

2. HAZARD IDENTIFICATION AND MITIGATION

The OU 7-10 Glovebox Excavator Method Project includes excavation, handling, sizing (when needed), and packaging of waste, samples, and soils. Materials within the waste zone are placed primarily in 55-gal drums and secondarily in 85-gal drums. Operation of the project facilities will present physical, chemical, and radiological hazards to operations personnel, so identification and mitigation of these hazards is imperative to prevent injury or exposure to personnel conducting these activities. The primary objective of this section is to identify existing and anticipated hazards based on project operations and to provide controls to eliminate or mitigate these hazards which includes the following:

- Evaluation of project operations to determine the extent that potential industrial safety, radiological, nonradiological, and physical hazards may affect facility personnel
- Establishment of the necessary monitoring and sampling required to evaluate exposure and contamination levels, determine action levels to prevent exposures, and provide specific actions to be followed if action levels are reached
- Determination of necessary engineering controls, isolation methods, administrative controls, work practices, and (where these measures will not adequately control hazards) PPE to further protect project personnel from hazards.

The purpose of this hazard identification section is to lead the user to an understanding of the occupational safety and health hazards associated with project operational tasks. This will enable project management and safety and health professionals to make effective and efficient decisions related to the equipment, processes, procedures, and the allocation of resources to protect the safety and health of project personnel.

The magnitude of danger presented by these hazards to personnel conducting project operations in the WMF-671 WES, RCS, and PGS is dependent on both the nature of tasks being performed and the proximity of personnel to the waste materials. Engineering controls have been implemented along with administrative controls, work procedures, and PPE to further mitigate potential exposures and hazards.

The following section describes the chemical, radiological, safety, and environmental hazards that personnel may encounter while conducting project operational activities. Hazard mitigation will be accomplished through a combination of designed engineering controls with other work controls (such as technical procedures, work orders, JSA, and Guide-62 12, "Hazard Mitigation Guide for Integrated Work Control Process"). This hazard mitigation strategy will be used to eliminate or mitigate project hazards in accordance with Program Requirements Document (PRD) -25, "Activity Level Hazard Identification, Analysis, and Control," to the extent possible.

2.1 Chemical and Radiological Hazards and Mitigation

Personnel may be exposed to industrial safety hazards or to radiological, nonradiological, and physical agents while conducting project operations. Designed engineering controls will be implemented along with work procedures, real-time monitoring of contaminants, and project facility-specific hazard training to further mitigate potential hazards and exposures. Formal preplanning (e.g., job walk-down, completion of the hazard profile screening checklists, and prejob briefing checklists), JSAs, and other work controls will be written based on the hazards identified in this HASP, technical procedures, STD-101, "Integrated Work Control Process," work packages, and operational conditions. These documents will specify specific operational hazard mitigation measures to follow.

The dominant waste forms (see Table 2-1) that will be encountered in the waste zone have been assessed based on an evaluation of shipping records for waste placed in a 40 x 40-ft area, also referred to as the Stage I area, in and near the project excavation area. The results of this assessment are shown in Table 2-1 (see Footnote D). The dominant waste form for this area of OU 7-10 is drums of Series 743 sludge (see Footnote E) containing organics such as cutting oils and carbon tetrachloride. The next significant types of waste are drums containing contaminated combustible materials. Of lesser number are drums of evaporated salts (nitrates) and drums of graphite material (believed to be intact or crushed molds).

Table 2-1. Dominant waste forms in the Stage I (project excavation) area.

Waste Stream	Content Code	Summary Characteristics	Packaging	Estimated Quantity
Series 741 sludge first stage sludge	001	Salt precipitate containing plutonium and americium oxides, depleted uranium, metal oxides, and organic constituents.	40 to 50 lb of Portland cement added to bottom of drum and each of two (inner and outer plastic bags, and the top of the outer bags to absorb any free liquids. Lead sheeting may line inside of the drum as well	3 drums
Series 742 sludge second stage sludge	002	Salt plutonium and americium oxides, metal oxides, and organic constituents.	40 to 50 lb of Portland cement added in layers to absorb any free liquids. Waste is double-bagged and drummed.	27 drums
Series 743 sludge organic setups	003	Organic liquid waste solidified using calcium silicate (paste or greaselike).	30 gal of organic waste mixed with 100 lb calcium silicate. Small quantities (10 to 20 lb) of Oil-Dri added to top or bottom of drum, if necessary. Double-bagged.	379 drums
Series 744 sludge special setups	004	Complexing chemicals (liquids) including Versenes, organic acids and alcohols solidified with cement.	190 lb of Portland cement and 50 lb of magnesia cement in drum followed by the addition of 26.5 gal of liquid waste. Additional cement top and bottom. Double-bagged.	2 drums
Series 745 sludge evaporator salts	005	Salt residue from evaporated liquids from solar ponds containing 60% sodium nitrate, 30% potassium nitrate, and 10% miscellaneous.	Salt residue packaged in plastic bag and drum. Cement added to damp or wet salt, when necessary.	42 drums
Noncombustible waste	480	Various miscellaneous waste (e.g., gloveboxes, lathes, ducting, piping, angle iron, electronic instrumentation, pumps, motors, power tools, hand tools, chairs, desks).	Varies by process line generating the waste. Waste may have been wrapped in plastic or placed directly into the waste container.	28 drums
Combustible waste	330	Dry combustible materials (e.g., paper, rags, plastics, surgeons' gloves, cloth coveralls and booties, cardboard, wood, wood filter frames, polyethylene bottles).	Varies by process line generating the waste. Plastic bags used in some instances, but in other instances waste placed directly into waste container.	260 drums
Graphite	300	Graphite mold pieces after excess plutonium removal. Molds are broken into large pieces before packaging.	Drums lined with polyethylene bags and, most likely, a cardboard liner.	22 drums
Empty 55-gal drums	No code	Empty drums that originally held lathe coolant at Rocky Flats Plant. Some drums may contain residues.	Single drum placed in cardboard carton.	544 drums

Several tables are presented in this section that identify the potential hazards that may be encountered during project operations based on known waste inventory and operational activities, which state the associated monitoring methods and other hazard-specific mitigation measures. These tables are listed below:

- Table 2-2: Total activities for radiological contaminants in OU 7-10
- Table 2-3: Chemical inventory for OU 7-10 and the Stage I area
- Table 2-4: Evaluation of chemicals and potential agents that may be encountered
- Table 2-5: Summary of project operational activities, associated hazards, and mitigation.

2.1.1 Routes of Exposure

Exposure pathways exist for radiological and nonradiological contaminants that will be encountered during project operations. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards to a large extent; however, the potential for exposure still exists. Exposure pathways include those listed below:

- **Inhalation** of radiological and nonradiological contaminated soil or fugitive dusts during waste handling and sorting, packaging, or decontamination tasks. Inhalable or respirable (dependent on the particle aerodynamic diameter) fugitive dusts may have trace amounts of radiological or nonradiological contaminants associated with them, resulting in potential respiratory tract deposition.
- **Skin absorption and contact** with radiological and nonradiological contaminated soil or surfaces during waste handling and sorting, packaging, decontamination, or system maintenance tasks. Radiological and nonradiological contaminants can be absorbed through broken skin or by solvent action, resulting in uptake, and skin contamination or irritation.
- **Ingestion** of radiological and nonradiological contaminated soil or materials adsorbed to fugitive dust particles or waste residues, resulting in potential uptake of contaminants into the upper respiratory tract or directly into the through the gastrointestinal (GI) tract (placing contaminated surfaces in mouth) that may result in GI irritation, internal tissue irradiation, or deposition to target organs.
- **Injection** of radiological and nonradiological contaminated materials by breaking of the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all project operations. Where these hazards cannot be eliminated or isolated through engineering controls, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards through the routes of entry listed above. Table 2-5 summarizes each primary operational activity, associated hazards, and mitigation procedures.

The RWPs will be used and SWPs may be used in conjunction with this HASP to provide task- or activity-specific requirements for project operations. When used, these permits will further detail specialized PPE and dosimetry requirements.

Table 2-2. Total activities for radiological contaminants in Operable Unit 7-10 decayed to 34 years (1969–2003) using RadDecay.^{a,b}

Radionuclide	Ci	Half-Life (Year)	34-Year Decay Activity (1969 to 2003) (Ci)
Am-241	3.2E+03	4.32E+02	3.5E+03
Ba-137m	5.8E-01	4.80E-05	2.5E-01
C-14	3.4E-04	5.73E+03	3.4E-04
Ce-144	4.2E-01	7.80E-01	0
CO-58	3.0E-03	1.94E-01	0
Co-60	1.2E+00	5.27E+00	1.4E-02
Cr-51	5.9E-01	7.59E-03	0
Cs-137	5.8E-01	3.02E+01	2.7E-01
Eu-154	8.8E-07	8.80E+00	6.0E-08
Eu-155	3.0E-03	2.73E+00	2.6E-05
Fe-55	1.1E+00	2.73E+00	5.0E-04
Mn-54	5.0E-03	8.57E-03	0
Nb-95	6.4E-02	9.75E-02	0
Ni-59	1.7E-04	7.60E+04	1.7E-04
Ni-63	1.3E-01	1.00E+02	1.0E-01
Pr-144	4.2E-01	3.30E-05	0
Pu-238	5.0E+01	8.77E+01	3.8E+01
Pu-239	1.7E+03	2.41E+04	1.7E+03
Pu-240	3.9E+02	6.56E+03	3.9E+02
Pu-241	1.1E+04	1.44E+01	2.1E+03
Pu-242	2.0E-02	3.75E+05	2.0E-02
Ru-106	2.1E-01	1.01E+00	0
Rh-106	2.1E-01	9.50E-07	0
Sb-125	9.1E-02	2.77E+00	1.8E-05
Sr-90	3.5E-01	2.86E+01	1.5E-01
Tc-99	5.5E-05	2.13E+05	5.5E-05
U-234	7.5E-01	2.46E+08	7.5E-01
U-235	5.3E-02	7.04E+08	5.3E-02
U-238	4.0E+00	4.47E+09	4.0E+00
Y-90	3.5E-01	1.20E-04	1.5E-01
Zr-95	6.4E-02	1.75E-02	0

a. (RadDecay)

b. (Einerson and Thomas 1999)

Table 2-3. Chemical inventory for Operable Unit 7-10 and the Stage I area.

Chemical	Content Code	OU 7-10 Inventory (g)	OU 7-10 Inventory (L)	Stage I Area (g)	Stage I Area (L)
Asbestos	335,338,490	4.0E+05	—	—	—
Ascorbic acid	004	1.4E+06	—	6.67E+04	—
Beryllium	001	5.8E+04	—	2.70E+02	—
Beryllium	002	1.9E+04	—	2.59E+03	—
Beryllium (total)	001,002	7.7E+04	—	2.86E+03	—
Butyl alcohol	001,002	1.1E+03	1.36E+00	5.25E+01	6.48E-02
Cadmium	001,002	5.4E+02	—	2.58E+01	—
Carbon tetrachloride	001,002,003,004	9.4E+07	1.54E+04	3.13E+07	5.13E+03
Chloroform	001,002,003,004	1.6E+05	1.07E+02	3.49E+04	2.34E+01
EDTA (assumed to be tetrasodium)	004	1.4E+06	—	6.67E+04	—
Ethyl alcohol	004	1.1E+06	1.39E+03	5.24E+04	6.64E+01
Freon 113	003	8.5E+05	1.42E+02	2.51E+05	4.74E+01
Lead		5.2E+06	—	—	—
Lithium oxide	002	Trace	—	Trace	—
Mercury	002	— ^a	— ^a	— ^a	— ^a
Methyl alcohol	004	2.2E+03	7.51E-01	1.07E+02	3.57E-02
Methyl alcohol	001,002	2.4E+03	8.01E-01	1.14E+02	3.82E-02
Methyl alcohol (total)	001,002	4.6E+03	1.55E+00	2.22E+02	7.39E-02
Methylene chloride	001,002,003,004	1.6E+05	1.20E+02	3.49E+04	2.61E+01
Polychlorinated biphenyls	003	unknown	unknown	unknown	unknown
Potassium chloride	005	1.4E+06	—	2.21E+05	—
Potassium dichromate	005	3.7E+04	—	5.84E+03	—
Potassium cyanide	002	— ^b	—	— ^b	—
Potassium nitrate	005	3.2E+07	—	5.05E+06	—
Potassium phosphate	005	7.7E+05	—	1.22E+05	—
Potassium sulfate	005	1.4E+06	—	2.21E+05	—
Silver	INEEL Waste	1.0E+00	—	—	—
Sodium chloride	005	3.0E+06	—	4.74E+05	—
Sodium dichromate	005	7.8E+04	—	1.23E+04	—
Sodium cyanide	002	— ^b	—	— ^b	—
Sodium nitrate	005	6.50E+07	—	1.03E+07	—
Sodium phosphate	005	1.40E+06	—	2.21E+05	—
Sodium sulfate	005	3.00E+06	—	4.74E+05	—
Tetrachloroethene	003	2.70E+07	4.46E+03	8.98E+06	1.48E+03
1,1,1-Trichloroethane	001,002,003,004	2.20E+07	4.17E+03	7.31E+06	1.39E+03
Trichloroethene	003	2.50E+07	4.52E+03	8.31E+06	1.50E+03
Xylene	001,002	5.20E+03	5.98E+00	2.48E+02	2.58E-01
Zirconium	INEEL Waste	1.5E+07	—	—	—

a. Clements (1982) reports that pint bottles of mercury were periodically disposed of through the Series 742 sludge waste stream. It is unknown how much, if any, mercury is in OU 7-10 or the OU 7-10 Glovebox Excavator Method Project area. A 1-pt bottle of mercury is assumed to be in the project area.

b. Two 25-lb packs of sodium cyanide or potassium cyanide pellets were distributed in Series 742 sludge waste drums buried in the Subsurface Disposal Area. It is assumed that the cyanide is in the project area.

INEEL = Idaho National Engineering and Environmental Laboratory

OU = operable unit

Table 2-4. Evaluation of chemicals and potential agents that may be encountered.

