frequency specified by this procedure.

5.1.4 Evaluate the disposition of leaking or degraded sources.
5.1.5 Direct a search, make notifications, and evaluate potential consequences in the event of a lost source.

5.1.6 Verify that the source inventory is current.

5.1.7 Verify that sources under their control be stored, issued, and used in accordance with this procedure.

5.2 Health Physics Technicians shall:

5.2.1 Perform source leak test surveys.

5.2.2 Perform source inventories.

5.2.3 Maintain a current inventory of sources, as directed by the RPM.

5.2.4 Forward a copy of all survey and related documentation to the RPM, or designee, for review.

6.0 Procedure

6.1 Radioactive Source Accountability

6.1.1 The radioactive source shall be assigned a specific number and the number shall be entered on Attachment 3, “Radioactive Source Log And Inventory” (or equivalent) upon receipt. The manufacturer’s original serial number may be used as the specific number.

6.1.2 Each source shall be accounted for on Attachment 3 (or equivalent). Attachment 3 may be maintained electronically if either electronic or paper backup copies exist.

6.1.3 The source tracking number shall be indicated on the source Certificate of Calibration and source container.

6.1.4 Source storage locations shall be posted, lockable, and controlled to prevent loss, theft, or unauthorized use.

6.1.5 The source or source holder will be physically labeled with the assigned number, and placed in the source storage location.

6.1.6 A physical inventory will be conducted at least semi-annually and documented on Attachment 3 (or equivalent) in accordance with Section 6.4 of this procedure to account for all radioactive sources.

6.1.7 The results of the inventory shall be entered into the current source inventory file.

6.1.8 Records of the inventories shall be maintained for inspection by regulatory agencies and shall include the quantities and kinds of radioactive material, location of the source, and the date of the inventory.

6.2 Leak Tests

6.2.1 Upon receipt, and at the frequency specified in Attachment 1, “Sealed Source Leak Test Frequency”, all sources that meet or exceed the activity threshold specified in Attachment 1 shall be surveyed for removable
contamination (leak tested) in accordance with AVESI HP-11, “Radiological Monitoring”.

6.2.2 Do not touch or smear the surface upon which radioactive material is deposited. Smears(s) should be taken on the back of the source, the interior of the source storage container, or any other location where one might expect to find contamination.

6.2.3 Leak test surveys should be documented on Attachment 2, or equivalent. Activity results shall be converted from DPM to microcuries as shown on Attachment 2. Leak test results that indicate no detectable activity above background are to be documented as less than the minimum detectable activity (MDA).

6.2.4 If the survey results indicate removable activity above the MDA; contain (i.e., in a radbag or other appropriate method) the source, conspicuously label the source as “Out of Service”, and notify the RPM. The equipment or area associated with the leaking source shall be surveyed and decontaminated, if required.

6.2.5 The RPM, or designee should evaluate sources with leakage above the MDA, but below 0.005 microcuries for repair or disposal. Any source with leakage equal to or greater than 0.005 microcuries shall be disposed of in accordance with this procedure.

6.3 Issuance of Sources

6.3.1 Sources will only be issued to response test and calibrate radiation measuring instruments, unless otherwise authorized by the RPM.

6.3.2 Each source will be signed out on Attachment 4, “Radioactive Sealed Source Issue Log”, prior to removing the source from the immediate storage area (i.e. room).

6.3.3 Sources in use shall be under the constant surveillance and control of the authorized user.

6.3.4 When returned to its designated storage location, the source must be signed in.

6.4 Inventory of Sources

6.4.1 Obtain a list of sources from the Source Inventory Database or a photocopy of the current Attachment 3, “Radioactive Sealed Source Log And Inventory”.

6.4.2 Perform a physical inventory of each source, and document the inventory on Attachment 3, or equivalent.

6.4.3 Visually inspect the source for cracks, chips, corrosion, or other conditions that could result in the leakage of radioactive material. If any source degradation is evident, perform a source leak test. Ensure the source/source container bears appropriate warning labels.
6.4.4 Notify the RPM if any sources are unaccounted for, physically degraded, or not at the location specified on Attachment 3.

6.5 Disposal of Radioactive Sources

6.5.1 The RSO shall approve the disposal of all sources.

6.5.2 Sources shall be disposed of in accordance with applicable shipping procedures.

6.5.3 Indicate source disposal on Attachment 3.

6.5.4 The disposal of sources shall be performed in accordance with state and federal regulations after approval from the RSO and the Corporate Environmental Health and Safety (EH&S) Manager.

6.6 Reports of Theft or Loss of Radioactive Material

6.6.1 If a radioactive source is lost or stolen, the RPM shall direct a search for the source and make the appropriate notifications in accordance with the guidance provided in AVESI HP-22, “Radiological Reporting”.

6.6.2 The RSO shall provide reports of lost or stolen radioactive material to the appropriate regulatory authorities in accordance with AVESI HP-22.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
# RADIOACTIVE SEALED SOURCE LEAK TEST FREQUENCY

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Use</th>
<th>Activity</th>
<th>Minimum Leak Test Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta/gamma-emitting</td>
<td>Active</td>
<td>≥ 100 microcuries</td>
<td>6 months</td>
</tr>
<tr>
<td>Alpha-emitting</td>
<td>Active</td>
<td>≥ 10 microcuries</td>
<td>3 months</td>
</tr>
<tr>
<td>Beta/gamma-emitting</td>
<td>Not in use</td>
<td>Any</td>
<td>Not required</td>
</tr>
<tr>
<td>Alpha-emitting</td>
<td>Not in use</td>
<td>Any</td>
<td>Not required</td>
</tr>
<tr>
<td>Beta/gamma-emitting</td>
<td>Active</td>
<td>&lt; 100 microcuries</td>
<td>Not required</td>
</tr>
<tr>
<td>Alpha-emitting</td>
<td>Active</td>
<td>&lt; 10 microcuries</td>
<td>Not required</td>
</tr>
</tbody>
</table>
# RADIOACTIVE SEALED SOURCE LEAK TEST SURVEY

Technician Name: ___________________________ Date: ___________________________

<table>
<thead>
<tr>
<th>Instrument/Detector</th>
<th>Serial #</th>
<th>Cal Due Date</th>
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<th>Instrument/Detector</th>
<th>Serial #</th>
<th>Cal Due Date</th>
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<table>
<thead>
<tr>
<th>Source ID</th>
<th>Isotope(s)</th>
<th>Removable Beta&lt;sup&gt;1&lt;/sup&gt; (dpm/smear)</th>
<th>Removable Beta&lt;sup&gt;1&lt;/sup&gt; (µCi/smear)</th>
<th>Removable Alpha&lt;sup&gt;1&lt;/sup&gt; (dpm/smear)</th>
<th>Removable Alpha&lt;sup&gt;1&lt;/sup&gt; (µCi/smear)</th>
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<sup>1</sup> Conversion from dpm to µCi should be calculated as follows: Activity (µCi) = Activity (dpm) * (1µCi/2.22E6 dpm)

**REVIEWED BY:** ___________________________ **DATE:** ___________________________
RADIOACTIVE SOURCE LOG AND INVENTORY\textsuperscript{1,2}

<table>
<thead>
<tr>
<th>SOURCE TRACKING NO.</th>
<th>RADIONUCLIDE(S)</th>
<th>ACTIVITY ((\mu\text{Ci}))\textsuperscript{3}</th>
<th>STORAGE LOCATION</th>
<th>CUSTODIAN</th>
<th>COMMENTS</th>
<th>VERIFIED PRESENT (INITIALS /DATE)</th>
</tr>
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\textsuperscript{1} The Source Log may be copied to perform an inventory, indicate “INVENTORY” at the top of the form.

\textsuperscript{2} When a source has been disposed of, note the source disposal date in the “COMMENTS” column.

\textsuperscript{3} List activity from last assay date.

REVIEWED BY: ________________________________

DATE: ________________

RPM
# RADIOACTIVE SOURCE ISSUE LOG

**LOCATION:** __________________________

**YEAR:** __________

<table>
<thead>
<tr>
<th>SERIAL NUMBER</th>
<th>DATE/TIME SOURCE OUT</th>
<th>SIGNATURE</th>
<th>DATE/TIME SOURCE IN</th>
<th>SIGNATURE</th>
</tr>
</thead>
<tbody>
<tr>
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**REVIEWED BY:** __________________________

**DATE:** __________

**RPM**
HEALTH PHYSICS PROCEDURE

AVESI HP-26

CONTAMINATION CONTROL

APPROVED BY: ___________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ___________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<td>6.0 Procedure</td>
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<tr>
<td>7.0 Records</td>
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</table>
1.0 Purpose
This procedure outlines the methods for preventing the spread of radioactive contamination and controlling contaminated or potentially contaminated areas, equipment and materials.

2.0 Scope
This procedure applies to all personnel, areas, equipment and materials at a site working under this AVESI radiation safety program.

3.0 References
3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 AVESI HP-01, “Radiation Protection Program”
3.3 AVESI HP-11, “Radiological Limits”
3.4 AVESI HP-10, “Personnel and Equipment Decontamination”
3.5 AVESI HP-21, “Radiological Monitoring”
3.6 AVESI HP-23, “Health Physics Oversight”
3.7 AVESI HP-24, “Radiological Posting and Labeling”
3.8 AVESI HP-28, “Storage and Control of Radioactive Waste”

4.0 Definitions
4.1 Contamination (Radioactive) – Deposition of radioactive material in any place not desirable. The presence of unwanted radioactive material on tools, equipment, surfaces, clothing, personnel, and etc.

4.2 Contamination Area – Any area with total and/or smearable (removable) contamination levels greater than site specific contamination limits as documented on Attachment 2 of AVESI HP-11, “Radiological Limits” or other site specific documentation (i.e., Site Safety and Health Plan (SSHP), Radiation Protection Plan (RPP), etc.).

4.3 Removable Contamination – Radioactive material easily transferred by normal handling and contact.

4.4 Restricted Area – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

4.5 Step-off Pad – A buffer zone between clean areas and contaminated areas to prevent the spread of contamination. Typically, a step-off pad is used as the primary ingress/egress point to an indoor Contamination Area.

4.6 Unrestricted Area – An area to which access is neither limited nor controlled by the responsible party.

5.0 Responsibilities
5.1 The Radiation Protection Manager (RPM) shall:
5.1.1 Approve PPE, internal and external radiation exposure monitoring, RWP, and Site Safety and Health Plan contamination control requirements.

5.2 Health Physics Technicians (HPTs) shall:
5.2.1 Perform surveys in accordance with AVESI HP-21, “Radiological Monitoring” to identify the presence of contamination.
5.2.2 Provide direction to radiological workers to control the spread of contamination.

5.3 Radiological workers shall:
5.3.1 Wear protective clothing and respirators properly and when required by signs, RWPs, HPTs, procedures or instructions.
5.3.2 Minimize the spread of a known or a possible radioactivity spill and promptly notify the HPT covering the activity.
5.3.3 Avoid unnecessary contact with contaminated surfaces, including clothing (if contaminated), tools and other equipment.
5.3.4 Minimize the amount of uncontaminated materials brought into Contamination Areas.
5.3.5 Maintain good housekeeping practices to minimize the spread of contamination.

6.0 Procedure
6.1 Removable contamination shall be controlled to the extent practical in order to prevent:
6.1.1 Personnel contamination events.
6.1.2 The spread of contamination within Restricted Areas.
6.1.3 The spread of contamination to the environment.
6.1.4 Unnecessary airborne exposure.

6.2 The RPM, or designee shall specify contamination control requirements on RWPs.

6.3 Every contamination control situation cannot be procedurally anticipated, however, the following shall be considered in the control of radioactive contamination:
6.3.1 Temporary enclosures to separate highly contaminated work from adjacent areas.
6.3.2 Establishing a step-off pad or RBA between contaminated and uncontaminated areas to prevent the spread of contamination.
6.3.3 Ventilation of areas and enclosures.
6.3.4 Keeping potentially contaminated soil wet.
6.3.5 Dust minimization.
6.3.6 Wrapping items before taking them into a Contamination Area.
6.3.7 Containerizing contaminated material.
6.3.8 Covering contaminated material.
6.3.9 Regular monitoring of the site.
6.3.10 Decontamination of areas and items.
6.3.11 Good housekeeping practices.
6.3.12 Administrative and engineering controls.

6.4 Contamination surveys shall be performed in accordance with AVESI HP-21, “Radiological Monitoring”.

6.5 Contamination Areas shall be surveyed routinely in accordance with the requirements of AVESI HP-23, “Health Physics Oversight”.

6.6 Contamination areas shall be controlled and posted in accordance with AVESI HP-24, “Radiological Posting and Labeling”.

6.7 When entering a Contamination Area, personnel protective equipment should be worn in accordance with RWP requirements.

6.8 Items taken into a Contamination Area should be treated as potentially contaminated until surveys are performed to demonstrate compliance with site specific release criteria for unrestricted use.

6.9 An HPT shall survey equipment and/or materials prior to release from a Contamination Area in accordance with AVESI HP-23, “Health Physics Oversight”. Equipment and/or material release surveys shall be documented in accordance with AVESI HP-21, “Radiological Monitoring”.

6.10 Personnel shall conduct a frisk survey, or be surveyed by an HPT, in accordance with AVESI HP-23, “Health Physics Oversight” and RWP requirements.

6.11 Contaminated personnel shall be decontaminated in accordance with AVESI HP-27, “Personnel and Equipment Decontamination”.

6.12 Contaminated equipment/material shall be either containerized or decontaminated in accordance with AVESI HP-27, “Personnel and Equipment Decontamination”.

6.13 Radioactive wastes shall be controlled in accordance with AVESI HP-28, “Storage and Control of Radioactive Waste”.

7.0 Records

No records are generated as a result of this procedure.
HEALTH PHYSICS PROCEDURE

AVESI HP-27

PERSONNEL AND EQUIPMENT DECONTAMINATION

APPROVED BY: _______________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _______________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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2. PERSONNEL CONTAMINATION REPORT LOG ..................................... 6
1.0 Purpose
This procedure establishes guidelines for performing and documenting decontamination of personnel and equipment.

2.0 Scope
This procedure applies to decontamination at sites working under this AVESI radiation protection program.

3.0 References
3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 AVESI HP-01, “Radiation Protection Program”
3.3 AVESI HP-11, “Radiological Limits”
3.4 AVESI HP-21, “Radiological Monitoring”
3.5 AVESI HP-22, “Radiological Reporting”
3.6 U.S. Army Corps of Engineers Manual No. EM 385-1-1, Section 06.E, “Ionizing Radiation”
3.7 U.S. Army Corps of Engineers Regulation No. ER 385-1-80, “Ionizing Radiation Safety”

4.0 Definitions
4.1 Contamination - The deposition of radioactive material on accessible surfaces of structures, objects, equipment, or personnel that exceeds site surficial release limits pursuant to AVESI HP-11, “Radiological Limits”. Contamination may be either "fixed" (e.g., not removable by rubbing with a dry smear) or "removable". Total Contamination refers to fixed plus removable contamination.
4.2 Decontamination – The removal of radioactive contamination from surfaces, people or equipment.
4.3 Restricted Area – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

5.0 Responsibilities
5.1 The Radiation Protection Manager (RPM) shall:
   5.1.1 Verify compliance with this procedure during planned and periodic audits of the radiation safety program.
   5.1.2 Review incidents involving contamination pursuant to AVESI HP-22, “Radiological Reporting”.
5.2 Health Physics Technicians (HPTs) shall:
   5.2.1 Perform personnel decontamination in accordance with the requirements of this procedure.
5.2.2 Direct equipment decontamination in accordance with the requirements of this procedure.

6.0 Procedure

6.1 General Decontamination

6.1.1 Personnel or equipment shall be considered to be contaminated if any surface exceeds the contamination limits specified in AVESI HP-11, “Radiological Limits”.

6.1.2 Surveys shall be performed and documented pursuant to AVESI HP-21, “Radiological Monitoring”.

6.1.3 Following decontamination, surfaces shall be resurveyed to determine if the surface meets release criteria.

6.1.4 Personnel performing decontamination shall wear protective clothing appropriate for the levels of contamination encountered.

6.1.5 Decontamination shall be performed starting at areas of low contamination levels and moving to higher levels of contamination.

6.1.6 The RPM shall be notified of all personnel contamination incidents.

6.2 Personnel Decontamination

6.2.1 Decontamination shall be performed with the least possible insult to the individual. If skin irritation occurs, decontamination efforts shall be discontinued and the RPM shall be immediately notified.

6.2.2 If extraordinary means (in excess of this procedure) are required to decontaminate an individual, or when decontaminating a wound, medical personnel shall direct the decontamination.

6.2.3 The temperature of personnel decontamination water should be lukewarm.

6.2.4 Decontaminate skin in the following manner:

6.2.4.1 Survey the affected area to determine the magnitude and extent of the contamination. Document initial survey results on Attachment 1, “PCR”, Attachment 1 from AVESI HP-21, “Radiological Monitoring” and/or equivalent forms.

6.2.4.2 Wash the affected area thoroughly using soap and water (or, if water is not available, wipe the area with pre-moistened towelettes).

6.2.4.3 If multiple washings are not effective, consider wrapping the affected area in plastic to induce sweating.

6.2.4.4 Continue the decontamination effort until the contamination has been removed. If the contamination cannot be removed, contact the RPM.
6.2.5 During the decontamination process, care should be taken to avoid cross contamination of the hair, mouth, eye, or nose.

**NOTE:**
Lifesaving measures and medical attention to seriously injured personnel shall take precedence over personnel decontamination procedures.

6.2.6 To decontaminate nasal passages, have the individual use moderate nose blowing to remove the contamination. Nasal passages may be surveyed using cotton swabs. The RPM shall determine if a bioassay sample is required.

6.2.7 All contamination incidents shall be documented on Attachment 1, “Personnel Contamination Report” (PCR) and/or Attachment 1 from AVESI HP-21, “Radiological Monitoring”. All contamination incidents shall be tracked on Attachment 2, “Personnel Contamination Log” and reported in accordance with the requirements in AVESI HP-22, “Radiological Reporting”. Equivalent forms may be used at the discretion of the RPM.

6.2.8 If radon is suspected as the cause of the contamination incident, attempt to verify by determining the half-life of the contaminant (i.e. on the decontamination materials), or performing an immediate lab analysis. Note the investigation results on the PCR.

6.2.9 If personnel contamination activity in excess of 15,000 dpm/100cm² is encountered, save the decontamination materials for lab analysis in order to support a skin dose evaluation, at the direction of the RPM.

6.3 Personal Clothing Decontamination

6.3.1 Personal clothing may be decontaminated by the following methods:

- 6.3.1.1 Attempt to remove the contamination by tape press.
- 6.3.1.2 Send the contaminated item to a licensed laundering vendor.
- 6.3.1.3 With the owner’s permission, cut out the contaminated areas of the clothing or shoes and dispose of as radwaste.
- 6.3.1.4 Other appropriate methods as determined by the RPM.

6.4 Equipment Decontamination

6.4.1 Equipment shall be decontaminated in a Restricted Area.

6.4.2 Loose contamination may be removed from equipment surfaces by one of the following methods:

- 6.4.2.1 Wiping the surface with a moist rag.
- 6.4.2.2 Vacuuming the surface with a high efficiency particulate (HEPA) filter equipped vacuum.
- 6.4.2.3 Spraying the equipment with pressurized hot water/steam.
6.4.3 Liquid waste generated during decontamination shall be collected so that the liquids may be contained, unless waived by the RPM.

6.4.4 Fixed contamination may be removed by removing the top surface layer using abrasive means (i.e. angel grinder, disc sander, sand blaster, etc.).

7.0 Records

All records generated as a result of this procedure shall be maintained by RPM until transmitted to the appropriate Central Records Facility.
PERSONNEL CONTAMINATION REPORT

Site: ____________________________________________

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<thead>
<tr>
<th>Employee Name</th>
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INDICATE THE CONTAMINATED AREAS IN THE DIAGRAM ABOVE

SPECIFY CALCULATED ACTIVITY IN UNITS OF DPM/100cm²

DESCRIBE THE CONTAMINATION INCIDENT, THE SITE LOCATION WHERE THE INDIVIDUAL BECAME CONTAMINATED, THE DECONTAMINATION METHODS USED, AND THE POST-DECONTAMINATION SURVEY RESULTS:

PERSONNEL MONITORING INCIDENT REPORT INITIATED IN ACCORDANCE WITH AVESI HP-22? □ YES □ NO

Initiated By: ____________________________ Date: _____________

Contaminated Individual: ____________________________ Date: _____________

Reviewed By: ____________________________ Date: _____________

______________________________
# PERSONNEL CONTAMINATION REPORT LOG

Site: _____________________    Year: ____________

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<th>Remarks</th>
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REVIEWED BY __________________________ DATE ______________________

6 of 6
HEALTH PHYSICS PROCEDURE

AVESI HP-28

STORAGE AND CONTROL OF RADIOACTIVE WASTE

APPROVED BY: _______________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _______________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

This procedure describes the methods for the storage, control, segregation, characterization, and disposal of radioactive waste.

