3706

HEALTH AND SAFETY PLAN FOR THE PLANT 1 ORE SILOS REMOVAL ACTION 13 AUGUST 1992

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Health and Safety Plan for the Plant 1 Ore Silos Removal Action 13

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio

WEMCO Subcontract No. 2-21487
August 1992
Revision No. 1

Operable Unit 3, Project Order 22

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

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Health and Safety Plan
for the
Plant 1 Ore Silos Removal Action 13

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Health and Safety Plan
for the
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LIST OF ACRONYMS AND ABBREVIATIONS

AEDO	Assistant Emergency Duty Officer
ALARA	As Low As Reasonable Achievable
ANSI	American National Standards Institute
CFR	Code of Federal Regulations
DAC	Derived Air Concentration
dBA	A-Weighted Decibels
DOE	United States Department of Energy
EMS	Emergency Message System
FEMP	Fernald Environmental Management Project
HEPA	High-Efficiency Particulate Air
HP	Health Physics
IH	Industrial Hygiene
IRS&T	Industrial, Radiological Safety and Training
NIOSH	National Institute or Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
TLDs	Thermoluminescent Dosimeters
WEMCO	Westinghouse Environmental Management Company

SECTION 1

TASKS TO BE PERFORMED

This task-specific Health and Safety Plan was prepared as a supplement to the formal Site Health and Safety Plan at the Fernald Environmental Management Project (FEMP). This task-specific Health and Safety Plan will be used by Westinghouse Environmental Management Company of Ohio (WEMCO) personnel and their subcontractors in conducting field activities as described herein. This plan is consistent with 29 Code of Federal Regulations (CFR) 1910.120 and the *FEMP Site Health and Safety Plan*. As described in the Plant 1 Ore Silos Removal Action Work Plan, dismantling and removal will generally be performed as follows:

1) Isolate the dismantling area with appropriate signs and barriers.

2) Remove radioactive materials from surrounding facilities and storage areas to the maximum extent practicable.

3) Install protective barriers for surrounding facilities and storage areas as necessary.

4) Erect ground level containment areas for size reduction and packaging and locate ventilation filters and blowers.

5) Remove loose equipment and non-load bearing structure at ground level.

6) Remove conveyors between Building 1A and tile and concrete silos.

7) Collect process residues.

8) Remove structure and equipment on top of concrete silos.

9) Remove concrete silos. These will be removed as complete units with size reduction done at the ground level.

10) Install scaffolding as needed for the sequence of tile silo removal.

11) Remove structure and equipment on top of the tile silos.

12) Remove tile silo caps.

13) Complete the installation of containment around tile silo removal work areas.

14) Remove tile silos.

15) Remove the remaining structural steel.

16) Remove the concrete supporting piers and refurbish the concrete surface.

17) Remove temporary dismantling structures, protective barriers, dismantling area isolation barriers; and clean up the entire area.

18) Perform periodic monitoring, sampling, and inspection activities.

Listed below is a checklist of standard actions that will occur during the Plant 1 Silos Removal Action:

No	Disturb Surface Soil	No	Sample Surface Water
No	Disturb Subsurface Soil	No	Sample Lagoons
Yes	Use Heavy Equipment	No	Use Boat
No	Enter Confined Space	Yes	Involve Radioactivity
No	Disturb Containerized Matter	No	Involve Trenches

SECTION 2

SITE HISTORY

The Plant 1 Ore Silos were constructed in 1953. The Silos provided storage for process residues which were subsequently transferred to Plant 2/3 or Silo 3 in the Waste Storage Area. Structures elevate the silos, so the bottom hopper outlets are above ground level. The silo contents included residues which were the hot and cold metal oxides byproduct from the processing of pitchblende ores. Due to the processes, the more soluble radionuclides forms, including isotopes of radium, were dissolved from the byproduct. Prior to the hot and cold metal oxides being stored in the silos, some Q-11 material was stored there, but the silos were emptied of Q-11 prior to the metal oxide storage.

Processing of these materials ceased during the 1960s and the silos were declared to be "abandoned in place." Residues remaining in the silos range from negligible quantities to an approximate depth of 3.5 feet in the conical bases.

On February 6, 1991, leakage of residues from the silos was noted. Samples were collected, and the loose residues were recovered. Approximately 2,600 pounds of residues were released below Silos 1, 2, and 5. Expedited maintenance activities that followed included attachment of plates at the bottom opening of each silo to prevent any further release. Covers were sandbagged over top openings to prevent intrusion of precipitation and to assure containment.

During mid-March 1991, more detailed radiation surveys were made and samples were collected from the silos to characterize the contents. Subsequent sampling continued through May 1, 1991.

Located south of Building 1A are eight tile silos and six concrete silos (see Figure 2-1). The 14-foot diameter tile silos are mounted on a 38-foot-high steel structure and consist of four tile silos 44-feet-high and four tile silos 10-feet high. The concrete silos are mounted on a 38-feet-high steel structure and are 10-feet high.

The preliminary assessment included a structural analysis and the glazed tile silos were found to be in poor condition. If left in place, or dismantled, there is some threat to two adjacent facilities. There are four tanks containing uranyl nitrate solutions close to the Plant 1 Ore Silos. These are the subject of another Removal Site Evaluation - Processing of Refinery Solutions and part of another Removal Action.

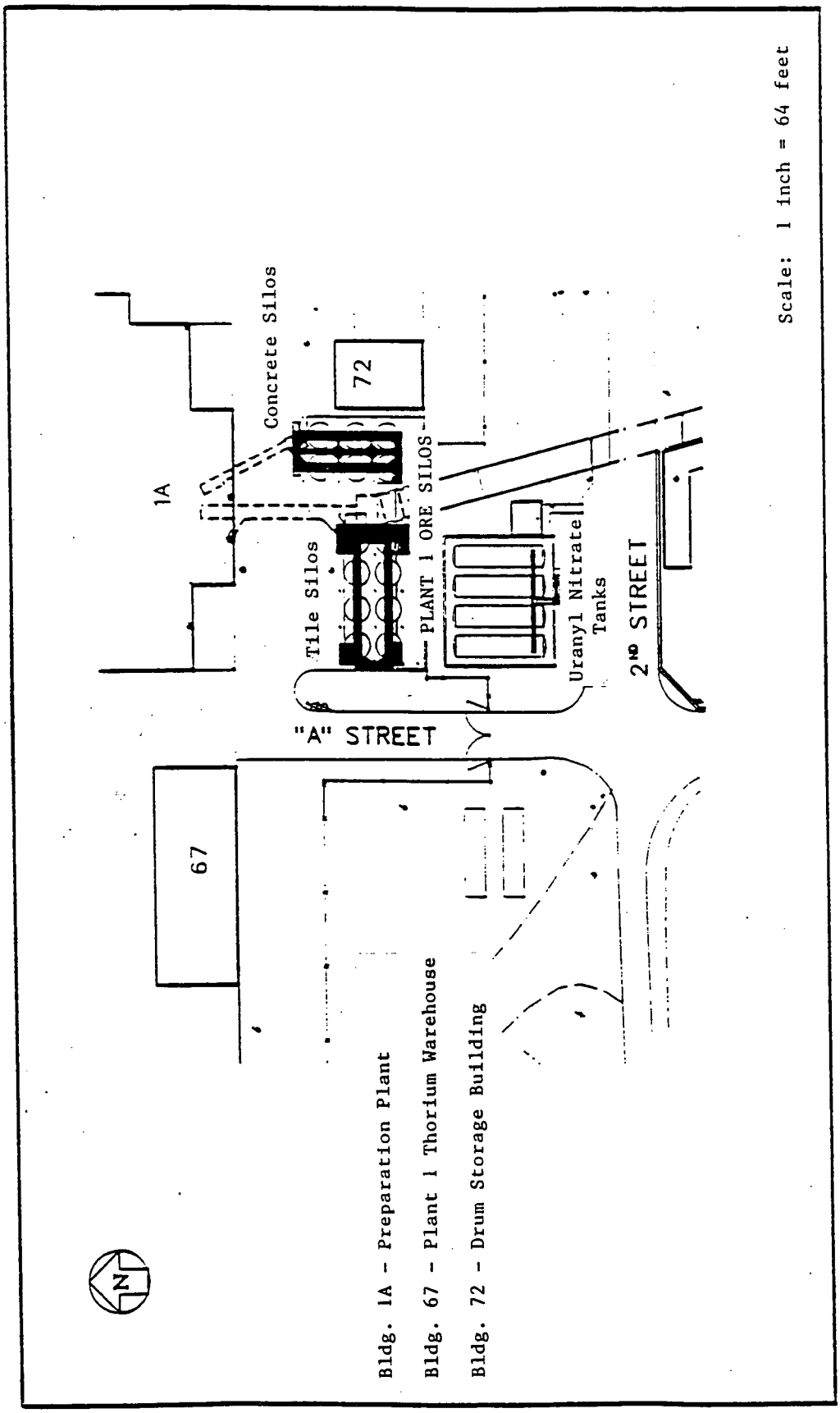

Figure 2-1 - FEMP Plant 1 Ore Silos Area

SECTION 3

TASK-SPECIFIC HAZARD ASSESSMENTS

An evaluation of the tasks to be conducted during the Plant 1 Ore Silos Removal Action indicates that physical, radiological, and chemical hazards will be present. Table 3-1 lists the anticipated hazards associated with each of the major work tasks identified in Section 1.