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy) ^a	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Organic Compounds						
Ascorbic acid (50-81-7)	None established	Ih, Ig	Eye irritation	Mild irritation of eyes only	No	Content Code 004, solid
Butyl alcohol (75-65-0) VD = 2.55 IE = 9.7 eV	TLV: 20 ppm	Ih, Ig, Con	Irritation eyes, skin, nose, throat; drowsiness, narcois	Eyes, skin, respiratory system, central nervous system	No	Content Codes 001,002, liquid
Carbon tetrachloride (56-23-5) VD = 5.3 IE = 11.5 eV	TLV: 5 ppm STEL: 10 ppm Ceiling: 25 ppm	Ih, Ig, S, Con	Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, uncoordination; (potential occupational carcinogen)	Central nervous system, eyes, lungs, liver, kidneys, skin	Yes—NIOSH A2-ACGIH	Content Codes 001 through 004, liquid
Chloroform (67-66-3) VD = 4.12 IE = 11.4 eV	TLV: 10 ppm	Ih, Ig, S, Con	Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; (potential occupational carcinogen)	Liver, kidneys, heart, eyes, skin, central nervous system	No	Content Codes 001 through 004, liquid
Diesel fuel (68476-34-6) VD = 1.0 IE = NA	TLV: 100mg/m ³ (ACGIH—diesel fuel vapor or aerosol)	Ih, Ig, S, Con	Eye irritation; respiratory system changes; dermatitis	Eye, respiratory system	No	Fuel handling during refueling of excavator and other diesel powered equipment
Diesel exhaust (particulate aerodynamic diameter <1 µm)	TLV: 0.02 mg/m ³ (ACGIH 2002)	Ih	Respiratory, nose, throat or lung irritation with stinging and redness of the eyes; headache; nausea; dizziness; unconsciousness	Respiratory system	A2—ACGIH	Exhaust from excavator and other diesel-powered equipment

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy)"	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
EDTA (tetrasodium) (64-02-8)	None established	Ig, S	Eye, skin, and mucous membrane irritation	Eyes, skin	No	Content Code 004, solid
Ethyl alcohol (64-17-5) VD = 1.6 IE = 10.47eV	TLV: 1000 ppm	Ih, Ig, S, Con	Irritation eyes, skin, nose; headache, drowsiness, fatigue, narcosis; cough; liver damage; anemia; reproductive, teratogenic effects.	Eyes, skin, respiratory system, central nervous system, liver, blood, reproductive system	No	Content Code 004, liquid
Freon 113 (76-13-1) VD = 2.9 IE = 11.99eV	TLV: 1000 ppm STEL: 1250 ppm	Ih, Ig, Con	Irritation skin, throat, drowsiness, dermatitis; CNS depressant and depression (in animals); cardiac arrhythmia, narcosis.	Skin, heart, CNS cardiovascular system	No	Content Code 003, liquid
Methyl alcohol (67-56-1) VD = 1.11 IE = 10.84eV	TLV: 200 ppm	Ih, Ig, S, Con	Eye, skin, nose and throat irritation; headache; drowsiness; optic nerve atrophy; chest tightness; narcosis	Eyes, skin, respiratory system, CNS	No	Content Codes 001, 002, and 004
Methylene chloride (75-09-2) VD = 2.9 IE = 11.3eV	TLV: 50 ppm OSHA (29 CFR 1910.1052, 2002) PEL: 25 ppm STEL: 125 ppm	Ih, Ig, S, Con	Eye and skin irritation; fatigue, weakness, somnia, lightheadedness; numbness, tingling limbs; nausea	Eyes, skin, cardiovascular system, CNS	Yes—NIOSH A3—ACGIH	Content Codes 001 through 004, liquid
Polychlorinated biphenyls not specified (Aroclor-1254 used for toxicological evaluation purposes)	TLV: 0.5 mg/m ³ —skin	Ih, Ig, S, Con	Eye irritation; chloracne; liver damage; reproductive effects	Skin, eyes, liver, reproductive system	Yes-NTP Yes-IARC No-OSHA	Content Code 003

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy)"	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Tetrachloroethene (127-18-4) VD = 5.8 IE = 9.3 eV	TLV: 25 ppm STEL: 100 ppm	Ih, Ig, S, Con	Eye, skin, nose, throat, and respiratory system irritation; nausea; flush face, neck; vertigo, dizziness, uncoordination; headache, somnolence; skin erythema; liver damage	Eyes, skin, respiratory system, liver, kidneys, CNS	Yes—NIOSH	Content Code 003, liquid
1,1,1-Trichloroethane (71-55-6) VD = 4.6 IE = 11.1 eV	TLV: 350 ppm STEL: 450 ppm	Ih, Ig, Con	Eye and skin irritation; headache, lassitude, CNS depressant or depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, CNS, cardiovascular, liver	No A4—ACGIH	Content Codes 001 through 004, liquids
Trichloroethene (79-01-6) VD = 4.53 IE = 9.5 eV	TLV: 50 ppm STEL: 100 ppm	Ih, Ig, S, Con	Eye and skin irritation; headache, vertigo; visual disturbance, fatigue, giddiness, tremor, somnolence, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury	Eyes, skin, respiratory system, heart, liver, kidneys, CNS	Yes—NIOSH	Content Code 003, liquid
Xylene (total) (95-47-6) VD = 5.2 IE = 8.6 eV	TLV: 100 ppm STEL: 150 ppm	Ih, Ig, S, Con	Headache, loss of appetite, nervousness and pale skin; skin rash; eye damage; damage to bone marrow, causing low blood cell count; liver and kidney damage	Skin, eyes, blood, liver, kidneys	No	Content Codes 001 and 002, liquid

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy) ^a	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Inorganic Compounds						
Asbestos (12001-29-5) VI-NA	TLV: 0.1 fiber/kc PEL: 0.1 fiber/kc Excursion Limit: 1.0 fiber/kc in 30 minutes (29 CFR 1926.1101, 2002)	Ih, Ig, Con	Irritation of eyes and skin, chronic asbestosis, restricted pulmonary function	Eyes, respiratory tract, lung lining	A1-ACGIH Yes-NTP Yes-IARC Yes-OSHA	Content Codes 335, 338, and 490
Beryllium (7440-41-7) VD = NA	TLV: 0.002 mg/m ³ STEL: 0.01 mg/m ³	Ih, Con	Berylliosis; anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis	Eyes, skin, respiratory system	Yes-NTP Yes-IARC NO-OSHA	Content Codes 001 and 002. solid
2 Cadmium (7440-43-9) VD = NA	TLV: 0.01 mg/m ³ Respirable: 0.002 mg/m ³ PEL: 5 µg/m ³ Action level: 2.5 µg/m ³ (29 CFR 1926.1127, 2002)	Ih, Ig	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia	Respiratory system, kidneys, prostate, blood	Yes-NTP Yes-IARC A2-ACGIH Yes-OSHA	Content Codes 001 and 002, solid
Lead (7439-92-1) VD = NA	TLV: 50 µg/m ³ OR A PEL in µg/m ³ equal to 400 divided by the number of hours worked per day for shifts longer than 8 hours. (29 CFR 1926.62, 2002)	Ih, Ig, Con	Weakness, lassitude, insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	Eyes, CNS, kidneys, blood, gingival tissue	No	Content Code (unknown), solid

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy)"	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Lithium oxide (12057-24-8) VD = NA	None established	Ih, Ig, Con	Corrosive to eyes, skin, nose and throat	Skin and eyes (corrosive)	No	Content Code 002, solid (trace amounts only)
Mercury	TLV: 0.025 mg/m ³ —skin STEL: 0.03 mg/m ³	Ih, Ig, S, Con	Irritation eyes, skin; cough, chest pain, dyspnea, bronchitis pneumonitis; tremor, insomnia, irritability, indecision, headache, fatigue, weakness; stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, CNS, kidneys	No	Content Code 002, liquid
Potassium chloride (7447-40-7) VD = NA	None established	Ih, Ig, Con	Eyes, irritation of mucous membranes	None identified, primarily a localized irritant	No	Content Code 005, solid
Potassium cyanide (150-50-8) VD = NA	PEL: 5 mg/m ³	Ih, Ig, S, Con	Irritation eyes, skin, upper respiratory system; asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased respiratory rate, slow gasping respiration; thyroid, blood changes	Eyes, skin, respiratory system, cardiovascular system, central nervous system, thyroid, blood	No	Content Code 002 ^g
Potassium & chromate (7778-50-9) VD = NA	TLV: 0.05 mg/m ³ (chromate)	Ih, Ig, Con (chromate)	Respiratory, eyes, dermis, skin irritation, discoloration, mucous membrane ulcerating, perforated septum (chromate)	Skin (chromate)	Yes-NPT Yes-IARC No-Z List No-OSHA (chromate)	Content Code 005, solid

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy)"	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Potassium nitrate (7757-79-1) VD = NA	None established	Ih, Ig, Con	Respiratory irritation, (Ig—GI pain, nausea and vomiting)	None identified, primarily a localized irritant	No	Content Code 005, solid
Potassium phosphate (7778-77-0) VD = NA	None established	Ih, Ig, Con	Eyes, minor skin irritation	None identified, primarily a localized irritant	No	Content Code 005, solid
Potassium sulfate (7778-80-5) VD = NA	None established	Ih, Ig	None identified	None identified	No	Content Code 005, solid
Silver (7440-22-4) VD = NA	TLV: 0.1 mg/m ³ TLV: 0.01 mg/m ³ (soluble compounds as silver)	Ih, Ig, Con	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	No	Content Code INEEL waste, solid
Sodium chloride (7647-14-5) VP-NA	None established	Ih, Ig, Con	Eyes, irritation of mucous membranes	None identified, primarily a localized irritant	No	Content Code 005, solid
Sodium cyanide (143- 33-9) VD = NA	PEL: 5 mg/m ³	Ih, Ig, S, Con	Irritation eyes, skin; asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased respiratory rate; slow gasping respiration; thyroid, blood changes	Eyes, skin, cardiovascular system, central nervous system, thyroid, blood	No	Content Code 002 ^g
Sodium & chromate (10588-01-9) VD = NA	TLV—0.05 mg/m ³ (chromate)	Ih, Ig, Con (chromate)	Respiratory, eyes, skin irritation or ulcerating (chromate)	Kidneys, liver (chromate)	Yes-NPT Yes-IARC Yes-Z List Yes-OSHA (chromate)	Content Code 005, solid

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy) ^a	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Sodium nitrate (7631-99-4) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis, (Ih/Ig may cause cyanosis)	None identified, primarily a localized irritant	No	Content Code 005, solid
Sodium phosphate (7558-79-4) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis	None identified, primarily a localized irritant	No	Content Code 005, solid
Sodium sulfate (7757-82-6) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis	None identified, primarily a localized irritant	No	Content Code 005, solid
Zirconium (7440-67-7) VD = NA	TLV: 5 mg/m ³ STEL: 10mg/m ³	Ih, Con	Skin, lung granulomas; irritation skin, mucous membrane; X-ray evidence of retention in lungs	Skin, respiratory system	No	Content Code INEEL waste, solid
Radionuclides (as listed in Table 2-1)						
Radionuclides (radiation fields)	ALARA, dose limit, in accordance with RWP Posting of radiation areas in accordance with INEEL <i>Radiological Control Manual</i> ^b Thermoluminescent dosimeters will be used to measure whole body TEDE.	Whole Body	Alarming electronic dosimetry or stationary radiation monitors or alarms, criticality alarm, and elevated readings on direct-reading instruments.	Blood-forming cells, GI tract, and rapidly dividing cells	Yes—IARC	OU 7-10 waste and waste streams, assay system
Radionuclides (fixed and removable surface contamination)	ALARA, dose limit, in accordance with RWP Posting of contamination areas in accordance with PRD-183	Ih, Ig, broken skin	Alarming CAMs, high counts on portable air samplers, direct-reading instruments, swipe counter (scaler), and alarm indication on personal contamination monitors.	GI tract, ionization of internal tissue through uptake of radionuclides	Yes—IARC	Contamination from OU 7-10 waste and waste streams

Table 2-4. (continued)

Material or Chemical (Chemical Abstract Service Number, Vapor Density and Ionization Energy)"	Exposure Limit ^b (PEL/TLV)	Routes of Exposure ^c	Indicators or Symptoms of Over-Exposure ^d (acute and chronic)	Target Organs and System	Carcinogen? (source) ^e	Matrix or Source to Be Encountered During Project Operations
Radionuclides (airborne radioactivity)	ALARA, dose limit, in accordance with RWP 10% of derived air concentration for specific radionuclide selected (10 CFR 835,2002) Posting of airborne radioactivity areas in accordance with PRD-183	Ih, Ig, broken skin	Alarming CAMs, high counts on portable air samplers and personal air samplers.	GI tract, ionization of internal tissue through uptake of radionuclides	Yes	OU 7-10 waste and waste streams. Entry into Retrieval Confinement Structure or contaminated areas of Packaging Glovebox System.

a. Material safety datasheets for chemicals other than waste types are available at the project.

b. ACGIH (2002); 29 CFR 1910(2002), 29 CFR 1926(2002); and substance-specific standards.

c. (Ih) inhalation; (Ig) ingestion; (S) skin absorption; (Con) contact hazard.

d. (Nervous system) dizziness, nausea, lightheadedness; (dermis) rashes, itching, redness; (respiratory) respiratory effects; (eyes) tearing, irritation.

e. If yes, identify agency and appropriate designation (ACGIH A1 or **A2**, NIOSH, OSHA, IARC, NTP).

f. Clements (1982) reports that pint bottles of mercury were periodically disposed of through the Series 742 sludge waste stream. It is unknown how much, if any, mercury is in OU 7-10 or the OU 7-10 Glovebox Excavator Method Project area. A 1-pt bottle of mercury is assumed to be in the project area.

g. Two 25 lb packs of sodium cyanide or potassium cyanide pellets were distributed in Series 742 sludge waste drums buried in the Subsurface Disposal Area. It is assumed that the cyanide is in the project area.

ACGIH = American Conference of Governmental Industrial Hygienists

ALARA = as low as reasonably achievable

CAM = constant air monitor

CFR = *Code of Federal Regulations*

CNS = central nervous system

GI = gastrointestinal

ARC = International Agency for Research on Cancer

IH = industrial hygienist

INEEL = Idaho National Engineering and Environmental Laboratory

NIOSH = National Institute of Occupational Safety and Health

NTP = National Toxicology Program

OSHA = Occupational Safety and Health Administration

OU = operable unit

PEL = permissible exposure limit

PRD = program requirements document

RWP = radiological work permit

TEDE = total effective dose equivalent

TLV = threshold limit value

Table 2-5. Summary of project operational activities, associated hazards, and mitigation.”

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Excavation Operations (RCS)		
<ul style="list-style-type: none"> • Overburden removal ▪ Waste retrieval • Underburden sampling • Sample handling and transportation 	<p>Radiological: Contamination—OU 7-10 waste material. Radiation exposure—OU 7- 10 waste material. Airborne radioactivity —Dust from waste material. Criticality— Accumulation of high FGE material with moderator and proper geometry.</p> <p>Chemical and nonradiological contaminants —OU 7- 10 waste material, airborne contaminants, chemical use for project RCS operations, equipment operation (CO), excavator fuel, preventive maintenance.</p> <p>Pinch points, and struck-by or caught-between hazards — Equipment movement and vehicle traffic, forklift movement, soil sack loading and handling, empty drum handling.</p> <p>Lifting and back strain — Staging excavator stands and end effectors and support materials, handling core sampling equipment, manual excavation of overburden,</p> <p>Heat and cold stress — Working outdoors and tasks requiring use of protective clothing and respiratory protection.</p>	<p>Safety-significant systems and engineering controls (confinement) of the RCS, DSS, controlled access, stationary continuous air and radiation monitors, criticality monitor and alarm, TPRs with hold points, qualified equipment operator, RWP, direct-reading instruments, compliance with PRD-183 radiological posting requirements, PPE, use of TLDs and supplemental dosimetry, and contamination surveys.</p> <p>Safety-significant systems and engineering controls (confinement) of the RCS, DSS, controlled access, area monitors and direct-reading instruments, TPRs with hold points, qualified equipment operator, JSAs, MSDS for all chemicals used, active exhaust system for excavator, and PPE.</p> <p>Technical procedures, equipment inspections, qualified equipment operators (hoisting and rigging) and forklift operators, backup alarms, JSAs, designated traffic lanes and areas, watch body position, and PPE.</p> <p>Mechanical equipment to lift and position heavy items, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person’s body weight, whichever is less) or awkward or unbalanced, body position awareness, and use of stands or designed jigs or fixtures for holding heavy items during manipulation tasks.</p> <p>Industrial hygienist monitoring, PPE, training, work and rest cycles as required (MCP-2704), stay times documented on SWP (or euivalent).</p>

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
<p>Tripping hazards and working and walking surfaces — Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, probes in pit, lines and cords, and ladders.</p>	<p>Stored energy sources — Elevated materials, electrical, compressed gases, hoisting and rigging (soil sacks), fire (reheling), running vehicles.</p>	<p>Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use of nonskid or high-fiction materials on walking surfaces, lines and cords maintained out of established aisles and walkways, proper footwear, and three-point contact when ascending and descending ladder.</p> <p>Secure all materials stored at elevated locations, identify and mark all utilities, ensure all lines and cords are checked for damage and continuity, use GFCI (circuit or receptacle) for all outdoor equipment and for all temporary installations, comply with minimum clearances for overhead lines, and secure compressed cylinders, caps, and bottles before movement, conduct inspections of equipment, grounding and bonding during all refueling operations, set brake and use tire chocks where appropriate, and do not leave any running vehicles or equipment unattended.</p>
<p>Hazardous noise — Areas around equipment and when operating equipment.</p>	<p>Source identification and labeling, Industrial Hygiene sound level monitoring and dosimetry, isolation, and PPE (as required).</p>	
Glovebox Operations (PGS)		
<ul style="list-style-type: none"> • Waste packaging • Waste Sorting • Waste handling • Drum preparation • Drumloadout 	<p>Radiological: Contamination — OU 7-10 waste material.</p> <p>Radiation exposure — OU 7-10 waste material and radiological sources</p> <p>Criticality — Overloaded drum.</p>	<p>Safety significant systems and engineering controls (confinement) of the PGS, controlled access, air and radiation monitors, FMM, TPRs with hold points, qualified glovebox operators, RWP, direct-reading instruments, compliance with PRD-183 radiological posting requirements, PPE, use of TLDs and supplemental dosimetry, and contamination surveys.</p>

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Chemical and nonradiological contaminants — OU 7-10 waste material handling, chemical use for project PGS operations, airborne contaminants, equipment operation, rehelng, and preventive maintenance.	Pinch points, struck-by, or caught-between hazards — Equipment, hoist and drum movement and forklift operations.	Safety significant systems and engineering controls (confinement) of the PGS, controlled access, area monitors and direct-reading instruments, TPRs with hold points, qualified glovebox operators, JSAs, MSDSs for all chemicals used, and PPE.
Lifting and back strain — Lifting glovebox loadout cover, handling and positioning waste in glovebox, drum loadout, drum preparation, waste sorting, and sample movement.	Heat and cold stress — Support work outdoors	Technical procedures, equipment inspections, designated operators (hoist), qualified forklift operators, backup alarms, JSAs, designated traffic lanes and areas, watch body position, and PPE.
Tripping hazards and working and walking surfaces — Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, material storage on elevated work platforms, lines and cords, and ladders.	Stored energy sources — Elevated materials (drums and hoisted materials and waste), electrical, running industrial vehicles (e.g., forklift).	Mechanical lifting devices (e.g., hoist) used to lift and move heavy waste items and loadout cover, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward or unbalanced, and awareness of body position. Ergonomic assessments performed by IH as deemed appropriate.
		Industrial Hygiene monitoring, PPE, training, and work-rest cycles (as required).
		Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use of nonskid or high-friction materials on walking surfaces, proper footwear, lines and cords maintained out of established aisles and walkways, and three-point contact when ascending and descending ladder.
		Secure all materials stored at elevated locations, inspect all lines and cords before use, use GFCI (circuit or receptacle) for all outdoor equipment and where liquids may be present, conduct inspections of tools, set brake and use tire chocks where appropriate, and do not leave any running vehicles or equipment unattended.