2.0 Scope

This procedure applies to waste materials at sites working under this AVESI radiation protection program.

3.0 References

3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.2 10 CFR 71, “Packaging and Transportation of Radioactive Material”
3.3 10 CFR 835 “Occupational Radiation Protection”
3.4 40 CFR, Part 240 through 281, "Resource Conservation and Recovery Act"
3.5 49 CFR, Subpart C, Parts 171 through 177, “Hazardous Materials Regulations”
3.6 APHA Method 7110 - American Public Health Association, Method 7110, "Gross Alpha and Gross Beta Radioactivity (Total, Suspended, and Dissolved)", Standard Methods for the Examination of Water and Wastewater.
3.7 Disposal site acceptance criteria.
3.8 AVESI HP-01, “Radiation Protection Program”
3.9 AVESI HP-21, “Radiological Monitoring”
3.10 AVESI HP-41, “Radioactive Material Shipping”

4.0 Definitions

4.1 Acceptance Criteria - Specified limits placed on characteristics of an item, process, or service defined in codes, standards, or other required documents.
4.2 Activity - Disintegration rate of a radioactive material stated in dps, becquerels, Ci, mCi, nCi, pCi, or other acceptable units.
4.3 Investigation Derived Waste (IDW) – waste derived from filed investigation activities (i.e., remedial investigation/feasibility studies, remedial design, characterization, final status survey, etc.) that may pose a risk to human health and the environment.
4.4 Radioactive Material Storage Area (RMSA) – An administratively designated area where radioactive material is stored and controlled.
4.5 Restricted Area – A radiological area, access to which is limited, for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.
4.6 **Sewer Release Criteria** - Minimum requirements for release or discharge of liquid effluent into the waters of the state or the sanitary sewer system.

5.0 Responsibilities

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Verify compliance with this procedure during planned and periodic audits of the Radiation Protection Program.

5.1.2 Identify waste collection points and supervise the storage of radioactive wastes at these locations.

5.1.3 Make final waste disposal arrangements with vendors, as necessary.

5.1.4 Maintain records of packaged waste.

5.2 Health Physics Technicians (HPTs) shall:

5.2.1 Ensure that only suitable containers are used for collection of contaminated waste.

5.2.2 Direct handling of radioactive waste in a manner that prevents the spread of contamination and minimizes direct radiation exposure.

5.2.3 Direct segregation of wastes into appropriately marked containers.

5.3 The Transportation Representative shall:

5.3.1 Coordinate with the client transportation representative, as applicable, to prepare radiological waste for shipment to a licensed disposal facility.

5.3.2 Prepare radiological waste for shipment in accordance with the requirements in AVESI HP-41, “Radioactive Material Shipping”.

5.3.3 The Transportation Representative (nor any other AVESI personnel) is not authorized to sign waste manifests or shipping papers for client radiological waste disposal.

5.4 The Environmental Compliance Manager (ECM) shall:

5.4.1 Ensure that containerization, labeling, tracking and management of radioactive waste placed in storage is conducted in compliance with applicable federal and state laws and regulations, the site waste management plan or other appropriate document/plan, and this procedure.

6.0 Procedure

6.1 Control of Waste

6.1.1 Control of radioactive waste materials (i.e., waste minimization) should be accomplished by preventing materials from becoming unnecessarily and/or excessively contaminated.

6.1.2 Additional control methods shall include, but are not limited to:

6.1.2.1 Decontaminating and reusing radioactive materials such as tools and equipment;
6.1.2.2 Re-cycling;
6.1.2.3 Using waste volume reduction techniques when practical; and
6.1.2.4 Monitoring materials for radioactivity and removing non-radioactive materials prior to disposal.

6.2 Collection of Waste
6.2.1 Each Restricted Area that generates radioactive waste shall have designated waste collection locations.
6.2.1.1 Suitable containers should be staged at each collection location or a location that is convenient to the generation point.
6.2.1.2 At the discretion of the RPM, a Container Inventory Form (Attachment 1 or equivalent form) may be initiated and affixed to the container.
6.2.2 Precautions to prevent mixing of various hazardous substances when organizing the waste disposal area should be instituted.
6.2.3 If a bag tears during collection, the waste shall be re-packaged and the area surveyed for contamination as determined appropriate by the responsible HPT.
6.2.4 Liquid radioactive wastes shall be stored in a secondary containment to prevent the spread or leakage of material.
6.2.5 If required by the RPM, each item added to a container should be recorded on a Container Inventory Form (Attachment 1 or equivalent form). Examples of item listings are; bag of PC’s, rags, mop heads, HEPA filter, tygon tubing, bag of poly trash, bag of cardboard trash, etc.
6.2.6 When required by the RPM, an estimate of the activity contained in each item shall be included on the Container Inventory Form.
6.2.7 Items should be added to the container in a manner that minimizes void spaces and volume.

6.3 Waste Tracking
6.3.1 The waste tracking and documentation requirements in paragraphs 6.3.2-6.3.10 are applicable for management of AVESI generated waste or when AVESI is responsible for management of client generated waste.
6.3.2 The RPM or designee shall contact the Environmental Compliance Manager or designee to obtain a waste inventory tracking (WITS) number for containerized radioactive waste staged for storage in a posted RMSA.
6.3.3 Containers staged at temporary waste collection locations (PPE waste containers at egress point from Restricted Area) do not require a waste inventory tracking number.
6.3.4 The radiological contents of contaminated waste staged for storage shall be documented on Attachment 4, “WITS Data/Waste Transfer Form” and
Attachment 2, “Waste Characterization Form” (or equivalent forms). A copy of the completed forms (Attachments 2 and 4) shall be forwarded to the ECM for entry into the waste inventory tracking system.

6.3.5 Radioactive waste collected at temporary waste collection locations (i.e., PPE, soil cuttings, etc.) that is transferred directly to another person (i.e., client, and the contractor, a waste broker, a licensed disposal facility, etc.) shall be coordinated with the ECM and documented on Attachment 4, “WITS Data/Waste Transfer Form” (or equivalent).

6.3.6 Shipping papers/manifests supercede the requirement to complete Attachment 4 (i.e., for a waste broker or licensed disposal facility).

6.3.7 Radioactive waste that is transferred directly to another person in accordance with §6.35 does not require a WITS number.

6.3.8 Management of investigation derived waste (IDW) shall be conducted in accordance with AVESI EH&S Procedure 25, “Management of Investigation Derived Waste”.

6.3.9 Tracking of radiological waste shall be conducted in accordance with AVESI EH&S Procedure-27, “Waste Inventory Tracking”.

6.3.10 The RPM or designee shall contact the ECM or designee to obtain a transfer log number for contaminated radioactive waste.

6.4 Preparation to Characterize Waste

6.4.1 The physical and radiological contents of all containerized waste staged for storage or disposal shall be documented.

6.4.2 Waste being prepared for shipment shall be characterized in accordance with AVESI HP-41, “Radioactive Material Shipping”, if not previously characterized.

6.4.3 The following steps shall be taken in preparation for characterization:

6.4.3.1 Record a unique identification number of the container to be characterized on the Waste Characterization Form (Attachment 2 or equivalent form).

6.4.3.2 Survey the exterior of the waste container in accordance with AVESI HP-21, “Radiological Monitoring” to determine if direct exposure controls are needed and support the activity determination, as applicable.

6.4.4 Record a description of the container contents of the container on the Waste Characterization Form.

6.4.4.1 The container may be a candidate to be opened and inspected if it does not have a Container Inventory Form affixed to it. Attempts to determine the history of the container shall be made prior to opening.
6.4.4.2 If the container is leaking, off-gassing, or bulging, it should not be opened and the RPM shall be notified.

6.4.4.3 If the RPM has confidence that the Container Inventory Form is accurate, the estimate shall be made based on the inventory in the container.

6.4.4.4 If the RPM does not have confidence that the Container Inventory Form is accurate, a plan shall be developed for opening and sampling the container.

6.4.5 When required, an estimate of the volume of each type of material comprising the waste shall be included on the Container Inventory Form.

6.4.6 The Container Inventory Form, if available, shall be maintained with the Waste Characterization Form.

6.4.7 The container shall be placed in its designated storage location, which should be recorded on the Waste Characterization Form. If the container is subsequently moved to another storage location, the Waste Characterization Form for that container shall be updated to reflect the new storage location.

6.4.8 Copies of the Container Inventory Form and Waste Characterization Form shall be forwarded to and maintained by the RPM.

6.5 General Disposal Requirements

6.5.1 Containerized radioactive waste should be stored on site in a posted RMSA.

6.5.2 Alternative means of disposal, such as the following, may be implemented, at the discretion of the RPM:

6.5.2.1 Transfer to a waste disposal service which is licensed to receive such waste in accordance with 10 CFR 20.2001 or applicable State, federal and local regulations;

6.5.2.2 Transfer to the original supplier if properly licensed to receive radioactive materials;

6.5.2.3 Transfer to an authorized recipient as provided for in 10 CFR 20.2001 or applicable State, federal, and local regulations;

6.5.2.4 Release into the sanitary sewer in conformance with 10 CFR 20.2003 or applicable State, federal and local regulations;

6.5.2.5 Segregating and storing short-lived radionuclides until the level of residual radioactivity permits conventional disposal.
6.5.2.6 Recycling; or
6.5.2.7 Other means specifically approved in advance by the NRC pursuant to 10 CFR 20, Subpart K or other applicable state or federal agencies.

6.6 Off-site Radioactive Waste Disposal

6.6.1 For off-site disposal, the RPM should coordinate with the AVESI Transportation Representative to perform the following:

6.6.1.1 Contract an independent licensed vendor to seal, survey, pick up and transport filled waste containers to a final disposal facility.

6.6.1.2 Perform and document all analyses on the waste required by the licensed vendor.

6.6.1.3 If the disposal is being coordinated by AVESI for a client, the AVESI Transportation Representative shall coordinate with the client transportation representative to obtain necessary signatures on waste shipping papers and manifest forms.

NOTE: AVESI PERSONNEL ARE NOT AUTHORIZED TO SIGN WASTE MANIFESTS OR SHIPPING PAPERS FOR THE DISPOSAL OF CLIENT GENERATED RADIOLOGICAL, HAZARDOUS, OR MIXED WASTE.

6.6.1.4 Arrange transfer and disposal of sealed, surveyed, and manifested waste containers to a disposal facility.

6.6.1.5 Ensure that all waste transporters meet the applicable requirements of AVESI HP-41, “Radioactive Material Shipping”.

6.6.1.6 If the disposal is being coordinated by AVESI for a client, the AVESI Transportation Representative should notify the client transportation representative prior to shipment of radioactive waste for disposal.

6.6.2 The RPM, in conjunction with the disposal vendor, shall confirm that each container is sealed and surveyed in accordance with AVESI HP-41, “Radioactive Material Shipping” before the containers are shipped for disposal.

6.6.3 The RPM shall provide the disposal vendor with the inventory of radioactive materials contained in the waste containers.

6.6.4 The RPM and/or the client representative shall determine when the capacity of a radioactive waste collection area dictates a radioactive waste shipment to a commercial disposal facility or waste broker.

6.7 Disposal into Sanitary Sewerage

6.7.1 The liquid waste to be discharged shall be confirmed:
6.7.1.1 To be soluble (or readily dispersible biological material) in water.

6.7.1.2 To meet the monthly and annual discharge limits specified in 10 CFR 20.2003(a)(4) and 10 CFR 20, Appendix B.

6.7.1.3 To have a “Sum of Ratios” (SOR) not exceeding unity (1.0) when multiple radionuclides are discharged pursuant to 10 CFR 20.2003(a)(3).

6.7.1.4 To meet all applicable state and local discharge permitting requirements prior to discharge.

6.7.2 Discharges shall be only into the discharge points authorized by the RPM.

6.7.3 During discharge:
6.7.3.1 Turn on water from the faucet for 10 seconds prior to discharge.
6.7.3.2 Pour liquid waste slowly into drain.
6.7.3.3 Leave water running from faucet for 30 seconds after discharge.

6.7.4 After discharge:
6.7.4.1 Survey the discharge point and surrounding work surfaces to confirm no residual radioactivity remains.
6.7.4.2 Decontaminate surfaces as necessary.
6.7.4.3 Record the activity concentration volume, and total activity of the material discharged in the Monthly Radioisotope Sewer Discharge Log (Attachment 3), or equivalent document.

7.0 Records
All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
<table>
<thead>
<tr>
<th>Waste Container #:</th>
<th>Description of Item Deposited (including radionuclide and concentration)</th>
<th>Date</th>
<th>Waste Form: (Circle)</th>
<th>Approximate Activity¹ (µCi)</th>
<th>Approximate Volume or Surface Area of Items¹ (Circle) mL cm²</th>
<th>Container Type:</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Solid</td>
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<td>Liquid</td>
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</tbody>
</table>

Container Closure Date: | Container Weight: | Closed by (signature): |

¹ Longlived radioactive waste only. Radioactive waste with short half lives being stored for decay and disposal in conventional trash does not require tracking of total activity or volume.
## AVESI WASTE CHARACTERIZATION FORM

<table>
<thead>
<tr>
<th>Container Number:</th>
<th>Container Type:</th>
<th>Container Weight:</th>
</tr>
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<tbody>
<tr>
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</table>

**Description of Contents:**

<table>
<thead>
<tr>
<th>Container Location:</th>
</tr>
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<tbody>
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</tbody>
</table>

- □ Container Inventory Form Attached

### Activity Determination

**Method (attach all documentation):**

- Analytical Results □
- Microshield Calculation □
- Other □

**Describe:**

- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________
- ___________________________________________________________

**Curie Content:**

<table>
<thead>
<tr>
<th>Activity determination performed by:</th>
<th>Date:</th>
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</table>

<table>
<thead>
<tr>
<th>Activity determination reviewed by:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
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<td></td>
</tr>
</tbody>
</table>
MONTHLY RADIOISOTOPE SEWER DISCHARGE LOG

<table>
<thead>
<tr>
<th>Date Poured</th>
<th>Inventory #</th>
<th>Nuclide</th>
<th>Activity Concentration ((\mu\text{Ci/mL}))</th>
<th>Total Volume Poured (mL)</th>
<th>Activity ((\mu\text{Ci}))</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Radionuclide 1
Radionuclide 2
Radionuclide 3
Radionuclide 4
Radionuclide 5

Year: ___________________ Month: ___________________

Monthly Facility Water Usage: ___________________

Instructions to calculate total monthly activity discharge per nuclide:
1. Calculate activity/discharge/nuclide: Activity concentration (\(\mu\text{Ci/mL}\)) * Volume discharged (mL)
2. Calculate total monthly activity discharged/nuclide (\(\mu\text{Ci}\)): \(\Sigma\) (Total activity per discharge)
3. Monthly activity concentration/nuclide (\(\mu\text{Ci/mL}\)): (Activity Concentration (\(\mu\text{Ci/mL}\)) * Volume (mL)/Monthly Facility Water Usage

Limits for Total Activity Discharged
5 \(\text{Ci/yr-H}^3\)
1 \(\text{Ci/yr-C}^{14}\)
1 \(\text{Ci/yr-All other radionuclides combined}\)
# WITS DATA WASTE/TRANSFER FORM

## SECTION I

### PART 1 GENERAL INFORMATION

<table>
<thead>
<tr>
<th>Transfer Log #</th>
<th>WITS ID #’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present location:</td>
<td></td>
</tr>
<tr>
<td>Container Description:</td>
<td></td>
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<tr>
<td>Category:</td>
<td></td>
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<tr>
<td>Class:</td>
<td></td>
</tr>
</tbody>
</table>

### TRANSPORTER LOG

<table>
<thead>
<tr>
<th>Quantity:</th>
<th>Units:</th>
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<tbody>
<tr>
<td>KG</td>
<td>YD³</td>
</tr>
</tbody>
</table>

## PART 2 REQUESTED ACTION: [check all that apply]

- Add New WITS Record
- Transfer to: ___________________________ Area/Code: _____________________ Storage Area manager initials
- Change Existing Records
- Create Labels
- Consolidated with WITS No: ___________________________

## PART 3 REGULATORY INFORMATION

- Regulation Class: [Not Regulated] [DOT] [MDNR/State regulated] [RCRA/DOT] [TSCA] [SPECIAL]

### [1] DOT PSN or Description:

### [2] DOT Technical Name:

### [3] DOT ID:

### [4] DOT Primary Hazard Class:

### [5] DOT Subsidiary Hazard Class:

### [6] EPA or MDNR ID’s:

- Waste Treatment Group
- Target Date: Treatment or Disposal Date: Method

## PART 4 CHARACTERISTICS [For Transfers Only. Check All That Apply]

- PCBs [concentration _________ PPM]
- Radioactive Material Contamination
- Friable Asbestos >1%
- Non-Friable Asbestos
- Characteristic or listed Hazardous waste [RCRA]
- Contains an RQ of a Hazardous Substance
- Petroleum Products or Residues

## PART 5 REQUESTER’S COMMENTS AND DATA

Requester’s NAME [printed]: Signature: Date:

## SECTION II TRANSFER APPROVAL AND CERTIFICATION [complete only for transfers]

- Approved
- Disapproved. Explanation ________________________________

Additional requirements for transfer: ________________________________

Approver’s NAME [printed]: Signature: Date:

## TRANSFER COMPLETE CERTIFICATION

NAME [printed]: Signature: Date transfer completed:

## SECTION III Data Review and entry

Date Reviewed: Reviewer initials: Date entered: Data entered by [initials]:

Shaded areas require exact nomenclature – See procedure EH&S 27 for appropriate entries
HEALTH PHYSICS PROCEDURE

AVESI HP-31

RADIOLOGICAL INSTRUMENTATION

APPROVED BY: ___________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ___________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose
This procedure establishes the guidelines and requirements for the calibration, setup, operation, and quality control of radiological survey instruments.

2.0 Scope
This procedure applies to all radiation survey instruments utilized at locations where this AVESI radiation protection program is implemented.

3.0 References
3.1 10 CFR 20, “Standards for Protection Against Radiation”
3.4 AVESI HP-01, “Radiation Protection Program”
3.5 AVESI HP-11, “Radiological Limits”
3.7 NRC NUREG-1507, “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions”

4.0 Definitions
4.1 Background Test – Daily verification of satisfactory count rate instrument operation by measuring background counts at fixed location.
4.2 Bench Counter – alpha and/or beta scintillation (non-portable) counting system.
4.3 Calibration – Adjustment of instrumentation so the accuracy and performance meet requirements specified by procedures.
4.4 Calibration Equipment – Equipment that is certified as calibrated to standards which are traceable to the National Institute of Standards and Technology (NIST) and that is used to perform calibration tests on radiation survey instruments.
4.5 Due Date – The next date an instrument is due to be calibrated.
4.6 Frisker – Geiger-Mueller (GM), alpha and/or beta scintillation, or other appropriate portable contamination survey instruments.
4.7 Minimum Detectable Concentration (MDC) - The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time.
4.8 Out-of-Calibration (OOC) – Instrument removed from service due to a lapsed calibration due date.
4.9 Out of Service (OOS) – Status of any instrument not available for issue and use due to damage, equipment failure, or removed from service for long-term storage.
4.10 **Out-of-Specification Condition** – Status of instrument that does not meet calibration criteria or QC checks.

4.11 **Portable Scaler** – Frisker instrument with a timed integrated count function.

4.12 **Pre-operational Checks (POCs)** – Checks performed on any portable instrument daily or prior to use.

4.13 **QC Checks** – Daily response checks on radiation survey instrumentation to verify acceptable instrument performance.

4.14 **Radiation Survey Instruments** – Instrumentation used to measure radiation or sample mediums where radioactive material may be present.

4.15 **Source Test** – Verification of satisfactory instrument operation using a radioactive source.

5.0 **Responsibilities**

5.1 The Radiation Protection Manager (RPM) shall:

5.1.1 Approve of instrument calibration laboratories, after verifying that they meet the requirements of this procedure.

5.1.2 Review and approve instrument background acceptance criteria, source test acceptance criteria, instrument efficiency, and MDCs.

5.2 Radiological Workers and Health Physics Technicians (HPTs) shall:

5.2.1 Perform pre-operational and QC checks on radiation survey instruments in accordance with this procedure.

5.2.2 Maintain instrument accountability in accordance with this procedure.

5.2.3 Operate radiation survey instruments in accordance with this procedure or Technical Manual guidance.

6.0 **Procedure**

6.1 **Instrument Calibration**

6.1.1 Radiation survey instruments shall be calibrated under any of the following conditions:

6.1.1.1 Prior to calibration due date,

6.1.1.2 After maintenance and repair that may affect calibration,

6.1.1.3 If a pre-op check, background test, or source test out-of-specification condition cannot be corrected by minor repair, such as battery change, cord replacement, or detector window replacement.

6.1.2 Instrumentation shall be calibrated at the frequencies specified in Attachment 5. More frequent calibrations may be necessary due to instrument repair or performance concerns, as determined by the RPM.
6.1.3 Instruments shall be calibrated in accordance with the guidance of ANSI N323A-2004.