3.1 Physical Hazards

The physical hazards associated with the Plant 1 Ore Silos removal action are standard construction hazards associated with elevated demolition. The potential physical hazards are enhanced due to the large amount of personal protective equipment (PPE) needed. They include the items listed in Table 3-1 for the associated steps of the work to be performed.

3.2 Radiological Hazards

On March 16, 1991, WEMCO personnel measured the dose rate, took smear samples from the silos surface, and collected grab samples of residue from inside the tile silos. The contact dose rates ranged from <0.5 to 7.5 mrem/hr, with the highest reading at the base of the northwest silo, Silo 1. At 3 ft from the silos, the highest dose rate was 2 mrem/hr from the southeast silo, Silo 5. The smear samples ranged from non-detectable to 12,101 dpm alpha/100 cm^2 and to 4,754 dpm beta-gamma/100 cm^2 on the floor underneath the northwest silo, Silo 1. The highest levels measured on the surfaces of the silos were 3,253 dpm alpha/100 cm^2 and 1,002 dpm beta-gamma/100 cm^2; these were found on Silo 1. The grab samples contained radium, thorium, and uranium as shown in Table 3-2. Silos 1 and 8 did not have grab samples taken because there was not enough sample matrix present in Silo 1 and Silo 8 was covered.

3.3 Chemical Hazards

Possible asbestos containing materials are the tiles, tile mortar, electrical wire insulation, shed (15 ft by 20 ft transite walls and roof), rain roof (20 ft by 10 ft transite panels), peaked rain roof (each side 20 ft by 20 ft transite), rain roof (20 ft by 40 ft transite), and 100 ft NFS asbestos insulated pipe run. Lead exists in the paint on the steel structures and in the residue in the silos. Crystalline silica exists in the tile which form the tile silos.

Table 3-3 lists the primary hazards, exposure limit, and action level for the chemicals and radionuclides that may be encountered during the Plant 1 Ore Silos Removal Action.

Table 3-1 - Hazards Associated with Plant 1 Ore Silos Removal

TASK	PHYSICAL HAZARDS	CHEMICAL HAZARDS	RADIOLOGICAL HAZARDS
Isolate dismantling area	Slip, trip, fall	None	Low-level ionizing radiation, potential for resuspension of loose radioactive material and potential for skin contamination
Remove radioactive material from adjacent areas	Slip, trip, fall, heat/cold stress, lifting, moving heavy equipment	Vehicle emissions	
Install protective barriers	Slip, trip, fall, heat/cold stress, lifting	Vehicle emissions	
Erect containment areas	Slip, trip, fall, heat/cold stress, lifting	Vehicle emissions	
Remove loose equipment and non-load bearing structure	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions, lead, asbestos	
Remove conveyors between Building 1A and silos	Noise, slip, trip, fall, heat/cold stress, strike by loose object, overhead electrical hazards	Vehicle emissions	
Collect process residues	Noise, slip, trip, fall, heat/cold stress, moving heavy equipment	Vehicle emissions, lead	
Remove structure and equipment on top of concrete silos	Noise, slip, trip, fall, heat/cold stress, lifting, electrical overhead hazards, strike by loose object, moving heavy equipment	Vehicle emissions, lead, asbestos	
Remove concrete silos	Noise, slip, trip, fall, heat/cold stress, lifting, electrical overhead hazards, strike by loose object, moving heavy equipment	Vehicle emissions, lead, asbestos	
Install scaffolding for tile silo removal	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions	

Table 3-1 - Hazards Associated with Plant 1 Ore Silos Removal (Continued)

TASK	PHYSICAL HAZARDS	CHEMICAL HAZARDS	RADIOLOGICAL HAZARDS
Remove structure and equipment on top of tile silos	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions, lead, asbestos	Low-level ionizing radiation, potential for resuspension of loose radioactive material, and potential for skin contamination
Remove tile silo caps	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions, lead, asbestos	
Complete installation of containment around tile silos	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions	
Remove tile silos	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions, crystalline silica	
Remove remaining structural steel	Noise, slip, trip, fall, heat/cold stress, lifting, overhead electrical hazards, strike by loose object, moving heavy equipment	Vehicle emissions; potential lead hazard, asbestos	
Remove concrete piers	Noise, slip, trip, fall, heat/cold stress, lifting, strike by loose object, moving heavy equipment	Vehicle emissions	
Remove dismantling structures and protective barriers, and clean area	Noise, slip, trip, fall, heat/cold stress, lifting, strike by loose object, moving heavy equipment	Vehicle emissions	
Perform periodic monitoring, sampling, and inspection activities	Slip, trip, fall, strike by loose object, heat/cold stress	Vehicle emissions, lead, asbestos, crystalline silica	

Table 3-2 - Environmental Sampling Results - Plant 1 Ore Silos

Tile Silo Number	Alpha Activity (pCi/gm)	Beta Activity (pCi/gm)
1	No sample	No sample
2	3,400	970
3	990	320
4	1,400	420
5	120,000	28,000
6	3,200	1,000
7	34,000	9,500
8	No sample	No sample

Table 3-3 - Chemical and Radiological Hazard Table

POTENTIAL CONTAMINANT	PRIMARY HAZARD	EXPOSURE[1] LIMIT
Lead-210	Ingestion/ Inhalation	1×10^{-10} μCi/ml[2]
Radium-226	Ingestion/ Inhalation	3×10^{-10} μCi/ml[2]
Radium-228	Ingestion/ Inhalation	5×10^{-10} μCi/ml[2]
Thorium-228	Ingestion/ Inhalation	4×10^{-12} μCi/ml[2]
Thorium-230	Ingestion/ Inhalation	3×10^{-12} μCi/ml[2]
Thorium-232	Ingestion/ Inhalation	5×10^{-13} μCi/ml[2]
Uranium-234	Ingestion/ Inhalation	2×10^{-11} μCi/ml[2]
Uranium-238	Ingestion/ Inhalation	2×10^{-11} μCi/ml[2]
Radon-220	Inhalation	1 Working Level[2/3]
Radon-222	Inhalation	1/3 Working Level[2/3]
Lead	Ingestion/ Inhalation	0.05 mg/m^3
Silica	Ingestion/ Inhalation	0.1 mg/m^3
Asbestos	Inhalation	0.2 fiber/cc

NOTES:

1/ The Exposure Limit values are given for individual radionuclides. For known mixtures of radionuclides, the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding limit for all radionuclides in the mixture must not exceed 1.0.

2/ This is the Derived Air Concentration (DAC).

3/ A "Working Level" is any combination of short-lived radon daughters, in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3×10^5 MeV of alpha energy.

SOURCES:

DOE Order 5480.11, "Radiation Protection For Occupational Workers," United States Department of Energy, July 20, 1989.

NIOSH Pocket Guide to Chemical Hazards, United States Department of Health and Human Services, June 1990.

SECTION 4

MONITORING

4.1 Goals

Prior to any removal action being performed on the Plant 1 Ore Silos, air monitoring will be conducted by WEMCO Radiological Safety and Environmental Monitoring personnel, as required at the time of work permit(s) issuance, to ensure that exposure limits are not exceeded. Radioactive contamination monitoring will be performed when demolition/dismantling activities occur in order to ensure that the spread of contamination is minimized.

4.2 Monitoring Equipment and Frequency of Monitoring

4.2.1 Airborne Radioactive Particulates

Air samples in the immediate breathing zone of the worker will be collected to determine the concentration of long-lived airborne radioactive particulates to which workers are exposed. The samples will be collected in accordance with WEMCO Industrial, Radiological Safety and Training (IRS&T) Procedure SP-P-35-026, "Occupational Air Sampling for Radioactivity." Each air sample filter will be checked for gross radioactivity to verify the adequacy of respiratory protection.

4.2.2 Radioactive Surface Contamination

When personnel are working on the silos, daily surveys of removable radioactive surface contamination will be performed by WEMCO Radiological Safety personnel in the work area. Alpha and beta-gamma field portable instruments will be used for measuring total (fixed plus removable) contamination and low background counters will be used to count swipe samples for removable contamination. Materials and equipment will be released from the work area, and from the site, in accordance with WEMCO Procedure IRS&T SP-P-35-010, "Unrestricted Release of Materials from the FEMP." Each individual exiting the work area shall be frisked with radiation detection instrumentation.

4.2.3 Radiation Surveys

Radiation surveys will be conducted by WEMCO Radiological Safety personnel prior to beginning work and periodically during field activities. Portable radiation monitoring devices will be maintained in accordance with WEMCO Procedure SP-P-35-028, "Inspection and Performance Testing of Portable Radiation Survey Instruments."

4.2.4 Chemical Hazards

Exposure to significant chemical vapor concentrations is not expected during the removal action field tasks. However, a photoionization detector (HNu meter) will be used by WEMCO Industrial Hygiene personnel to monitor chemical vapor concentrations in the breathing zone of workers actively involved in removal of the process residues in the Plant 1 Ore Silos.