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Cutting, crushing, and pinch points—Glovebox tools and equipment, sizing operations, debris handling, sampling.	Follow manufacturer’s operating instructions, keep areas clear of nonessential materials, wear required PPE (as listed in the JSA), be aware of body position and other glovebox personnel before starting and during tool use.
	Hazardous noise—Sizing tools and during operation of the forklift.	Source identification and labeling, IH sound level monitoring or dosimetry, isolation, and PPE (as required).
General Project Operational Support Tasks		
<ul style="list-style-type: none"> • Drum handling • Forklift operations • Waste transportation and storage • Waste inspections • Drum assay 	<p>Radiological: Contamination—OU 7-10 waste material. Radiation exposure—OU 7-10 waste material. Assay system operation—drum assay for storage.</p> <p>Chemical and nonradiological contaminants—OU 7-10 waste container handling, chemical use for project operations, equipment operation, rehelng, preventive maintenance, cryogenics (LN₂) for assay detector cooling.</p>	<p>Engineering controls, controlled access, TPRs, qualified positions (where required), RWP, direct-reading instruments, collection and counting of swipes, compliance with PRD-183 radiological posting requirements, interlocks (assay system), PPE, use of TLDs and supplemental dosimetry, and contamination surveys.</p> <p>Engineering controls, controlled access, area monitors and direct-reading instruments, TPRs, JSAs, MSDS for all chemicals used, compliance with PRD-5038, requirements for cryogenic use and handling, and PPE.</p>
	Pinch points, struck-by or caught-between hazards—Equipment, drum movement, forklift operations, material handling tasks.	Technical procedures, equipment inspections, qualified forklift operators, JSAs, backup alarms, designated traffic lanes and areas, proper body position, and PPE.
	Lifting and back strain—Material handling, handling and positioning waste containers and sample movement.	Mechanical lifting devices (e.g., forklift) to lift and move heavy waste items, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person’s body weight, whichever is less) or awkward or unbalanced, and awareness of body position. An IH may perform ergonomic assessments as deemed appropriate.
	Heat and cold stress—Support work outdoors	Monitoring by IH, PPE, training, and work-rest cycles (as required).

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces — Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, lines and cords, entry into waste storage area, and ladders.	Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use nonskid or high-traction materials on walking surfaces, proper footwear, keep lines and cords out of established aisles and walkways, and three-point contact when ascending and descending ladder.
	Stored energy sources — Elevated materials (stored drums and waste), compressed gas (P ₁₀), running industrial vehicles (forklift).	Secure all materials stored at elevated locations, inspect all lines and cords before use, use GFCI (circuit or receptacle) for all outdoor equipment and where liquids may be present, secure compressed cylinders, caps, and bottles before movement, conduct inspections of tools, set brake and use tire chocks where appropriate, and do not leave any running vehicles or equipment unattended.
	Hazardous noise — Areas around equipment and when operating some equipment or while using hand tools.	Source identification and labeling, IH sound level monitoring or dosimetry, isolation, and PPE (as required).

Decontamination Tasks

<ul style="list-style-type: none"> • Operational tools and equipment • RCS and PGS decontamination 	<p>Radiological: Contamination — OU 7-10 waste material.</p> <p>Radiation exposure — Hot particles or dose rate associated with decontamination waste and debris.</p>	<p>Radiological work permit, RCT surveys, hold points, direct-reading instruments, collection and counting of swipes, compliance with PRD-183 radiological posting requirements, PPE, and use of dosimetry or survey requirements, and ALARA principles (Section 4).</p>
	<p>Chemical and nonradiological contaminants — Contaminants associated with decontamination process and secondary waste streams generated.</p>	<p>Controlled areas, JSAs, SWPs (as required), air monitoring and sampling, direct-reading instruments, TPRs, and PPE.</p>
	<p>Pinch points, struck-by, and caught-between — Positioning items to be decontaminated.</p>	<p>Job safety analyses, TPRs, watch body position, and PPE.</p>
	<p>Lifting and back strain — Moving and positioning components and decontamination waste containers.</p>	<p>Use mechanical lifting devices where possible, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or in awkward or unbalanced situations, and an IH will conduct ergonomic evaluation of tasks (as required).</p>

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Heat and cold stress — Working outdoors and in PPE	Monitoring by IH, PPE, training, work and rest cycles as required (MCP-2704), stay times documented on SWP (or equivalent).
	Tripping hazards and working and walking surfaces — Uneven surfaces and terrain, ice- and snow-covered and wet surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Electrical — Use of electrical equipment or equipment in area where water or wet surfaces are present.	Use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present. Use of barrier material to isolate overspray.
Maintenance of Project Systems		
<ul style="list-style-type: none"> • Electrical • Piping, valves, fittings, hoses • Communication • Heating, and ventilating • Mechanical equipment 	<p>Radiological contamination — Contact with waste material, contaminated equipment, and components.</p> <p>Radiation exposure — In close proximity to waste containers and contamination with associated dose rate.</p>	<p>Engineering controls (confinement), RWP, RCT surveys, work package hold points, direct-reading instruments, collection and counting of swipes, compliance with PRD-183 radiological posting requirements, PPE, and use of dosimetry and survey requirements, and ALARA principles (Section 4).</p>
	<p>Chemical and inorganic contaminants — Contact with waste material, contaminated equipment, and components, hydraulic fluids, fuel, and use of chemicals associated with maintenance tasks.</p>	<p>Controlled areas, JSAs, SWPs (as required), work package hold points, air monitoring and sampling, direct-reading instruments, MSDS for all chemicals, and PPE.</p>
	<p>Pinch points, struck-by or caught-between hazards — Equipment, drum movement, forklift operations, material handling tasks.</p>	<p>Technical procedures, equipment inspections, qualified forklift operators, JSAs, designated traffic lanes and areas, backup alarms, watch body position, and PPE.</p>
	<p>Lifting and back strain — Moving and positioning components.</p>	<p>Use mechanical lifting and positioning devices, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person’s body weight, whichever is less) or awkward and unbalanced, IH conduct ergonomic evaluation of tasks (as required).</p>
	<p>Heat and cold stress — Working outdoors and in PPE</p>	<p>Industrial hygienist monitoring, PPE, training, work-rest cycles as required (MCP-2704), stay times documented on SWP (or equivalent).</p>

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Tripping hazards and working-walking surfaces — Uneven surfaces and terrain, ice- and snow-covered and wet surfaces, and ladders.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole, and three-point contact when ascending and descending ladder.	Qualified operators; equipment and rigging inspections; hoisting and rigging operations in accordance with MCP-6501, MCP-6502, MCP-6503, MCP-6504, and MCP-6505; and applicable facility supplement.
Hoisting and rigging — Equipment and component movement and placement, project overhead hoists.	Stored energy — Electrical, mechanical, thermal, elevated materials, pressurized systems, cylinders, and fire systems.	Piping and conduit labeling, LO/TO training, Standard-101 work packages, LO/TO in accordance with MCP-3650, MCP-365 1, and PRD-505 1.
Elevated work or work near open excavation.	Fall protection training, use of fall protection system and devices, fall protection competent person, and follow all requirements of PRD-5096.	
Facility Lay-up		
<ul style="list-style-type: none"> • Backfill excavation • Fix removable contamination • Decontamination on RCS and PGS • Secure Waste Management Facility- 671 Weather Enclosure Structure 	<p>Radiological: Contamination — OU 7- 10 waste material. Radiation exposure — Hot particles or dose rate associated with decontamination waste and debris.</p> <p>Chemical and nonradiological contaminants — Contaminants associated with decontamination process and secondary waste streams generated, decontamination solutions, spray fixative compound(s), grout, fuel, hydraulic fluids, compressed gas cylinders.</p>	<p>Engineering controls (ventilation), controlled areas, TPRs, RWP, RCT surveys, fixed and portable air sampling instruments, hold points, direct-reading instruments, collection and counting of swipes, compliance with PRD-183 radiological posting requirements, PPE, and use of dosimetry and survey requirements, and ALARA principles (Section 4).</p> <p>Controlled areas, TPRs, JSAs, SWPs (as required), MSDS for chemicals used for decontamination, fixative, grout and fluids drained, air monitoring and sampling, direct-reading instruments, PPE.</p> <p>Vehicles use designated traffic lanes and ramps, backup alarms, JSAs, TPRs, watch body position, and wear PPE.</p>
	Pinch points, struck-by, or caught-between — Vehicle and equipment movement, material and equipment handling, use of hand and power tools.	

Table 2-5. (continued)

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Lifting and back strain—Moving and positioning grout hose, lifting components, positioning equipment, carrying decontamination and fixadent equipment and supplies or components.		Use mechanical lifting devices where possible, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person’s body weight, whichever is less) or awkward and unbalanced, IH conduct ergonomic evaluation of tasks (as required).
Heat and cold stress—Working outdoors and in PPE		Industrial hygienist monitoring, PPE, training, work-rest cycles as required (MCP-2704), stay times documented on SWP (or equivalent).
Tripping hazards and working-walking surfaces—Uneven surfaces and terrain, ice- and snow-covered and wet surfaces, plastic sheeting, cords, hoses, and lines, and ladders.		Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, keep lines and cords out of established aisles and walkways, wear adequate footwear with traction sole.
Electrical—Use of electrical equipment or equipment in area where water of wet surfaces are present.		Use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present. Use of barrier material to isolate overspray.

a. All hazards Will be identified, evaluated and controls established in accordance with PRD-25, “Activity Level Hazard Identification, Analysis, and Control,” requirements. Additionally, project assigned industrial hygienist, safety professional, and Radiological Control personnel will be available to assist With the PRD-25 process and to assist in the develop of TPRs, work orders or packages, and permits associated with project operational activities.

ALARA = as low as reasonably achievable	MSDS = material safety datasheet	RCT = radiological control techmcian
DSS = dust-suppression system	OU = operable unit	RWP = radiological work permit
GFCI = ground-fault circuit interrupter	PGS = Packaging Glovebox System	SWP = safe work permit
JSA =job safety analysis	PPE = personal protective equipment	TLD = thermoluminescent dosimeter
LO/TO = lockout and tagout	PRD = program requirements document	TPR = techmcal procedure
MCP = management control procedure	RCS = Retrieval Confinement Structure	

2.2 Safety and Physical Hazards and Mitigation

Industrial safety and physical hazards will be encountered while performing project operations. Section 4.2 provides general safe-work practices that must be followed at all times. This section describes specific industrial safety hazards and procedures to be followed to eliminate or minimize safety and physical hazards that will be encountered by project personnel.

2.2.1 Material Handling and Back Strain

Material handling and maneuvering of various pieces of equipment, drums, end effector stands, and waste in the PGS during project operations may result in employee injury. Mechanical lifting devices such as hoists and forklifts will be used wherever possible to eliminate the need for manual materials handling and lifting. Where these devices are not feasible, lifting and material-handling tasks will be performed in accordance with MCP-2692, "Ergonomic Program." Personnel will not physically lift objects weighing more than 50 lb or 33% of their body weight (whichever is less) alone.

The IH will conduct ergonomic evaluations of various project operations to determine the potential ergonomic hazards presented by various material handling and equipment use operations. Following this evaluation, the IH will provide recommendations to mitigate these hazards including additional engineering controls or work practices. Applicable requirements from MCP-2739, "Material Handling, Storage, and Disposal," also will be followed.

2.2.2 Repetitive Motion and Musculoskeletal Disorders

Project operational tasks such as material handling and glovebox operations may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project industrial hygienist will evaluate project tasks and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with MCP-2692.

2.2.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. Project operations inside the WMF-671 WES will present potential tripping or slip hazards from uneven flooring surfaces, equipment cords, pit surface during manual excavation (probes), wet surfaces or floor obstructions. Outside the WMF-671 WES the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces. All personnel will be made aware of tripping hazards that cannot be eliminated by marking them (e.g., probes). All operations personnel will wear required protective footwear with adequate traction sole to further mitigate slip and fall potential. Tripping and slip hazards will be evaluated during the course of the project in accordance with PRD-5 103, "Walking and Working Surfaces."

2.2.4 Proper Housekeeping to Prevent Slips, Trips, and Falls

The floor of every WMF-671 WES, RCS, and PGS area shall be maintained, so far as possible, in a clean and dry condition. All walking and working surfaces will be kept clean, orderly, and free of foreign objects to prevent possible slip, trip, and fall hazards. Proper drainage and use of dry standing stations will be provided where wet processes (e.g., decontamination) are used that could cause a potential slip and fall hazard. All tools and equipment used during each shift will be placed back in the designated storage location unless required to be left in place. Cords and lines will be routed around walkways, stairs,

and entrances and exits to eliminate tripping hazards. Elevated walkways and platforms will be kept clear of potential tripping hazards at all times.

2.2.5 Elevated Work Areas

Personnel performing maintenance tasks or other operations may be required to work on elevated equipment or at heights above 6 ft. Personnel required to access the RCS area around the pit excavation (with an unprotected side or edge [trench box] which is 6 ft or more above a lower level) shall be protected from falling by the use of guardrail systems, personal fall-arrest systems or fall restraint system (travel restriction system) that prevents personnel from approaching the fall hazard in accordance with PRD-5096, “Fall Protection.”

Although not anticipated, leading edge work in areas that will not allow for traditional fall protection controls will require a fall protection plan to be prepared in accordance with PRD-5096. Additionally, the following MCP requirements will be followed as they relate to project operations associated with elevated work:

- MCP-2709, “Aerial Lifts and Elevating Work Platforms”
- PRD-5067, “Ladders”
- PRD-5098, “Scaffolding.”

2.2.6 Means of Egress

Established means of egress (continuous and unobstructed way of travel to an exit, exit access, and exit discharge) shall be maintained within all WMF-671 WES and RCS areas in accordance with NFPA 101 (2000), “Life Safety Code,” requirements. This includes emergency lighting, illumination of signs, and marking of means of egress. A functional test of emergency lighting shall be conducted on every required emergency lighting system at 30-day intervals for not less than 30 seconds. An annual test shall be conducted on every required battery-powered emergency lighting system for not less than 1-1/2 hours (unless the system meets the exception under the Section 7.9.3 of the “Life Safety Code”). Equipment shall be fully operational for the duration of the test. Written records of the visual inspections and tests shall be maintained.