6.1.4 Upon completion of calibration, each instrument shall labeled with the following information:

   6.1.4.1 Instrument serial number
   6.1.4.2 Initials or other specific identifying mark of the calibrator, and
   6.1.4.3 Calibration due date.

6.1.5 Radiation survey instruments shall be uniquely identified on the instrument housing.

6.2 Source Decay Corrections

   6.2.1 Radioactive source decay corrections shall be performed at a frequency to ensure the reported source activity used to determine instrument response does not exceed ± 5% of the actual source activity. Source decay corrections should be calculated by the formula provided in Attachment 4, Equation 3.

6.3 Determination of Acceptance Criteria

   6.3.1 Instrument Setup General Requirements

   6.3.1.1 Following on-site instrument calibration, or upon receipt from a calibration facility, survey instrument background acceptance criteria, source acceptance criteria, and instrument efficiency (for alpha and/or beta) shall be established and documented on Attachments 1, 2 or 11, or equivalent forms.

   NOTE: It may be necessary to establish site specific background acceptance criteria, source acceptance criteria and instrument efficiency when using instruments at different sites having significantly different background count rates, as determined by the RPM.

   6.3.1.2 QC parameters may be updated due to change in instrument location, area background, or other parameters that affect instrument response.

   6.3.1.3 Source tests shall be performed in a consistent and reproducible manner.

6.3.2 Bench Counter Setup

   6.3.2.1 Bench counter background, source, and efficiency data shall be recorded on Attachment 2, or equivalent.

   6.3.2.2 Count times for bench counters shall be established in order to meet MDC requirements, as practical. Count times may be initially set as:

   6.3.2.2.1 Air sample (occupational) – 10 minutes
6.3.2.2 Air sample (non occupational) – 60 minutes
6.3.2.3 Smear – 1 minute

6.3.2.3 In order to establish bench counter background acceptance criteria:

6.3.2.3.1 Obtain 10 background counts.
6.3.2.3.2 Determine the standard deviation of the 10 background counts.
6.3.2.3.3 Determine the mean of the background counts.
6.3.2.3.4 Establish background acceptance criteria as ± 3 standard deviations of the mean background.

6.3.2.4 In order to establish bench counter source test acceptance criteria:

6.3.2.4.1 Obtain 10 source counts using a NIST traceable source.
6.3.2.4.2 Determine the mean source counts.
6.3.2.4.3 Establish source acceptance criteria as ± 20% of the mean source counts.

6.3.2.5 In order to establish bench counter instrument efficiency:

6.3.2.5.1 Determine the net count-rate by subtracting the mean background count-rate from the mean source count-rate.
6.3.2.5.2 Determine the instrument efficiency by dividing the net count-rate by the source activity. Source activity should be calculated as shown on Attachment 4 Equation 6, or by other methods as determined appropriate by the RPM.

6.3.2.6 Calculate the MDC for counting smears in accordance with Attachment 4, equation 2. Compare the smear MDC with the contamination release limit pursuant to AVESI HP-11, “Radiological Limits”. If the smear MDC is greater than the release limit, increase the count time until the analysis of the smear with the bench counter can detect less than the release limit.

6.3.2.7 Calculate MDC for counting air samples, given a minimum air sample volume, in accordance with Attachment 4, equation 5. Compare the air sample MDC with 0.10 DAC. If necessary, increase the minimum sample volume and/or count time to achieve an MDC less than 0.10 DAC, as practical.

6.3.2.8 Bench counter MDC data shall be recorded on Attachment 3, “Bench Counter MDC Record”, or equivalent.
6.3.3 Portable Scaler Setup
6.3.3.1 Portable scaler setup data shall be recorded on Attachment 2, or equivalent.

6.3.3.2 Portable scaler background acceptance criteria, source test acceptance criteria, and efficiency should be setup in the same manner as a bench counter, except:

6.3.3.2.1 When the detector surface area is at least 3 times larger than the source active surface area; obtain 3 source counts at the top of the active area of the detector, 4 source counts at the center of the active area of the detector, and 3 source counts at the bottom of the active area of the detector (total of 10 source counts altogether).

6.3.3.2.2 Establish background acceptance criteria as ±20% of the mean background count for NaI gamma walkover survey instruments.

6.3.4 Frisker Setup
6.3.4.1 Friskers with a timed scaler function shall be setup as a portable scaler.

6.3.4.2 Friskers without a timed scaler function should be setup in accordance with the following guidance.

6.3.4.2.1 Frisker setup data shall be recorded on Attachment 11, or equivalent.

6.3.4.2.2 Observe background and source count rates.

6.3.4.2.3 Frisker source acceptance criteria shall be determined on one scale as ± 20% of ratemeter source response.

6.3.4.2.4 Frisker background shall be determined as ± 20% of ratemeter local background response.

6.3.4.2.5 In order to establish frisker instrument efficiency, divide the net count-rate by the source activity.

6.3.5 Exposure Rate Meter Setup
6.3.5.1 Exposure rate meter setup data shall be recorded on Attachment 1, or equivalent.

6.3.5.2 Observe ratemeter source response on the most appropriate scale (i.e., the scale where the response is nearest the mid-scale reading).
6.3.5.3 Exposure rate meter source acceptance criteria shall be determined as ± 20% of ratemeter source response using an appropriate gamma emitting check source.

6.4 Pre-Operational Checks

6.4.1 Pre-operational checks shall be performed prior to instrument use. The following pre-operational checks shall be satisfactorily completed:

6.4.1.1 Verify instrument calibration is current.
6.4.1.2 Check the instrument for physical damage that may affect correct operation.
6.4.1.3 Battery check the instrument.
6.4.1.4 Verify all external cable connections are hand tight, as applicable.
6.4.1.5 Check zero adjustment of instrument, as applicable.
6.4.1.6 Ensure source and background tests have been completed for the current day by checking the Instrument QC Check Log (Attachment 8, or equivalent form) or the instrument’s daily source check sticker, if applicable.

6.4.2 If any pre-operational check fails to meet requirements, make an immediate repair (e.g. replace batteries), or tag the instrument as Out of Service in accordance with Section 6.7.1 of this procedure.

6.5 Quality Control (QC) Checks

6.5.1 General Requirements

6.5.1.1 QC checks shall be performed daily, prior to initial use, for in use radiation survey instruments. QC checks consist of the following:

6.5.1.1.1 Pre-operational checks identified in Section 6.4 of this procedure, as appropriate;
6.5.1.1.2 Background Test (except exposure rate meters);
6.5.1.1.3 Source Test.

6.5.1.2 Upon completion of a satisfactory daily QC check, document that the QC check has been completed on Attachment 8, “Instrument QC Check Log”, or equivalent form.

6.5.1.3 Instruments failing a QC check shall be tagged OOS, and an investigation performed, as required by Section 6.8 of this procedure.

6.5.1.4 Relocation of a bench counter instrument may require re-verification of acceptable QC checks.

6.5.2 Background Test
6.5.2.1 Background test shall be performed in a consistent manner and location.

6.5.2.2 The instrument background shall be verified to respond within background acceptance criteria.

6.5.2.3 Background tests are not required for exposure rate instruments.

6.5.3 Source Test

6.5.3.1 Source tests shall be performed in a consistent and reproducible manner.

6.5.3.2 The following source tests are required:

6.5.3.2.1 For exposure rate and count rate instruments, one point shall be verified to respond within source acceptance criteria.

6.6 Instrument Operation

6.6.1 Refer to Attachment 10 for (commonly used) instrument operation instructions. If instrument instructions are not provided, operate the instrument in accordance with the instrument Technical Manual.

6.7 Instrument Operational Status

6.7.1 Attachment 6, “Out of Service” tag, or equivalent, shall be attached to an instrument if any of the following occur:

6.7.1.1 The calibration interval has expired.

6.7.1.2 Maintenance or major repair is required.

6.7.1.3 The instrument has failed a QC check or pre-operational check, as determined by the RPM, or HPT.

6.7.2 The OOS tag shall remain attached to the instrument and the instrument shall not be released for use until appropriate action and documentation are complete.

NOTE: OOS tags are not required for instruments located in the calibration laboratory, provided that the instruments are stored in a location that clearly indicates their status.

6.7.3 Personnel using radiation survey instruments shall perform QC Checks anytime instrument response is questionable. Any instrument that provides “As Found” data within acceptance criteria will be considered as having provided satisfactory survey results and will not require an instrument investigation.

6.7.4 Equipment considered to be out-of-specification shall be tagged OOS until proper disposition is determined by the RPM or Senior HPT. Disposition may include any of the following:

6.7.4.1 Recalibration,
6.7.4.2 Repair,  
6.7.4.3 Replacement of the equipment, or  
6.7.4.4 Re-evaluation or revision of the acceptance criteria for the equipment as determined by the RPM.

6.8 Instrument Investigations

6.8.1 Only those out-of-specification conditions that affect proper instrument performance need to be considered for investigative purposes. The following conditions do not require investigation:

6.8.1.1 Loose cable connectors,
6.8.1.2 Meter light not operational, or
6.8.1.3 Plastic or rubber covers not pertaining to radiation detector, torn or missing.
6.8.1.4 The instrument was damaged while in use and was removed from service as soon as damage was suspected (e.g. hole in mylar window of scintillator causing upscale readings).
6.8.1.5 Other conditions, as determined by the RPM.

6.8.2 Investigations shall determine if the instrument was used for any of the following:

6.8.2.1 Assigning permanent record exposure.
6.8.2.2 Unconditional releases of equipment, material or personnel.
6.8.2.3 Determining radioactive effluent concentrations.
6.8.2.4 Shipping, receiving or labeling radioactive material.

6.8.3 If any condition of Section 6.8.2 is applicable, Attachment 7, “Defective Instrument Report” form (or equivalent) shall be completed and the need for a Radiological Incident Report (AVESI HP-22) shall be evaluated by the RPM.

6.8.4 For instruments that fail a quality control check, the investigation need only trace the instrument use back to the time of the last satisfactory quality control check.

6.9 Instrument Accountability

6.9.1 Instrument accountability should be maintained by documenting instrument sign-out and return on Attachment 9 (Instrument Sign-Out Log or equivalent form).

6.9.2 The RPM may waive the use of Attachment 9, as appropriate.

7.0 Records

All records generated as a result of this procedure shall be maintained by the RPM until transmitted to the appropriate Central Records Facility.
# Exposure Rate Meter Setup Record

**Date:** ____________________  
**Location:** ____________________

**Instrument Type:** ______________  
**Instrument Serial Number:** ______________

<table>
<thead>
<tr>
<th>Instrument Range</th>
<th>Source</th>
<th>Source Position</th>
<th>Observed Exposure Rate&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Acceptance Criteria&lt;sup&gt;1,2&lt;/sup&gt;</th>
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</thead>
<tbody>
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<td>mR/hr   µR/hr</td>
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</table>

<sup>1</sup> Circle correct units.

<sup>2</sup> ± 20% of observed exposure rate

**Comments/Restrictions:** ____________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

Calculated By: ____________________  
Date: ____________________

Approved: ____________________  
RPM/Designee: ____________________  
Date: ____________________
## Initial Instrument Check In (EXAMPLE)

**Meter Number:** 164328  
**Meter Model:** 2360  
**Cal. Due:** 02/12/2002  
**Detector Number:** 168667  
**Detector Model:** 43-89 “A”  
**Cal. Due:** 02/12/2002

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Source #:</th>
<th>Threshold</th>
<th>High Voltage</th>
<th>Bkg. count time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALPHA</td>
<td>Th-230</td>
<td>120 mV</td>
<td>775 V</td>
<td>10 minutes</td>
</tr>
<tr>
<td>BETA</td>
<td>SrY-90</td>
<td>3.5 mV</td>
<td>775 V</td>
<td>1 minute</td>
</tr>
</tbody>
</table>

### ALPHA Source

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Source #:</th>
<th>Source DPM</th>
<th>Source count time</th>
<th>Average Bkg. (CPM):</th>
<th>Average Source (GCPM):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Th-230</td>
<td>AVESI-0001</td>
<td>21300</td>
<td>1 minute</td>
<td>0.3</td>
<td>3662</td>
</tr>
</tbody>
</table>

#### Source GCPM | BKG CPM
| 3664  | 0 |
| 3798  | 0.6 |
| 3601  | 0.1 |
| 3677  | 0.4 |
| 3566  | 0.4 |
| 3669  | 0.4 |
| 3651  | 0.1 |
| 3684  | 0.3 |

#### Source Range (GCPM): 2929 to 4394

#### Background Range (CPM): 0 to 0.8

#### Determined Efficiency: 17.2%

#### 20% of Bkg.  NA

#### 3 Standard Deviations of Bkg.  0.54

### Beta/Gamma (Circle One)

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Source #:</th>
<th>Threshold</th>
<th>High Voltage</th>
<th>Bkg. count time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BETA</td>
<td>SrY-90</td>
<td>3.5 mV</td>
<td>775 V</td>
<td>1 minute</td>
</tr>
</tbody>
</table>

#### Source GCPM | BKG CPM
| 2979  | 141 |
| 3015  | 120 |
| 2910  | 130 |
| 3031  | 139 |
| 2958  | 126 |
| 2949  | 115 |
| 2948  | 118 |
| 2973  | 148 |

#### Source Range (GCPM): 2379 to 3564

#### Background Range (CPM): 92 to 171

#### Determined Efficiency: 24.1%

#### 20% of Bkg.  NA

#### 3 Standard Deviations of Bkg.  39.83

---

**Calculated By:**  
**Date:**  
**Approved:**  
(RPM/Designee)  
**Date:**
# Bench Counter MDC Record

**Date:** __________  
**Location:** ____________________________________________________________________

**Instrument Type:** ____________________________________________________________________  
**Instrument Serial Numbers:** ____________________________________________________________________

<table>
<thead>
<tr>
<th>Smear MDC</th>
<th>Smear MDC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALPHA</strong></td>
<td><strong>BETA</strong></td>
</tr>
<tr>
<td>Background count time ($T_b$)</td>
<td>min</td>
</tr>
<tr>
<td>Background count rate ($R_b$)</td>
<td>counts</td>
</tr>
<tr>
<td>Smear count time ($T_g$)</td>
<td>min</td>
</tr>
<tr>
<td>Instrument efficiency ($\epsilon$)</td>
<td>cpm/dpm</td>
</tr>
<tr>
<td>Smear MDC&lt;sup&gt;a&lt;/sup&gt;</td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Release limit</td>
<td>dpm/100cm²</td>
</tr>
<tr>
<td>Fraction of release limit</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupational Air Sample MDC</th>
<th>Occupational Air Sample MDC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALPHA</strong></td>
<td><strong>BETA</strong></td>
</tr>
<tr>
<td>Background count time ($T_b$)</td>
<td>min</td>
</tr>
<tr>
<td>Background count rate ($R_b$)</td>
<td>counts</td>
</tr>
<tr>
<td>Air sample count time ($T_g$)</td>
<td>min</td>
</tr>
<tr>
<td>Instrument efficiency ($\epsilon$)</td>
<td>cpm/dpm</td>
</tr>
<tr>
<td>Collection Efficiency ($\epsilon_c$)</td>
<td>fraction (.99)</td>
</tr>
<tr>
<td>Minimum sample volume</td>
<td>liters</td>
</tr>
<tr>
<td>Air Sample MDC</td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Air sample DAC</td>
<td>µCi/ml</td>
</tr>
<tr>
<td>DAC fraction MDC</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> This calculation assumes the smear was taken over a 100 cm² area. Smears taken over different sized areas should be normalized to 100 cm² to compare to the release limit.

**Calculated By:** ____________________________________________________________________  
**Date:** __________

**Approved:** ____________________________________________________________________  
**Date:** __________

**RPM/Designee**

---

12 of 30
# Bench Counter MDC Record

Date: ______________  Location: ____________________________________________

Instrument Type: __________________________  Instrument Serial Numbers: __________________________

<table>
<thead>
<tr>
<th>ALPHA</th>
<th>BETA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Occupational Air Sample MDC</strong></td>
<td><strong>Non-Occupational Air Sample MDC</strong></td>
</tr>
<tr>
<td>Background count time ((T_b))</td>
<td>min</td>
</tr>
<tr>
<td>Background count rate ((R_b))</td>
<td>counts</td>
</tr>
<tr>
<td>Air sample count time ((T_g))</td>
<td>min</td>
</tr>
<tr>
<td>Instrument efficiency ((\varepsilon_i))</td>
<td>cpm/dpm</td>
</tr>
<tr>
<td>Collection Efficiency ((\varepsilon_c))</td>
<td>fraction (.99)</td>
</tr>
<tr>
<td>Minimum sample volume</td>
<td>liters</td>
</tr>
<tr>
<td>Air Sample MDC</td>
<td>µCi/ml</td>
</tr>
<tr>
<td>Air sample AE</td>
<td>µCi/ml</td>
</tr>
<tr>
<td>AE fraction MDC</td>
<td></td>
</tr>
</tbody>
</table>

Calculated By: __________________________  Date: __________

Approved: __________________________  Date: __________

RPM/Designee
**Instrument Setup Calculations**

**Portable Counter (timed count) Minimum Detectable Concentration (MDC)**
(Equation 1)

\[
MDC \, (\text{dpm}/100 \text{cm}^2) = \frac{3 + 3.29 \sqrt{(R_b)(T_g)(1 + \frac{T_s}{T_b})}}{[DA][\varepsilon_i][\varepsilon_s][T_g]} \]

- DA = detector area (cm²)
- \(\varepsilon_i\) = instrument efficiency (cpm/dpm)
- \(\varepsilon_s\) = surface efficiency (unitless)
- \(R_b\) = background count rate (cpm)
- \(T_b\) = background count time (minutes)
- \(T_g\) = gross count time (minutes)

Notes: Surface efficiency is typically only used for final status surveys and is otherwise set to 1.0

**Bench Counter Smear Minimum Detectable Concentration (MDC)**
(Equation 2)

\[
\text{Smear MDC} \, (\text{dpm}/100 \text{cm}^2) = \frac{3 + 3.29 \sqrt{(R_b)(T_g)(1 + \frac{T_s}{T_b})}}{(T_g)(\varepsilon_i)}
\]

- \(\varepsilon_i\) = instrument efficiency (cd⁻¹)
- \(R_b\) = background count rate (cpm)
- \(T_b\) = background count time (minutes)
- \(T_g\) = smear count time (minutes)

NOTE: This calculation assumes the smear was taken over a 100 cm² area. Smears taken over different sized areas should be normalized to 100 cm² to compare to the release limit.
Radioactive Source Decay
(Equation 3)

\[ A(t) = A_0 e^{-0.693t/T} \]

\( A_0 = \) original source activity
\( A(t) = \) source activity at time \( t \)
\( t = \) difference between \( t_0 \) and time \( t \) (same units as \( T \))
\( T = \) radionuclide half life (same units as \( t \))
Instrument Setup Calculations

Frisker/Floor Monitor Scan Minimum Detectable Concentration (MDC) – (Equation 4)

The observable background counts ($b'$) is defined as the number of background counts observed within the observation interval ($i$). The equation used for calculating $b'$ is as follows:

$$b' = (BCPM) \times (i) \times (1 \text{ min}/60 \text{ sec}) = \text{counts/interval}$$

$BCPM$ = instrument or reference area background count rate (cpm)
$i$ = observation interval (seconds)

The minimum detectable number of net source counts in the interval is given by $s_i$. Therefore, for an ideal observer, the number of source counts required for a specified level of performance can be arrived at by multiplying the square root of the number of background counts by the detectability value associated with the desired performance ($d'$) as shown below:

$$s_i = d' \sqrt{b'}$$

The MDCR is defined as the increase above background recognizable during a survey in a given period of time. The variable, $d$, is defined as the index of sensitivity and is dependent on the selected decision errors for Type I (alpha) and Type II (beta) errors. A true positive error (1–$\beta$) of 95% and a false positive error (alpha) of 60% may be selected to be consistent with NUREG 1507. The value of 1.38 was obtained from Table 6.1 in NUREG 1507 (Table 6.5 in MARSSIM).

$$\text{MDCR (cpm)} = s_i \times (60/i)$$

Finally, the scan MDCs for surfaces may be calculated:

$$\text{Scan MDC} = \frac{\text{MDCR}}{\sqrt{p \varepsilon_i \varepsilon_s DA} \frac{100 \text{ cm}^2}{100 \text{ cm}^2}}$$

where:
- $\text{MCDR} =$ minimum detectable count rate (cpm)
- $\varepsilon_i =$ instrument efficiency (cpm/dpm)
- $\varepsilon_s =$ surface efficiency (unitless – typically only used for final status surveys, otherwise set to 1.0)
- $p =$ surveyor efficiency (unitless – typically assumed to be 0.5)
- $\text{DA} =$ detector area
**Instrument Setup Calculations**

<table>
<thead>
<tr>
<th><strong>Air Sample Minimum Detectable Concentration (MDC)</strong> (Equation 5)</th>
</tr>
</thead>
</table>
| \[
\text{Air Sample MDC (µCi/mL)} = \frac{3 + 3.29 \sqrt{(R_b) (T_g) \left(1 + \frac{T_g}{T_b}\right)}}{(T_g) (\varepsilon_i) (\varepsilon_c) (V)(2.22E^9)}
\] |

- \(R_b\) = background count rate (cpm)
- \(T_b\) = background count time (minutes)
- \(T_g\) = air sample count time (minutes)
- \(\varepsilon_i\) = Instrument efficiency, to be expressed as counts per disintegration (e.g. 0.12)
- \(\varepsilon_c\) = Collection efficiency, default with 0.99
- \(V\) = Sample volume (liters) [if converting from ft^3, multiply ft^3 by 28.3 to calculate liters]
- 2.22E9 = conversion factor from dpm to µCi and L to ml.