A representative air sample will be taken in the immediate breathing zone or general work area of a worker actively involved in the removal or handling of asbestos-containing material to determine the concentration of airborne asbestos-containing materials to which workers are exposed. The sample will be collected by WEMCO Industrial Hygiene personnel through use of portable, battery-powered air pumps with 37-mm diameter membrane filters. The air samples will be checked for asbestos fibers to verify the adequacy of respiratory protection.

A representative air sample will also be taken in the immediate breathing zone or general work area of a worker actively involved in the removal of the process residues in the Plant 1 Ore Silos. This sample will be collected by WEMCO Industrial Hygiene personnel and will be used to determine the concentration of airborne lead dust to which workers are exposed and to verify the adequacy of respiratory protection.

4.2.5 Thermoluminescent Dosimetry

Thermoluminescent dosimeters (TLDs) are required for entry into all radiologically controlled areas at the FEMP site including the silo demolition exclusion area.

4.2.6 Physical Hazards

Depending on temperature and wind conditions at the time of field activities, heat/cold stress monitoring of personnel may be required. See Attachments A and B, respectively, for guidance on heat stress and cold stress monitoring and prevention. Cold and heat stress monitoring of personnel will be performed by WEMCO Industrial Hygiene personnel. The WEMCO Field Supervisor will check with WEMCO Security each day prior to activities in order to receive a weather forecast. If severe weather is forecast, frequent contact will be made with WEMCO Security for updated weather reports.

Noise levels associated with dismantling operations will be monitored by a WEMCO Industrial, Radiological Safety and Training (IRS&T) representative. Worker hearing protection will be required if noise levels exceed an average of 85 dBA over any length of time.

Underground and overhead utilities, i.e., electricity, natural gas, storm sewers, and telephone lines, will be identified and marked by WEMCO utility engineers prior to initiating any removal action field activities. Overhead power lines will be de-energized, grounded, and locked out unless certain minimum distances can be maintained between the line(s) and adjacent operating equipment (e.g., a crane).

4.3 Field Action Limit Guidelines

Table 4-1 presents the field action limit guidelines for radiological and chemical contaminants that may be encountered in the work environment during field activities.

Table 4-1 - Field Action Limit Guidelines

INSTRUMENT	INTERVAL	LIMIT[1]	ACTION
Exposure Rate Meter	Pre-Job	>2mR/hr	Radiological Safety Review
Alpha Probe[2]	Pre-Job and Intermittent[3]	20 dpm/100 cm^2 (removable)[4] 300 dpm/100 cm^2 (total) [4]	Radiological Safety Review
Beta/Gamma Probe[2]	Pre-Job and Intermittent[3]	1,000 dpm/100 cm^2 (removable)[4] 5,000 dpm/100 cm^2 (total)[4]	Radiological Safety Review
Hnu Meter	Intermittent[5]	Detection to 10 ppm[4] 10-25 ppm >25 ppm	APR[6] SAR[7] Withdraw
Air Sampling Device	Continuous	3×10^{-13} μCi/cc[8]	Radiological Safety Review

1/ Limits based on values in Attachments 1 and 2 of DOE Order 5480.11 for Th-230 and beta emitters other than those listed in the table.

2/ "Frisking" for alpha contamination and beta/gamma contamination using hand held alpha scintillator and Geiger Mueller detectors respectively.

3/ "Intermittent is as deemed necessary by the WEMCO Radiological Safety and/or Environmental Monitoring, or at a minimum of once a day.

4/ Above background.

5/ Intermittent is as deemed necessary by WEMCO Industrial Hygiene personnel to verify that no chemical exposure exists.

6/ Full-face APR (air purifying respirators) with high-efficiency particulate air (HEPA) filter or organic vapor, acid gas, fume cartridges (HP Review). Disposable protective clothing and a step-off decontamination will also be required at any time an APR is used.

7/ Supplied Air Respirator.

8/ 3×10^{-13} μCi/cc is 10 percent of DAC which is the limit for posting "Airborne Reactivity Areas."

SECTION 5

PERSONAL PROTECTIVE EQUIPMENT

The following PPE is required to be worn by personnel who perform the removal action field tasks listed in Section 1.

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Isolate dismantling area	Eye injury Foot injury Hand injury Head injury	Safety glasses Steel-toed boots and shoe covers Canvas gloves Hard hat
Remove radioactive material from adjacent areas	Eye injury Foot injury Hand injury Head injury	Safety glasses Steel-toed boots and shoe covers Canvas gloves Hard hat
Install protective barriers	Eye injury Foot injury Hand injury Head injury	Safety glasses Steel-toed boots and shoe covers Canvas gloves Hard hat
Erect containment areas	Eye injury Foot injury Hand injury Head injury	Safety glasses Steel-toed boots and shoe covers Canvas gloves Hard hat

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Remove loose equipment and non-load bearing structure	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Remove conveyors between Building 1A and silos	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Collect process residue	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Remove structures and equipment on top of concrete silos	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Remove concrete silos	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Install scaffolding for the silo removal	Eye injury	Safety glasses
	Foot injury	Steel-toed boots and shoe covers
	Hand injury	Leather-palm gloves
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hearing loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Remove structure and equipment on top of tile silos	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Remove the silo caps	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Complete installation of containment around tile silos	Eye injury Foot injury Hand injury Head injury Body contamination Hearing loss Fall injury	Safety glasses Steel-toed boots and shoe covers Leather-palm gloves Hard hat Disposable anti-contamination clothing[1/] Earplugs if noise level exceeds 85 dBA over any time period Safety harness and line if working 6 feet or more above ground
Remove tile silos	Foot injury Head injury Body contamination Hand injury/contamination Inhalation of airborne particulates Hearing Loss Fall injury	Steel-toed boots and shoe covers Hard hat Disposable anti-contamination clothing[1/] Leather-palm gloves with inner latex gloves Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges Earplugs if noise level exceeds 85 dBA over any time period Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Remove remaining structure steel	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Remove concrete piers	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

Work Tasks	Potential/Expected Hazard	Personal Protective Equipment
Remove dismantling structure and protective barriers and clean area	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground
Perform periodic monitoring, sampling, and inspection activities	Foot injury	Steel-toed boots and shoe covers
	Head injury	Hard hat
	Body contamination	Disposable anti-contamination clothing[1/]
	Hand injury/contamination	Leather-palm gloves with inner latex gloves
	Inhalation of airborne particulates	Full-face air purifying respirator with HEPA filter and organic vapor/acid gas combination cartridges
	Hearing Loss	Earplugs if noise level exceeds 85 dBA over any time period
	Fall injury	Safety harness and line if working 6 feet or more above ground

1/ If available for use, launderable anti-contamination clothing may be used in lieu of disposable anti-contamination clothing.

Additional PPE may be specified by WEMCO Radiological Safety and Industrial Hygiene personnel. Specialized protective equipment may be required for specific tasks (e.g., welder goggles, gloves, and apron during torch cutting).

SECTION 6

WORK SITE SAFETY REQUIREMENTS

6.1 Equipment Safety

All utility vehicles and trailers used during the removal action field activities must be maintained in good condition for hauling loads to and from the work site. When parked at the work site, all utility vehicles must be secured by wheel chocks or any other device to prevent accidental rolling or movement. Acceptable wheel chocks are those constructed of reinforced rubber or wood. Pickup trucks and other vehicles used primarily for personnel transportation do not require wheel chocks. Backup alarms are required on all engine-driven vehicles.

6.2 Dismantling Area Safety

The dismantling area shall be identified by signs, ropes or other barriers in accordance with 29 CFR 1926, Subpart G. Entry to this area will be restricted to those personnel requiring access. All required equipment and materials will be placed around the work site in a neat orderly manner in an area where the hazards from falling debris are minimized.

6.3 Crane Operations Safety

Rated load capacities, recommended operating speeds, and special hazard warnings or instructions shall be conspicuously posted on all crane equipment. Instructions or warnings shall be visible from the operator's station. Equipment shall be inspected by a competent person before each use and during use, and all deficiencies corrected before further use.

Accessible areas within the swing radius of the rear of the rotating superstructure shall be properly barricaded to prevent employees from being struck or crushed by the crane.

Removal action operations which use a crane will comply with the requirements specified in 29 CFR 1926.550, "Crane and Derricks," 29 CFR 1926.552, "Material Hoists, Personnel Hoists, and Elevators," 29 CFR 1926.251, "Rigging Equipment for Material Handling," 29 CFR 1910.180, "Crawler Locomotive and Truck Cranes," and 29 CFR 1910.184, "Slings." These requirements include crane inspections prior to use, the use of hand signals during operations, and load limits for crane and rigging equipment.

Certain minimum clearances apply to high-voltage power lines. Should the crane come within the minimum clearance as given below, the line must be de-energized, grounded, and locked out, or the work will not be done.

Line Voltage	Minimum Clearance
50 kV or less	10 feet
50 to 345 kV	20 feet
345 to 750 kV	34 feet

The crane mast can act as a very efficient lightning rod. Therefore, whenever a thunderstorm with visible lightning approaches the work site, all work shall stop. The crew, including the operator, must move away from the crane and take cover. No one shall remain on or anywhere near the crane during a thunderstorm. The crew may return to the crane and resume work only when the thunderstorm has moved away from the area.