2.2.7 Powered Equipment and Tools

Powered equipment and tools will be used during project operations for material handling and glovebox operations. Use of this equipment presents potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer’s specifications. At no time will safety guards be removed. Requirements from PRD-5101, “Portable Equipment and Handheld Power Tools,” will be followed for all work performed with powered equipment including hand tools. All tools will be inspected by the user before use.

2.2.8 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as maintenance of project facility electrical systems, may pose shock or electrocution hazards to personnel. Ground-fault protected electrical circuits and receptacles in combination with safety-related work practices will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. All electrical work will be reviewed

and completed under the appropriate work controls (e.g., TPRs or work orders). Before conducting electrical work, hazardous energy of the affected system will be brought to a zero energy state through the use of isolation methods in accordance with the following:

- MCP-3650, “Chapter IX Level I Lockouts and Tagouts”
- MCP-365 1, “Chapter IX Level II Lockouts and Tagouts”
- Applicable facility supplemental procedures for the system or component being worked

If work on energized systems is necessary, these practices will conform to the requirements in PRD-5099, “Electrical Safety,” and Parts I through III of the NFPA 70E (2000), “Electrical Safety Requirements for Employee Work Places.” Additionally, all electrical and other utilities will be identified before conducting surface penetration maintenance activities in accordance with PRD-22, “Excavation and Surface Penetrations.”

2.2.9 Operational Fire Hazards and Prevention

The *Fire Hazards Analysis for the OU 7-10 Glovebox Excavator Method Project* (Call 2003) and the hazards analysis identify the fire hazards as fire involving the following:

- Contents of the excavation pit
- Retrieval equipment
- Materials in the PGS
- Combustible materials in the WMF-671 WES exterior to the RCS and PGS, and fire involving packaged waste materials during transport.

From the inventory discussion in Section 2, approximately 21% of the waste material in the excavation area is considered combustible. Nitration reaction and mixtures with free-flammable or combustible liquids may have increased the flammability of the combustible materials. Combustible liquids (mainly oils in both damaged and intact containers) are expected. Pyrophoric metals in the form of plutonium oxide or hydrated plutonium oxide are present in small quantities in the retrieval area. These could be fire initiators. There is no indication that other pyrophoric metals such as zirconium turnings are in the excavation area. Hydrogen generation, because of the radiolysis of waste zone materials, is expected in staged and stored containers of waste; however, because of the deteriorated condition of waste containers in the retrieval area and venting of drums, the risk of an explosion from retrieved containers is very low (Call 2003).

Firewater distribution for the project is provided through a connection to the existing RWMC firewater distribution system. The project dry-pipe, deluge, and fire department hose systems interface with the RWMC firewater distribution system at the Fire Riser Building. Because of excavation restrictions at the SDA, the firewater delivery system from the Fire Riser Building to the suppression systems is aboveground and is maintained dry to ensure the system will not freeze during cold weather.

Project objectives identified by DOE Order 420.1A, “Facility Safety,” are met by the Project Fire Hazards Analysis (Call 2003). Review and approval of an equivalency request by DOE-ID also found that the fire protection strategy adequately satisfies the fire protection objectives of DOE Order 420.1A, and that it has been demonstrated that an equivalent level of fire protection to that specified in NFPA 801

(1998), “Standard for Fire Protection for Facilities Handling Radioactive Material,” has been provided (see Footnote B).

2.2.10 Flammable and Combustible Materials Hazards

Fuel will be required for the excavator and other equipment during project operations. Flammable hazards include transfer and storage of flammable or combustible liquids in the project operations area. Portable fire extinguishers with a minimum rating of 10A or 60BC shall be strategically located at the facility to combat Class ABC fires. Portable fire extinguishers will be located in all active project operations areas, on or near all facility equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. When storing project chemicals, MCP-2707, “Compatible Chemical Storage,” will be consulted. The requirements of PRD-308, “Handling and Use of Flammable and Combustible Liquids,” will be followed at all times.

2.2.10.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. The assigned fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled in all project operational areas including the surrounding project and support trailers area. Class A combustibles (e.g., trash, cardboard, rags, wood, and plastic) will be properly disposed of in appropriate waste containers. The fire protection engineer also may conduct periodic site inspections to ensure all fire protection requirements are being met.

2.2.10.2 Flammable and Combustible Liquids. Fuel used at the project for fueling the excavator and generator(s) must be safely stored, handled, and used. Only portable containers approved by Factory Mutual and Underwriters Laboratories (labeled with the contents) will be used to store flammable liquids. All fuel containers will be stored at least 50 ft from any facilities and ignition sources, stored inside an approved flammable storage cabinet or tank meeting the requirements of NFPA 30 (1998), “Flammable and Combustible Liquids Code.” Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer’s operating instructions before being refueled to minimize the potential for a fuel fire.

2.2.10.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from PRD-5 110, “Welding, Cutting, and Other Hot Work,” will be followed whenever these types of activities are conducted. This includes the requirement for a hot work permit (documented on a safe work permit) and designation of a fire watch.

2.2.11 Pressurized Systems

Pressurized plant and breathing air systems will be operated in support of project operations. The hazards presented to personnel, equipment, facilities or the environment because of inadequately designed or improperly operated pressure systems (vessels) include blast effects, shrapnel, fluid jets, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, or compressed-gas systems. The applicable requirements in PRD-5, “Boilers and Unfired Pressure Vessels,” must be followed as well as the manufacturer’s operating and maintenance instructions. This includes inspection, maintenance, and testing of systems and components in accordance with applicable American National Standards Institute (ANSI) requirements.

All pressure systems will be operated within the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. Additionally, all hoses, fittings,

lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.2.12 Cryogenics

Cryogenics may be used in support of project operations for cooling of detectors or other applications. If required, all cryogenic tasks will be conducted and protective equipment worn in accordance with PRD-5038, "Cryogenic Liquids." Personal protective equipment will be worn at all times when handling, transferring, or dispensing cryogenic liquids in accordance with PRD-5038. Additional hazards associated with cryogenic liquids include the following:

- **Pressure buildup:** Boiling of liquefied gases within a closed system increases pressure. Cryogenic liquids will not be contained in a closed system other than an approved Dewar. Cold fingers and similar devices have exploded when either an ice dam has formed within the apparatus or when users created a closed system by shutting off all of the valves.
- **Oxygen enrichment:** Liquid nitrogen may fractionally distill air, causing liquid oxygen to collect in the cryogenic container. Liquid oxygen increases the combustibility of many materials, creating potentially explosive conditions. Adequate venting will be provided when working with cryogenic liquids in a closed system or enclosed space.
- **Asphyxiation:** If vented into a closed space, a cryogenic liquid will vaporize, displacing oxygen and possibly causing asphyxia. Cryogenic liquid will not be stored in a closed space.
- **Embrittlement:** Cryogenic liquids will not be disposed of down any drains. Ordinary materials such as metal or PVC piping may not be able to withstand cryogenic temperatures. Cryogenic liquids will be allowed to evaporate in a well-ventilated area. Materials exposed to cryogenic temperatures for long periods or materials that have undergone periodic warming and freezing will be examined regularly for cracks and warping.

2.2.13 Compressed Gases

Compressed gases may be used in support of project operations. If used, all cylinders will be used, stored, handled, and labeled in accordance with PRD-5040, "Handling and Use of Compressed Gases." All transportation, handling, storage, and use of compressed-gas cylinders will be conducted in accordance with the Compressed Gas Association Pamphlet P-1-1965, "Safe Handling of Compressed Gases" (CGA 1965). Additionally, the assigned project safety professional should be consulted about any compressed gas cylinder storage, transport, and use issues.

2.2.14 Excavator, Equipment, and Vehicle Hazards

The excavator and forklifts will be used as part of the project operations. Hazards associated with the operation of the excavator and forklifts include injury to personnel (e.g., struck by and caught between hazards), equipment contact with the RCS, and property damage. All equipment will be operated in the manner in which it was intended and in accordance with the manufacturer's instructions or equipment design. Only authorized qualified personnel will be allowed to operate equipment. Personnel in proximity to operating equipment must maintain visual communication with the operator and stay out of the arm swing radius. Personnel also must comply with the applicable requirements of the following:

- MCP-2745, "Heavy Industrial Vehicles"

- PRD-5 123, “Motor Vehicle Safety”
- DOE-STD-1090-01, Chapter 10, “Forklift Trucks.”

Additional safe practices will include the following:

- All parked forklifts will have the forklift tines in the lowered position (resting on ground or floor).
- All heavy equipment and industrial vehicles will have backup alarms.
- Walking directly behind or to the side of equipment without the operator’s knowledge is prohibited.
- While operating equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.
- All equipment will be operated away from established traffic lanes and personnel access ways (whenever possible) and will be stored so as not to endanger personnel at any time.
- All unattended equipment will have appropriate reflectors or be barricaded if left on or next to roadways.
- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.
- Personnel will be protected from the excavator swing radius when working inside the RCS. This may be accomplished by any or a combination of the following as determined appropriate by the safety professional and documented in work control. The swing radius area may be barricaded or marked to warn personnel, train personnel on the swing radius and the safe work practices required for the task and work location, or shutting down the excavator when personnel are working inside the swing radius area.

2.2.15 Excavation, Surface Penetrations, and Outages

No utilities or lines are buried in the project area to be excavated. Existing Type A and B probes will be hand excavated during overburden excavation. During waste removal, the Type A probes will be dislodged and set aside.

Excavation of the targeted project area will progress in the sequence specified in the *Excavation Plan and Sequential Process Narrative for the OU 7-10 Glovebox Excavator Method Project* (Jamison and Preussner 2002). The basic sequence will involve the following:

- Hand excavation around areas that will be hard to reach with the excavator (e.g., cluster of probes). A rough estimate of the manually excavated material is 120 ft³ or about two soil sacks.
- The backhoe will remove overburden soils in two passes (depth of 2 ft followed by removal of the remaining overburden on the next pass) across the entire dig area, and removed overburden soil will be placed in soil sacks.

Waste excavation will proceed in stages with three discrete sections being excavated in sequence:

- Section 1 will excavate approximately one-half of the total pit volume and will core sample the underburden within this section
- Section 2 will remove the remaining balance of the waste zone material to be removed and will core sample the underburden within this section
- Section 3 will expose the underburden in proximity of the P9-20 probe for sampling.

All of the required underburden core sampling will be performed within these sections. A 52% angle of repose for the excavation will try to be maintained if the excavator is not capable of cutting vertical faces through the waste.

Modifications to the project structures in support of operations that will require surface penetrations. No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation documented. All surface penetrations and related outages will be coordinated through the field supervisor and will require submittal of a Form 433.01, "Outage Request." The submission of an outage request will not be considered an approval to start the work.

All excavation and surface penetration activities will be conducted and monitored in accordance with PRD-22, "Excavation and Surface Penetrations," and 29 CFR 1926.9 (2002), Subpart P, "Excavations." Key elements from these requirements include the following:

- Daily inspections of excavations and protective systems (shoring box) will be made by a competent person (visual inspection from outside the RCS) for evidence of situations that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. Inspections also will be made following any hazard-increasing occurrence. These inspections are required only when employee exposure can be reasonably anticipated and will be documented on Form 440.31, "Daily Trench Safety Report," or equivalent.
- Designs of support systems, shield systems, and other protective systems shall be selected and constructed in accordance with the requirements set forth in 29 CFR 1926 (2002), Subpart P. The project shoring system and excavation method has been designed and approved by a professional engineer.
- When material or equipment used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot ensure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

2.2.16 Hoisting and Rigging of Equipment

A hoist system in the PGS will be used in support of project operation and maintenance tasks. All hoisting and rigging operations will be performed in accordance with MCP-6501, "Hoisting and Rigging Operations," MCP-6502, "Hoisting and Rigging Maintenance," MCP-6503, "Inspection and Testing of Hoisting and Rigging Equipment," MCP-6504, "Hoisting and Rigging Lift Determination and Lift Plan Preparation," MCP-6505, "Hoisting and Rigging Training," and DOE-STD-1090-01 as applicable for these project operations.

Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by designated operators. Additionally, if mobile crane or boom trucks are used in support of project operations, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation
- Crane hooks and latches for deformation, cracks, and wear
- Hydraulic systems for proper oil level
- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage
- Hoist ropes for kinking, crushing, birdcaging, and corrosion
- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

Note: The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

2.2.17 Overhead Hazards

Personnel may be exposed to overhead impact (contact) hazards during the course of the project operations from walking in, between, and around operational equipment and support structures in the WMF-671 WES, RCS, PGS, and storage buildings. Sources for these hazards will be identified and mitigated in accordance with PRD-5 103, “Walking and Working Surfaces.” In the case of overhead impact hazards, they will be marked by using engineering-controls/protective systems where there is a potential for falling debris, in combination with head protection PPE.

2.2.18 Personal Protective Equipment

Wearing PPE will reduce a worker’s ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with PRD-5 121, “Personal Protective Equipment,” and MCP-432, “Radiological Personal Protective Equipment.” All personnel who wear PPE will be trained in its use and limitations in accordance with PRD-5 121 and 29 CFR 1910 (2002), Subpart I, “Personal Protective Equipment.”

2.2.19 Decontamination

Decontamination of waste containers, powered equipment, tools, and WMF-671 WES, RCS, and PGS components will be required as part of project operations. Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. Additionally, electrical hazards may be present if water is used in areas with exposed electrical cords or receptacles. Mitigation of these walking working surfaces and electrical hazards are addressed in prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with

manufacturer's operating instructions, personnel will wear appropriate PPE to prevent high-pressure spray injuries, use GFCI protection, and these tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5 and as listed on the associated JSA and RWP.

2.3 Environmental Hazards and Mitigation

Potential environmental hazards will present potential hazards to personnel during project operations. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states what procedures and work practices will be followed to mitigate them.

2.3.1 Noise

Personnel performing project operations activities may be exposed to noise levels from the excavator trucks, hand tools, and compressors that exceed 85 decibel A-weighted (dBA). For an 8-hour time-weighted average (TWA), 83 dBA for 10-hour TWA. The effects of high sound levels (noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear and pain and temporary or permanent hearing loss
- Interference with communication that would warn of danger

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with MCP-2719, "Controlling and Monitoring Exposure to Noise," to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8 hours of exposure or lower TWA for 10- or 12-hour work-shift exposures).

Note: Exposures exceeding 8 hours per day will be evaluated by the assigned project IH.
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Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with MCP-2719.

2.3.2 Heat and Cold Stress and Ultraviolet Light Hazards

Project operational tasks will be conducted during times when there is a potential for both heat and cold stress that could present a potential hazard to personnel. The assigned IH will be responsible for obtaining meteorological information to determine if additional heat or cold stress administrative controls are required. All operations personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Management Control Procedure-2704 (2002), "Heat and Cold Stress," guidelines will be followed when determining work and rest schedules or when to halt work activities because of temperature extremes.

2.3.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to

unconsciousness, to death. In addition, operational tasks requiring the use of PPE or respiratory protection prevent the body from cooling. Personnel must inform their supervisor when experiencing any signs or symptoms of heat stress or observing a fellow employee experiencing such symptoms.

Heat stress stay times will be documented on the appropriate work control document(s), that is, an SWP, prejob briefing form, RWMC Form 3 15, or other when personnel wear PPE that may increase heat body burden. These stay times will take into account the amount of time spent on a task, the nature of the work (i.e., light, moderate, or heavy), type of PPE worn, and ambient work temperatures. Table 2-6 lists heat stress signs and symptoms of exposure.

Individuals showing any of the symptoms of heat exhaustion listed in Table 2-6 shall do the following:

- Stop work
- Exit or be helped from the work area
- Remove and decontaminate PPE (as applicable)
- Move to sheltered area to rest
- Be provided cool drinking water
- Be monitored by a medic or employee certified in cardiopulmonary resuscitation (CPR) and first-aid.

Table 2-6. Heat stress signs and symptoms of exposure.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating.	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness.	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; <u>cold, clammy skin</u> ; <u>heavy perspiration</u> ; total body weakness; dizziness that sometimes leads to unconsciousness.	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.
Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; <u>dry, hot skin</u> ; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching.	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

Note: Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The shift supervisor should immediately request an ambulance (777 or 526-1515) be dispatched from the Central Facilities Area (CFA) - 1612 medical facility and the affected individual cooled as described in Table 2-6 based on the nature of the heat stress illness.