**Note:**
When setting up a bench counter, it is necessary to make assumptions about sample volume. In the absence of work specific information, the minimum occupational sample run time may be set as 4 hours. (i.e. 4 hours x 60 minutes x 3 LPM = 720 Liters) Adjust the minimum run time as necessary to achieve 0.10 DAC, as practical.

**Radioactive Sealed Source Activity Determination** (Equation 6)

**Sr/Y-90 Beta Sources (Other beta sources can be done the same way but may not need correction for daughter product in-growth)**

1. If source activity is given on the source calibration certificate as Sr-90 activity, the activity should be doubled and then decay corrected using Equation 5. Note that backscatter corrections are not made.
2. If source activity is not given on the source calibration certificate, then the surface beta emission rate will be given. In this case the surface beta emission rate typically includes contributions from Sr-90 activity, Y-90 activity, and backscatter. The backscatter factor may or may not be given. If the backscatter factor is given then use it, if not then assume the value of 0.43 (NUREG-1507). The source activity is calculated as:

\[
\text{Activity (dpm)} = \frac{R}{1 + B} \times 2
\]

- \(R\) = Source surface emission rate (dpm) – This includes the \(2\pi\) activity plus backscatter.
- \(B\) = Backscatter factor (unitless) – This corrects \(R\) to the source Sr/Y-90 \(2\pi\) activity.

**Note:** Instrument efficiencies determined from these calculations will be high because of the actual backscatter from the source (unless you are surveying a material made of the same material as the source holder). Efficiency corrections for the material to be surveyed can be made using the methodology outlined in NCRP-112.

**Alpha Sources**

Backscatter is negligible for alpha sources, therefore if source activity is given on the source calibration certificate then you are done (That is the \(4\pi\) activity as long as there is no concern for daughter product in-growth). If surface alpha emission rate is given then you have to double it to calculate the source \(4\pi\) activity.
# RADIATION SURVEY INSTRUMENT CALIBRATION FREQUENCY

<table>
<thead>
<tr>
<th>Instrument Type</th>
<th>Application</th>
<th>Calibration Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count rate meters (alpha, beta, or both)</td>
<td>Personnel monitoring and surface contamination measurement</td>
<td>Annually</td>
</tr>
<tr>
<td>Exposure or dose equivalent rate meters</td>
<td>Determining exposure or dose equivalent rates</td>
<td>Annually</td>
</tr>
<tr>
<td>Alpha/beta scaler</td>
<td>Quantify radioactive material on smears and air sample media</td>
<td>Annually</td>
</tr>
<tr>
<td>Air samplers</td>
<td>Collect airborne radioactive material samples</td>
<td>Annually</td>
</tr>
<tr>
<td>Liquid Scintillation Counter</td>
<td>Quantify radioactive material on smears, air sample media, and liquid sample media.</td>
<td>Annually</td>
</tr>
</tbody>
</table>
Instrument Out of Service Tag (Example)

 Instrument Out of Service

Instrument ID: _____________________
Date: ____________________________
Technician: _______________________
Defect Description:
________________________________
________________________________
________________________________
________________________________
________________________________
## Defective Instrument Report

Model: ____________________  Serial Number: ____________________  Date: ________

Problem with Instrument: ____________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

Date Found Out-of-Spec: __________  By: ____________________ / ____________________

(Print)  Signature

Last Calibration Date: ________________
Last Pre-Op Test: ________________
Last QC Check: ________________

Was this instrument used for any of the following surveys since the last satisfactory QC check?:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
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<tr>
<td>☐</td>
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<td>☐</td>
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<tr>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

If any of the above questions are marked “Yes” a Radiological Incident Report shall be considered by the RPM.

Corrective actions taken: ____________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

Evaluation Performed By: ____________________ / ____________________ / ____________________

(Print)  (Signature)  Date

Reviewed By: ____________________ / ____________________

RPM/Designee  (Date)
# INSTRUMENTATION QC CHECK LOG

**Meter:** __________  **DATE (MO/YR):** __________

<table>
<thead>
<tr>
<th>Meter Number</th>
<th>Cal. Due</th>
<th>Bkgrd. QC (cpm) range</th>
<th>Source QC (ncpm) range</th>
<th>Alpha</th>
<th>Beta</th>
<th>Source Type</th>
<th>Source Number</th>
<th>Inst. Efficiency</th>
<th>Inst. Avg. Bkgrd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alpha</td>
<td>Beta</td>
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<tr>
<td>Detector</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Time</td>
<td>Bkgrd. QC (cpm)</td>
<td>Source QC (ncpm)</td>
<td>Bat. Check</td>
<td>QC</td>
<td>HPT</td>
<td>Comment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alpha</td>
<td>Beta</td>
<td>Sat/Unsat</td>
<td>Sat/Unsat</td>
<td>Initial</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 An unsatisfactory QC check requires recording the result in the comment column and repeating the evaluation. Tag the instrument out of service and notify the HP Supervisor upon failing the QC check two times in succession.

**Reviewed By:** ____________________________ *(RPM/Designee)*  **Date:** __________
## INSTRUMENTATION QC CHECK LOG

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Number</th>
<th>Acceptance Criteria</th>
<th>Meter Detector</th>
<th>Model</th>
<th>Number</th>
<th>Cal. Due</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bkgrd. QC (cpm) range to Source QC (cpm) range</td>
<td>Pre-use Source cpm to Post Source cpm¹</td>
<td>Bat Check</td>
<td>HV Check</td>
<td>Pre-use HPT Initials</td>
</tr>
</tbody>
</table>

1  Gamma scan instruments used for confirmation or verification surveys require a post check-in.

Reviewed By: ____________________________ (RPM/Designee)  Date: _________________
## DAILY CHECK-IN OF DOSE RATE INSTRUMENTS (IN USE INSTRUMENTS)

<table>
<thead>
<tr>
<th>Source</th>
<th>Acceptance Criteria</th>
<th>Model</th>
<th>Number</th>
<th>Cal. Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Source QC</td>
<td>Scale</td>
<td>Meter</td>
<td>Detector</td>
</tr>
<tr>
<td>Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Reading</th>
<th>Pre-op Check</th>
<th>Bat Check</th>
<th>Initial</th>
<th>Comments</th>
</tr>
</thead>
</table>

Reviewed By: ___________________________ Date: __________________

RPM/Designee

23 of 30
### Instrument Sign-Out Log

Location: ___________________________  Month/Year: ____________

<table>
<thead>
<tr>
<th>LAST NAME (PRINT)</th>
<th>DETECTOR/INSTRUMENT TYPE/_SERIAL#</th>
<th>JOB LOCATION</th>
<th>DATE/TIME OUT</th>
<th>DATE/TIME IN</th>
<th>RETURNED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Ludlum Model 3 with 43-5 probe - Operating Instructions

Instrument Operation:

1) Turn the selector knob to the “ON” position.
2) Adjust meter dial to appropriate scale.
3) When scanning, adjust response to “FAST”.
4) Plug in headset, if used.

Instrument Control Features:

**AUDIO:** Built in speaker with volume control
**AUDIO JACK:** For optional headset
**METER DIAL:** 0 – 5K cpm
**MULTIPLIERS:** X0.1, X1, X10, X100
**DIGITAL RATEMETER:** Provides a digital display of count rate when selector switch is in Dig. Rate position. (added option only)
**RESPONSE:** Toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10% to 90% of final reading
**RESET:** Push-button to zero meter
**POWER:** 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
**BATTERY LIFE:** Typically 2000 hours with alkaline batteries (*battery condition can be checked on digital display*)
**TEMPERATURE RANGE:** -4° F(-20° C) to 122° F(50° C)
Ludlum Model 18 with 44-9 probe - Operating Instructions

Instrument Operation:

1) Turn the selector knob to the “ON” position.
2) Adjust meter dial to appropriate scale.
3) When scanning, adjust response to “FAST”.
4) Plug in headset, if used.

Instrument Control Features:

**AUDIO:** Built in unimorph speaker with volume control  
**METER DIAL:** 0 - 500 cpm, 0 – 2.5 kV, BAT OK  
**MULTIPLIERS:** X1, X10, X100, X1000  
**SCALER:** LCD display, and colons to indicate when a count is in process. (option only)  
**COUNT:** Push-button to initiate scaler count  
**HIGH VOLTAGE ADJUST:** Accessible from front of instrument (*protective cover provided*)  
**RESPONSE:** Will vary according to number of counts present. Typically 2 - 11 seconds from 10% to 90% of final reading  
**POWER:** 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)  
**BATTERY LIFE:** Greater than 350 hours with alkaline batteries (*battery condition can be checked on meter*)  
**TEMPERATURE RANGE:** -4° F(-20° C) to 122° F(50° C)
# Ludlum 2360 Alpha/Beta Datalogger with 43-93 probe - Operating Instructions

## Instrument Operation:

1. Turn the selector knob to the “ON” position.
2. Select alpha only, beta only, or both to display.
3. Use switch to select count time, as desired.
4. To obtain a fixed-point count, depress button in handle to activate scaler.
5. Adjust meter dial to appropriate scale.

## Instrument Control Features:

**INDICATED USE:** Alpha, beta discrimination, and data logging

**DATA LOGGER:** Capable of logging up to 550 individual data points with the following identifiers for each point *(All data is stored allowing batteries to be removed without loss of data)*

**LOGGING PUSHBUTTON:** Located in the handle; used to activate scaler and/or log a count

**LOGGING FUNCTION CONTROL:** Internal selection that enables the pushbutton to log the ratemeter reading, initiate a scaler count, and log the resulting reading, log both the scaler and ratemeter reading, or disables the logging function.

**LOCATION CODE:** A 10 character alphanumeric identifier. *(by bar code reader or PC)*

**CALIBRATION DUE DATE:** An internal date that disables the instrument if the required calibration interval has been missed

**HEADER INFORMATION:** Six lines of user defined memory at the beginning of the stack for storing user name, survey name, serial numbers, etc. *(Information is dumped with logged data)*

**RS-232 PORT:** Allows the instrument to be connected to a PC for data dump, and setup parameters.

**AUDIO:** Built in unimorph speaker with volume control

**AUDIO DIVIDE:** Selectable dual or individual click-per-event for alpha and beta counts and divisions of 1, 10, 100, or 1000 events-per-click *(beta channel only)*

**METER DIAL:** 0 - 500 cpm, 0 - 2 kV, BAT OK, OL *(overload)*

**MULTIPLIERS:** X1, X10, X100, X1000

**SCALER:** 6 digit LCD, overflow arrow, and colons to indicate when a count is in process

**COUNT TIME:** Switch selectable times of 0.1, 0.5, 1, 2, 5, 10, and 60 minutes, or PC to allow for a specific count time to be set from a PC.

**SELECTOR SWITCH:** Toggle switch to select alpha+beta, alpha only, or beta only

**RESET/READ HV:** A two position momentary action switch to allow for the meter to be reset or a reading of the HV setting.

**OVERLOAD:** Senses detector saturation. Indicated by red lamp on meter and meter deflecting to full scale *(Adjustable depending on detector selected)*

**RESPONSE:** Will vary according to the number of counts present. Typically 2 - 11 seconds from 10% - 90% of final reading

**POWER:** 2 each "D" cell batteries *(housed in compartment that in front of instrument)*

**BATTERY LIFE:** Greater than 150 hours *(battery condition can be checked on meter)*

**TEMPERATURE RANGE:** -4° F(-20° C) to 122° F(50° C)
Ludlum 2929 with 43-10-1 Probe - Alpha/Beta Bench Counter Operating Instructions

Instrument Operation:

1) Turn the selector knob to the “ON” position.
2) Instrument simultaneously displays alpha and beta.
3) Use numeral thumbwheel and multiplier to select count time.
4) Disengage sample tray locking device, and slide tray out.
5) Place smear or air sample in sample tray.
6) Slide in sample tray, and engage locking device.
7) Press “COUNT”.

Instrument Control Features:

**INDICATED USE:** Alpha beta sample counting with ZnS(Ag) adhered to plastic scintillation material

**SAMPLE HOLDER:** Anodized aluminum tray with 1” diameter sample ring to allow for 1” or 2” diameter samples

**SAMPLE SIZE (maximum):** 2” (5.1cm) diameter X 0.4” (0.9cm) thick

**AUDIO:** Built in unimorph type speakers with volume controls to provide a dual tone (1 per channel) click-per-event audio

**SCALERS:** 2 ea. 6 digit LED displays providing a range of 0 - 999999 counts (*controlled by COUNT and HOLD buttons*)

**TIMER:** Thumbwheel adjustment from 0 - 99 minutes with selectable divisions of X0.1, X1, X10, or EXT for manual timing

**METER DIAL:** 0 - 2.5 kV; BAT TEST

**TEMPERATURE RANGE:** -4° F (-20° C) to 122° F (50° C)
Bicron Model RSO – 50E MicroR Meter - Operating Instructions

Instrument Operation:

1) Turn the selector knob to the appropriate range.

Instrument Control Features:

**INDICATED USE:** Measurements of superficial or deep doses.
**METER DIAL:** 0 - 5 microR/hr, 0 - 50 microR/hr
**RANGE SELECTIONS:** 12 KeV – 7MeV
**LIGHT:** Push-button to activate
**RESET:** Adjustable potentiometer knob to zero
**POWER:** Two 9 volt cell batteries (housed in sealed compartment that is externally accessible)
**BATTERY LIFE:** Typically 250 hours with alkaline batteries (battery condition can be checked on meter)
**TEMPERATURE RANGE:** -4° F(-20° C) to 122° F(50° C)
# Frisker Setup Record

<table>
<thead>
<tr>
<th>Instrument Range</th>
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<td>Source Response (B)</td>
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<td></td>
<td>to</td>
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<tr>
<td>Efficiency(^2): (%)</td>
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</tbody>
</table>

\(^1\) ± 20% of observed background or source count rate.

\(^2\) Efficiency = Net count rate (B-A) / Source DPM

**Comments/Restrictions:**

---

Performed By ____________    Date ____________

(RPM/Designee) ____________ Date ____________
HEALTH PHYSICS PROCEDURE

AVESI HP-41

RADIOACTIVE MATERIAL SHIPPING

APPROVED BY: ___________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ___________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

To provide general requirements for shipment of radioactive material, including radioactive waste.

2.0 Scope

2.1 The requirements for the following types of radioactive material shipments are not defined by this procedure and must be defined by the Radiation Safety Officer (RSO) or Radiation Protection Manager (RPM), if assigned.

- Radioactive material containing other hazardous material
- Fissile material that is not “fissile excepted”
- Special Nuclear Material
- Oxidizing Class 7 radioactive material
- Pyrophoric Class 7 radioactive material
- Thorium nitrate
- Uranyl nitrate
- International shipments
- Rail shipments
- Vessel shipments
- Shipments via United States Postal Service
- Shipments via passenger aircraft

2.2 Computer software for radioactive material management, approved by the RSO or RPM, if assigned, may be used consistent with Administrative Procedure QAPP 19.1 “Software Quality Assurance (QA)” to execute applicable steps in this procedure and generate the forms necessary to properly document radioactive material shipments. Care must be exercised to ensure that all required information is included on computer generated forms.

2.3 Steps in this procedure may be performed in any order or in parallel.

3.0 References

3.1 Code of Federal regulations

A. 10 CFR 20, "Standards for Protection Against Radiation"
B. 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
C. 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
D. 10 CFR 71, "Packaging and Transportation of Radioactive Material"
E. 49 CFR 107 "Registration of Persons Who Offer or Transport Hazardous Materials"
F. 49 CFR 171-178, "Transportation"

3.2 International Air Transport Association (IATA) Dangerous Goods Regulations

3.3 U.S. Nuclear Regulatory Commission (NRC) Guidance Documents:
   A. I&E Bulletin No. 79-19
   B. I&E Notice 84-72

3.4 Vendor Radioactive or Special Nuclear Material Licenses

3.5 Appropriate Vendor’s Radioactive Waste Acceptance Criteria

4.0 Definitions

3.6 \( \text{A1:} \) The maximum activity of special form Class 7 (radioactive) material permitted in a Type A package. These values are either listed in 49 CFR 173.435, or derived, according to the procedure prescribed in 49 CFR 173.433.

3.7 \( \text{A1:} \) The maximum activity of Class 7 (radioactive) material, other than special form, LSA or SCO, permitted in a Type A package. These values are either listed in 49 CFR 173.435, or derived, according to the procedure prescribed in 49 CFR 173.433.

3.8 Bulk Packaging: A packaging, other than a vessel or a barge, including a transport vehicle or freight container, in which hazardous materials are loaded with no intermediate form of containment and which has:

   A. A maximum capacity greater than 450 L (119 gallons) as a receptacle for a liquid;
   B. A maximum net mass greater than 400 kg (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid; or
   C. A water capacity greater than 454 kg (1000 pounds) as a receptacle for a gas as defined in 49 CFR 173.115.

3.9 Cargo aircraft only: An aircraft that is used to transport cargo and is not engaged in carrying passengers.

1.1 Closed transport vehicle: A transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) material. The enclosure may be either temporary or permanent, and in the case of packaged materials, may be of the “see through” type, and must limit access from top, sides, and bottom.
1.2 **Consignment:** A package or group of packages or load of radioactive material offered by a person for transport in the same shipment.

1.3 **Contamination:** The presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm² for beta and gamma emitters and low toxicity alpha emitters or 0.04 Bq/cm² for all other alpha emitters. Contamination exists in two phases:
   A. Fixed radioactive contamination means radioactive contamination that cannot be removed from a surface during normal conditions of transport.
   B. Non-fixed radioactive contamination means radioactive contamination that can be removed during normal conditions of transport.

1.4 **Conveyance:**
   A. For transport by public highway: Any transport vehicle or large freight container.
   B. For transport by aircraft: Any aircraft.
   C. For transport by water: Any vessel or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel.

1.5 **Exclusive use:** Sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out according to the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must provide to the initial carrier specific written instructions for maintenance of exclusive use shipment controls, including the vehicle survey requirement of 49 CFR 173.443(c) as applicable, and include these instructions with the shipping paper information provided to the carrier by the consignor.

1.6 **Fissile material:** Plutonium-239, plutonium-241, uranium-233, uranium-235 or any combination of these nuclides. The definition does not apply to non-irradiated natural uranium and non-irradiated depleted uranium, or to natural uranium or depleted uranium that has been irradiated in thermal reactors only.

1.7 **Ground Transportation Only:** A shipment transported by commercial carrier over public highways only. Private vehicles and air carriers do not apply.

1.8 **Hazard class:** The category of hazard assigned to a hazardous material. The hazard class for radioactive material is “7.” See 49 CFR 172.101, Table A, for additional hazard classes.

1.9 **Hazardous material:** A substance or material, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been
so designated. The term includes hazardous substances, hazardous wastes, and materials designated as hazardous under the provision of 49 CFR 172.101.

1.10 **Hazardous substance:** A material, including its mixtures and solutions, that contain a Reportable Quantity, as listed in Appendix A to 172.101.

1.11 **Hazardous waste:** Means any material that is subject to the Hazardous Waste Manifest Requirements of the U.S. Environmental Protection Agency specified in 40 CFR Part 262.

1.12 **Hazmat Employee:** A person who is employed by a hazmat employer and who, in the course of employment, directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term includes an individual, employed by a hazmat employer who, during the course of employment:

   A. Loads, unloads, or handles hazardous materials;

   B. Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packaging as qualified for use in the transportation of hazardous materials;

   C. Prepares hazardous materials for transportation;

   D. Is responsible for safety of transporting hazardous materials; or

   E. Operates a vehicles used to transport hazardous materials.

1.13 **Hazmat Employer:** A person who uses one or more of its employees in connection with: transporting hazardous materials in commerce; causing hazardous materials to be transported or shipped in commerce; or representing, marking, certifying, selling, offering manufacturing, reconditioning, testing, repairing, or modifying containers, drums, or packaging as qualified for use in the transportation of hazardous materials. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term also includes any department, agency, or instrumentality of the United States, a State, a political subdivision of a State, or an Indian tribe engaged in an activity described in the first sentence of this definition.

1.14 **Hermetically sealed:** Closed by fusion, gasketing, crimping, or equivalent means so that no gas or vapor can enter or escape.