6.4 Sample Handling and Transportation Safety

Residue samples collected during the dismantling will be preserved, packaged, and transported according to WEMCO procedures. Samples will be screened with direct reading radiation and chemical detection instruments before being taken from the area. Containers into which samples are placed, will be surveyed and cleaned to ensure that no radiological contamination is transported off-site. If samples are transported off-site for analysis, DOE/FEMP and Department of Transportation packaging, labelling, and transportation requirements will be met.

6.5 Concrete, Concrete Forms, and Shoring

All equipment and material used shall comply with ANSI A10.9-1970, "Safety Requirements for Concrete Construction and Masonry Work" and 29 CFR 1926, Subpart Q.

Employees shall not be permitted to work above vertically protruding reinforcing steel, unless it has been protected to eliminate the hazard of impalement.

Powered and rotating-type concrete troweling machines that are manually guided shall be equipped with a deadman-type operating control.

Formwork and shoring shall safely support all loads imposed during concrete placement. Drawings or plans of jack layout, formwork, shoring, working decks, and scaffolding systems shall be available at the jobsite.

6.6 Disposal Chutes

Whenever materials are dropped more than 20 feet to any exterior point of a building, an enclosed chute shall be used in accordance with 29 CFR 1926, Subpart T.

When debris is dropped through holes in the floor without the use of chutes, the area where the material is dropped shall be enclosed with barricades not less than 42 inches high and not less than 6 feet back from the projected edges of the opening above. Warning signs of the hazard of falling material shall be posted at each level. The dust shall be controlled through the attached heating, ventilating, and air conditioning system.

6.7 Electrical

All electrical work shall be in compliance with the latest edition of the National Electrical Code, unless otherwise provided by OSHA regulations, 29 CFR 1926, Subpart K.

Extension cords used with portable electric tools shall be the 3-wire type, shall be protected from damage, and shall not be fastened with staples, hung from nails, or suspended from wires. Splices shall have soldered wire connections with insulation equal to the cable. Worn or frayed cables shall not be used.

Except where bulbs are deeply recessed in the reflector, bulbs on temporary lights shall be equipped with guards. Temporary lights shall not be suspended by their electric cords unless designed for suspension.

Receptacles for attachment plugs shall be of the approved, concealed contact type. Where different voltages, frequencies, or types of current are supplied, receptacles shall be of such design that attachment plugs are not interchangeable.

Each disconnecting means for motors and appliances and each service feeder or branch circuit at the point where it originates shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

Cable passing through work areas shall be covered or elevated to protect it from damage which would create a hazard to employees.

Boxes for disconnecting means shall be securely and rigidly fastened to the surface upon which they are mounted and fitted with covers.

Working personnel shall not be permitted to work in such proximity to any part of an electric power circuit that he/she may contact the same in the course of his/her work unless the worker is protected

against electric shock by de-energizing the circuit and grounding it or by guarding it by effective insulation or other means.

For 15- and 20-ampere receptacle outlets on single-phase, 120-volt circuits for construction sites which are not a part of the permanent wiring of the building or structure, ground-fault circuit interrupters shall be used for employee protection.

6.8 Floor Openings

Floor openings shall be guarded in accordance with 29 CFR 1926, Subpart M, by a standard railing and toeboards or cover. In general, the railing shall be provided on all exposed sides, except at entrances to stairways.

Every open-sided floor or platform, 4 feet or more above adjacent floor or ground level, shall be guarded by a standard railing, or the equivalent, on all open sides except where there is entrance to a ramp, stairway, or fixed ladder.

Runways 4 feet or more high shall have standard railings on all open sides, except runways 18 inches or more wide used exclusively for special purposes may have the railing on one side omitted where operating conditions necessitate.

Ladderway floor openings or platforms shall be guarded by standard railings with standard toeboards on all exposed sides, except at entrance to opening, with the passage through the railing either provided with a swinging gate or so offset that a person cannot walk directly into the opening.

Temporary floor openings shall have standard railings.

Floor holes into which persons can accidentally walk shall be guarded by either a standard railing with standard toeboard on all exposed sides, or a standard floor hole cover that is so marked. While the cover is not in place, the floor hole shall be protected by a standard railing. The floor hole cover must be strong enough to support a 300-pound load.

6.9 Ladders

The use of ladders with broken or missing rungs or steps, broken or split side rails, or with other faulty or defective construction is prohibited. When ladders with such defects are discovered, they shall immediately be withdrawn from service.

Portable ladders shall be placed on a substantial base at a 4-1 pitch, have clear access at top and bottom, extend a minimum of 36 inches above the landing, or where not practical, be provided with grab rails and be secured against movement while in use.

Portable metal ladders shall not be used at the FEMP.

Job-made ladders shall be constructed for their intended use. Cleats shall be inset into side rails 1/2 inch, or filler blocks used. Cleats shall be uniformly spaced, 12 inches, top-to-top.

Except where either permanent or temporary stairways or suitable ramps or runways are provided, ladders shall be used to give safe access to all elevations.

All ladders shall be in accordance with 29 CFR 1926.450 and 29 CFR 1926.1050.

6.10 Power Transmission

Belts, gears shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment shall be guarded if such parts are exposed to contact by employees or otherwise constitute a hazard.

Guarding shall meet the requirements of ANSI B15.1-1953 (R 1958), "Safety Code for Mechanical Power Transmission Apparatus."

6.11 Railings

A standard railing shall consist of top rail, intermediate rail, toeboard, and posts, and have a vertical height of approximately 42 inches from upper surface of top rail to the floor, platform, etc., in accordance with 29 CFR 1926, Subpart L.

The top rail of a railing shall be smooth-surfaced, with a strength to withstand at least 200 pounds. The intermediate rail shall be approximately halfway between the top rail and floor.

A stair railing shall be of construction similar to a standard railing, but the vertical height shall be not more than 34 inches nor less than 30 inches from upper surface of top rail to surface of tread in line with face of riser at forward edge of tread.

6.12 Safety Nets

Safety nets shall meet the requirements of 29 CFR 1926.105 and shall be provided when work places are more than 25 feet above the surface where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical.

Where nets are required, operations shall not be undertaken until the net is in place and has been tested.

6.13 Scaffolds

Scaffolds shall be erected in accordance with 29 CFR 1926, Subpart L, on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement.

Scaffolds and their components shall be capable of supporting, without failure, at least four times the maximum intended load.

Guardrails and toeboards shall be installed on all open sides and ends of platforms more than 10 feet above the ground or floor, except needle beam scaffolds and floats. Scaffolds 4 feet to 10 feet in height, having a minimum dimension in either direction of less than 45 inches, shall have standard guardrails installed on all open sides and ends of the platform.

There shall be a screen with maximum 1/2-inch openings between the toeboard and the guardrail, where the persons are required to work or pass under the scaffold.

All planking shall be Scaffold Grade or equivalent as recognized by approved grading rules for the species of wood used.

The maximum permissible spans for 2 x 10 inches or wider planks are shown in the following table:

MATERIAL

	Full thickness undressed lumber			Nominal thickness lumber	
Working load (p.s.f.).....	25	50	75	25	50
Permissible span (ft.).....	10	8	6	8	6

The maximum permissible span for 1-1/4 x 9 inch or wider plank of full thickness is 4 feet, with medium loading of 50 p.s.f.

Scaffold planking shall be overlapped a minimum of 12 inches or secured from movement.

Scaffold planks shall extend over their end supports not less than 6 inches nor more than 12 inches.

All scaffolding and accessories shall have any defective parts immediately replaced or repaired.

An access ladder or equivalent safe access shall be provided.

Scaffolds shall be properly braced by cross bracing or diagonal braces, or both, for securing vertical members together laterally, and the cross braces shall be of such length as will automatically square and aline vertical members so that the erected scaffolds is always plumb, square, and rigid. All brace connections shall be made secure.

Guardrails made of lumber, not less than 2 x 4 inches (or other material providing equivalent protection), approximately 42 inches high, with a midrail, of 1 x 6 inches lumber (or other material providing equivalent protection), and toeboards, shall be installed at all open sides and ends on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Where persons are required to work or pass under the scaffold, wire mesh shall be installed between the toeboard and the guardrail, extending along the entire opening, consisting of No. 18 gauge U.S. Standard wire 1/2-inch mesh, or the equivalent.

6.14 Toeboards

Railings protecting floor openings, platforms, scaffolds, etc., shall be equipped with toeboards wherever, beneath the open side, persons can pass, there is moving machinery, or there is equipment with which falling material could cause a hazard.

A standard toeboard shall be at least 4 inches in height, and may be of any substantial material either solid or open, with openings not to exceed 1 inch in greatest dimension.

6.15 Welding

Employers shall instruct employees in the safe use of welding equipment. A FEMP Flame/Welding permit is required, and all welding shall be conducted in accordance with 29 CFR 1926, Subpart J. Fire watchers shall be required to have "hands on" fire extinguisher training.

Proper precautions (isolating welding and cutting, removing fire hazards from the vicinity, providing a fire watch, etc.) for fire prevention shall be taken in areas where welding or other "hot work" is being done. No welding, cutting or heating shall be done where the application of flammable paints, or the presence of other flammable compounds, or heavy dust concentrations creates a fire hazard.

Arc welding and cutting operations shall be shielded by noncombustible or flameproof shields to protect employees from direct arc rays.

When electrode holders are to be left unattended, the electrodes shall be removed and the holder shall be placed or protected so that they cannot make electrical contact with employees or conducting objects.