Monitoring for heat stress conditions shall be performed in accordance with MCP-2704. Depending on the ambient weather conditions, work conditions, type of PPE worn, and the physical response of work operations personnel, the IH shall inform the field supervisor or RCT of necessary adjustments to the work and rest cycle. Additionally, physiological monitoring may be conducted to determine if personnel are replenishing liquids fast enough. A supply of cool drinking water will be provided in designated eating areas and consumed only in these areas. Project personnel may periodically be interviewed by the IH, RCT, or safety professional to ensure that the controls are effective and that excessive heat exposure is not occurring. Workers will be encouraged to monitor personal body signs and to take breaks if symptoms of heat stress occur.

2.3.2.2 Low Temperatures and Cold Stress. For outdoor project-support operations, personnel will be exposed to low temperatures during fall and winter months or at other times of the year if relatively cool ambient temperatures combine with wet or windy conditions. The IH will be responsible for obtaining meteorological information to determine if additional cold stress administrative controls are required. Appendices B and C of MCP-2704 discuss the hazards and monitoring of cold stress. Table 2-7 provides the cold stress work and warm-up schedule if cold stress conditions exist (late fall, winter, early spring).

Additional cold weather hazards may exist from working on snow- or ice-covered surfaces. Slip, fall, and material-handling hazards are increased under these conditions. Every effort must be made to ensure walking surfaces are kept clear of ice. The assigned project safety professional should be notified immediately if slip or fall hazards are identified at any project location.

2.3.2.3 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet light (UV) (i.e., sunlight) when conducting project operations outdoors. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following are mitigative actions that should be taken to minimize UV exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Apply a sunscreen with a sun protection factor of at least 15 to areas exposed to the sun
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

Table 2-7. Cold stress work and warm-up schedule.

Air Temperature °F (Approximate)	No Noticeable Wind		Wind 5 mph		Wind 10 mph		Wind 15 mph		Wind 20 mph	
	Maximum Work Period	Number of Breaks								
-15 to -19	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-20 to -24	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-25 to -29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease	
-30 to -34	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease			
-35 to -39	40 minutes	4	30 minutes	5	Nonemergency work should cease					
-40 to -44	30 minutes	5	Nonemergency work should cease							
-45 and below	Nonemergency work should cease									

2.3.3 Confined Spaces

Entry inside the gloveboxes has been identified as a confined space entry in the OU 7-10 Project operations area. Work in confined spaces can subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. If confined spaces are identified at the OU 7-10 Project area, they will be evaluated in accordance with MCP-2749, “Confined Spaces,” to determine if they are permit-required. If entry into identified project confined spaces is required, then all requirements of MCP-2749 will be followed.

2.3.4 Biological Hazards

The project facilities and support buildings and structures provide habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, it can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the assigned IH will be notified immediately and **no attempt will be made to remove or to clean the area**. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with MCP-2750, “Preventing Hantavirus Infection.”

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) also may be encountered at the project. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear, and contact the assigned IH for additional guidance as required.

Insect repellent (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of the declivity (areas other than the established SDA ditches and silt basin).

2.3.5 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project area (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold) these conditions will be evaluated and a decision made by the IH, safety professional, RCT, and other operations personnel, as appropriate, to stop work, employ compensatory measures or proceed with operations. The shift supervisor and operations personnel shall comply with INEEL MCPs and facility work control documents and design requirements that specify limits for project operations.

During all project activities, assigned health and safety professionals in consultation with RadCon and the shift supervisor will determine if wind or other weather conditions pose unacceptable hazards to personnel or the environment.

2.4 Other Project Hazards

Project personnel should continually look for potential hazards and immediately inform the shift supervisor or other operations lead personnel of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with MCP-553, “Stop Work Authority,” if it is perceived that an imminent safety or health hazard exists or take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards and then inform the shift supervisor.

Personnel working at the project are responsible to use safe-work practices, report unsafe working conditions, near misses or acts, and exercise good housekeeping habits during project operations with respect to tools, equipment, and waste.

2.5 Site Inspections

The shift supervisor, IH, safety professional, RCT, and operations personnel may participate in project site inspections during the work control preparation stage of the project (e.g., the hazard identification and verification walkdowns), and conduct self-assessments or other inspections. Additionally, periodic safety inspections will be performed by the operations supervisors and assigned health and safety professionals in accordance with MCP-3449, “Safety and Health Inspections.”

Targeted or required self-assessments will be performed during project operations in accordance with MCP-8, “Self-Assessment Process for Continuous Improvement,” as directed by the operations manager or shift supervisor. All inspections and assessments will be documented and available for review by the shift supervisor, as a minimum. Health and safety professionals present during project operations may, at any time, recommend changes in work habits to the shift supervisor. However, all changes that may affect the facility written work control documents (e.g., HASP, JSAs, RWPs, SWPs, and work orders) must have concurrence from the appropriate operations technical discipline representative onsite and a Form 412.11, “Document Management Control Systems (DMCS) Document Action Request (DAR),” prepared for the applicable document as required.

3. EXPOSURE MONITORING AND SAMPLING

The potential for exposure to chemical, radiological, and physical hazards exists during OU 7-10 Glovebox Excavator Method Project operations and will affect all project operations personnel who are involved with operational waste handling, sorting, storage, transporting, and decontamination activities. Refinement of project operational area access requirements, work control zones (see Section 7), use of engineering and administrative controls, worker training, and wearing PPE provide the mitigation strategy for these hazards. Monitoring and sampling will be used throughout project operations to (1) assess the effectiveness of engineering controls, (2) determine the appropriate PPE requirements for individual tasks, and (3) determine the need for upgrading and downgrading of PPE as described in Section 5. Monitoring with direct-reading, stationary, and mobile instruments will be conducted to provide RadCon and Industrial Hygiene personnel with real-time and trending data to assess the effectiveness of control measures.

Tables provided in this section present the strategy for conducting exposure monitoring and sampling. These include:

- Table 3-1: Tasks and hazards to be monitored and monitoring instrument category
- Table 3-2: Monitoring instrument category and description
- Table 3-3: Action levels and associated responses for specific hazards.

3.1 Airborne Exposure Engineering Controls

Radiological engineering controls and isolation features designed for the WMF-671 WES, RCS, and PGS will serve as the primary defense to control both radiological and nonradiological hazards. Specifically, the ventilation system ensures that confinements are maintained during personnel or equipment accesses to the RCS and during an accidental breach of confinement contingency.

The project ventilation system design is a once-through system that ensures airflow is from the cleanest to the most contaminated confinement zones. The airflow is from the outside environment through the WMF-671 WES; from the WMF-671 WES through the PGS gloveboxes, drum loadout enclosures, and RCS; and then from the RCS through the exhaust filter bank and stack.

A primary fan and a manually activated backup fan are located outside the WMF-671 WES at the exhaust stack. Both fans are capable of drawing air from outside the WMF-671 WES through an inlet filter structure and damper in the ceiling of the WMF-671 WES. Air is then drawn through a series of inlet filters and dampers in the personnel monitoring and access rooms, RCS, PGS, drum loadout enclosures, and through the exhaust filter bank and stack. A fan in the transfer area draws air from outside the WMF-671 WES through a filtered inlet.

The exhausted air is monitored by a shrouded probe that meets ANSI and Health Physics Society standard ANSI/Health Physics Society N 13.1-1999 (1999), "Sampling Airborne Radioactive Materials in Nuclear Facilities." The probe system consists of (1) lines from the stack for collecting real time and recording samples of conditions in the stack, (2) a climate-controlled cabinet for storing radiological samples, and (3) monitoring instrumentation. Real-time samples are analyzed by the system and returned to the stack. Record samples are retained for analysis.

Table 3-1. Tasks and hazards to be monitored and monitoring instrument category.

Tasks	Hazard(s) to be Monitored”	Instrument Category to be Used
Excavation Operations (RCS)		
• Overburden removal	Ionizing radiation —(alpha, beta, gamma, criticality)	1
• Waste retrieval	Radionuclide contamination —(alpha,beta, gamma)	2
• Underburden sampling	Chemical and nonradiological constituents, hazardous atmospheres	3, 4
• Sample handling and transportation	Respirable dust—silica and other particulates of concern	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Glovebox Operations (PGS)		
• Waste packaging	Ionizing radiation —(alpha, beta, gamma, fissile material)	1
• Waste sorting	Radionuclide contamination —(alpha,beta, gamma)	2
• Waste handling	Chemical and nonradiological constituents, hazardous atmospheres	3, 4
• Drum preparation	Respirable dusts and other particulates of concern	3,4,5
• Drum loadout	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
General Project Operational Support Tasks		
• Drum handling	Ionizing radiation —(alpha, beta, gamma)	1
• Forklift operations	Radionuclide contamination —(alpha,beta, gamma)	2
• Waste transportation and storage	Chemical constituents —organic vapors, lead	3, 4
	Respirable dust—silica (area and personal)	3, 5
• Waste inspections	Hazardous noise	6
• Drum assay	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8

Table 3-1. (continued).

Tasks	Hazard(s) to be Monitored ^a	Instrument Category to be Used
Maintenance of Project Systems		
• Electrical	Ionizing radiation —(alpha, beta, gamma)	1
• Piping, valves, fittings, hoses	Radionuclide contamination — (alpha,beta, gamma)	2
• Communication	Respirable dust—silica (area)	4, 5
• Heating, ventilating		
• Mechanical equipment		
Decontamination Tasks		
• Operational tools and equipment	Ionizing radiation —(alpha, beta, gamma)	1
• RCS and PGS	Radionuclide contamination — (alpha,beta, gamma)	2
• decontamination	Respirable dust—silica (area and personal)	4, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Facility Lay-up		
• Backfill excavation	Radionuclide contamination — (alpha,beta, gamma)	2
• Fix removable contamination	Chemical constituents —organic vapors, lead, cadmium	3, 4
• Housekeeping in RCS and PGS	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
• Secure Waste Management Facility-671 Weather Enclosure Structure	Heat and cold stress	8
<p>a. Monitoring and sampling Will be conducted as deemed appropriate by project Industrial Hygiene and Radiological Control personnel based on specific tasks and site conditions.</p> <p>PGS = Packaging Glovebox System RCS = Retrieval Confinement Structure</p>		

Table 3-2. Monitoring instrument category and description.

Instrument Category	Instrument Category Number Description”
1	<p>Alpha: Count rate—Bicron NE Electra (DP-6 or AP-5 probe) or equivalent. Stationary—Eberline RM-25 (HP-380AB or HP-380A probe) or equivalent.</p> <p>Beta-gamma: Count rate—Bicron NE Electra (DP-6, BP-17 probes) or equivalent. Stationary—Eberline RM-25 (HP-360AB probe) or equivalent. Criticality alarm system Fissile material monitor</p>
2	<p>CAM (alpha)—ALPHA 7-A-1 (in-line and radial sample heads, pump, RS-485) or equivalent (as required). CAM (beta)—AMs-4 (in-line and radial head, pump RS-485) or equivalent (as required). Grab sampler—SAIC H-8 10 or equivalent.</p>
3	<p>Organic vapor: Direct-reading instruments (photoionization detector, flame ionization detector, infrared detector, or other as determined by IH), detector tubes or grab samples, or organic vapor monitor canisters or badges.</p> <p>Dust: Direct-reading instrument (miniram).</p>
4	<p>Organic vapors and other airborne constituents, particulate or hazardous atmospheres: Personal sampling pumps with appropriate media for partial and full period sampling using NIOSH or OSHA-validated methods, direct-reading instruments, or remote sensing detectors.</p>
5	<p>Silica dust, respirable: NIOSH 7500 or equivalent, personal sampling pump, 10-mm cyclone, full-period sampling.</p>
6	<p>Sound-level meter or dosimeter (A-weighted scale for time-weighted average dosimetry, C-weighted scale for impact dominant sound environments).</p>
7	<p>Observation and ergonomic assessment of activities in accordance with Management Control Procedure-2692.</p>
8	<p>Heat stress: wet-bulb globe temperature, ambient temperature.</p> <p>Cold stress: ambient air temperature, wind chill charts.</p>

a. Equivalent instrumentation other than those listed may be used

CAM = constant air monitor

NIOSH = National Institute for Occupational Safety and Health

OSHA = Occupation Safety and Health Administration

SAIC = Science Applications International Corporation

Table 3-3. Action levels and associated responses for project operational hazards

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Nonradiological nuisance particulates (not otherwise classified)	>10mg/m ³ (inhalable fraction) >3 mg/m ³ (respirable fraction)	<ol style="list-style-type: none"> 1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions and reschedule tasks or reposition personnel to upwind position of source 4. Move operation to alternant location (with engineering controls if possible) 5. Use wetting or misting methods to minimize dust and particulate matter 6. <u>IF</u> wetting or misting methods prove ineffective, <u>THEN</u> don respiratory protection” (as directed by IH).
Nonradiological airborne contaminant (chemical, dust fume, fiber or particulate)	<p>Based on individual contaminant exposure limit (ACGIH TLV or OSHA PEL) and 29 CFR 1910 (2002) or 1926 substance-specific requirements.</p> <p>Generally, sustained levels at the TLV or PEL in the worker’s breathing zone for two minutes should be used as action limit. Where ceiling values or OSHA substance-specific action limit exists, use these values.</p>	<ol style="list-style-type: none"> 1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions reschedule tasks or reposition personnel to upwind position of source 4. Move operation to alternant location (with engineering controls if possible) 5. <u>IF</u> engineering and administrative controls do not control contaminant below exposure limit, <u>THEN</u> reevaluate engineering and administrative controls or don respiratory protection” (as directed by IH) 6. <u>IF</u> OSHA substance-specific standard action limit is exceeded, <u>THEN</u> initiate applicable medical surveillance reauirements.

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Nonradiological hazardous atmosphere Chemical IDLH, oxygen deficient, oxygen enriched, 10% of chemical LEL	As defined by Management Control Procedure-2749, confined spaces are based on criteria such as oxygen level, individual contaminant IDLH value, and LEL. Note: <i>No entry into an area or space containing a hazardous atmosphere is permitted without the authorization of the project operations manager, or representative, in conjunction with health and safety professionals. This authorization will be demonstrated through the use of approved operational procedures or other work control documents.</i>	<ol style="list-style-type: none"> 1. Eliminate hazardous atmosphere through use of engineering controls. 2. Reschedule operations when area or space will not have hazardous atmosphere. 3. Evaluate space or area to be entered. IF the operation can be conducted outside the area or space, THEN perform operation without entry. 4. Measure atmosphere before initiating operation or personnel entry and verify acceptable entry conditions have been met (e.g., oxygen and LEL) and use engineering controls to maintain safe atmosphere and below specified exposure limit. Use permit system to authorize entry. 5. IF engineering control fails to control contaminant below safe atmospheric and exposure limit, THEN stop operation and evacuate personnel until safe atmosphere and specified entry conditions can be achieved. 6. IF IDLH atmosphere must be entered, THEN don appropriate air supplied respiratory protection (with escape capacity) and protective clothing."At least one stand-by person dressed in proper PPE must be present for each entrant. <p>Note: <i>The INEEL fire department also must be notified for any area or space entry into an IDLH atmosphere to ensure adequate rescue equipment and resources are in place.</i></p>

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded	
Hazardous noise levels	<85 dBA 8-hour TWA or equivalent TWA for 10- or 12-hour exposure.	No action.	
	85 to 114 dBA or equivalent TWA for 10- or 12-hour exposure.	<ol style="list-style-type: none"> 1. Isolate noise source or place sound-absorbing barrier in noise path 2. Hearing protection required to attenuate hazard to below 85 dBA 8-hour TWA or equivalent TWA for 10- or 12-hour exposure (device NRR). 	
	(a) >115 dBA (b) >140 dBA	<table border="0"> <tr> <td data-bbox="961 553 1381 647">(a) Isolate source, evaluate NRR for single device, double protection as needed.</td> <td data-bbox="1444 553 1881 649">(b) Control entry around source and isolate source, only IH approved double hearing protection to be worn.</td> </tr> </table>	(a) Isolate source, evaluate NRR for single device, double protection as needed.
(a) Isolate source, evaluate NRR for single device, double protection as needed.	(b) Control entry around source and isolate source, only IH approved double hearing protection to be worn.		
Radiation field	<5 mrem/hour	No action, no posting required.	
	5 to 100 mrem/hour @ 30 cm (10 CFR 835.603b, 2002)	<ol style="list-style-type: none"> 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Placement of shielding as feasible. <p>Required Posting: Caution, Radiation Area</p> <p>Supplemental Posting: RWP and Personnel Dosimeter Required for Entry</p> <p>Required Training: Radiological Worker I or II training</p>	