1.15 **Highway route controlled quantity:** A quantity within a single package that exceeds:
A. 3,000 times the A1 value of the radionuclides as specified in 49 CFR 173.435 for special form Class 7 (radioactive) material;

B. 3,000 times the A2 value of the radionuclides as specified in 49 CFR 173.435 for normal form Class 7 (radioactive) material; or

C. 1,000 TBq (27,000 Ci), whichever is least.

1.16 **IATA**: Acronym for International Air Transport Association.

1.17 **Inner packaging**: A packaging for which an outer packaging is required for transport. It does not include the inner receptacle of a composite packaging.

1.18 **Inner receptacle**: A receptacle which requires an outer packaging to perform its containment function. The inner receptacle may be an inner packaging of a combination packaging or the inner receptacle of a composite packaging.

1.19 **Limited Quantity**: The maximum amount of a hazardous material for which there is a specific labeling or packaging exception.

1.20 **Limited Quantity of Class 7 (radioactive) Material**: A quantity of Class 7 (radioactive) material not exceeding the materials package limits specified in 49 CFR 173.425 and conforming with requirements specified in 49 CFR 173.421.

1.21 **Liquid**: A material, other than an elevated temperature material, with a melting point or initial melting point of 20 °C (68 °F) or lower at a standard pressure of 101.3 kpa (14.7 psi). A viscous material for which a specific melting point cannot be determined, must be subjected to the procedures specified in ASTM D 4359 “standard test method for determining whether a material is liquid or solid.”

1.22 **Low Specific Activity (LSA)**: Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

A. **LSA I**:

   1. Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;

   2. Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;
3. Radioactive material other than fissile material, for which the $A_2$ value is unlimited; or

4. Other radioactive material, excluding fissile material in quantities not excepted under 49 CFR 173.453, in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 49 CFR 173.436, or 30 times the default values listed in Table 8 of 49 CFR 173.433.

B. LSA-II:

1. Water with tritium concentration up to 0.8 TBq/liter (20 Ci/ liter); or

2. Material in which the Class 7 (radioactive) material is distributed throughout and the average specific activity does not exceed $10^{-4} A_2/g$ for solids and gases, and $10^{-5} A_2/g$ for liquids.

C. LSA-III: Solids (for example, consolidated wastes, activated materials), excluding powders, that meet the requirements of 49 CFR 173.468 and which:

1. The Class 7 (radioactive) material is distributed throughout a solid or a collection of solid objects, or is distributed throughout in a solid compact binding agent (such as, concrete, bitumen, ceramic, and so forth);

2. The Class 7 (radioactive) material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) material per package by leaching which placed in water for seven days would not exceed 0.1 $A_2$; and

3. The estimated average specific activity of the solid does not exceed $2.0 \times 10^{-3} A_2/g$.

1.23 Low toxicity alpha emitters:

A. Natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; and

B. Alpha emitters with a half-life of less than ten days.
1.24 **Marking:** A descriptive name, identification number, instruction, cautions, weight, specification, or UN marks, or combinations thereof, required by this procedure on outer packaging of hazardous materials.

1.25 **Non-bulk packaging:** Packaging, which has the following:

A. A maximum capacity of 450 L (119 gallons) or less as a receptacle for a liquid;

B. A maximum net mass of 400 kg (882 pounds) or less and a maximum capacity of 450 L (119 gallons) or less as a receptacle for a solid; or

C. A water capacity of 454 kg (1000 pounds) or less as a receptacle for a gas as defined in 49 CFR 173.115.

1.26 **Normal form Class 7 (radioactive) material:** Class 7 (radioactive) material which has not been demonstrated to qualify as “special form Class 7 (radioactive) material.”

1.27 **Outer packaging:** The outermost enclosure of a composite or combination packaging together with any absorbent materials, cushioning and any other components necessary to contain and protect inner receptacles or inner packaging.

1.28 **Over-pack:** An enclosure that is used by a single consignor to provide protection or convenience in handling of a package or to consolidate two or more packages. Over-pack does not include a transport vehicle, freight container, or aircraft unit load device.

1.29 **Package:** For Class 7 (radioactive) material, the packaging together with its radioactive contents as presented for transport.


B. “Type A package” means a packaging that, together with its radioactive contents limited to A1 or A2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate. A Type A package does not require Competent Authority Approval.
C. “Type B package” means a packaging designed to transport greater than an A1 or A2 quantity of radioactive material that, together with its radioactive contents, is designed to retain the integrity of containment and shielding, when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

1. “Type B (U) package” means a Type B packaging that, together with its radioactive contents, for international shipments requires unilateral approval only of the package design and of any stowage provisions that may be necessary for heat dissipation.

2. “Type B (M) package” means a Type B packaging, together with its radioactive contents, that for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment. Type B (M) packages are those Type B package designs which have a maximum normal operating pressure of more than 700 kilopascals per square centimeter (100 pounds per square inch) gauge or a relief device which would allow the release of Class 7 (radioactive) material to the environment under the hypothetical accident conditions specified in 10 CFR Part 71.

D. “Fissile material package” means a packaging, together with its fissile material contents, which meets the requirements for fissile material packages described in subpart E of 10 CFR 71. A fissile material package may be a Type AF package, a Type B(U)F package, or a Type B(M)F package.

E. “Industrial package” means a packaging that, together with its low specific activity (LSA) material or surface contaminated object (SCO) contents, meets the requirement of 49 CFR 173.410 and 173.411. Industrial packages are categorized in 49 CFR173.411 as either:

1. “Industrial package Type 1 (IP-1)”;
2. “Industrial package Type 2 (IP-2)”;
3. “Industrial package Type 3 (IP-3)”

1.30 Packaging: For Class 7 (radioactive) materials, the assembly of components necessary to ensure compliance with the packaging requirements of this procedure. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, service equipment for filling, emptying, venting and pressure relief, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging.
1.31 **Proper shipping name:** The name of the hazardous material shown in Roman print (not italics) in 49 CFR 172.101.

1.32 **Proper shipping name:** The name of the hazardous material shown in Roman print (not italics) in 49 CFR 172.101.

1.33 **Radioactive contents:** A Class 7 (radioactive) material, together with any contaminated or activated solids, liquids and gases within the package.

1.34 **Radioactive instrument and article:** Any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article having Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.

1.35 **Radioactive material:** Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in 49 CFR 173.436 or values derived according to the instructions in 49 CFR 173.433.

1.36 **Reportable Quantity (RQ):** Those quantities of radioactive materials deemed by EPA and DOT (49 CFR 172.101, Appendix A, Column 2) needed to be reported in the event of a spill. Releases of radionuclides must be reported to the State Emergency Response Center of the affected state.

   A. The letters "RQ" are to appear on all non-bulk packages containing a hazardous substance in association with the proper shipping name.

   B. Radioactive Manifests are to include the letters "RQ" with the shipping name prescribed for the material, if there is a reportable quantity in the shipment.

1.37 **Sievert (Sv):** The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 1 J/kg = 100 rem).

1.38 **Special Nuclear Material 10 CFR 74.4:**

   A. Plutonium, uranium-233, uranium enriched in the isotope uranium-233 or in the isotope uranium-235, or any other material which the Commission pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or

   B. Any material artificially enriched by any of the foregoing, but does not include source material.
1.39 Special form Class 7 (radioactive) material: Either an indispensible solid radioactive material or a sealed capsule containing radioactive material which satisfies the following conditions:

A. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

B. The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

C. It satisfies the test requirements of 49 CFR 173.469.

1.40 Specific activity of a radionuclide: The activity of a radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

1.41 Surface Contaminated Object (SCO): A solid object which is not itself radioactive but which has Class 7 (radioactive) material distributed on any of its surfaces.

A. SCO - I: A solid object on which:

1. The non-fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4.0 Bq/cm² (10⁻⁴ microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm² (10⁻⁵ microcuries/cm²) for alpha emitters;

2. The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4.0 X 10⁴ Bq/cm² (1.0 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 4.0 X 10³ Bq/cm² (0.1 microcuries/cm²) for all other alpha emitters; and

3. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4.0 X 10⁴ Bq/cm² (1.0 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 4.0 X 10³ Bq/cm² (0.1 microcuries/cm²) for all other alpha emitters.

B. SCO - II: A solid object on which the limits for SCO - I are exceeded and on which:

1. The non-fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not
exceed 400 Bq/cm² (10⁻² microcuries/cm²) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm² (10⁻³ microcuries/cm²) for all other alpha emitters;

2. The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 8.0 X 10⁵ Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters or 8.0 X 10⁴ Bq/cm² (2.0 microcuries/cm²) for all other alpha emitters; and

3. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 8.0 X 10⁵ Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters or 8.0 X 10⁴ Bq/cm² (2.0 microcuries/cm²) for all other alpha emitters.

1.42 Transport index (TI): The dimensionless number (rounded up to the next tenth) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The Transport Index is equivalent to the maximum radiation level in mrem/h at one meter (3.3 feet) from the external surface of the package.

1.43 Transport vehicle: A cargo-carrying vehicle such as an automobile, van, tractor, truck, semi trailer, tank car or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (trailer, rail car, and so forth) is a separate transport vehicle.

1.44 Type A quantity: A quantity of Class 7 (radioactive material, the aggregate radioactivity which does not exceed A₁ for special form Class 7 (radioactive) material or A₂ for normal form Class 7 (radioactive) material.

1.45 Type B quantity: A quantity of material greater than a Type A quantity.

1.46 U.S. DOT Hazmat Reg. No. (49 CFR 107): The registration number that corresponds to the annual registration and fee requirements which apply to any person who offers for transportation, or transports hazardous material, in foreign, interstate or intrastate commerce.

5.0 Responsibilities

5.1 The Transportation Representative (or RSO/RPM if none assigned), is responsible for:

A. Making interpretation of regulations governing the transportation of radioactive materials.
B. Ensuring that shipments of radioactive materials performed by or under the control of AVESI comply with federal, state and, if applicable, burial or processing site criteria.

C. Ensuring all personnel involved in packaging and shipping radioactive material are properly trained and qualified and this training is maintained current in accordance with applicable federal regulations and AVESI requirements.

5.2 Health Physics Technicians are responsible for:
A. Preparing radioactive materials for shipment according to applicable regulations.
B. Ensuring that required shipping surveys are complete and accurate.

6.0 Procedure
6.1 Specifications
6.1.1 General Packaging Requirements:

A. Radiolytically Generated Combustible Gases
1. For any package containing water or organic substances (such as, resins, binders, waste sludge, and wet filters) or a combination of both that could radiolytically generate combustible gases, tests or measurements or calculations must be performed on a representative package to determine whether or not the following criteria is met for a period of time that is twice the expected shipment time:
   a. The hydrogen generated must be limited to a molar quantity that would be no more than 5% by volume (or equivalent limits for other inflammable gases) of the secondary container gas void, if present, at STP (for example, not more that 0.063 g-moles/ft³ at 14.7 psia and 70 degrees (F));

   OR

   b. The secondary container and cask cavity must be inerted with a diluent to ensure that oxygen is limited to 5% by volume in those portions of the package that could have hydrogen greater than 5%.

2. For any package delivered to a carrier for transport, the secondary container must be prepared for shipment in the same manner in which determination for gas generation is made. The shipment
period begins when the package is prepared (sealed) and must be completed within twice the expected shipment time.

3. For any package containing materials with radioactivity concentrations not exceeding that for Low Specific Activity (LSA) material, and shipped within ten days of preparation, or within ten days after venting of drums or other secondary containers, the determination above need not be made, and the time restriction above does not apply.

4. If the ten-day preparation time is not feasible, then specific approval must be obtained from NRC Office of Nuclear Materials and Safeguards. The application should address those factors that would preclude the generation of combustible gases over at least twice the expected shipment time.

5. For dry compacted or non-compactable waste and irradiated hardware, the combustible gas criterion does not apply.

6.2 Precautions

6.2.1 Radioactive material packages and shipments of radioactive material prepared for transport shall remain under the control of the AVESI Health Physics Program until the driver has signed all applicable shipping papers and assumed responsibility for the conveyance.

6.2.2 NRC certified packages shall be used according to the conditions stated on the Certificate of Compliance. Confirm possession of the current Certificate of Compliance before each use.

6.2.3 The requirements in NRC IE Information Notice 84-72 for hydrogen gas generation determination shall be implemented if a Certificate of Compliance for a NRC certified package does not include equivalent requirements for hydrogen gas generation determination.

6.2.4 Calculations and computer data inputs shall be conducted with great attention to detail, as per QAPP 19.1. Special attention to detail shall be given to the use of formulas and units.

6.2.5 Radioactive material with subsidiary hazards shall be identified and marked, labeled or placarded, as appropriate. Requirements for subsidiary hazards shall be according to instruction provided by the Transportation Representative.

6.2.6 Typically, resin, dry active waste (DAW) and laundry are classified as LSA. For other material to be treated as LSA distributed mixtures, the
specific activity differences between portions of the shipment volume should be less than a factor of ten. The Transportation Representative should be consulted for this determination.

6.2.7 Package and vehicle radiation and contamination levels shall not exceed the administrative limits provided in Attachment 1, *Package and Transport Vehicle Radiation Limits*, and Attachment 2, *Non-Fixed (Removable) Contamination Limits* unless authorized by the Transportation Representative.

6.3 Procedure

6.3.1 Radioactive Shipment Authorization and Notification

A. **BEFORE** making a shipment of radioactive material, **CONFIRM** that the intended recipient's license authorizes the type, form, and quantity of byproduct material to be transferred.

1. **OBTAIN** a current copy of the recipient's license or registration certificate.

   a. **IF** performing an emergency shipment **AND** confirmation will be sent in writing or electronically within ten days, **THEN** **ACCEPT** oral certification from the recipient that they possess a license to receive the type, form and quantity of by-product material to be shipped.

   (1) **RECORD** and **RETAIN** with the appropriate shipping package documentation, the following information from the oral certification:

      • License or registration certificate number
      • Issuing agency
      • Expiration date

   b. **IF not** performing an emergency shipment, **THEN** **VERIFY** through one of the following methods that the most current revision of the recipient’s license or registration certificate is being used:

      • Phone or electronically or a combination of both

   **OR**
• A written or electronic certification by the recipient authorizing the type, form and quantity of by-product material to be shipped

c. **CONFIRM** the following information is included in the certification:
   • License or registration certificate number
   • Issuing agency
   • Expiration date

B. **IF** transferring samples to a non-licensed laboratory, **THEN CONFIRM** the following:
   • The sample radioactivity concentration does *not* exceed the requirements of 10 CFR 30.14 AND the total package activity to be transferred does not exceed 10 CFR 30.18
   • The sample does *not* contain special nuclear material OR radionuclides other than those listed in 10 CFR 30.71, Schedule B
   • The transfer is *not* for purposes of waste disposal

C. **IF** preparing a shipment that meets any of the categories in 49 CFR 107.601, **THEN CONFIRM** AVESI has a current DOT Hazardous Materials registration number.

6.3.2 Choice of Shipment Mode

**NOTE:**

Package and vehicle radiation and contamination levels shall not exceed the administrative limits provided in Attachment 1, *Package and Transport Vehicle Radiation Limits*, and Attachment 2, *Non-Fixed (Removable) Contamination Limits*, unless authorized by the Transportation Representative.

A. **CHOOSE** a shipment mode, as follows:

1. Radioactive material, excepted package-empty package:
   a. A radioactive material shipment, which includes any package or container which previously contained radioactive material and has been emptied of content as far as practical, is excepted from the shipping paper and certification, marking (except for UN identification number) and labeling requirements provided that the conditions in 49 CFR 173.428(a) through (f) are met.

2. Radioactive material, excepted package-instruments or articles:
NOTE:
Process monitors containing radioactive check sources, explosive detectors, and the NITON XRF analyzer are examples of items that may be shipped as radioactive material, instruments or articles.

a. A radioactive material shipment which includes instruments and manufactured articles or similar devices having radioactive materials in gaseous or non-dispersible solid form as a component part is excepted from the shipping paperwork, marking (except for UN identification number) and labeling requirements provided:

(1) The activity of the instrument or article and package does not exceed the limits in Attachment 3, Activity Limits for Limited Quantities, Instruments and Articles.

3. Radioactive material, excepted package-limited quantity (LQ):
   a. A radioactive material shipment in which the activity per package does not exceed the limits in Attachment 3, Activity Limits for Limited Quantities, Instruments and Articles, is excepted from the shipping paperwork, marking (except for UN identification number) and labeling requirements.

   b. When a limited quantity radioactive material meets the definition of another hazard class or division, it must be classed and packaged as directed by the Transportation Representative.

   c. Solids, liquids and gases may all be shipped as limited quantities if the activity limits are not exceeded.

4. Radioactive material, low specific activity (LSA):
   a. LSA is radioactive material with limited specific activity which satisfies the descriptions and limits set forth. Shielding material surrounding the LSA material may not be used in determining the estimated average specific activity of the package contents. LSA material must be in one of the three categories described in 49 CFR 173.403 as LSA I, II or III.

   b. LSA material may be classified as LSA I, II or III. Additionally;

      (1) Material may not contain fissile material unless excepted.
Exceptions are applied to small quantities (not greater than 15 grams) and to situations where criticality is impossible under any circumstance, such as very dilute solutions and mixtures.

(2) The external dose rate must not exceed 1.0 rem/h at 3 meters (9.8 ft) from the unshielded material.

(3) Except for transportation by aircraft, LSA material with very low concentrations of hydrogen-3 or carbon-14 (0.05 μCi/g or 1.85 KBq/g) in liquid scintillation media or animal tissue are excepted from radioactive material shipping requirements when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions relating to that hazard class.

c. The quantity of LSA in any single conveyance shall not exceed the limits in Attachment 4, LSA and SCO Conveyance Limits.

5. Radioactive material, surface contaminated object (SCO):
   a. SCOs are solid objects, which not by itself are radioactive, but have radioactive material distributed on any of its surfaces. SCO must be in one of two groups, SCO-I or SCO-II, with the surface activity not exceeding the limits in Attachment 5, Surface Contaminated Object (SCO) Limits.
   
b. The quantity of SCO material in a single conveyance shall not exceed the limits in Attachment 4, LSA and SCO Conveyance Limits.

6. Type A and Type B radioactive material:
   a. A radioactive material shipment which could exceed the limits for LSA and could be shipped in either DOT Type A or B packaging is not excepted from specification packaging, marking and labeling requirements and shipping paperwork.

7. Radioactive material, special form:
   a. A radioactive material shipment which satisfies all of the following conditions can be considered special form:
      (1) Either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;
(2) The piece or capsule has at least one dimension no less than 5 millimeters (0.197 inch); and
(3) Satisfies the test requirements of 49 CFR 173.469 and 10 CFR 71.75.

b. Specific guidance for shipment of special form radioactive material shall be provided by the Transportation Representative.

8. Radioactive material, fissile:
   a. A radioactive material shipment which includes one or more fissile radionuclides. These nuclides are uranium-233, uranium-235, plutonium-239 and plutonium-241 (refer to 49 CFR 173.453 for fissile material exceptions).

   b. Specific guidance for shipment of fissile material shall be provided by the Transportation Representative.

7.0 Records
   No records are generated by this procedure.
## Attachment 1

**PACKAGE AND TRANSPORT VEHICLE RADIATION LIMITS**

<table>
<thead>
<tr>
<th>External Package Surface</th>
<th>AVESI Administrative Limit (mrem/h)(^1)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exected package – Empty Package</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Exected package – Limited Quantity</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Exected package – Instruments and Articles</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>(1.5 if exclusive use, domestic transport)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.0 at 10 cm from any point on external surface of unpackaged instrument or article</td>
<td>10</td>
</tr>
<tr>
<td>Non-Exclusive Use-all package surfaces</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>(TI ≤ 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclusive Use Open Transportation Vehicle-all package surfaces(^2)</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Exclusive Use Closed Transport - all package surfaces(^3)</td>
<td>700</td>
<td>1,000</td>
</tr>
</tbody>
</table>

### The Following Apply to Exclusive Use Transport Vehicles

<table>
<thead>
<tr>
<th>Outer Surface of Vehicle</th>
<th>AVESI Administrative Limit (mrem/h)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Transport Vehicle – any surface including top and underside of vehicle</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Open Transport Vehicle – any point on vertical planes projected by outer edges, on upper surface of load or enclosure and lower external surface of vehicle</td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 Meters</th>
<th>AVESI Administrative Limit (mrem/h)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Transport Vehicle – any point 2 m from outer lateral surfaces (excluding top and underside of vehicle)</td>
<td>7.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Open Transport Vehicle – any point 2 m from vertical planes projected by outer edges (excluding top and underside of vehicle)</td>
<td>7.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Any Normal Occupied Space</th>
<th>AVESI Administrative Limit (mrem/h)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cab of vehicle, including sleeping compartment</td>
<td>1.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

---

1. AVESI administrative limits may be exceeded with the approval of the RSO or RPM, if assigned. However, the DOT limits shall never be exceeded.