All arc welding and cutting cables shall be completely insulated and be capable of handling the maximum current requirements for the job. There shall be no repairs or splices within 10 feet of the electrode holder, except where splices are insulated equal to the insulation of the cable. Defective cable shall be repaired or replaced.

Fuel gas and oxygen hose shall be easily distinguishable and shall not be interchangeable. Hoses shall be inspected at the beginning of each shift and shall be repaired or replaced if defective.

Proper eye protective equipment to prevent exposure of personnel shall be provided.

6.16 Wire Ropes, Chains, and Ropes

Wire ropes, chains, ropes, and other rigging equipment shall be in accordance with ANSI B30 and shall be inspected prior to use and as necessary during use to assure their safety. Defective gear shall be removed from service.

Job or shop hooks and links, or makeshift fasteners, formed from bolts, rods, etc., or other such attachments, shall not be used.

When U-bolts are used for eye splices, the U-bolt shall be applied so that the "U" section is in contact with the dead end of the rope.

When U-bolt wire rope clips are used to form eyes, the following table shall be used to determine the number and spacing of clips.

NUMBER AND SPACING OF U-BOLT WIRE ROPE CLIPS

Improved plow steel, rope diameter inches	Number of clips		Minimum
	Drop forged	Other material	Spacing (inches)
1/2	3	4	3
5/8	3	4	3-3/4
3/4	4	5	4-1/2
7/8	4	5	5-1/4
1	5	6	6
1-1/8	6	6	6-3/4
1-1/4	6	7	7-1/2
1-3/8	7	7	8-1/4
1-1/2	7	8	9

6.17 Asbestos Removal

Removal of asbestos-containing material (e.g., asbestos insulated pipe, transite panels, etc.) will be conducted in accordance with the requirements of WEMCO Procedures IH&S-IH-03 (Rev. 0), "Control of Work Involving Asbestos" and OSH-P-41-006 (Rev. 3), "Issuing Permits for Asbestos Work." Only trained and qualified asbestos workers will be permitted to perform asbestos removal activities. An Asbestos Work Permit will be required for these removal activities.

SECTION 7

SITE CONTROL

7.1 Access

The field tasks associated with this removal action will occur entirely within a controlled area of the FEMP site. Controlled areas of the FEMP site are maintained in accordance with the *Radiological Controls Requirements Manual* (RM-0009) which requires the following:

1) The wearing of dosimetry
2) Radiation safety training
3) Limitations on entry for personnel with open wounds or recent medical tests with radionuclides
4) Radiological area postings
5) Protective clothing
6) Limitations on food, beverages, and tobacco
7) General rules for work
8) Contamination control
9) Monitoring and showering requirements upon exiting from the Controlled Area and Radiological Areas

A Radiation Work Permit with the specifications of this task-specific health and safety plan will be required for work in the Plant 1 Ore Silos area.

Per the requirements of 29 CFR Part 1910.120, a controlled zone (defined by a barricade rope) will be established around the immediate work area. The controlled zone is an area of high potential hazard due to physical, chemical, and/or radiological dangers. Access to the controlled zone will be restricted to trained and qualified personnel who are required to enter to perform their job duties. Radiological Safety will establish controls consisting of step-off pads at the controlled area exit point. This contamination reduction zone will be used for monitoring at the step-off pad, and removal of disposable personal protective equipment. Only limited equipment decontamination will be allowed at the work site.

7.1.1 Radiological Postings

Radiological areas will be posted in accordance with *Radiological Controls Requirements Manual* (RM-0009). Table 7-1 provides a brief summary of posting requirements applicable to radionuclides likely to be encountered during removal action activities.

Table 7-1 - Posting Requirements

Controlled Area Posting	Contamination Level
Regulated Area	
U-natural, U-234, and U-238	> 1,000 dpm α/100 cm^2 removable > 5,000 dpm α/100 cm^2 fixed plus removable
Ra-226, Ra-228, Th-230, and Th-228	> 20 dpm α/100 cm^2 removable > 300 dpm α/100 cm^2 fixed plus removable
Th-232	> 200 dpm α/100 cm^2 removable > 1,000 dpm α/100 cm^2 fixed plus removable
Beta-Gamma Emitters	> 1,000 dpm β - γ/100 cm^2 removable > 5,000 dpm β - γ/100 cm^2 fixed plus removable
Contamination Areas	
U-natural, U-234, and U-238	> 10,000 dpm α/100 cm^2 removable > 50,000 dpm α/100 cm^2 fixed plus removable
Ra-226, Ra-228, Th-230, and Th-228	> 20 dpm α/100 cm^2 removable > 3,000 dpm α/100 cm^2 fixed plus removable
Th-232	> 2,000 dpm α/100 cm^2 removable > 10,000 dpm α/100 cm^2 fixed plus removable
Beta-Gamma Emitters	> 2,000 dpm β - γ/100 cm^2 removable > 50,000 dpm β - γ/100 cm^2 fixed plus removable
Airborne Radioactivity Area	> 10 percent of the DAC for Th-230 is present $\geq$ 5,000 dpm α/100 cm^2 removable (Th-230) $\geq$ 100,000 dpm β - γ/100 cm^2 removable
Respirator Area	> 25 percent of the DAC for Th-230 is present $\geq$ 5,000 dpm α/100 cm^2 removable (Th-230) $\geq$ 100,000 dpm β - γ/100 cm^2 removable
Radiation Area	$\geq$ 5 mrem/hr and < 100 mrem/hr
SOURCE: *Radiological Controls Requirements Manual (RM-0009)*, May 13, 1992. NOTE: The Plant 1 Ore Silo Removal Action will be controlled for Th-230.	

7.2 Bioassay Samples

Base-line fecal sampling is required for all field personnel involved in the dismantling of the Plan 1 Ore Silos. Incidents which result in personnel skin contamination events, or air sample results which indicate that an individual could have been exposed to airborne concentrations greater than 10 percent of the DAC (for Th-230) will require follow-up fecal samples. The protection factor of the respirator type worn by the individual can be considered when determining airborne concentrations to the immediate breathing zone.

7.3 Medical Monitoring

In accordance with 29 CFR 1910.120 requirements, all personnel are required to participate in a medical monitoring program which consists of the following items:

1) A baseline medical examination
2) Annual medical examination
3) Medical examinations may be required after potential exposures
4) WEMCO respirator clearance for users

Each individual shall be subject to a medical surveillance approval by the WEMCO Director, Medical Services. The approval statement shall certify that each individual is medically qualified to perform the work and is physically fit to wear PPE.

7.4 Training Requirements

All personnel assigned to the tasks will, as a minimum, meet the following training requirements:

1) Documented review of the health and safety plan for this work including site specified hazards and procedures

2) WEMCO radiation safety training

3) WEMCO annual respiratory training and quantitative fit test or equivalent approved by WEMCO Industrial Hygiene

4) Site nuclear criticality training

5) Portable Fire Extinguisher, General Safety, You and OSHA, and Energy Control Procedures Awareness training

6) 40-hour OSHA training

7) 8-hour annual refresher training, as necessary

8) 8-hour supervisory training (for supervisors)

9) 24-hour supervised field experience (general site workers) or 8-hour supervised field experience (occasional site workers)

10) Fire watcher training for designated fire watchers shall include "hands on" fire extinguisher training

The completion of this training shall be documented by the site training personnel.

WEMCO asbestos workers, including the Supervisor-In-Charge of asbestos workers, must meet the training and qualification requirements specified in WEMCO Procedure IH&S-IH-03 (Rev. 0), "Control of Work Involving Asbestos." Subcontractor/vendor personnel shall meet the training and qualification requirements for asbestos workers and supervisory personnel as specified by the laws of the State of Ohio and shall provide documentation of such training and qualification to WEMCO.

7.5 Safety Meetings

A safety meeting, which must be documented, shall be conducted prior to the start of each day's work. These safety meetings will cover the following applicable subjects:

1) Work operations
2) Personal protective equipment
3) All monitoring data
4) Hazard communications
5) Monitoring tests and results
6) Decontamination
7) Task organization
8) Physical stress
9) Emergency procedures
10) Communications
11) General safety
12) Housekeeping
13) Problems encountered

SECTION 8

EXPOSURE SYMPTOMS

8.1 Radiological Contaminants

Exposure to low levels of radiation does not produce acute exposure symptoms. Such exposures may cause delayed effects such as cancer. Since any radiation exposure may involve some degree of risk, exposures are to be kept as low as reasonably achievable (ALARA). Radiation exposures will be monitored by thermoluminescent dosimeters.

8.2 Chemical Contaminants

Representative symptoms that may appear in personnel who are exposed to potential nonradiological chemical contaminants associated with this removal action are as follows:

Potential Contaminant	Representative Symptoms
Asbestos	Difficulty breathing, restricted pulmonary function, and finger clubbing
Lead	Weakness, abdominal pain, exhaustion, and irritated eyes
Silica (crystalline)	Coughing, wheezing, and impaired pulmonary function
Source: *NIOSH Pocket Guide to Chemical Hazards*, United States Department of Health and Human Services, June 1990.	

SECTION 9

SITE ENTRY PROCEDURES

Prior to the initiation of the overall project and/or the beginning of daily work activities, the WEMCO Field Supervisor will ensure that the following procedures have been conducted:

1) Procure the necessary work permits (e.g., radiation, asbestos) for operations.