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Radionuclide contamination	>100 mrem to 500 Rad @ 100 cm (10 CFR 835.603b, 2002)	<p>No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon personnel in conjunction with the radiological engineer.</p> <ol style="list-style-type: none"> 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing (as applicable) 4. Placement of shielding as feasible. <p>Required posting: Caution or Danger, High Radiation Area</p> <p>Supplemental posting: Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry'</p> <p>Required training: Radiological Worker I (with high radiation area training) or II training</p>
	Removable contamination levels 1 to 100times the values in Table 2-2 of the INEEL RCM ^b (10 CFR 835.603d, 2002)	<p>Bioassay submittal (as required)</p> <p>Respiratory protection (as deemed appropriate)</p> <p>Required posting: Caution or Danger, High Contamination Area</p> <p>Supplemental posting: RWP and Protective Clothing Required for Entry</p> <p>Required training: Radiological Worker II training</p>

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Airborne radioactivity	Removable contamination levels >100 times the values in Table 2-2 of the INEEL RCM ^b (10 CFR 835.603d, 2002)	<p>No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon manager in conjunction with the radiological engineer.</p> <ol style="list-style-type: none"> 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing 4. Supplied breathing air (as deemed appropriate) <p>Bioassay submittal (as required).</p> <p>Required Posting: Caution or Danger, High Contamination Area</p> <p>Supplemental posting: RWP and Protective Clothing Required for Entry</p> <p>Required training: Radiological Worker II training</p>
	Airborne concentrations ($\mu\text{Ci/ml}$) >30% of and derived air concentration value (10 CFR 835.603d, 2002)	<p>No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon manager in conjunction with the radiological engineer.</p> <ol style="list-style-type: none"> 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing 4. Supplied breathing air. <p>Bioassay submittal and lung count (as deemed appropriate)</p> <p>Required posting: Caution, Contamination Area</p> <p>Supplemental posting: RWP and Protective Clothing Required for Entry</p> <p>Required Training: Radiological Worker II training</p>

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Response to abnormal radiological conditions or alarms	Supplemental radiation dosimetry or area radiation monitor alarm	<ol style="list-style-type: none"> 1. Stop work activities and place the area in a safe condition (i.e., secure excavator equipment, terminate activities that may result in more severe conditions) 2. Alert others 3. Affected individuals exit the area 4. Notify RadCon personnel.
	Personal contamination monitor alarm	<ol style="list-style-type: none"> 1. Remain in the immediate area 2. Notify RadCon personnel 3. Take actions to minimize cross-contamination (e.g., putting a glove on a contaminated hand) 4. Take follow-up actions in accordance with Article 541 of the INEEL RCM Article 541 (PRD-183).
	Constant air monitor alarm	<ol style="list-style-type: none"> 1. Stop work activities and place the area in a safe condition (i.e., secure excavator equipment, terminate activities that may result in more severe conditions) 2. Warn others in area and exit the area 3. Notify RadCon personnel.
	Spill of radioactive material	<ol style="list-style-type: none"> 1. Stop or secure the operation causing the spill^d 2. Warn others in the area 3. Isolate the spill area if possible 4. Minimize individual exposure and contamination 5. Secure unfiltered ventilation 6. Notify RadCon personnel.

Table 3-3. (continued)

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
	Criticality alarm	<ol style="list-style-type: none"> 1. Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring 2. Report to designated assembly area
	Fissile material monitor set point alarm or 200 FGE indicator	<ol style="list-style-type: none"> 1. Identify source of high FGE material 2. Notify RadCon personnel 3. Take corrective actions to separate or split high FGE material into two or more containers of less than 200-g FGE 4. Maintain critically safe storage configuration in accordance with limiting condition for operation.
Other facility or INEEL alarms	Project operations, RWMC or INEEL alarm	See Section 10.6 for emergency response action following facility or INEEL alarms.

- a. Respiratory protection and clothing as prescribed by the project IH and RadCon personnel (based on contaminant of concern). See Section 5 for additional PPE requirements
- b. *Manual 1 SA – Radiation Protection – INEEL Radiological Control Manual* (PRD-183).
- c. Access requirements may be deleted or modified if personnel access is specifically prohibited.
- d. For radioactive spills involving highly toxic chemicals, workers should immediately exit the area without attempting to stop or secure the spill. They should then promptly notify the IH or INEEL HAZMAT team and Project RadCon personnel.

ACGIH = American Conference of Governmental Industrial Hygienists	IDLH = immediately dangerous to life or health IH = Industrial Hygiene	PRD = program requirements document RadCon = Radiological Control
ALAR = as low as reasonably achievable	INEEL = Idaho National Engineering and Environmental Laboratory	RCM = <i>Radiological Control Manual</i>
CFR = <i>Code of Federal Regulation</i>	LEL = lower explosive limit	RWMC = Radioactive Waste Management Complex
dBA = decibal A-weighted	NRR = noise reduction rating	RWP = radiological work permit
FGE = fissile gram equivalent	OSHA = Occupational Safety and Health Administration	TLV = threshold limit value TWA = time-weighted average
HAZMAT = hazardous material	PEL = permissible exposure limit	

3.2 Exposure Limits

Only limited entry into the RCS is anticipated (e.g., during overburden removal tasks, to stage equipment, and for repairs). Exposure limits identified in Table 3-3 serve as the initial action limits for specific project operations and contaminants. Radiological control and Industrial Hygiene personnel will conduct monitoring of project operations with direct-reading instruments and stationary monitors, collect swipes, and conduct full- and partial-period air sampling, as deemed appropriate, in accordance with applicable TPRs, MCPs, and other guidelines. As new project processes or hazards are introduced, each will be evaluated and controlled in accordance with PRD-25. Action limits should be adjusted as required based on changing site conditions, exposure mitigation practices, and PPE levels. Such changes will be reflected in applicable work control documents, permits, and procedures.

3.3 Environmental and Personnel Monitoring

The potential for exposure to radiological and nonradiological hazards exists during project operations. All project operations personnel who handle, store, transport, and conduct disposal or decontamination activities will be protected from radiological and nonradiological contaminants to the extent feasible through the use of engineering controls, work controls, and PPE. However, the potential for exposure to these contaminants cannot be eliminated. Environmental and personnel monitoring will be conducted to determine the effectiveness of these exposure control practices and assist health, safety, and radiological professionals in establishing additional administrative controls and PPE requirements.

Industrial Hygiene and RadCon personnel will conduct monitoring with direct-reading instrumentation, collect contamination control swipes, and conduct full- and partial-period air sampling during project operations in accordance with applicable MCPs, OSHA substance-specific standards, and as stated on project operational RWPs. Instrumentation listed on Table 3-1 (or equivalent) will be selected based on the Site-specific conditions and contaminants associated with OU 7-10 Project tasks. The RCT and IH will be responsible for determining the best monitoring technique for radiological and nonradiological contaminants (respectively). Safety hazards and other physical hazards will be monitored and mitigated as outlined in Section 2.

3.3.1 Industrial Hygiene Area and Personal Monitoring and Instrument Calibration

The assigned OU 7-10 Project IH will conduct full- and partial-period sampling of airborne contaminants and monitoring of physical agents during operations at a frequency deemed appropriate based on direct-reading instrument readings and changing conditions. When performed, all air sampling will be conducted using applicable NIOSH, OSHA, or other validated method. Both personal and area sampling and remote sensing monitoring may be conducted.

Various direct-reading instruments may be used to determine the presence of nonradiological and other physical agents. The frequency and type of sampling and monitoring will be determined by OU 7-10 Project operations conditions, direct-reading instrument results, observation, professional judgment, and in accordance with the MCP- 153, “Industrial Hygiene Exposure Assessment.”

All monitoring instruments will be maintained and calibrated in accordance with the manufacturer’s recommendations, existing IH protocol, and in conformance with MCP-2391, “Calibration Program,” and in conformance with the companywide safety and health manuals, *Safety and Health — Occupational Safety and Fire Protection* (Manual 14A, 2003) and *Safety and Health — Occupational, Medical, and Industrial Hygiene* (Manual 14B, 2003). Calibration information, sampling and monitoring data, results from direct-reading instruments, and field observations will be recorded as stated in Section 12.

3.3.2 Radiological Monitoring and Instrument Calibration

Radiological instrumentation to be used during OU 7-10 Project operations will include alpha and beta-gamma CAMs positioned in strategic locations identified by RadCon personnel. Stationary beta-gamma and alpha self-survey instruments for hand monitoring will be located in close proximity to all gloveports. Radiation area monitors will be centrally located to identify any high radiation source when it is uncovered in the retrieval area or in a glovebox. The PCMs for automated whole-body survey will be located at normal egress points. Additionally, scalers, high-volume samplers, lapel samplers, and other instrumentation will be available to collect and quantify radiological contamination levels.

In addition to these routine radiological monitoring and sampling instruments and equipment, other instrumentation provided for project operations will include a criticality alarm system (CAS) and FMM system. The CAS detectors are set to alarm at 100mrem/hour. The CAS will alarm on a high radiation (high alarm) condition or on a loss of signal (low alarm). An alarming CAS would cause an evacuation of personnel within the WMF-671 WES and from areas surrounding the WMF-671 WES.

Radiological monitoring of radiation and contamination will be conducted during OU 7-10 Project operations to ensure that personnel are given adequate protection from potential radiological exposure. Instruments and sampling methods listed in Table 3-2 may be used by the RCT as deemed appropriate and as required by general or task-specific RWPs. When conducted, monitoring will be performed in accordance with *Radiation Protection Procedures* (Manual 15B, 2003) and *Radiological Control Procedures* (Manual 15C, 2003). The data obtained from monitoring will be used by RadCon personnel to evaluate the effectiveness of OU 7-10 Project engineering controls, decontamination methods and procedures, and to alert personnel to potential radiation sources.

All portable survey instruments will be source-checked daily to ensure they are within the specified baseline calibration limits. Accountable radioactive sources will be maintained in accordance with MCP-137, "Radioactive Source Accountability and Control." All radiological survey and monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommendations, existing RadCon protocol, in accordance with companywide *Radiation Protection Procedures* (Manual 15B, 2003) and in conformance with MCP-93, "Health Physics Instrumentation."

3.3.3 Fissile Material Monitoring

The FMM system is used to monitor the accumulation of fissile materials in new waste drums during the drum loadout process. Waste types requiring fissile monitoring are listed below:

- Intact HEPA filters
- HEPA filter media
- Materials not distinguishable from HEPA filter media
- Intact graphite molds and large chunks of graphite molds (i.e., pieces greater than 2 in. in diameter)
- Other containerized unknown waste materials with potential of having unsafe masses of plutonium.

These waste types may not undergo fissile monitoring if new data become available that indicate that the actual drum loadings are less than 200 g.

A drum assay station will be set up to ensure the following drum loading and storage requirements are met:

- Fissile-loading limits of 200 g per drum
- More than 380-g FGE per drum for criticality safety fissile material content (drum spacing and handling).

3.3.4 Personnel Radiological Exposure Monitoring

Personal radiological monitoring will be conducted during OU 7-10 Project operational activities to quantify radiation exposure and potential for uptakes as stated in the general or task-specific RWP. This will include the use of external dosimetry, surface monitoring, and internal dosimetry methods to ensure that engineering controls, administrative controls, and work practices are effectively mitigating radiological hazards. General ALARA considerations are discussed further in Section 4.4.

3.3.4.1 External Dosimetry. Dosimetry requirements will be based on the radiation exposure potential during OU 7-10 Project operations. All personnel who enter OU 7-10 Project operational areas will be required to wear a minimum of a TLD and other personal dosimetry devices (e.g., albedo dosimetry) specified by RadCon personnel, in applicable RWPs, and in accordance with the *Manual I SA—INEEL Radiological Control Manual* (PRD-183).

The Radiological Control and Information Management System (RCIMS) will be used to track external radiation exposures to OU 7-10 Project personnel and to serve as the administrative control mechanism for working in accordance with individual RWPs. Individual OU 7-10 Project personnel are responsible for ensuring all required personal information is provided to RadCon personnel for entry into RCIMS and logging in when electronic dosimeters are used.

3.3.4.2 Internal Monitoring. The purpose of internal dose monitoring is to demonstrate the effectiveness of contamination control practices and to document the nature and extent of any internal uptakes that may occur. Internal dose evaluation programs will be adequate to demonstrate compliance with 10 CFR 835 (2002), "Occupational Radiation Protection." The requirement for whole body counts, lung counts, and bioassays will be based on specific OU 7-10 Project operational evaluations conducted by the assigned radiological engineer. Select OU 7-10 Project operations personnel will be entered into a plutonium bioassay program based on the hazards associated with individual job functions. Bioassay requirements will be specified on the RWP and OU 7-10 Project personnel will be responsible for submitting required bioassay samples upon request.

4. ACCIDENT AND EXPOSURE PREVENTION

The OU 7-10 Glovebox Excavator Method Project operations will present numerous safety, physical, chemical, and radiological hazards to personnel conducting these activities. It is critical that all personnel understand and follow the requirements of this HASP. Project facility design features, engineering controls (confinement), hazard isolation, specialized work practices, and the use of PPE will be in place to eliminate or mitigate all potential hazards and exposures. However, given the nature of the OU 7-10 Project scope and the waste material being excavated, all hazards cannot be eliminated. Personnel are responsible for the identification and control of hazards in their respective project work areas in accordance with Integrated Safety Management System (ISMS) principals and practices.

Note: Hazards will not be left unmitigated without implementing some manner of controls or abatement (e.g., engineering controls, administrative controls, or the use of PPE).

Personnel should use stop work authority in accordance with MCP-553, “Stop Work Authority,” where it is perceived that imminent danger to personnel, equipment, or the environment exists.

This HASP is to be used in conjunction with PRD-25 and OU 7-10 Project work authorization and control documents such as STD-101; work orders; JSAs; MCP-3562, “Hazard Identification, Analysis, and Control of Operational Activities”; and OU 7-10 Project operational technical procedures. Where appropriate, MCP-3562 and Guide-6212, “Hazard Mitigation Guide for Integrated Work Control Process,” mitigation guidance will be incorporated into applicable work controls, JSAs, and RWPs.

4.1 Voluntary Protection Program and Integrated Safety Management System

Project operations will incorporate Voluntary Protection Program (VPP) and ISMS criteria, principles, and concepts to identify and mitigate hazards, thereby preventing accidents. All management and workers are responsible for implementing safety policies and programs and for maintaining a safe and healthful work environment. Personnel will take a proactive role in preventing accidents, ensuring safe working conditions for themselves and fellow personnel, and complying with all work control documents, procedures, and permits.

The **ISMS** is focused on the **system** side of conducting operations, and **VPP** concentrates on the **people** aspect of conducting work. Both programs define work scope, identify and analyze hazards, and mitigate the hazards. The INEEL and its subcontractors participate in VPP and ISMS. This OU 7-10 Project operations HASP includes all elements of both systems. The five key elements of VPP and ISMS and their corresponding HASP sections are as shown in Table 4-1.

4.2 General Safe-Work Practices

Sections 1 and 2 defined the *Second Revision to the Scope of Work for the Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study* (Holdren and Broomfield 2003) and associated operations-specific hazards and mitigation. Section 3 provided the exposure monitoring and sampling strategy for ensuring the effectiveness of facility safety systems and engineering control. The following general safe-work practices are mandatory for all personnel to further reduce the likelihood of accidents, injuries, and exposures. In addition, all visitors permitted to enter OU 7-10 Project operational work areas must follow these requirements. Failure to follow these practices may result in permanent removal from the OU 7-10 Project and other disciplinary actions. The OU 7-10

Project shift supervisor in conjunction with assigned health and safety and RadCon personnel will be responsible for ensuring the following safe-work practices are adhered to OU 7-10 Project operations:

Table 4-1. Five key elements of the Voluntary Protection Program and Integrated Safety Management System and corresponding sections of the Operable Unit 7-10 Project health and safety plan.