2. Packages with a TI greater than 10 must be shipped exclusive use.

3. The following conditions must also be met:
   - Shipment is in a closed transport vehicle;
   - Package is secured within the vehicle so that it’s position remains fixed during transportation; and
   - There are no loading or unloading operations between the beginning and end of transportation.
Attachment 2

NON-FIXED (REMOVABLE) CONTAMINATION LIMITS

<table>
<thead>
<tr>
<th></th>
<th>AVESI Administrative Limit (dpm/100 cm²)¹,²</th>
<th>DOT Limit (dpm/100 cm²)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Package Surface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>1,000</td>
<td>22,000</td>
</tr>
<tr>
<td>All other alpha emitting radionuclides</td>
<td>20</td>
<td>2,200</td>
</tr>
<tr>
<td><strong>The Following Apply to Exclusive Use Transport Vehicles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Package Surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>N/A</td>
<td>220,000 ³,⁴,⁶</td>
</tr>
<tr>
<td>All other alpha emitting radionuclides</td>
<td>N/A</td>
<td>22,000 ³,⁴,⁶</td>
</tr>
<tr>
<td>Transport Vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>1,000</td>
<td>22,000 ⁵,⁶</td>
</tr>
<tr>
<td>All other alpha emitting radionuclides</td>
<td>20</td>
<td>2,200 ⁵,⁶</td>
</tr>
</tbody>
</table>

1. Averaged over 300 cm² with a wipe efficiency assumed to be 0.1.

2. AVESI administrative limits may be exceeded with the approval of the RSO or RPM, if assigned. However, the DOT limits shall never be exceeded.

3. Packages transported as exclusive use shipments may not exceed these limits at any time during transport. The contamination levels at the beginning of transport may not exceed 22,000 dpm/100 cm² βγ or 2,200 dpm/100 cm² α (AVESI administrative limits apply at the beginning of transport).

4. The vehicle may not be placed back into service until there is no significant removable surface contamination (not greater than 22,000 dpm/100 cm² βγ or 2,200 dpm/100 cm² α) and the dose rate at each accessible surface is 0.5 nrem/h or less.

5. Applies to all transport vehicle surfaces.

6. These limits do not apply to the interior surfaces of a closed transport vehicle used solely for the transportation of Class 7 material packages with contamination levels that do not exceed 220,000 dpm/100 cm² βγ or 22,000 dpm/100 cm² α if the conditions of 49 CFR 173.443(d)(1), (2) and (3) are satisfied.
# ACTIVITY LIMITS FOR LIMITED QUANTITIES, INSTRUMENTS AND ARTICLES

<table>
<thead>
<tr>
<th>Nature of Contents</th>
<th>Instruments and Articles</th>
<th>Material Package Limits¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instrument and Article Limits¹</td>
<td>Package Limits¹</td>
</tr>
<tr>
<td>Solids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Form</td>
<td>≤ 1E-2 A₁</td>
<td>≤ A₁</td>
</tr>
<tr>
<td>Other Form</td>
<td>≤ 1E-2 A₂</td>
<td>≤ A₂</td>
</tr>
<tr>
<td>Liquids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tritiated Water:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 0.1 Ci/liter²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tritiated Water:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 Ci/liter to 1.0 Ci/liter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 0.1 Ci/liter</td>
<td>≤ 1E-3 A₂</td>
<td>≤ 1E-1 A₂</td>
</tr>
<tr>
<td>Other liquids</td>
<td>≤ 1E-3 A₂</td>
<td>≤ 1E-1 A₂</td>
</tr>
<tr>
<td>Gases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tritium³</td>
<td>≤ 2E-2 A₂</td>
<td>≤ 2E-1 A₂</td>
</tr>
<tr>
<td>Special Form</td>
<td>≤ 1E-3 A₁</td>
<td>≤ 1E-2 A₁</td>
</tr>
<tr>
<td>Other Form</td>
<td>≤ 1E-3 A₂</td>
<td>≤ 1E-2 A₂</td>
</tr>
</tbody>
</table>

1. For mixtures of radionuclides, see 49 CFR 173.433. Although outside the scope of this procedure, for ground transport via U.S. Postal Service the allowable limits are 10% of the values in this table. NOTE: Air transport of Class 7 radioactive material via the U.S. Postal Service is prohibited.

2. 1 Ci/liter = 1 mCi/ml = 1,000 μCi/ml

3. These values apply to tritium in activate luminous paint and tritium absorbed on solid carriers.
## Attachment 4

### LSA AND SCO CONVEYANCE LIMITS

<table>
<thead>
<tr>
<th>Material</th>
<th>Activity Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSA-I</td>
<td>No Limit</td>
</tr>
<tr>
<td>LSA-II and LSA-III; Non-combustible solids</td>
<td>No Limit</td>
</tr>
<tr>
<td>LSA-II and LSA-III; Combustible solids and all liquids and gases</td>
<td>100 A&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>SCO</td>
<td>100 A&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
## SURFACE CONTAMINATED OBJECT (SCO) LIMITS

<table>
<thead>
<tr>
<th>SCO Type</th>
<th>Accessible Surfaces</th>
<th>Inaccessible Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Fixed (dpm/100cm²)</td>
<td>Fixed (dpm/100cm²)</td>
</tr>
<tr>
<td>SCO-I Beta, Gamma and low toxicity Alpha emitters¹</td>
<td>22,200</td>
<td>2.22E+08</td>
</tr>
<tr>
<td>SCO-I Alpha emitters</td>
<td>2,220</td>
<td>2.22E+07</td>
</tr>
<tr>
<td>SCO-II Beta, Gamma and low toxicity Alpha emitters¹</td>
<td>222,000</td>
<td>4.44E+09</td>
</tr>
<tr>
<td>SCO-II Alpha emitters</td>
<td>222,000</td>
<td>4.44E+08</td>
</tr>
</tbody>
</table>

¹ Low toxicity alpha emitters: Natural uranium, depleted uranium, and natural thorium; ores, concentrates or tailings containing U-235, U-238, Th-232, Th-228 and Th-230; or alpha emitters with half-life less than 10 days.
PACKAGING AND SHIPPING OF RADIOACTIVE MATERIAL/WASTE

General Requirements

APPROVED BY: Michael J. Donah
Certified Health Physicist (CAVESI HP) DATE: 7/06/2010

APPROVED BY: [Signature]
Radiation Protection Manager (RPM) DATE: 7/06/2010
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LIST OF ATTACHMENTS

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Attachment 2, Non-Fixed (Removable) Contamination Limits........................................11
Attachment 3, Activity Limits for Limited Quantities, Instruments and Articles...........12
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Attachment 5, Surface Contamination Object (SCO) Limits.........................................14
1.0 Purpose

To provide general requirements for shipment of radioactive material, including radioactive waste.

2.0 Scope

2.1 The requirements for the following types of radioactive material shipments are not defined by this procedure and must be defined by the Radiation Safety Officer (RSO) or Radiation Protection Manager (RPM), if assigned.

- Radioactive material containing other hazardous material
- Fissile material that is not “fissile excepted”
- Special Nuclear Material
- Oxidizing Class 7 radioactive material
- Pyrophoric Class 7 radioactive material
- Thorium nitrate
- Uranyl nitrate
- International shipments
- Rail shipments
- Vessel shipments
- Shipments via United States Postal Service
- Shipments via passenger aircraft

2.2 Computer software for radioactive material management, approved by the RSO or RPM, if assigned, may be used consistent with Administrative Procedure QAPP 19.1 “Software Quality Assurance (QA)” to execute applicable steps in this procedure and generate the forms necessary to properly document radioactive material shipments. Care must be exercised to ensure that all required information is included on computer generated forms.

2.3 Steps in this procedure may be performed in any order or in parallel.

3.0 References

3.1 Code of Federal regulations
A. 10 CFR 20, "Standards for Protection Against Radiation"
B. 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
C. 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
D. 10 CFR 71, "Packaging and Transportation of Radioactive Material"
E. 49 CFR 107 "Registration of Persons Who Offer or Transport Hazardous Materials"
3.2 International Air Transport Association (IATA) Dangerous Goods Regulations
3.3 U.S. Nuclear Regulatory Commission (NRC) Guidance Documents:
   A. I&E Bulletin No. 79-19
   B. I&E Notice 84-72
3.4 Vendor Radioactive or Special Nuclear Material Licenses
3.5 Appropriate Vendor’s Radioactive Waste Acceptance Criteria

4.0 Definitions
   See AVESI HP-61, Packaging and Shipment of Radioactive Material/Waste, Definitions

5.0 Responsibilities
5.1 The Transportation Representative (or RSO/RPM if none assigned), is responsible for:
   A. Making interpretation of regulations governing the transportation of radioactive materials.
   B. Ensuring that shipments of radioactive materials performed by or under the control of AVESI comply with federal, state and, if applicable, burial or processing site criteria.
   C. Ensuring all personnel involved in packaging and shipping radioactive material are properly trained and qualified and this training is maintained current in accordance with applicable federal regulations and AVESI requirements.
5.2 Health Physics Technicians are responsible for:
   A. Preparing radioactive materials for shipment according to applicable regulations.
   B. Ensuring that required shipping surveys are complete and accurate.

6.0 Procedure
6.1 Specifications
   6.1.1 General Packaging Requirements:
   A. Radiolytically Generated Combustible Gases
1. For any package containing water or organic substances (such as, resins, binders, waste sludge, and wet filters) or a combination of both that could radiolytically generate combustible gases, tests or measurements or calculations must be performed on a representative package to determine whether or not the following criteria is met for a period of time that is twice the expected shipment time:
   a. The hydrogen generated must be limited to a molar quantity that would be no more than 5% by volume (or equivalent limits for other inflammable gases) of the secondary container gas void, if present, at STP (for example, not more that 0.063 g-moles/ft³ at 14.7 psia and 70 degrees (F));

   OR

   b. The secondary container and cask cavity must be inerted with a diluent to ensure that oxygen is limited to 5% by volume in those portions of the package that could have hydrogen greater than 5%.

2. For any package delivered to a carrier for transport, the secondary container must be prepared for shipment in the same manner in which determination for gas generation is made. The shipment period begins when the package is prepared (sealed) and must be completed within twice the expected shipment time.

3. For any package containing materials with radioactivity concentrations not exceeding that for Low Specific Activity (LSA) material, and shipped within ten days of preparation, or within ten days after venting of drums or other secondary containers, the determination above need not be made, and the time restriction above does not apply.

4. If the ten-day preparation time is not feasible, then specific approval must be obtained from NRC Office of Nuclear Materials and Safeguards. The application should address those factors that would preclude the generation of combustible gases over at least twice the expected shipment time.

5. For dry compacted or non-compactable waste and irradiated hardware, the combustible gas criterion does not apply.
6.2 Precautions

6.2.1 Radioactive material packages and shipments of radioactive material prepared for transport shall remain under the control of the AVESI Health Physics Program until the driver has signed all applicable shipping papers and assumed responsibility for the conveyance.

6.2.2 NRC certified packages shall be used according to the conditions stated on the Certificate of Compliance. Confirm possession of the current Certificate of Compliance before each use.

6.2.3 The requirements in NRC IE Information Notice 84-72 for hydrogen gas generation determination shall be implemented if a Certificate of Compliance for a NRC certified package does not include equivalent requirements for hydrogen gas generation determination.

6.2.4 Calculations and computer data inputs shall be conducted with great attention to detail, as per QAPP 19.1. Special attention to detail shall be given to the use of formulas and units.

6.2.5 Radioactive material with subsidiary hazards shall be identified and marked, labeled or placarded, as appropriate. Requirements for subsidiary hazards shall be according to instruction provided by the Transportation Representative.

6.2.6 Typically, resin, dry active waste (DAW) and laundry are classified as LSA. For other material to be treated as LSA distributed mixtures, the specific activity differences between portions of the shipment volume should be less than a factor of ten. The Transportation Representative should be consulted for this determination.

6.2.7 Package and vehicle radiation and contamination levels shall not exceed the administrative limits provided in Attachment 1, Package and Transport Vehicle Radiation Limits, and Attachment 2, Non-Fixed (Removable) Contamination Limits unless authorized by the Transportation Representative.

6.3 Procedure

6.3.1 Radioactive Shipment Authorization and Notification

A. BEFORE making a shipment of radioactive material, CONFIRM that the intended recipient's license authorizes the type, form, and quantity of byproduct material to be transferred.

1. OBTAIN a current copy of the recipient's license or registration certificate.
a. **IF** performing an emergency shipment **AND** confirmation will be sent in writing or electronically within ten days, **THEN ACCEPT** oral certification from the recipient that they possess a license to receive the type, form and quantity of by-product material to be shipped.

(1) **RECORD** and **RETAIN** with the appropriate shipping package documentation, the following information from the oral certification:

- License or registration certificate number
- Issuing agency
- Expiration date

b. **IF not** performing an emergency shipment, **THEN VERIFY** through one of the following methods that the most current revision of the recipient’s license or registration certificate is being used:

- Phone or electronically or a combination of both

  **OR**

- A written or electronic certification by the recipient authorizing the type, form and quantity of by-product material to be shipped

c. **CONFIRM** the following information is included in the certification:

- License or registration certificate number
- Issuing agency
- Expiration date

B. **IF** transferring samples to a non-licensed laboratory, **THEN CONFIRM** the following:

- The sample radioactivity concentration does **not** exceed the requirements of 10 CFR 30.14 **AND** the total package activity to be transferred does not exceed 10 CFR 30.18
- The sample does **not** contain special nuclear material **OR** radionuclides other than those listed in 10 CFR 30.71, Schedule B
- The transfer is **not** for purposes of waste disposal
C. **IF** preparing a shipment that meets any of the categories in 49 CFR 107.601, **THEN CONFIRM** AVESI has a current DOT Hazardous Materials registration number.

6.3.2 Choice of Shipment Mode

**NOTE:**

Package and vehicle radiation and contamination levels shall not exceed the administrative limits provided in Attachment 1, *Package and Transport Vehicle Radiation Limits*, and Attachment 2, *Non-Fixed (Removable) Contamination Limits*, unless authorized by the Transportation Representative.

A. **CHOOSE** a shipment mode, as follows:

1. Radioactive material, excepted package-empty package:
   a. A radioactive material shipment, which includes any package or container which previously contained radioactive material and has been emptied of content as far as practical, is excepted from the shipping paper and certification, marking (except for UN identification number) and labeling requirements provided that the conditions in 49 CFR 173.428(a) through (f) are met.
   

2. Radioactive material, excepted package-instruments or articles:

   **NOTE:**
   Process monitors containing radioactive check sources, explosive detectors, and the NITON XRF analyzer are examples of items that may be shipped as radioactive material, instruments or articles.

   a. A radioactive material shipment which includes instruments and manufactured articles or similar devices having radioactive materials in gaseous or non-dispersible solid form as a component part is excepted from the shipping paperwork, marking (except for UN identification number) and labeling requirements provided:

      (1) The activity of the instrument or article and package does not exceed the limits in Attachment 3, *Activity Limits for Limited Quantities, Instruments and Articles*.

   b. **REFER** to AVESI HP-65, *Shipment of Radioactive Material, Excepted Package, Instruments or Articles* for specific shipping guidance.
3. Radioactive material, excepted package-limited quantity (LQ):
   a. A radioactive material shipment in which the activity per package does not exceed the limits in Attachment 3, Activity Limits for Limited Quantities, Instruments and Articles, is excepted from the shipping paperwork, marking (except for UN identification number) and labeling requirements.

   b. When a limited quantity radioactive material meets the definition of another hazard class or division, it must be classed and packaged as directed by the Transportation Representative.

   c. Solids, liquids and gases may all be shipped as limited quantities if the activity limits are not exceeded.

   d. REFER to AVESI HP-60, Radioactive Materials Shipping, for specific shipping guidance.

4. Radioactive material, low specific activity (LSA):
   a. LSA is radioactive material with limited specific activity which satisfies the descriptions and limits set forth. Shielding material surrounding the LSA material may not be used in determining the estimated average specific activity of the package contents. LSA material must be in one of the three categories described in 49 CFR 173.403 as LSA I, II or III.

   b. LSA material may be classified as LSA I, II or III. Additionally:

      (1) Material may not contain fissile material unless excepted. Exceptions are applied to small quantities (not greater than 15 grams) and to situations where criticality is impossible under any circumstance, such as very dilute solutions and mixtures.

      (2) The external dose rate must not exceed 1.0 rem/h at 3 meters (9.8 ft) from the unshielded material.

      (3) Except for transportation by aircraft, LSA material with very low concentrations of hydrogen-3 or carbon-14 (0.05 μCi/g or 1.85 KBq/g) in liquid scintillation media or animal tissue are excepted from radioactive material shipping requirements when offered for transportation for disposal or recovery. A material which meets the definition of another
hazard class is subject to the provisions relating to that hazard class.

c. The quantity of LSA in any single conveyance shall not exceed the limits in Attachment 4, *LSA and SCO Conveyance Limits*.

d. REFER to AVESI HP-61, *Limited Quantity Shipping*, for specific shipping guidance.

5. Radioactive material, surface contaminated object (SCO):
   a. SCOs are solid objects, which not by itself are radioactive, but have radioactive material distributed on any of its surfaces. SCO must be in one of two groups, SCO-I or SCO-II, with the surface activity not exceeding the limits in Attachment 5, *Surface Contaminated Object (SCO) Limits*.
   b. The quantity of SCO material in a single conveyance shall not exceed the limits in Attachment 4, *LSA and SCO Conveyance Limits*.

6. Type A and Type B radioactive material:
   a. A radioactive material shipment which could exceed the limits for LSA and could be shipped in either DOT Type A or B packaging is not excepted from specification packaging, marking and labeling requirements and shipping paperwork.
   b. REFER to AVESI HP-69, *Shipment of Radioactive Material, Type A or Type B*, for specific shipping guidance.

7. Radioactive material, special form:
   a. A radioactive material shipment which satisfies all of the following conditions can be considered special form:
      (1) Either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;
      (2) The piece or capsule has at least one dimension no less than 5 millimeters (0.197 inch); and
      (3) Satisfies the test requirements of 49 CFR 173.469 and 10 CFR 71.75.
b. Specific guidance for shipment of special form radioactive material shall be provided by the Transportation Representative.

8. Radioactive material, fissile:
   a. A radioactive material shipment which includes one or more fissile radionuclides. These nuclides are uranium-233, uranium-235, plutonium-239 and plutonium-241 (refer to 49 CFR 173.453 for fissile material exceptions).
   
   b. Specific guidance for shipment of fissile material shall be provided by the Transportation Representative.

7.0 Records
   
   No records are generated by this procedure.
### Attachment 1

**PACKAGE AND TRANSPORT VEHICLE RADIATION LIMITS**

<table>
<thead>
<tr>
<th>External Package Surface</th>
<th>AVESI Administrative Limit (mrem/h)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excepted package – Empty Package</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Excepted package – Limited Quantity</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Excepted package – Instruments and Articles</td>
<td>0.3 (1.5 if exclusive use, domestic transport)</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>7.0 at 10 cm from any point on external surface of unpackaged instrument or article</td>
<td>10</td>
</tr>
<tr>
<td>Non-Exclusive Use-all package surfaces</td>
<td>150 (TI ≤ 10)</td>
<td>200 (TI ≤ 10)</td>
</tr>
<tr>
<td>Exclusive Use Open Transportation Vehicle-all package surfaces</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Exclusive Use Closed Transport - all package surfaces</td>
<td>700</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**The Following Apply to Exclusive Use Transport Vehicles**

<table>
<thead>
<tr>
<th>Outer Surface of Vehicle</th>
<th>AVESI Administrative Limit (mrem/h)</th>
<th>DOT Limit (mrem/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Transport Vehicle – any surface including top and underside of vehicle</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Open Transport Vehicle – any point on vertical planes projected by outer edges, on upper surface of load or enclosure and lower external surface of vehicle</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>2 Meters</td>
<td>Closed Transport Vehicle – any point 2 m from outer lateral surfaces (excluding top and underside of vehicle)</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>Open Transport Vehicle – any point 2 m from vertical planes projected by outer edges (excluding top and underside of vehicle)</td>
<td>7.0</td>
</tr>
<tr>
<td>Any Normal Occupied Space</td>
<td>Cab of vehicle, including sleeping compartment</td>
<td>1.5</td>
</tr>
</tbody>
</table>

1. AVESI administrative limits may be exceeded with the approval of the RSO or RPM, if assigned. However, the DOT limits shall never be exceeded.

2. Packages with a TI greater than 10 must be shipped exclusive use.

3. The following conditions must also be met:
   - Shipment is in a closed transport vehicle;
   - Package is secured within the vehicle so that it’s position remains fixed during transportation; and
   - There are no loading or unloading operations between the beginning and end of transportation.
## Attachment 2

**NON-FIXED (REMOVABLE) CONTAMINATION LIMITS**

<table>
<thead>
<tr>
<th></th>
<th>Administrative Limit (dpm/100 cm²)</th>
<th>DOT Limit (dpm/100 cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Package Surface</strong></td>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>All other alpha emitting radionuclides</td>
<td>20</td>
</tr>
<tr>
<td><strong>The Following Apply to Exclusive Use Transport Vehicles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>External Package Surface</strong></td>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>All other alpha emitting radionuclides</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Transport Vehicle</strong></td>
<td>Beta and gamma emitters and low toxicity alpha emitters</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>All other alpha emitting radionuclides</td>
<td>20</td>
</tr>
</tbody>
</table>

1. Averaged over 300 cm² with a wipe efficiency assumed to be 0.1.

2. AVESI administrative limits may be exceeded with the approval of the RSO or RPM, if assigned. However, the DOT limits shall never be exceeded.