2) Procure utilities clearance.

3) Conduct safety inspection of all heavy equipment.

4) Conduct pre-work plan and safety meeting prior to each day's work activities; exclusion zone contamination reduction zone, and break areas will be identified.

5) Discuss alternate communication signals (if applicable).

6) Perform respirator check-out and inspection prior to use, if necessary.

7) Inspect and calibrate all devices to be used for monitoring volatile organic compounds. All calibration records are to be maintained with the device.

8) Ensure that all devices to be used for radiation monitoring have met the requirements of WEMCO Procedure IRS&T SP-P-35-028 (Rev. 0), "Inspection and Performance Testing of Portable Radiation Survey Instruments." Calibration certificates for each radiation detection instrument are maintained by the S&TIL (IRS&T) Instrument Laboratory.

9) Assign all personnel who will be working in the exclusion zone to a buddy system.

10) Test and maintain clean liquid in eyewash station.

11) Verify location and operation of all emergency equipment.

Entrance to the radiologically controlled exclusion zone will be controlled by the WEMCO Field Supervisor (or designee) and WEMCO Radiological Safety Technicians.

SECTION 10

DECONTAMINATION

An exclusion zone will be established around the Plant 1 Ore Silos in order to control the potential spread of contamination from work activities. As stated in Section 7.1, a contamination reduction zone will be established for removal of disposable personal protective clothing and cleaning of contaminated equipment. Personnel will enter and exit the posted work area through a step-off pad. Upon exit, personnel will remove any disposable protective clothing and monitor themselves and any outgoing equipment for contamination. All personnel and outgoing equipment will be monitored for contamination in accordance with WEMCO Procedure SP-P-30-010 (Rev. 2), "Unrestricted Release of Materials from the FEMP." Limits for releasing equipment and personal materials from the demolition exclusion area are 20 dpm α/100 cm^2 (removable), 300 dpm α/100 cm^2 (total, fixed plus removable), and 1,000 dpm β - γ/100 cm^2 (total, fixed plus removable) and shall be surveyed by only a Radiological Safety Technician. Items exceeding these values may be removed from the radiologically controlled exclusion area if they are wrapped and sealed for staging as radioactive waste, or are going to undergo decontamination for unrestricted release in a specified and radiologically controlled area.

Detectable alpha contamination, or contamination levels greater than 1,000 dpm beta-gamma on personnel exiting the radiologically controlled exclusion area will be reported to WEMCO Radiological Safety, who will assist in decontamination in accordance with WEMCO Procedure SP-P-35-017, Revision 0, "Procedure for Personnel Decontamination." Any equipment that cannot initially be decontaminated will be contained and transported to the FEMP Site Decontamination Facility. If the equipment cannot be decontaminated to acceptable levels, it will be disposed as radioactive waste.

SECTION 11

WASTES

Waste that is expected to be generated during work activities includes tiles, concrete, structural steel, silo residues, asbestos insulation, disposable personal protective clothing, and decontamination solution and material. Waste determination will be made based on process knowledge or analytical data as appropriate. Potentially contaminated waste material will be collected, segregated, and placed in drums or other containers. Disposable protective clothing will be placed in plastic bags and disposed as compactible, potentially contaminated waste. Liquid waste will be collected, stored, and disposed in accordance with applicable WEMCO procedures.

Waste drums or containers shall meet the requirements of 49 CFR Parts 171-178, 40 CFR Parts 264-265 and 300, and OSHA. Hazard warning labels will be applied immediately to all drums as specified by WEMCO management/supervisors and Operable Unit 3 Compliance.

SECTION 12

CONTINGENCY PLANS

All contingency plans shall be consistent with the *FEMP Emergency Plan (PL-3015).*

12.1 Incidents or Injuries Involving Possible Intake of Radiological or Chemical Substances by Employees

Incidents or injuries involving potential intake of uranium or other hazardous substances shall be reported to the WEMCO Field Supervisor and the WEMCO Medical Section by the involved employee, and an Incident Investigation Report shall be completed by the involved employee. Incident urine samples shall be submitted at the end of the shift and at the start of the next shift if exposure involves uranium. Appendix C contains a blank copy of an Incident Investigation Report.

12.2 Pre-Emergency Planning

During the training and pre-work safety meetings, employees involved in this task shall be trained and reminded of the provisions of the plant emergency procedure, alarm signals and communications, evacuation routes, emergency reporting, and the importance of maintaining continual communications with FEMP Emergency Preparedness personnel via two-way radio or cellular phone.

12.3 Lines of Authority

The WEMCO Field Supervisor or his/her designated representative, has the primary responsibility for the prevention of and the initial response to emergency conditions. The Field Supervisor will direct emergency response actions at the work site until relieved by the WEMCO Assistant Emergency Duty Officer (AEDO), or the Emergency Response Team. In the event an emergency does occur, the individual involved in or observing the condition shall immediately notify the following personnel in order of availability: the WEMCO Field Supervisor; the communications center; the AEDO; the WEMCO Health and Safety Officer; the Project Engineer/Operable Unit Manager.

The AEDO is responsible for ensuring that corrective actions have been implemented, the appropriate personnel notified, and reports completed as required. Personnel observing unsafe conditions at the work site shall report same to the WEMCO Field Supervisor or to the WEMCO Health and Safety Officer, who will stop work activity in the affected area until the hazardous condition can be remedied.

12.4 Evacuation

In the event an evacuation of the Plant 1 Ore Silos area is required, the WEMCO Field Supervisor will be responsible for notifying all personnel involved. All personnel will proceed to the rally point as designated by the WEMCO Field Supervisor. The FEMP-designated rally points within the DOE property are shown on Figure 12-1. The primary rally point for the Plant 1 Ore Silos area is Rally Point 6. When the WEMCO Field Supervisor is informed that an all-clear condition has been achieved, personnel will be released from the rally point.

In the event of an emergency which necessitates an evacuation of the Exclusion Area, the Plant Alarm System (2-2, 2-2 or 3-3,3-3 signal) shall be sounded. A voice message will follow over the Emergency Message System (EMS) which instructs personnel to go to their designated rally point or conduct in-place accountability. Personnel shall immediately proceed to the rally point. Personnel will follow instructions given by the rally point coordinator and participate in the accountability process. In the event of in-place accountability, personnel shall meet at a designated gathering place and conduct accountability through their supervisor or WEMCO Construction Coordinator. When an all-clear condition has been achieved, personnel will be released from the rally point.

12.5 Emergency Equipment

The following safety equipment will be available for employee usage:

1) Fire extinguisher
2) Portable eyewash
3) Absorbent
4) Telephone
5) Spill drums
6) Two-way radio
7) Respirators
8) Clean-up materials
9) Local evacuation alarm