Voluntary Protection Program	Integrated Safety Management System	Project Operations Health and Safety Plan Section
Work site analysis	Define work scope	Section 1
	Analyze hazards	Sections 2, 3, 5 and 8
Hazard prevention and control	Develop and implement controls	Sections 2, 3, 4, 5, 7, 10 and 11
Safety and health training	Perform within work controls	Section 6
Employee involvement		Sections 2, 3 and 4
Management leadership	Provide feedback and improvement	Sections 6 and 9

- Limit access to OU 7-10 Project operations areas to authorized personnel only, in accordance with PRD-1007, “Work Coordination and Hazard Control.”
- Personnel must be aware of and comply with all safety signs, tags, barriers, and color codes as identified in PRD-5117, “Accident Prevention Signs, Tags, Barriers, and Color Codes.”
- Be familiar with the physical characteristics of the OU 7-10 Project facilities and operational requirements, including, but not limited to the following:
 - Layout of the WMF-671 WES, controlled areas, and egress routes
 - Project waste types, labeling, and storage requirements
 - Facility safety-significant structures, systems, and components; technical safety requirements; and limiting conditions of operation
 - Facility and RWMC warning devices and alarms
 - Communications with the OU 7-10 Project and RWMC shift supervisors
 - Major SDA roads and means of access to and from the OU 7-10 Project
 - Location of facility emergency response equipment and first-aid supplies
- Be alert for dangerous situations (e.g., facility alarms, spills, accidents, and injuries) and report dangerous situations and near misses to the shift supervisor. The shift supervisor will make required notification in accordance with Section 10.
- Provide adequate information to the oncoming shift personnel, including equipment and system status and inspection logs, and communicate all systems, monitors, and safety components that are nonoperational and ensure they are tagged as to their appropriate status (e.g., out-of-service or do not use).

- Plan and review all operational tasks before initiating the activity. Verify all work control documents (e.g., the RWP, JSA, TPR, or work order) are current and correct for the activity. A prejob briefing is required to be conducted for all activities in accordance with MCP-3003, “Performing Prejob Briefings and Post-Job Reviews.”
- Conduct all OU 7-10 Project operations in accordance with the applicable TPR or work order. All operational activities will be conducted as stated in the applicable work control document including hold points and requirements for initials upon completion of certain steps (use Type 1 TPR only) or work orders. Use Type 2 TPRs will be followed in a step-by-step sequence.

<p>Note: It is the responsibility of all operations personnel to identify, understand, and follow the appropriate work controls for their operational activities.</p>
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- All personnel shall have the authority to initiate STOPWORK actions in accordance with MCP-553, “Stop Work Authority.”
- Personnel shall be familiar with OU 7-10 Project facility tools and equipment for which they are responsible to operate including operating limitations, maintenance, inspection, and manufacturer’s operating instructions requirements. Tools and equipment shall only be used for their intended use.
- Understand the PPE requirements for all tasks as stated on the applicable JSA or work order. This includes the proper use and limitation of all PPE. If questions arise about PPE, contact the assigned IH, safety professional, or RCT as applicable.
- Personnel must wear all required dosimetry as stated on the RWP. This includes any supplemental dosimetry (e.g., electronic dosimeters and albedo dosimeters). Respond to all radiological alarms including but not limited to CAMs, criticality system, radiation, and PCM alarms.
- Avoid direct contact with OU 7-10 Project waste material or containers. Personnel shall not walk through spills or other areas of contamination and shall avoid kneeling, leaning, or sitting on equipment or surfaces that may be contaminated.
- Personnel shall not eat, drink, chew gum or tobacco, smoke, apply cosmetics or sunscreen, or perform any other practice that increases the probability of hand-to-mouth transfer and ingestion of materials in OU 7-10 Project operations areas, except within designated administrative break areas and only after having completed required contamination surveys.
- Practice good housekeeping at all times. Turn in or place tools in the designated storage location after use. Put waste materials in the appropriate waste container or receptacle. If there is a question as to where to dispose of a waste article, personnel should ask the supervisor or the shift supervisor
- Additional health, safety, and radiological requirements will be identified in OU 7-10 Project operations technical procedures and work packages.

4.3 Subcontractor Responsibilities

Where subcontractors are used to support OU 7-10 Project operations, subcontractors are responsible for meeting all applicable INEEL MCP, PRD, VPP, and ISMS flow-down requirements such as those listed on the completed INEEL Form 540.10, “Safety Checklist of Subcontractor Requirements for On-Site Nonconstruction Work”; *Subcontractor Requirements Manual* (TOC-59 2003); and contract

general and special conditions. Additionally, subcontractors are expected to take a proactive role in hazard identification and mitigation while conducting operational support tasks. Subcontractors will report unmitigated hazards to the OU 7-10 Project shift supervisor after taking protective actions (within the documented work controls) and emergency protective actions.

4.4 Radiological and Chemical Exposure Prevention

The OU 7-10 Project operational facilities (i.e., RCS and PGS) have been designed to minimize exposure to personnel from the radiological and chemical contaminants in OU 7-10 during excavation and glovebox operations. The concept of defense-in-depth has been applied to protect personnel from the most significant hazards and provide additional barriers, engineering controls, access restrictions, and administrative controls to abate radiological and chemical exposure to personnel. Where entry into contaminated areas is required, chemical, radiological, and physical hazards will be mitigated through the use of work procedures and hold points, area and personnel monitoring, and PPE where possible or to minimize them where engineering controls are not feasible. All personnel are responsible for understanding the hazard identification and mitigation measures necessary to prevent or reduce exposures. This section presents radiological and chemical exposure prevention strategies for use where engineering controls are not feasible and as good work practices.

4.4.1 Radiological Exposure Prevention—As Low as Reasonably Achievable Principles

The radiation exposure of personnel will be controlled such that exposures are well below regulatory limits established in “Occupational Radiation Protection” (10 CFR 835, 2002) and that no radiation exposure occurs without commensurate benefit. All personnel have the responsibility for following ALARA principles and practices.

Note: Unplanned and preventable exposures are considered unacceptable.

The OU 7-10 Project shall establish work controls that will ensure that personnel are adequately protected from known sources of radiation in OU 7-10 Project operations areas. The issuance of RWPs, establishment and posting of radiological controlled areas, and review of OU 7-10 Project operational activities by the RWMC ALARA committee will form the basis for controlling exposure to ionizing radiation during OU 7-10 Project operations. Personnel working at the OU 7-10 Project must strive to keep both external and internal radiation doses ALARA by adopting the following practices in the following sections.

4.4.1.1 External Radiation Dose Reduction. Sources for external radiation exposure will be primarily from radioisotopes in the OU 7-10 waste (see Table 2-1). Project operational processes have been designed to minimize radiation dose to workers through barriers and shielding in waste excavation and handling areas (i.e., RCS and PGS). Area radiation monitors and criticality system alarms have been installed to alert operations personnel if radiation levels increase in these working areas. Personal supplemental electronic dosimetry will be programmed to alarm at radiation levels much below the area monitors.

The RWPs written for OU 7-10 Project operations will define radiological hold points, required dosimetry, RCT coverage, radiological controlled areas, and radiological limiting conditions in accordance with MCP-7, “Radiological Work Permit.” Radiological Control personnel will participate in the prejob briefing required by MCP-3003 to ensure all personnel understand the dose rate limits and limiting conditions on the RWP. All personnel will be required to read and acknowledge the RWP

requirements before being allowed to sign the RWP (or scan the RWP bar code in the RCIMS) and obtain electronic dosimetry.

Basic ALARA protective measures used to reduce external doses include (1) minimizing time in radiation areas, (2) maximizing the distance from known sources of radiation, and (3) using shielding whenever possible. Specific examples of these methods are provided in the following subsections.

4.4.1.1.1 Methods for Minimizing Time in Radiation Areas — Personnel will incorporate the following methods for minimizing time in radiation areas:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Plan and discuss the tasks before entering a radiation area (including having all equipment and tools prepared)
- Perform as much work as possible outside radiation areas and take advantage of lower dose rate areas (as shown on the radiological survey maps)
- Take the most direct route to the task area and work efficiently
- Hold technical discussions outside radiation areas if problems occur in the radiation areas, then return to the work area to complete the task
- Know stay time and use appropriate signal and communication method to inform others in the area when the stay time is up, if stay times are required
- Respond to electronic dosimetry alarms by notifying others in the area and the RCT, and exit the radiation area through the designated entry and exit point
- Know individual current dose and dose limit.

<p>Note: If RCIMS indicates an individual is approaching or has exceeded the dose limit, the RCT should be notified immediately and the worker should not proceed into the radiation work area.</p>
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4.4.1.1.2 Methods for Maximizing Distance from Radiation Source — Personnel will incorporate the following methods for maximizing the distance from radiation sources:

- Use remote operated equipment or controls where available
- Stay as far away from the source of radiation as possible (extremely important for point sources where, in general, if the distance between the source is doubled, the dose rate falls to one-fourth of the original dose rate)
- Become familiar with the radiological survey map for the OU 7-10 Project operations area where work will be performed, as well as high and low dose-rate locations, and take advantage of low dose-rate areas.

4.4.1.1.3 Proper Use of **Shielding**—Personnel will incorporate the following methods for the proper use of shielding as a protective measure used to reduce external radiation doses:

- Know what shielding is required and how it is to be used for each radiation source
- Take advantage of the equipment and enclosures for shielding from radiation sources
- Verify interlocks are functional and use shielding when operating drum assay equipment
- Wear safety glasses to protect eyes from beta radiation.

4.4.7.2 Internal Radiation Dose Reduction. The most significant internal radiation dose potential exists during entry into the RCS for manual overburden removal, from repairs, and from routine and unscheduled maintenance activities that may be required (during excavation and waste processing) within the RCS and PGS. An internal dose is a result of radioactive material being taken into the body. Radioactive material can enter the body through inhalation, ingestion, absorption through wounds, or injection from a puncture wound. Reducing the potential for radioactive material to enter the body is critical to avoid an internal dose. The following are methods to minimize the hazard of an internal radiation dose:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Verify CAMs and other area contamination monitors and samplers are functional before entry into contamination or airborne radioactivity areas
- Review the RadCon survey map for areas of known contamination and potential high contamination sources and minimize or avoid activities in those areas (where possible)
- Wear protective clothing and respiratory protection as identified on the RWP, perform all respirator leak checks, and inspect all PPE before entering contaminated areas or areas with airborne radioactivity
- When inside contaminated areas, do not touch your face (adjust glasses or PPE) or other exposed skin
- Respond to all CAM alarms or other indications of increased contamination levels (RCT directions)
- When exiting contaminated areas, follow all posted instructions and remove PPE in the order prescribed (if questions arise, consult RadCon personnel)
- Conduct whole-body personnel survey when exiting the contaminated area, then proceed directly to the PCM
- Report all wounds or cuts (including scratches and scrapes) before entering radiologically contaminated areas
- Wash hands and face before eating, drinking, smoking, or engaging in other activities that may provide a pathway for contaminants.

Monitoring for radiation and contamination during project tasks will be conducted in accordance with the RWP; PRD-183; companywide *Manuals 15A* (PRD-183), *Radiation Protection Procedures*

(Manual 15B, 2003), and *Radiological Control Procedures* (Manual 15C, 2003); and as deemed appropriate by RadCon personnel.

4.4.2 Chemical and Physical Hazard Exposure Avoidance

Note: Identification and control of exposures to carcinogens will be conducted in accordance with MCP-2703, “Carcinogens.”

The primary potential for exposure to nonradiological contaminants is the same as the radiological sources (i.e., OU 7-10 waste [see Table 2-2]). Additionally, chemicals (e.g., fuels, lubricants, and cleaners) will be used in support of OU 7-10 Project operations. An MSDS is required to be available for all chemicals used in accordance MCP-2715, “Hazard Communication.” All chemicals entering the OU 7-10 Project must be entered into and tracked using the INEEL Chemical Management System. The INEEL Chemical Management System is used for maintaining and tracking the inventory of chemical containers and basic functionality includes the following:

- Identify container
- Track the location and location changes of a container
- Define the contents of a container at any point in time
- Record distributions into and out of a container
- Record distributions to a waste stream
- Provide a running inventory based on the distributions entered
- Produce regulatory reports from the data entered
- Calculate conversions from one unit of measure to another
- Define container update authorization for a location
- Provide flexibility in how to manage chemicals.

Note: Project waste streams are not considered chemicals for purposes of entry into INEEL Chemical Management System.

Threshold limit values or other occupation exposure limits have been established for numerous chemicals and physical agents (e.g., noise, heat, or cold stress) that may be encountered. These exposure limits provide guidelines in evaluating airborne, skin, and physical agent exposures. The TLVs represent levels and conditions under which it is believed that nearly all workers may be exposed day after day without adverse health effects. The TLV TWA is a TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects. Action limits (instantaneous concentrations for short time periods) have been established to further reduce the likelihood of exceeding TLVs or as regulatory triggers for additional medical surveillance and actions. These concentrations for nonradiological contaminants of concern are provided in Table 2-3.

The RCS and PGS have been designed to minimize exposure to personnel from the radiological and chemical contaminants of concern (see Tables 2-1 and 2-2). Design features include a negative

pressure HEPA filtered ventilation system, remote waste handling equipment and tools, and double barriers where appropriate. These controls will eliminate or mitigate chemical and physical hazards to a great extent.

Where personnel are required to enter the RCS or PGS during excavation and waste handling activities (e.g., for repairs and routine or unscheduled maintenance), additional exposure monitoring and PPE will be required. Supplied breathing air and protective clothing is available for personnel required to enter contaminated or suspected contaminated areas to perform these tasks. In addition, use of technical procedures and work orders, hold points, training, and monitoring of hazards will be used to reduce exposure potential. Some other exposure minimization methods include the following:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Wear all required PPE, inspecting all pieces before donning, and taping all seams
- Change PPE if it becomes damaged or shows signs of degrading
- Minimize time in direct contact with hazardous material or waste
- Doff PPE following posted radiological instructions (i.e., rolling outer surfaces in and down) and follow doffing sequence
- Wash hands and face before eating, smoking, or engaging in other activities that may provide a pathway for contaminants.

Exposure to nonchemical hazards (e.g., hazardous noise) and physical hazards will be controlled through the implementation of existing INEEL MCPs and PRDs in conjunction with the PRD-25 process. New or previously unidentified hazards shall be reported to the appropriate health, safety, or RadCon personnel.

4.5 Buddy System

The two-person or buddy system will be used during some OU 7-10 Project operations. The buddy system is most often used during operational activities requiring the use of protective clothing and respiratory protection where heat stress and other hazards may impede a person's ability to self-rescue or in situations that are IDLH. The buddy system requires each employee to assess and monitor his or her buddy's mental and physical well being during the course of the operation. A buddy must be able to perform the following activities:

- Provide assistance if required
- Verify the integrity of PPE
- Observe his or her buddy for signs and symptoms of heat stress, cold stress, or contaminant exposure
- Notify other personnel in the area if emergency assistance is needed.

The need to use the buddy system during OU 7-10 Project operations will be determined by the assigned IH or safety engineer in conjunction with the shift supervisor and RadCon personnel.

5. PERSONAL PROTECTIVE EQUIPMENT

Facility designed engineering safety systems and components for the OU 7-10 Glovebox Excavator Method Project will serve as the primary hazard controls during OU 7-10 Project operations to confine radiological and chemical waste hazards. Additionally, chemical and physical hazards will be encountered in conjunction with routine operational activities as presented in Section 2. Where hazards cannot be eliminated through engineering or administrative controls, PPE will be used to protect personnel.

Project operations personnel and visitors who enter the OU 7-10 Project operational areas must be protected against potential safety, health, and radiological hazards. The PRD-25 will be used to evaluate all OU 7-10 Project activities and define the appropriate PPE for all operational activities and areas in accordance with 29 CFR 1910 (2002) Subpart I hazard assessment requirements. This section provides guidance for the selection and use of PPE to be worn for OU 7-10 Project operations and contingencies for upgrading or downgrading PPE. The actual PPE requirement for specific OU 7-10 Project operational tasks will be specified in applicable JSAs, technical procedures, work packages, SWP, or RWP.