3. Packages transported as exclusive use shipments may not exceed these limits at any time during transport. The contamination levels at the beginning of transport may not exceed 22,000 dpm/100 cm² βγ or 2,200 dpm/100 cm² α (AVESI administrative limits apply at the beginning of transport).

4. The vehicle may not be placed back into service until there is no significant removable surface contamination (not greater than 22,000 dpm/100 cm² βγ or 2,200 dpm/100 cm² α) and the dose rate at each accessible surface is 0.5 nrem/h or less.

5. Applies to all transport vehicle surfaces.

6. These limits do not apply to the interior surfaces of a closed transport vehicle used solely for the transportation of Class 7 material packages with contamination levels that do not exceed 220,000 dpm/100 cm² βγ or 22,000 dpm/100 cm² α if the conditions of 49 CFR 173.443(d)(1), (2) and (3) are satisfied.
### Attachment 3

**ACTIVITY LIMITS FOR LIMITED QUANTITIES, INSTRUMENTS AND ARTICLES**

<table>
<thead>
<tr>
<th>Nature of Contents</th>
<th>Instruments and Articles</th>
<th>Material Package Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instrument and Article Limits&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Package Limits&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Solids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Form</td>
<td>≤ 1E-2 A&lt;sub&gt;1&lt;/sub&gt;</td>
<td>≤ A&lt;sub&gt;1&lt;/sub&gt;</td>
</tr>
<tr>
<td>Other Form</td>
<td>≤ 1E-2 A&lt;sub&gt;2&lt;/sub&gt;</td>
<td>≤ A&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Liquids</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tritiated Water:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 0.1 Ci/liter&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 Ci/liter to 1.0 Ci/liter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 0.1 Ci/liter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other liquids</strong></td>
<td>≤ 1E-3 A&lt;sub&gt;2&lt;/sub&gt;</td>
<td>≤ 1E-1 A&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Gases</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tritium&lt;sup&gt;3&lt;/sup&gt;</td>
<td>≤ 2E-2 A&lt;sub&gt;2&lt;/sub&gt;</td>
<td>≤ 2E-1 A&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td>Special Form</td>
<td>≤ 1E-3 A&lt;sub&gt;1&lt;/sub&gt;</td>
<td>≤ 1E-2 A&lt;sub&gt;1&lt;/sub&gt;</td>
</tr>
<tr>
<td>Other Form</td>
<td>≤ 1E-3 A&lt;sub&gt;2&lt;/sub&gt;</td>
<td>≤ 1E-2 A&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

1. For mixtures of radionuclides, see 49 CFR 173.433. Although outside the scope of this procedure, for ground transport via U.S. Postal Service the allowable limits are 10% of the values in this table. NOTE: Air transport of Class 7 radioactive material via the U.S. Postal Service is prohibited.

2. 1 Ci/liter = 1 mCi/ml = 1,000 μCi/ml

3. These values apply to tritium in activate luminous paint and tritium absorbed on solid carriers.
Attachment 4

LSA AND SCO CONVEYANCE LIMITS

<table>
<thead>
<tr>
<th>Material</th>
<th>Activity Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSA-I</td>
<td>No Limit</td>
</tr>
<tr>
<td>LSA-II and LSA-III; Non-combustible solids</td>
<td>No Limit</td>
</tr>
<tr>
<td>LSA-II and LSA-III; Combustible solids and all liquids and gases</td>
<td>100 A²</td>
</tr>
<tr>
<td>SCO</td>
<td>100 A²</td>
</tr>
</tbody>
</table>
## Attachment 5

### SURFACE CONTAMINATED OBJECT (SCO) LIMITS

<table>
<thead>
<tr>
<th>SCO-I</th>
<th>Accessible Surfaces</th>
<th>Inaccessible Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Fixed (dpm/100cm²)</td>
<td>Fixed (dpm/100cm²)</td>
</tr>
<tr>
<td>Beta, Gamma and low toxicity Alpha emitters¹</td>
<td>22,200</td>
<td>2.22E+08</td>
</tr>
<tr>
<td>Alpha emitters</td>
<td>2,220</td>
<td>2.22E+07</td>
</tr>
<tr>
<td>SCO-II</td>
<td>Accessible Surfaces</td>
<td>Inaccessible Surfaces</td>
</tr>
<tr>
<td></td>
<td>Non-Fixed (dpm/100cm²)</td>
<td>Fixed (dpm/100cm²)</td>
</tr>
<tr>
<td>Beta, Gamma and low toxicity Alpha emitters¹</td>
<td>222,000</td>
<td>4.44E+09</td>
</tr>
<tr>
<td>Alpha emitters</td>
<td>222,000</td>
<td>4.44E+08</td>
</tr>
</tbody>
</table>

1. Low toxicity alpha emitters: Natural uranium, depleted uranium, and natural thorium; ores, concentrates or tailings containing U-235, U-238, Th-232, Th-228 and Th-230; or alpha emitters with half-life less than 10 days.
HEALTH PHYSICS PROCEDURE

AVESI HP-61

PACKAGING AND SHIPPING OF RADIOACTIVE MATERIAL/WASTE

DEFINITIONS

APPROVED BY: __________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: __________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<td>12</td>
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</table>
1.0 Purpose
To provide definitions applicable to packaging, labeling and shipment of radioactive material and radioactive waste.

2.0 Scope
This procedure applies to the shipment of radioactive waste and radioactive materials by or under the control of AVESI.

3.0 References
3.1 Code of Federal Regulations:
A. 10 CFR 20, "Standards for Protection Against Radiation"
B. 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
C. 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
D. 10 CFR 71, “Packaging and Transportation of Radioactive Material”
E. 49 CFR 107 "Registration of Persons Who Offer or Transport Hazardous Materials"
F. 49 CFR 171-178, "Transportation"

4.0 Definitions
4.1 $A_1$: The maximum activity of special form Class 7 (radioactive) material permitted in a Type A package. These values are either listed in 49 CFR 173.435, or derived, according to the procedure prescribed in 49 CFR 173.433.

4.2 $A_1$: The maximum activity of Class 7 (radioactive) material, other than special form, LSA or SCO, permitted in a Type A package. These values are either listed in 49 CFR 173.435, or derived, according to the procedure prescribed in 49 CFR 173.433.

4.3 Bulk Packaging: A packaging, other than a vessel or a barge, including a transport vehicle or freight container, in which hazardous materials are loaded with no intermediate form of containment and which has:

A. A maximum capacity greater than 450 L (119 gallons) as a receptacle for a liquid;
B. A maximum net mass greater than 400 kg (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid; or
C. A water capacity greater than 454 kg (1000 pounds) as a receptacle for a gas as defined in 49 CFR 173.115.

4.4 Cargo aircraft only: An aircraft that is used to transport cargo and is not engaged in carrying passengers.
4.5 **Closed transport vehicle:** A transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) material. The enclosure may be either temporary or permanent, and in the case of packaged materials, may be of the “see through” type, and must limit access from top, sides, and bottom.

4.6 **Consignment:** A package or group of packages or load of radioactive material offered by a person for transport in the same shipment.

4.7 **Contamination:** The presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm² for beta and gamma emitters and low toxicity alpha emitters or 0.04 Bq/cm² for all other alpha emitters. Contamination exists in two phases:
   
   A. **Fixed radioactive contamination** means radioactive contamination that cannot be removed from a surface during normal conditions of transport.
   
   B. **Non-fixed radioactive contamination** means radioactive contamination that can be removed during normal conditions of transport.

4.8 **Conveyance:**
   
   A. **For transport by public highway:** Any transport vehicle or large freight container.
   
   B. **For transport by aircraft:** Any aircraft.
   
   C. **For transport by water:** Any vessel or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel.

4.9 **Exclusive use:** Sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out according to the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must provide to the initial carrier specific written instructions for maintenance of exclusive use shipment controls, including the vehicle survey requirement of 49 CFR 173.443(c) as applicable, and include these instructions with the shipping paper information provided to the carrier by the consignor.

4.10 **Fissile material:** Plutonium-239, plutonium-241, uranium-233, uranium-235 or any combination of these nuclides. The definition does not apply to non-irradiated natural uranium and non-irradiated depleted uranium, or to natural uranium or depleted uranium that has been irradiated in thermal reactors only.

4.11 **Ground Transportation Only:** A shipment transported by commercial carrier over public highways only. Private vehicles and air carriers do not apply.
4.12 **Hazard class:** The category of hazard assigned to a hazardous material. The hazard class for radioactive material is “7.” See 49 CFR 172.101, Table A, for additional hazard classes.

4.13 **Hazardous material:** A substance or material, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. The term includes hazardous substances, hazardous wastes, and materials designated as hazardous under the provision of 49 CFR 172.101.

4.14 **Hazardous substance:** A material, including its mixtures and solutions, that contain a Reportable Quantity, as listed in Appendix A to 172.101.

4.15 **Hazardous waste:** Means any material that is subject to the Hazardous Waste Manifest Requirements of the U.S. Environmental Protection Agency specified in 40 CFR Part 262.

4.16 **Hazmat Employee:** A person who is employed by a hazmat employer and who, in the course of employment, directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term includes an individual, employed by a hazmat employer who, during the course of employment:

A. Loads, unloads, or handles hazardous materials;

B. Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packaging as qualified for use in the transportation of hazardous materials;

C. Prepares hazardous materials for transportation;

D. Is responsible for safety of transporting hazardous materials; or

E. Operates a vehicles used to transport hazardous materials.

4.17 **Hazmat Employer:** A person who uses one or more of its employees in connection with: transporting hazardous materials in commerce; causing hazardous materials to be transported or shipped in commerce; or representing, marking, certifying, selling, offering manufacturing, reconditioning, testing, repairing, or modifying containers, drums, or packaging as qualified for use in the transportation of hazardous materials. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term also includes any department, agency, or instrumentality of the Untied States, a
State, a political subdivision of a State, or an Indian tribe engaged in an activity described in the first sentence of this definition.

4.18 **Hermetically sealed:** Closed by fusion, gasketing, crimping, or equivalent means so that no gas or vapor can enter or escape.

4.19 **Highway route controlled quantity:** A quantity within a single package that exceeds:

A. 3,000 times the $A_1$ value of the radionuclides as specified in 49 CFR 173.435 for special form Class 7 (radioactive) material;

B. 3,000 times the $A_2$ value of the radionuclides as specified in 49 CFR 173.435 for normal form Class 7 (radioactive) material; or

C. 1,000 TBq (27,000 Ci), whichever is least.

4.20 **IATA:** Acronym for International Air Transport Association.

4.21 **Inner packaging:** A packaging for which an outer packaging is required for transport. It does not include the inner receptacle of a composite packaging.

4.22 **Inner receptacle:** A receptacle which requires an outer packaging to perform its containment function. The inner receptacle may be an inner packaging of a combination packaging or the inner receptacle of a composite packaging.

4.23 **Limited Quantity:** The maximum amount of a hazardous material for which there is a specific labeling or packaging exception.

4.24 **Limited Quantity of Class 7 (radioactive) Material:** A quantity of Class 7 (radioactive) material not exceeding the materials package limits specified in 49 CFR 173.425 and conforming with requirements specified in 49 CFR 173.421.

4.25 **Liquid:** A material, other than an elevated temperature material, with a melting point or initial melting point of 20 °C (68 °F) or lower at a standard pressure of 101.3 kpa (14.7 psi). A viscous material for which a specific melting point cannot be determined, must be subjected to the procedures specified in ASTM D 4359 “standard test method for determining whether a material is liquid or solid.”

4.26 **Low Specific Activity (LSA):** Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:
A. LSA I:

1. Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;

2. Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;

3. Radioactive material other than fissile material, for which the $A_2$ value is unlimited; or

4. Other radioactive material, excluding fissile material in quantities not excepted under 49 CFR 173.453, in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the values for activity concentration specified in 49 CFR 173.436, or 30 times the default values listed in Table 8 of 49 CFR 173.433.

B. LSA-II:

1. Water with tritium concentration up to 0.8 TBq/liter (20 Ci/liter); or

2. Material in which the Class 7 (radioactive) material is distributed throughout and the average specific activity does not exceed $10^{-4} A_2/g$ for solids and gases, and $10^{-5} A_2/g$ for liquids.

C. LSA-III: Solids (for example, consolidated wastes, activated materials), excluding powders, that meet the requirements of 49 CFR 173.468 and which:

1. The Class 7 (radioactive) material is distributed throughout a solid or a collection of solid objects, or is distributed throughout in a solid compact binding agent (such as, concrete, bitumen, ceramic, and so forth);

2. The Class 7 (radioactive) material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) material per package by leaching which placed in water for seven days would not exceed 0.1 $A_2$; and

3. The estimated average specific activity of the solid does not exceed $2.0 \times 10^{-3} A_2/g$. 
4.27 **Low toxicity alpha emitters:**

A. Natural uranium; depleted uranium; natural thorium; uranium-235 or uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical and chemical concentrates; and

B. Alpha emitters with a half-life of less than ten days.

4.28 **Marking:** A descriptive name, identification number, instruction, cautions, weight, specification, or UN marks, or combinations thereof, required by this procedure on outer packaging of hazardous materials.

4.29 **Non-bulk packaging:** Packaging, which has the following:

A. A maximum capacity of 450 L (119 gallons) or less as a receptacle for a liquid;

B. A maximum net mass of 400 kg (882 pounds) or less and a maximum capacity of 450 L (119 gallons) or less as a receptacle for a solid; or

C. A water capacity of 454 kg (1000 pounds) or less as a receptacle for a gas as defined in 49 CFR 173.115.

4.30 **Normal form Class 7 (radioactive) material:** Class 7 (radioactive) material which has not been demonstrated to qualify as “special form Class 7 (radioactive) material.”

4.31 **Outer packaging:** The outermost enclosure of a composite or combination packaging together with any absorbent materials, cushioning and any other components necessary to contain and protect inner receptacles or inner packaging.

4.32 **Over-pack:** An enclosure that is used by a single consignor to provide protection or convenience in handling of a package or to consolidate two or more packages. Over-pack does not include a transport vehicle, freight container, or aircraft unit load device.

4.33 **Package:** For Class 7 (radioactive) material, the packaging together with its radioactive contents as presented for transport.

B. “Type A package” means a packaging that, together with its radioactive contents limited to A₁ or A₂ as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate. A Type A package does not require Competent Authority Approval.

C. “Type B package” means a packaging designed to transport greater than an A₁ or A₂ quantity of radioactive material that, together with its radioactive contents, is designed to retain the integrity of containment and shielding, when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

1. “Type B (U) package” means a Type B packaging that, together with its radioactive contents, for international shipments requires unilateral approval only of the package design and of any stowage provisions that may be necessary for heat dissipation.

2. “Type B (M) package” means a Type B packaging, together with its radioactive contents, that for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment. Type B (M) packages are those Type B package designs which have a maximum normal operating pressure of more than 700 kilopascals per square centimeter (100 pounds per square inch) gauge or a relief device which would allow the release of Class 7 (radioactive) material to the environment under the hypothetical accident conditions specified in 10 CFR Part 71.

D. “Fissile material package” means a packaging, together with its fissile material contents, which meets the requirements for fissile material packages described in subpart E of 10 CFR 71. A fissile material package may be a Type AF package, a Type B(U)F package, or a Type B(M)F package.

E. “Industrial package” means a packaging that, together with its low specific activity (LSA) material or surface contaminated object (SCO) contents, meets the requirement of 49 CFR 173.410 and 173.411. Industrial packages are categorized in 49 CFR 173.411 as either:

1. “Industrial package Type 1 (IP-1)”;

2. “Industrial package Type 2 (IP-2)”; or
3. “Industrial package Type 3 (IP-3).”

4.34 **Packaging:** For Class 7 (radioactive) materials, the assembly of components necessary to ensure compliance with the packaging requirements of this procedure. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, service equipment for filling, emptying, venting and pressure relief, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging.

4.35 **Proper shipping name:** The name of the hazardous material shown in Roman print (not italics) in 49 CFR 172.101.

4.36 **Proper shipping name:** The name of the hazardous material shown in Roman print (not italics) in 49 CFR 172.101.

4.37 **Radioactive contents:** A Class 7 (radioactive) material, together with any contaminated or activated solids, liquids and gases within the package.

4.38 **Radioactive instrument and article:** Any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article having Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.

4.39 **Radioactive material:** Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in the table in 49 CFR 173.436 or values derived according to the instructions in 49 CFR 173.433.

4.40 **Reportable Quantity (RQ):** Those quantities of radioactive materials deemed by EPA and DOT (49 CFR 172.101, Appendix A, Column 2) needed to be reported in the event of a spill. Releases of radionuclides must be reported to the State Emergency Response Center of the affected state.

   A. The letters "RQ" are to appear on all non-bulk packages containing a hazardous substance in association with the proper shipping name.

   B. Radioactive Manifests are to include the letters "RQ" with the shipping name prescribed for the material, if there is a reportable quantity in the shipment.

4.41 **Sievert (Sv):** The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 1 J/kg = 100 rem).
4.42 **Special Nuclear Material 10 CFR 74.4:**

A. Plutonium, uranium-233, uranium enriched in the isotope uranium-233 or in the isotope uranium-235, or any other material which the Commission pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or

B. Any material artificially enriched by any of the foregoing, but does not include source material.

4.43 **Special form Class 7 (radioactive) material:** Either an indispensible solid radioactive material or a sealed capsule containing radioactive material which satisfies the following conditions:

A. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

B. The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

C. It satisfies the test requirements of 49 CFR 173.469.

4.44 **Specific activity of a radionuclide:** The activity of a radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

4.45 **Surface Contaminated Object (SCO):** A solid object which is not itself radioactive but which has Class 7 (radioactive) material distributed on any of its surfaces.

A. **SCO - I:** A solid object on which:

1. The non-fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4.0 Bq/cm² (10⁻⁴ microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm² (10⁻⁵ microcuries/cm²) for alpha emitters;

2. The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4.0 X 10⁴ Bq/cm² (1.0 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 4.0 X 10³ Bq/cm² (0.1 microcuries/cm²) for all other alpha emitters; and
3. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed $4.0 \times 10^4$ Bq/cm² (1.0 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or $4.0 \times 10^3$ Bq/cm² (0.1 microcuries/cm²) for all other alpha emitters.

B. SCO - II: A solid object on which the limits for SCO - I are exceeded and on which:

1. The non-fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 400 Bq/cm² (10⁻² microcuries/cm²) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm² (10⁻³ microcuries/cm²) for all other alpha emitters;

2. The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed $8.0 \times 10^5$ Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters or $8.0 \times 10^4$ Bq/cm² (2.0 microcuries/cm²) for all other alpha emitters; and

3. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed $8.0 \times 10^5$ Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters or $8.0 \times 10^4$ Bq/cm² (2.0 microcuries/cm²) for all other alpha emitters.

4.46 **Transport index (TI):** The dimensionless number (rounded up to the next tenth) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The Transport Index is equivalent to the maximum radiation level in mrem/h at one meter (3.3 feet) from the external surface of the package.

4.47 **Transport vehicle:** A cargo-carrying vehicle such as an automobile, van, tractor, truck, semi trailer, tank car or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (trailer, rail car, and so forth) is a separate transport vehicle.

4.48 **Type A quantity:** A quantity of Class 7 (radioactive material, the aggregate radioactivity which does not exceed $A_1$ for special form Class 7 (radioactive) material or $A_2$ for normal form Class 7 (radioactive) material.

4.49 **Type B quantity:** A quantity of material greater than a Type A quantity.
4.50  **U.S. DOT Hazmat Reg. No. (49 CFR 107):** The registration number that corresponds to the annual registration and fee requirements which apply to any person who offers for transportation, or transports hazardous material, in foreign, interstate or intrastate commerce.

5.0  **Responsibilities**

The RSO is responsible for ensuring that definitions provided in this procedure are maintained up to-date with those provided in applicable regulations and industry standards.

6.0  **Performance**

Not Applicable

7.0  **Records**
HEALTH PHYSICS PROCEDURE

AVESI HP-62

RADIOACTIVE MATERIAL QUANTIFICATION, IDENTIFICATION AND WASTE CHARACTERIZATION

APPROVED BY: ___________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: ___________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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1.0 Purpose

To provide instructions for characterization of radioactive material and classification of radioactive waste for shipment.

2.0 Scope

2.1 The requirements for the following types of radioactive material shipments are not defined by this procedure and must be determined by the Transportation Representative, if assigned.