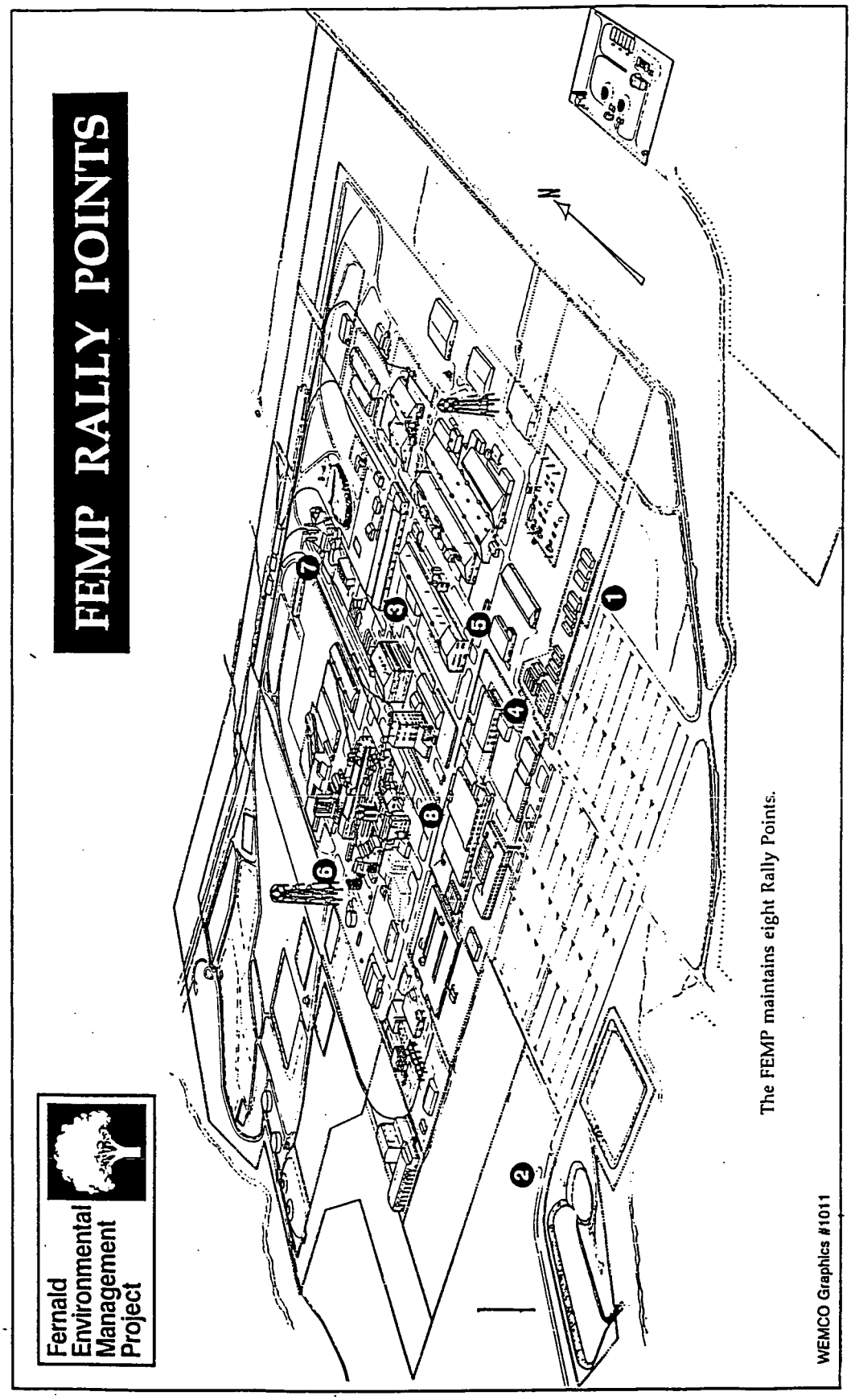

Figure 12-1 - FEMP Rally Points

12.6 Emergency Notification

All emergencies, including spills, leaks, or dike failure shall be reported immediately. Emergencies can be reported by telephone dialing x-6511 or by contacting the communications center via two-way radio. Any additional information pertaining to an emergency shall be reported to the responding personnel to assist in defining appropriate response to the emergency.

12.7 Fire, Explosion, or Medical Emergency

In the event of a fire, explosion, or medical emergency, the communication center shall be notified immediately by two-way radio, by manual fire alarm, or by calling x-6511. The communication center operator will activate the emergency response team and dispatch them to the emergency location. If a fire is in the incipient stage and perceived controllable without endangering oneself, personnel may use available fire extinguishers. If it is not in the incipient stage, personnel in the immediate area shall evacuate to a safe position and await instructions.

If medical attention is required, and the nature of the injury or illness is minor the affected personnel shall be taken to the FEMP Medical Department Facility located as shown on Figure 12-2. The path from the Plant 1 Ore Silos area is also indicated on Figure 12-2. The FEMP ambulance will be called to transport individuals who have suffered major injury or illness.

12.8 Spill Control Contingency Plan

Spills, regardless of their size or the classification of the liquid, shall be reported immediately. Emergencies can be reported by telephone by dialing x-6511 or by contacting the communications center via two-way radio. The Emergency Response Team and AEDO will respond to the spill according to the FEMP Spill Control Contingency Plan.

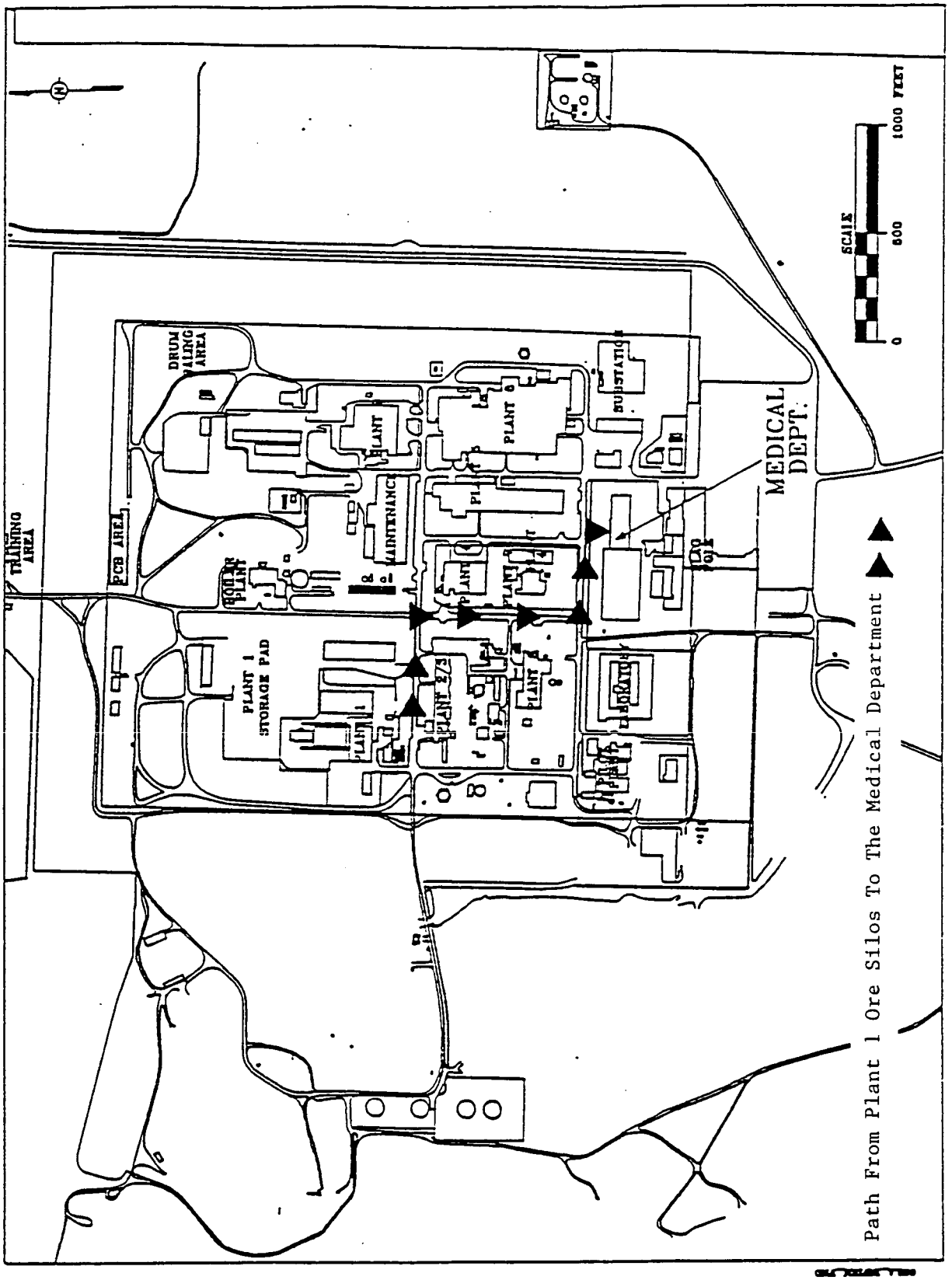

Figure 12-2 - Location of FEMP Medical Department Facility

12.9 Additional Information

12.9.1 Hospitals

The FEMP Medical Department Facility (Building 53) is the primary choice for on-site injuries. The FEMP ambulance will transport the injured workers to the nearest hospital, if necessary. FEMP maintains an emergency response capability that includes an ambulance and Emergency Medical Technicians.

12.9.2 Emergency Telephone Numbers

	Telephone	Radio
EMERGENCY RESPONSE	x6511	Control
Industrial Hygiene	x6207	357
Radiation Safety	x6851	385/381
Fire and Safety	x6235	303
Assistant Emergency Duty Officer (AEDO)	x6431 or x6295	202
Ambulance	x6511	
Hospital	x6511	
Fire	x6511	

SECTION 13

CONFINED SPACE ENTRY

A Confined Space Entry permit is not required because there are to be no entries into the silos.

SECTION 14

APPROVAL AND COMPLIANCE STATEMENT

14.1 Provisions

This site-specific Health and Safety Plan was produced for the FEMP and addresses safety-related aspects of all work related to the Plant 1 Ore Silos Removal. Personnel who perform the tasks listed in Section 1 must read, understand, and agree to abide by the procedures set forth in both this Health and Safety Plan and any subsequent amendments. Site workers are required to sign the attached approval and compliance acknowledgement form.

14.2 Amendments to Plan

This Health and Safety Plan is based on information available at the time of preparation. Unexpected conditions may arise which require reassessment of safety procedures. Unplanned activities and/or changes in the hazard status shall require a review of, and may result in changes to, this plan. Changes in the anticipated hazard status or unplanned activities are to be recorded as an amendment to this plan. Amendments must be approved by the plan author and WEMCO IRS&T prior to implementation of the amendment.

Compliance with the provisions of this Health and Safety Plan may be audited through announced or unannounced site visits. All provisions of this Health and Safety Plan are to be implemented. Reasons for field actions/changes, when they are necessary, should be fully documented.

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

I have been informed and understand and will abide by the procedures set forth in the Health and Safety Plan and Amendments for the Plant 1 Ore Silo Removal at the FEMP site.

Printed Name	Signature	Representing	Date

SECTION 15

REFERENCES

(DOE 1989) United States Department of Energy, July 20, 1989. DOE Order 5480.11, "Radiation Protection for Occupational Workers."

(DOE 1992) -----, November 1992. *FEMP Emergency Plan (PL-3015)*. Fernald Ohio: Fernald Environmental Management Project.

(NIOSH 1990) National Institute for Occupational Safety and Health, June 1990. *Pocket Guide to Chemical Hazards*. United States Department of Health and Human Services.