The purpose of PPE is to shield or isolate personnel from radiological, nonradiological, physical, and biological hazards that cannot be eliminated through engineering or other controls. It is important to realize that no single PPE ensemble can protect against all hazards under all conditions and that proper work practices and adequate training will serve to augment PPE to provide the greatest level of protection to workers.

The PPE will be selected, issued, used, and maintained in accordance with PRD-5 121. Selection of the proper PPE to protect facility personnel is based on the following:

- Specific conditions and nature of the tasks (e.g., overburden excavation, glovebox operations, waste container handling, and decontamination)
- Potential contaminant routes of entry
- Physical form and chemical characteristics of OU 7-10 Project chemicals or waste contaminants
- Acute and chronic effects from exposure to OU 7-10 Project chemicals or waste contaminants
- Local and systemic toxicity of OU 7-10 Project chemicals or waste contaminants
- Potential exposure levels (surface and airborne)
- The hazard analysis (Section 2) evaluation of this HASP.

Radiological contamination anticontamination clothing requirements will be developed in accordance with MCP-432 and listed on the RWP.

The PPE is generally divided into two broad categories: (1) respiratory protective equipment and (2) personal protective clothing. Table 5-1 provides guidance in the selection process for respiratory and protective clothing. Listed PPE levels may be augmented by SWP- or RWP-specific requirements. Project operations will be evaluated to determine the most appropriate PPE levels and any modifications required. Potential exposures and hazards associated with OU 7-10 Project operations will be monitored (as discussed in Section 3) during the course of the project to evaluate changing conditions and to determine PPE level adequacy and the need for modifications.

Table 5-1. Respiratory and protective clothing selection guidance.

Hazard	Level of Protection
Respiratory PPE Selection"	
Not IDLH or oxygen-deficient atmospheric conditions. Gaseous, vapor, particulate, and aerosol chemicals or radionuclides.	Level C—full-facepiece, as determined by the IH or radiological control technician Level B—full-facepiece supplied air respirator with an air-purifying escape cartridge or air hood (bubble hood). HEPA and chemical combination cartridge for concentrations up to the protection factor of an air-purifying full-facepiece respirator and within the assigned derived air concentration ^b value.
IDLH or oxygen-deficient atmospheric conditions. Gaseous, vapor, particulate and aerosol chemicals or radionuclides.	Level B—full-facepiece, supplied air respirator with an escape-only SCBA or Level A—SCBA.
Protective Clothing Selection	
Low atmospheric-contaminant levels that are present under stable conditions. No anticipated immersion, splashes, or potential for unexpected contact with radiological or nonradiological contaminants.	Level D
Moderate atmospheric contaminants under relatively stable conditions; liquid splashes or other direct contact that do not have corrosive characteristics or can be absorbed by exposed skin. Low radionuclide contamination and airborne radioactivity levels. ^c	Level C
Moderate to high atmospheric contaminants under unstable conditions; potential for contact with wet contaminated surfaces and material that can saturate or permeate Level C protective clothing. Moderate radionuclide contamination and airborne radioactivity levels. ^c	Level B
High and unknown atmospheric contaminants; potential for contact with substances that pose a high hazard potential to the skin; high potential for splash, immersion, or exposure to unexpected vapors, gases, aerosols, or dusts that may present an IDLH situation and readily absorbed through the skin. High radionuclide contamination and airborne radioactivity levels. ^c	Level A ^d (not anticipated)
<p>a. A HEPA or multichemical and HEPA combination cartridge may be selected by IH and Radiological Control personnel based on specific hazards.</p> <p>b. Derived air concentration based on specific radionuclides.</p> <p>c. Contamination levels and airborne radioactivity as defined by 10 CFR 835.603d 9 (2002).</p> <p>d. Level A PPE is not anticipated to be required for personnel conducting project operations.</p>	
HEPA = high-efficiency particulate air PPE = personal protective equipment	IDLH = immediately dangerous to life or health SCBA = self-contained breathing apparatus
	IH = industrial hygienist

5.1 Respiratory Protection

The primary objective will be to prevent or significantly reduce inhalation of potential toxic substances (i.e., air contaminated with harmful dusts, fumes, mists, gases, smokes, vapors, or airborne radioactivity). This will be accomplished as far as feasible through the implementation of existing OU 7-10 Project engineering controls (e.g., HEPA-filtered ventilation), confinements, and barriers. When effective engineering controls are not feasible or entry into the contaminated RCS or PGS areas is required, appropriate respirators will be selected and used.

The level and type of respiratory protection for OU 7-10 Project operations is operation-specific and relates directly to the airborne hazard for each given operation or activity. Assigned protection factors for respiratory devices are listed in MCP-2726, "Respiratory Protection," Appendix B, "Protection Factors."

All personnel required to wear respirators shall complete training and be fit-tested before being assigned a respirator. Requirements for respirator use, emergency use, storage, cleaning, and maintenance, as stated in MCP-2726 shall be followed.

5.2 Personal Protective Equipment Levels

The following sections provide general guidance on typical Hazardous Waste Operations and Emergency Response (HAZWOPER) levels of PPE. Project operational activities will be evaluated to determine the most appropriate PPE, which may or may not incorporate traditional HAZWOPER levels. When required to be worn, PPE requirements will be specified on applicable operational JSAs, RWP, and SWP (when written).

Table 5-2 lists PPE items typically included for the three traditional HAZWOPER levels of PPE. These PPE-level ensemble requirements will be determined by assigned OU 7-10 Project safety and health professionals in consultation with RadCon personnel based on the hazards presents, monitoring results, and nature of the operational task. Modifications to PPE levels will be made based on changing operational conditions and monitoring results. Such modifications are routinely employed to maximize efficiency and to meet operational-specific needs without compromising personnel safety and health.

5.2.1 Level D Personal Protective Equipment

Level D PPE will only be selected for protective clothing and not for OU 7-10 Project operations with respiratory or skin absorption hazards requiring whole-body protection. Level D PPE provides no protection against airborne chemical hazards, but rather is used for protection against surface contamination and physical hazards. Level D PPE will only be allowed in areas that have been characterized as having limited contamination hazards such as OU 7-10 Project operational support areas and low hazards areas of the WMF-671 WES.

5.2.2 Level C Personal Protective Equipment

Level C PPE will be worn when the task site chemical or radiological) contaminants have been well-characterized indicating that personnel are protected from airborne exposures by wearing an air-purifying respirator with the appropriate cartridges, no oxygen-deficient environments exist (less than 19.5% at sea level), and that no conditions exist that pose IDLH.

Table 5-2. Levels and options of personal protective equipment.

Personal Protective Equipment Level	Personal Protective Equipment Required ^a	Optional Personal Protective Equipment or Modifications
D	<p>Coveralls or standard work clothes (coverall material type based on industrial hygiene determination). Hardhat (based on task-specific overhead hazards) meeting ANSI 289.1-1969 requirements. Eye protection based on task-specific hazards (safety glasses meeting ANSI 287.1-1968 [1968] requirements as a minimum). Hand protection (material based on type of work and hazardous materials being handled). Safety footwear (steel or protective toe) meeting ANSI 241.1-1967 (1967) requirements, sturdy leather, or substantial footwear above the ankle for visitors, nonworkers, and construction tasks.</p>	<p>Chemical or radiological protective clothing (Tyvek or Saranex) by IH or RCT. Chemically resistant hand and foot protection (e.g., inner and outer gloves and boot liners). Radiological modesty garments under outer protective clothing (as required by the RWP). Any specialized protective equipment (e.g., hearing protection, cryogenic gloves, face shields, welding goggles, and aprons).</p>
C	<p>Level D ensemble with the following respiratory and whole-body protection upgrades:^b</p> <ul style="list-style-type: none"> • Full-facepiece air purifying respirator equipped with a NIOSH-approved HEPA filter or chemical and HEPA combination cartridge (IH to specify cartridge type) • Standard Tyvek (or equivalent) coverall <p>OR</p> <ul style="list-style-type: none"> • Chemical-resistant coveralls (e.g., Tyvek QC, Tychem 7500, or Saranex-23-P) (IH to specify material). 	<p>Chemical-resistant outer shoe or boot cover (IH or RCT to specify material). Inner chemical-resistant gloves with cotton liners (as determined by the IH and RWP). Outer chemical-resistant gloves (as determined by the IH). Radiological modesty garments under outer protective clothing (as required by RWP). Any specialized protective equipment (e.g., hearing protection, welding lens, and aprons). (Safety glasses not required if wearing a full-face respirator)</p>

Table 5.2. (continued)

Personal Protective Equipment Level	Personal Protective Equipment Required”	Optional Personal Protective Equipment or Modifications
B	<p>Level C ensemble with the following respiratory and whole body protection upgrades:^{b,c}</p> <ul style="list-style-type: none"> • Supplied breathing air system with escape capability. <p>OR for IDLH environment</p> <ul style="list-style-type: none"> • Full-facepiece supplied air respirator with a 10-minute escape bottle or an escape air-purifying combination HEPA or chemical cartridge (except for oxygen deficient atmospheres) <p>OR</p> <ul style="list-style-type: none"> • SCBA • Chemical-resistant coveralls or encapsulating suit (Tyvek QC, Tychem 7500, Saranex 23-C, or equivalent) • Any other chemical or radiological personal protective equipment prescribed in Site-specific RWP or safe work permit • Chemical-resistant butyl or one-time-use natural latex outer boots (as determined by the IH and RWP) • Inner chemical-resistant gloves with cotton liners (as determined by the IH and RWP) Outer chemical-resistant Viton or polyvinyl alcohol gloves (as determined by the IH). <p>Note: All seams must be taped and secured to prevent skin contact from hazardous substances in a soil, liquid, mist, and aerosolized form.</p>	<p>Chemical-resistant outer shoe or boot cover (IH or RCT to specify material)</p> <p>Radiological modesty garments under outer protective clothing (as required by RWP)</p> <p>Any specialized protective equipment (e.g., hearing protection, welding lens, and aprons).</p>
A	Not anticipated for OU 7-10 Project operations.	Not anticipated for OU 7-10 Project operations.

a. The personal protective equipment ensemble may be modified by the **M** or RCT to provide protection from skm or other physical hazards.

b. Upgrades are determined by the **M** in conjunction With other environment, safety, and health professionals.

c. Level B and A work Will require approval from the project operations manager and coordination With the INEEL fire department.

d. Supplied air respirator hose length no more manufacturer’s specification and under no circumstances greater than 300 ft).

ANSI = American National Standards Institute NIOSH = National Institute of Occupational Safety and Health
 HEPA = high-efficiency particulate air OU = operable unit
 IDLH = immediately dangerous to life or health RCT = radiological control technician
 IH = industrial hygienist RWP = radiological work permit
 INEEL = Idaho National Engineering and Environmental SCBA = self-contained breathing apparatus
 Laboratory

Note: Personnel must inspect all PPE before donning and entry into any work area. Items found to be defective or that become unserviceable during use, will be doffed and disposed of in accordance with posted procedures and placed into the appropriate waste stream. The PPE inspection guidance is provided in Table 5-3.

5.2.3 Level B Personal Protective Equipment

Level B PPE will be worn when personnel cannot be adequately protected with air purifying respirator because there are high levels of contaminants present, the appropriate respirator cartridges or combination is not available, a significant hazard exists for skin exposure, or IDLH or oxygen-deficient conditions exist. If IDLH conditions do not exist, then an escape air-purifying cartridge may be substituted for the escape bottle.

5.2.4 Level A Personal Protective Equipment

Level A PPE is not anticipated for OU 7-10 Project operations.

5.3 Personal Protective Clothing Upgrading and Downgrading

The OU 7-10-Project-assigned IH, industrial safety, and RadCon personnel will be responsible for determining when to upgrade or downgrade PPE requirements. Upgrading or downgrading of PPE based on changing operational conditions (e.g., equipment, waste types, location of tasks) and is a normal occurrence. If changing conditions are encountered, work control documents (e.g., work order, RWP, and JSA) may need to be updated to reflect these changes or augmented by a SWP. Additional reasons for upgrading or downgrading are listed in the following subsections.

5.3.1 Upgrading Criteria for Personal Protective Equipment

The level of PPE required will be upgraded for the following reasons and work will halt until PPE upgrading has been completed:

- New, unstable, or unpredictable hazards or exposures identified
- Temporary loss or failure of any engineering controls
- Contaminants that present difficulty in monitoring or detecting
- Known or suspected presence of skin absorption hazards
- Newly identified source or potential increasing concentration respiratory hazard(s) anticipated
- Operational activity change that may result in an increased contact with contaminants or triggering any of the criteria listed above.

5.3.2 Downgrading Criteria

The level of PPE will be downgraded under the following conditions:

- Elimination of hazard or completion of operational task(s) requiring specific PPE
- Implementation of new engineering or administrative controls that eliminate or significantly mitigate hazard

- Sampling information or monitoring data that show contaminant levels to be stable and lower than initial or estimated levels
- Elimination of potential skin absorption or contact hazards.

5.4 Inspection of Personal Protective Equipment

All PPE ensemble components must be inspected before use and when in use during OU 7-10 Project operations in accordance with PRD-5 121. Once PPE is donned, self-inspection will serve as the principal form of inspection. If PPE should become damaged or degradation or permeation is suspected, the individual wearing the PPE will inform others of the problem and proceed directly to the work area exit point. Following required surveys (as required) PPE will be doffed and replaced. In addition, all PPE that becomes grossly contaminated or presents a potential source for the spread of such contamination will be required to be decontaminated or replaced.

Table 5-3 provides a general inspection checklist for common PPE items. Not all PPE ensemble items listed may be required for OU 7-10 Project operational tasks. Where specialized protective clothing or respiratory protection is used or required, the manufacturer's inspection requirements in conjunction with regulatory or industry inspection practices will be followed. The assigned OU 7-10 Project IH, safety professional, or RCT should be consulted about specific PPE inspection criteria.

Table 5-3. Inspection checklist for personal protection equipment.

Personal Protection Equipment Item	Inspection
Respirators (full-facepiece air-purifying and supplied air respirators with escape-only SCBA bottles or escape cartridges)	<p>Before use:</p> <ul style="list-style-type: none"> • Verify that respirator id within three years of shelf life • Ensure airline matches the airline respirator to be used (black hose) • Inspect airline hose connections (sections of hose) to ensure all are threaded or permanent metal-to-metal connections (no quick disconnect pieces). • Check condition of the facepiece, head straps, valves, connecting lines, fittings, and all connections for tightness. • Check cartridge to ensure proper type or combination are being used for atmospheric hazards to be encountered, and inspect threads and O-rings for pliability, deterioration, and distortion. • Check for proper setting and operation of regulators and valves, check all hose connections back to the breathing-air compressor, check the pressure to the airline station and on individual airline connections to ensure pressure is within required range (in accordance with the manufacturer's specifications). <p>Before entry into Level B area:</p> <p>Ensure air compressor is providing adequate airflow when all personnel have airlines hooked up to the compressor manifold, in accordance with Management Control Procedure-2726.</p>

Table 5-3. (continued).

Personal Protection Equipment Item	Inspection
Air hoods	<ul style="list-style-type: none"> ● Before use: Ensure airline matches the air hood to be used Visually inspect all seams and surfaces for tears and cracks Pressurize air hood to check for pinholes or defective seams (no air should leak out when choking clear hood-piece) Before entry into contaminated area: Inspect all airline connections for tight fit (pull connections three times). Ensure air compressor is providing adequate airflow when all personnel have airlines hooked up to the compressor manifold.
Level D, C, and B clothing	<p>Before use: Visually inspect for imperfect seams, nonuniform coatings, and tears. Hold personal protective equipment up to the light and inspect for pinholes, deterioration, stiffness, and cracks.</p> <p>While wearing in the work zone: Inspect for evidence of chemical attack such as discoloration, swelling, softening, and material degradation. Inspect for tears, punctures, and zipper or seam damage. Check all taped areas to ensure they are still intact.</p>
Gloves	<p>Before use: Pressurize rubber gloves to check for pinholes: trap air in glove and roll to inflate glove for inspection. No air should escape.</p> <p>Leather gloves: Inspect seams and glove surface for tears and splitting and verify no permeation has taken place.</p>

SCBA = self-contained breathing apparatus