- Radioactive LSA-I and LSA-III
- Radioactive material containing other hazardous material
- Fissile material that is not “fissile excepted”
- Special Nuclear Material
- Oxidizing Class 7 radioactive material
- Pyrophoric Class 7 radioactive material
- Thorium nitrate
- Uranyl nitrate
- International shipments
- Rail shipments
- Vessel shipments
- Shipments via United States Postal Service
- Shipments via passenger aircraft
- Radioactive materials that are licensed to others (for example, radiography sources).

2.2 Computer software for radioactive material management (approved by the RSO per Administrative Procedure QAAP 19.1 “Software Quality Assurance [QA]”) may be used to execute applicable steps in this procedure and generate the forms necessary to properly document radioactive material shipments. Care must be exercised to ensure that all required information is included on computer generated forms.

2.3 Steps in this procedure may be performed in any order or in parallel.

3.0 References

3.1 Code of Federal Regulations:

A. 10 CFR 20, "Standards for Protection Against Radiation"
B. 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
C. 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
D. 10 CFR 71, "Packaging and Transportation of Radioactive Material"
E. 49 CFR 171-178, "Transportation"

3.2 International Air Transport Association (IATA) Dangerous Goods Regulations

3.3 U.S. Nuclear Regulatory Commission (NRC) Guidance Documents:
A. I&E Bulletin No. 79-19
B. I&E Notice 84-72

3.4 Vendor Radioactive or Special Nuclear Material Licenses

3.5 Appropriate Vendor’s Radioactive Waste Acceptance Criteria

4.0 Definitions
See AVESI HP-62, "Radioactive Material Quantification, Identification and Waste Characterization"

5.0 Responsibilities
5.1 The Transportation Representative (or RSO/RPM if none assigned), is responsible for:
5.1.1 Making detailed or exact interpretation of regulations governing the packaging and handling of radioactive materials, including radioactive waste.
5.1.2 Ensuring that radioactive materials are packaged to comply with Federal, State and, if applicable, burial or processing site criteria.
5.1.3 Ensuring all personnel involved in packaging radioactive material are properly trained and qualified and this training is maintained current in accordance with applicable federal regulations and AVESI requirements.
5.1.4 Determining if subsidiary hazards are present in radioactive material packages.
5.1.5 Determining packaging requirements when subsidiary hazards are present.
5.2 Health Physics Technicians are responsible for:

5.2.1 Preparing radioactive materials for shipment according to applicable regulations.

5.2.2 Ensuring that required shipping surveys are complete and accurate.

6.0 Performance

6.1 Precautions

6.1.1 Calculations and computer data inputs shall be conducted with great attention to detail, as per QAAP 19.1. Special attention to detail shall be given to the use of formulas and units.

6.1.2 A shipment containing multiple packages with identical nuclide distributions requires only one package to be used in determining the activity limits or waste classification, provided the most limiting package is used to perform the calculation. The most limiting package is the package with the highest specific activity or total activity, depending on the calculation performed.

6.1.3 Radioactive material with subsidiary hazards shall be identified and marked, labeled or placarded, as appropriate. Requirements for subsidiary hazards shall be according to instruction provided by the Transportation Representative.

6.1.4 Typically, resin, dry active waste (DAW) and laundry are classified as LSA. For other material to be treated as LSA distributed mixtures, the specific activity differences between portions of the shipment volume should be less than a factor of ten. The Transportation Representative should be consulted for this determination.

6.2 Pre-Shipment Record Verification

6.2.1 **OBTAIN** records generated for the package(s) according to AVESI HP-63, *Packaging for Shipment or Transportation of Radioactive Material/Waste.*

6.2.2 **VERIFY** all packaging records are complete.

6.2.3 **DOCUMENT** any additional actions, if performed.

6.3 Shipment Quantification and Identification
NOTE:
The following assumes the radionuclide constituents and activity/concentrations are known for each package containing radioactive material. It is acceptable to determine activity based on dose-to-curie calculations. Request guidance from the Transportation Representative if it is necessary to collect additional samples or perform dose-to-curie calculations.

NOTE:
Isotopic analysis for radioactive shipment requires RSO review and approval.

6.3.1 **PERFORM** one of the following, if not completed:
A. **COMPLETE** a form similar to Attachment 1, *Radioactivity Calculation Worksheet for Contaminated Objects*, to calculate the activity of contaminated objects using smear results.

   OR

B. **COMPLETE** a form similar to Attachment 2, *Sample Calculation Worksheet*, to calculate the activity from sample results.

6.3.2 **IF** fissile material or plutonium is present, **THEN COMPLETE** a form similar to Attachment 3, *Fissile and Special Nuclear Material Worksheet*.

NOTE:
The Transportation Representative may authorize methods for Surface Contaminated Object (SCO) classification other than the method described in Attachment 5, *SCO Classification*.

6.3.3 **COMPLETE** a form similar to Attachment 4, *Radioactive Material Classification Worksheet*.

6.3.4 **IF** the material meets the definition of a SCO, **THEN COMPLETE** Attachment 5, *SCO Classification*.

6.3.5 **IF** the package was classified using A1 values, **THEN FORWARD** a copy of the *Certificate of Approval of Design for Special Form Radioactive Material* with the shipment.

6.3.6 **IF** the package contains waste, **THEN COMPLETE** a form similar to Attachment 6, *Waste Activity Worksheet*.

6.3.7 **CHECK** for any other subsidiary hazard listed in 49 CFR 172.101.
6.3.8 **GO TO** AVESI HP-60, *Radioactive Material Shipping*.

7.0 **Records**

7.1 **ENSURE** all forms generated by this procedure are completed, reviewed, and filed with the appropriate shipping package documentation.
Shipment #: ___________ Date: ___________

Material Description: ________________________________________________________________

Analysis No. ___________ Analysis Units [ ] per 100 cm² [ ] touch (1 cm²) [ ] Other

Material Total Area (cm²) = __________________

Material
Analysis Smear Area Total Area
Nuclide $\mu$Ci/unit ÷ (cm²) = $\mu$Ci/cm² x (cm²) = $\mu$Ci ÷1000 = Activity (mCi)
$\div = x = \div1000 =$

TOTAL (mCi)

REMARKS:
Completed By: / Reviewed By: / ______________________

Date Trans. Rep. Date
HEALTH PHYSICS PROCEDURE

AVESI HP-63

PACKAGING FOR SHIPMENT OR TRANSPORTATION OF RADIOACTIVE MATERIAL/WASTE

APPROVED BY: _______________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: _______________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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LIST OF ATTACHMENTS

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Attachment 2, General Design Requirements.............................................................7
1.0 Purpose
To provide proper instructions for packaging of radioactive material and radioactive waste for shipment.

2.0 Scope
The requirements for the following types of radioactive material shipments are not defined by this procedure and must be defined by the Transportation Representative, if assigned.
- Radioactive material containing other hazardous material
- Fissile material that is not “fissile excepted”
- Special Nuclear Material
- Oxidizing Class 7 radioactive material
- Pyrophoric Class 7 radioactive material
- Thorium nitrate
- Uranyl nitrate
- International shipments
- Rail shipments
- Vessel shipments
- Shipments via United States Postal Service
- Shipments via passenger aircraft
- Radioactive materials that are licensed to others (for example, radiography sources).

2.2 Computer software for radioactive material management (approved by the RSO and as per Administrative Procedure QAPP 19.1) may be used to execute applicable steps in this procedure and generate the forms necessary to properly document radioactive material shipments. Care must be exercised to ensure that all required information is included on computer generated forms.

2.3 Steps in this procedure may be performed in any order or in parallel.

3.0 References
3.1 Code of Federal Regulations:
A. 10 CFR 20, "Standards for Protection Against Radiation"
B. 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
C. 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
D. 10 CFR 71, "Packaging and Transportation of Radioactive Material"
E. 49 CFR 107, "Registration of Persons Who Offer or Transport Hazardous Materials"
F. 49 CFR 171-178, "Transportation"
4.0 Definitions

See AVESI HP-61, Packaging and Shipment of Radioactive Material/Waste, Definitions

5.0 Responsibilities

5.1 The Transportation Representative (or RSO/RPM if none assigned) is responsible for:

5.1.1 Making detailed or exact interpretation of regulations governing the packaging and handling of radioactive materials, including radioactive waste.

5.1.2 Ensuring that radioactive materials are packaged to comply with federal, state and, if applicable, burial or processing site criteria.

5.1.3 Ensuring all personnel involved in packaging radioactive material are properly trained and qualified and this training is maintained current in accordance with applicable federal regulations and AVESI requirements.

5.1.4 Determining if subsidiary hazards are present in radioactive material packages.

5.1.5 Determining packaging requirements when subsidiary hazards are present.

5.2 Health Physics Technicians are responsible for:

5.2.1 Packaging radioactive materials.

5.2.2 Ensuring that required documents are complete and accurate.

6.0 Performance

6.1 Precautions

6.1.1 Radioactive material packages and shipments of radioactive material prepared for transport shall remain under the control of the AVESI Health Physics Program until the driver has signed all applicable shipping papers and assumed responsibility for the conveyance.

6.1.2 NRC certified packages shall be used according to the conditions stated on the Certificate of Compliance. Before each use, the Certificate of Compliance must be confirmed and verified current.

6.1.3 Material with contact dose rates > 150 mrem/h must be evaluated by the Transportation Representative to see if any additional packaging and shoring requirements are necessary.
6.1.4 Radioactive material suspected of containing other hazardous materials (subsidiary hazards) shall be evaluated by the Transportation Representative.

6.1.5 Radioactive material with subsidiary hazards shall be identified and marked, labeled, or placarded, as appropriate.

6.1.6 If an NRC certified package is used to package other than Type B quantities of radioactive material [that is, Limited Quantity, Type “A,” Low Specific Activity (LSA) or Surface Contaminated Objects (SCO)], the markings that identify the package as being NRC certified must be covered.

6.1.7 For shipments with initial package contact dose rates greater than 50 mrem/h, an independent verification survey shall be performed and documented.

6.1.8 All packages shall be packaged, braced or shored to ensure that the following conditions normally incident to transportation DO NOT occur:
- Radiation dose rates external to the package or vehicle exceed U.S. Department of Transportation (DOT) regulations.
- Package integrity is comprised.

6.1.9 When using a DOT 7A Type “A” or NRC Type “B” package, the closure device typically has torque requirements. The test certification records supplied by the manufacturer for the package includes the information that will be used to determine the closure torque value to be applied and for verification that the closure devices are properly secured and torqued.

6.2 Procedure

**NOTE:**
Only individuals actually completing actions shall sign appropriate documentation.

6.2.1 **IF** uncertain of the shipment mode, THEN CONTACT Transportation Representative for direction.

6.2.2 **SELECT** a package per Attachment 1, Package Selection Table.

6.2.3 **INSPECT** the package to ensure it meets the following:
- Requirements per Attachment 2, General Design Requirements.
- Unimpaired condition.
- When package is securely closed, there will be no leakage of radioactive materials under conditions normally incident to transportation.
6.2.4 Consult the IATA Limitations (Section 2.0) for specific relief granted by individual airlines for domestic air shipments.

6.2.5 **BRACE** or **CUSHION** the material in the package to ensure that under conditions normally incident to transportation, the following requirements will be met:

- Package integrity will not be compromised.
- External contact dose rates of the package will not change.

6.2.6 **IF** the package contains liquid, **THEN INCLUDE** one of the following for additional packaging:

A. Sufficient and suitable absorbent to absorb twice the liquid volume should a leak occur. The absorbent material must be compatible with the package contents and suitably positioned to contact the liquid in the event of leakage.

OR

B. A containment system composed of primary inner and secondary outer containment components. The containment components shall be designed to ensure retention of the liquid contents within the secondary outer component in the event of primary inner component leakage.

6.2.7 **PERFORM** and **DOCUMENT** package external beta-gamma and alpha loose surface contamination and dose rate surveys.

6.2.8 **IF** the initial package contact dose rate is greater than 50 mrem/h, **THEN PERFORM** and **DOCUMENT** an independent verification survey.

6.2.9 **IF** the initial package contact dose rate is greater than 150 mrem/h, **THEN REQUEST** that the Transportation Representative evaluate any additional packaging and shoring requirements.

6.2.10 **GO TO** AVESI HP-62, *Radioactive Material Quantification, Identification and Waste Characterization*.

7.0 Records

7.1 **ENSURE** all forms generated by this procedure are captured, reviewed, and filed with the appropriate shipping package documentation.
## ATTACHMENT 1

### PACKAGE SELECTION TABLE

<table>
<thead>
<tr>
<th>Shipment Type</th>
<th>Package</th>
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<tbody>
<tr>
<td>Limited Quantity, Instruments and Articles or Empty</td>
<td>Package meeting the general design requirements according to Attachment 2, <em>General Design Requirement</em>, of this procedure.</td>
</tr>
<tr>
<td>&lt;$\text{A2 SCO I, SCO II or LSA II}</td>
<td>Package meeting the general design requirements according to Attachment 2, <em>General Design Requirement</em>, of this procedure: <strong>OR</strong> USA DOT 7A Type “A” <strong>OR</strong> NRC Approved Type “B” <strong>OR</strong> Industrial Package</td>
</tr>
<tr>
<td>&gt;$\text{A2 SCO I, SCO II or LSA II}</td>
<td>USA DOT 7A Type “A” <strong>OR</strong> NRC Approved Type “B” <strong>OR</strong> Industrial Package</td>
</tr>
<tr>
<td>Type “A”</td>
<td>USA DOT 7A Type “A” <strong>OR</strong> NRC Approved Type “B”</td>
</tr>
<tr>
<td>Type “B”</td>
<td>NRC Approved Type “B”</td>
</tr>
</tbody>
</table>

1. Refer to 49 CFR 173.427 for use of Industrial Packages (IP-1, IP-2 or IP-3).

**NOTE:**

DOT 7A Type “A” and NRC Type “B” packages typically have torque requirements for the closure device. The Test Certification Records supplied by the manufacturer have the information that will be used to determine closure torque value and for verification that the closure devices are properly secured and torqued.
ATTACHMENT 2

GENERAL DESIGN REQUIREMENTS (49 CFR 173.410)

Each package used for the shipment of (radioactive) materials must be designed so that:

1. The package can be easily handled and properly secured in or on a conveyance during transport.
2. Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding, when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of 49 CFR 173.410. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.
3. The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.
4. The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.
5. Each feature that is added to the package will not reduce the safety of the package.
6. The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use. (Refer to 49 CFR 178.608 for test requirements.)
7. The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.
8. All valves through which the package contents could escape will be protected against unauthorized operation.
9. For transport by air:
   a. The temperature of the accessible surfaces of the package will not exceed 50 °C (122 °F) at an ambient temperature of 38 °C (100 °F) with no account taken for insulation;
   b. The integrity of containment will not be impaired, if the package is exposed to ambient temperatures ranging -40 °C (-40 °F) to +55 °C (131 °F); and
   c. Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less that 95 kpa (13.8 LB/in²).
HEALTH PHYSICS PROCEDURE

AVESI HP-65

SHIPPING OF RADIOACTIVE MATERIAL, EXCEPTED PACKAGE

APPROVED BY: __________________________ DATE: 7/06/2010
Certified Health Physicist (CHP)

APPROVED BY: __________________________ DATE: 7/06/2010
Radiation Protection Manager (RPM)
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<td>Error! Bookmark not defined.</td>
</tr>
</tbody>
</table>
1.0 Purpose
To provide instructions for shipment of radioactive material, excepted package, limited quantity of material.

2.0 Scope
This procedure applies to packaging, marking and shipment of limited quantity of radioactive material. This procedure includes limited quantity package verification, survey requirements, and marking and labeling.

3.0 References
3.1 Code of Federal Regulations:
3.1.1 10 CFR 20, "Standards for Protection Against Radiation"
3.1.2 10 CFR 30, "Rules of General Applicability to Domestic Licensing of By-Product Materials"
3.1.3 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"
3.1.4 10 CFR 71, "Packaging and Transportation of Radioactive Material"
3.1.5 49 CFR 171-178, "Transportation"
3.2 International Air Transport Association (IATA) Dangerous Goods Regulations
3.3 U.S. Nuclear Regulatory Commission (NRC) Guidance Documents:
3.3.1 I&E Bulletin No. 79-19
3.4 Vendor Radioactive or Special Nuclear Material Licenses
3.5 Appropriate Vendor’s Radioactive Waste Acceptance Criteria

4.0 Definitions
See AVESI HP-61, Packaging and Shipment of Radioactive Material/Waste, Definitions

5.0 Responsibilities
5.1 The Transportation Representative (or RSO/RPM if not assigned) is responsible for:
5.1.1 Making detailed or exact interpretation of regulations governing the packaging and shipment radioactive materials, including radioactive waste.
5.1.2 Ensuring that packages and shipments of radioactive materials comply with federal, state and, if applicable, burial or processing site criteria.
5.1.3 Ensuring all personnel involved in packaging and shipping radioactive material are properly trained and qualified and this training is maintained.
current in accordance with applicable federal regulations and AVESI requirements.

5.1.4 Determining if subsidiary hazards are present in radioactive material packages.

5.1.5 Determining packaging and shipment requirements when subsidiary hazards are present.

5.2 Health Physics Technicians are responsible for:

5.2.1 Preparing radioactive material/waste for shipment in accordance with applicable regulatory, vendor (if applicable) and/or disposal site requirements.

5.2.2 Ensuring that required documents are complete and accurate.

6.0 Performance

6.1 Precautions

6.1.1 Radioactive material packages and shipments of radioactive material prepared for transport shall remain under the control of the AVESI Health Physics Program until the driver has signed all applicable shipping papers and assumed responsibility for the conveyance.

6.1.2 Radioactive material suspected of containing other hazardous materials (subsidiary hazards) shall be evaluated by the Transportation Representative.

6.1.3 Radioactive material with subsidiary hazards shall be identified and marked, labeled, or placarded, as appropriate.

6.2 Procedure

**NOTE:** Only individuals actually completing actions shall sign appropriate documentation.

6.2.1 Pre-Shipment Record Verification


B. **VERIFY** all packaging records are completed, as required.

C. **DOCUMENT** any additional actions.

6.2.2 Limited Quantity Radioactive Material Shipment

A. **VERIFY** the following:
Material is packaged according to AVESI HP-63, *Packaging for Shipment or Transportation of Radioactive Material/Waste.*

Radiation level at any point on the external surface of the package(s) does not exceed the limits in AVESI HP-60, *Shipment of Radioactive Material/Waste, General Requirements,* Attachment 1, *Package and Transport Vehicle Radiation Limits;*

Loose surface contamination on the external surface of the package does not exceed AVESI HP-60, *Shipment of Radioactive Material/Waste, General Requirements,* Attachment 2, *Non-Fixed (Removable) Contamination Limits;* and

If shipping Special Form radioactive material, the special form certification is on file and a copy is included with the shipping package.

**B. MARK** the package as follows:

<table>
<thead>
<tr>
<th>NOTE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipments transported by air require the inner package be marked “Radioactive.”</td>
</tr>
</tbody>
</table>

1. **ENSURE** the package is marked with
   (a) The UN Number (2910) preceded by the letters “UN” on the outside of the package.
   (b) “Radioactive” on the outside of the inner package
   **OR**
   the outside package if there is no inner package.

2. **IF** the package contains waste AND will be transferred to a disposal facility, **THEN MARK** the package with the appropriate waste class.

3. **IF** the package is going to be shipped by Air, **THEN MARK** the package with the following:
   - Proper shipping name.
   - Full name and address of the consignee and shipper.
   - Permissible gross weight, if the package exceeds 50 kg (110 pounds).
   - Air eligibility marking adjacent to proper shipping name and UN number.
C. **IF** a subsidiary hazard is present, **THEN CONTACT** the Transportation Representative for additional shipping requirements, if any.

D. **IF** the package(s) is required to be shipped exclusive use, **THEN:**

1. **PERFORM** and **DOCUMENT** (before loading packages on the transport vehicle) contamination surveys in **one** of the following applicable locations to ensure non-fixed radioactive contamination does not exceed the limits in AVESI HP-60, *Shipment of Radioactive Material/Waste, General Requirements*, Attachment 2, *Non-Fixed (Removable) Contamination Limits*:
   - Cargo compartment.
   - Loading area of flat bed trailer.

2. **LOAD** packages on transport vehicle to prevent spillage, scattering of loose material, and puncturing of the shipping package.

3. **LOAD** packages on transport vehicle.

4. **ENSURE** that under conditions normally incident to transport, the following requirements are met:
   - Shipping package integrity will not be comprised.
   - External vehicle dose rates will not change.

5. **WHEN** loading is complete, **THEN PERFORM** and **DOCUMENT** radiological surveys of the vehicle.

6. **ENSURE** the following:

E. **COMPLETE** required shipping papers in accordance with AVESI HP-64, *Shipment of Radioactive Material, Shipping Papers*, if required by that procedure.

7.0 **Procedure**

7.1 **ENSURE** all forms generated by this procedure are completed, reviewed, and filed with the appropriate shipping package documentation.