(WEMCO 1990) Westinghouse Environmental Management Company of Ohio, June 1990. *FEMP Site Health and Safety Plan.*

(WEMCO 1992) -----, May 13, 1992. *Radiological Controls Requirements Manual RM-0009)*, Fernald Environmental Management Project.

ATTACHMENT A

GUIDANCE FOR HEAT STRESS MONITORING AND PREVENTION

Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness.
- Lack of acclimatization.
- Age.
- Dehydration.
- Obesity.
- Alcohol and drug use.
- Infection.
- Sunburn.
- Diarrhea.
- Chronic disease.

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the:

- Anticipated work rate.
- Ambient temperature and other environmental factors.
- Type of protective ensemble.
- Individual worker characteristics and fitness.

Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress [11]. If the actual clothing worn differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly [12].

Source:

NIOSH/OSHA/USCG/EPA Occupational Safety And Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

- For workers wearing semipermeable or impermeable[1] encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C) [6].

To monitor the worker, measure:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

  If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third [12].

- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

  If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.

  If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third [12].

  Do *not* permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C)[12].

- Body water loss, if possible. Measure weight on a scale accurate to ±0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. *The body water loss should not exceed 1.5 percent total body weight loss in a work day* [12].

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 8-10). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Prevention

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps:

- Adjust work schedules:

  Modify work/rest schedules according to monitoring requirements.

  Mandate work slowdowns as needed.

  Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.

  Add additional personnel to work teams.

  Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.

- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

- Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat [14]. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

  Maintain water temperature at 50° to 60°F (10° to 15.6°C).

  Provide small disposable cups that hold about 4 ounces (0.1 liter).

  Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.

  Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.

  Weigh workers before and after work to determine if fluid replacement is adequate.

- Encourage workers to maintain an optimal level of physical fitness:

  Where indicated, acclimatize workers to site work conditions: temperature, protective clothing, and workload (see *Level of Acclimatization* at the end of this chapter).

  Urge workers to maintain normal weight levels.

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:

  Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing.

  Cooling jackets, vests, or suits (see Table 8-5 for details).

- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress (see Table 8-11).

Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human characteristics that play a factor in these

[1]Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.

Table 8-10. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8° - 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1° - 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3° - 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (22.5° - 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Source: Reference [13].

[a]For work levels of 250 kilocalories/hour.

[b]Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 × % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

[c]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Table 8-11. Signs and Symptoms of Heat Stress[a]

- **Heat rash** may result from continuous exposure to heat or humid air.
- **Heat cramps** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- **Heat exhaustion** occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- **Heat stroke** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

[a]Source: Reference [6].

responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors may affect worker ability to function using PPE include:

- Physical condition.
- Level of acclimatization.
- Age.
- Gender.
- Weight.

Physical Condition

Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have [5,8,15,16]:

- Less physiological strain.
- A lower heart rate.
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury).
- A more efficient sweating mechanism.
- Slightly lower oxygen consumption.
- Slightly lower carbon dioxide production.

Level of Acclimatization

The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than unacclimatized individuals [17], and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimatized workers [18]. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss [8].

Acclimatization can occur after just a few days of exposure to a hot environment [15,16]. NIOSH recommends a progressive 6-day acclimatization period for the unacclimatized worker before allowing him/her to do full work on a hot job [16]. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and 10 percent is added each day through day 6 [16]. With fit or trained individuals, the acclimatization period may be shortened 2 or 3 days. However, workers can lose acclimitization in a matter of days, and work regimens should be adjusted to account for this.

When enclosed in an impermeable suit, fit acclimatized individuals sweat more profusely than unfit or unacclimatized individuals and may therefore actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming adequate quantities of water. See previous section on *Prevention* for additional information.

Age

Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well-conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rates and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work loads [19]. At moderate thermal loads. however, the physiological responses of "young" and "old" are similar and performance is not affected [19].

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

Gender

The literature indicates that females tolerate heat stress at least as well as their male counterparts [20]. Generally, a female's work capacity averages 10 to 30 percent less than that of a male [8]. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male [15]. However, a similar situation exists as with aging: not all males have greater work capacities than all females.

Weight

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per unit of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

ATTACHMENT B

GUIDANCE FOR COLD STRESS MONITORING AND PREVENTION

COLD STRESS [See page 81]

The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities (deep body temperature is the core temperature of the body determined by conventional methods for rectal temperature measurements). For a single, occasional exposure to a cold environment, a drop in core temperature to no lower that 35°C (95°F) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating dry clothing to maintain core temperatures above 36°C (96.8°F) must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill cooling rate and the cooling power of air are critical factors. [Wind chill cooling rate is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.] The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind ve-

TABLE 1. Progressive Clinical Presentations of Hypothermia*

Core Temperature °C	Core Temperature °F	Clinical Signs
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	89.6	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrilation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

* Presentations approximately related to core temperature. Reprinted from the January 1982 issue of *American Family Physician*, published by the American Academy of Family Physicians.

Source: American Conference of Governmental Industrial Hygienists, "1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices," 1990. Reproduced with permission.

locity is presented in Table 2. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of −32°C (25.6°F). Superficial or deep local tissue freezing will occur only at temperatures below −1°C (30.2°F) regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10–20 minutes in an environment below 16°C (60.8°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below −1°C (30.2°F).
2. If the air temperature falls below 16°C (60.8°F) for sedentary, 4°C (39.2°F) for light, −7°C (19.4°F) for moderate work and fine manual dexterity is not required, then gloves should be used by the workers.

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below −7°C (19.4°F) are within reach, a warning should be given to each worker by the supervisor to prevent inadvertent contact by bare skin.

TABLE 2. Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	*LITTLE DANGER* In < hr with dry skin. Maximum danger of false sense of security				*INCREASING DANGER* Danger from freezing of exposed flesh within one minute.				*GREAT DANGER* Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

TABLE 3. Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift*

Air Temperature—Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx.)	°F (approx.)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm. Breaks)	1	(Norm. Breaks)	1	75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm. Breaks)	1	75min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	4	30 min	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min	4	30 min	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

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Notes for Table 3:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available:
   5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

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3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/m²; 2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m². In general the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

* Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labour.

2. If the air temperature is -17.5°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). The workers should wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.
2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold area. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.
3. If exposed areas of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should be supplied in auxiliary heated versions.
4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.
5. Workers handling evaporative liquid (gasoline, alcohol or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (19.4°F), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these

shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing should be provided as necessary to prevent workers from returning to work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10.4°F) ECT, the following should apply:

1. The worker should be under constant protective observation (buddy system or supervision).
2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing should be provided.
3. New employees should not be required to work fulltime in the cold during the first days of employment until they become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
5. The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers should be instructed in safety and health procedures. The training program should include as a minimum instruction in:
   a. Proper rewarming procedures and appropriate first aid treatment.
   b. Proper clothing practices.
   c. Proper eating and drinking habits.
   d. Recognition of impending frostbite.
   e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
   f. Safe work practices.

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.
2. Special wind protective clothing should be provided based upon existing air velocities to which workers are exposed.

Special caution should be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60.8°F) so that overall compliance with the requirements of the TLV can be maintained.
2. Whenever the air temperature at a workplace falls below −1°C (30.2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.
3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).
4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below −1°C (30.2°F).
5. The equivalent chill temperature should be obtained from Table 2 in all cases where air movement measurements are required; it should be recorded with the other data whenever the equivalent chill temperature is below −7°C (19.4°F).

Employees should be excluded from work in cold at −1°C (30.2°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below −24°C (11.2°F) with wind speeds less than five miles per hour, or air temperatures below −18°C (0°F) with wind speeds above five miles per hour, should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissues in addition to providing for first aid treatment.

Note: Figure 2 from page 88 and Table 7 from page 89 of the 1989–90 TLV/BEI Booklet have been dropped as not directly applicable to the Cold Stress TLV. See Figure 12 and Table 22 on page 678 of the Documentation, 5th edition.

APPENDIX C

INCIDENT INVESTIGATION REPORT

FMPC

ENVIRONMENT, SAFETY AND HEALTH DEPARTMENT

3706

INCIDENT INVESTIGATION REPORT

This Section to be Completed by Employee

NAME:	BADGE:	JOB CLASSIFICATION:

PLANT/AREA:	JOB WORKED:	SHIFT WORKED:

INITIAL SAMPLE BOTTLE NUMBER:	SUPERVISOR'S NAME:

LOCATION OF INCIDENT:	DATE OF INCIDENT:	TIME OF INCIDENT:

MATERIALS INVOLVED IN INCIDENT:

DESCRIPTION OF INCIDENT:

HOW LONG EMPLOYEE INVOLVED IN INCIDENT:	DISTANCE AND DIRECTION FROM INCIDENT:

HOW POTENTIALLY EXPOSED: ☐ Inhalation ☐ Swallowing ☐ Skin Absorption

RESPIRATOR USED: ☐ Yes ☐ No	IF USED, HOW LONG?

IF USED, INDICATE TYPE:

☐ Half-Mask Air-Purifying ☐ Half-Mask Airline ☐ Self-Contained Breathing Apparatus (SCBA)

☐ Full-Face Air-Purifying ☒ Hooded Airline ☐ SCBA Inside Acid Suit

☐ Emergency Life Support Apparatus (ELSA)

CARTRIDGE COLOR IF AIR-PURIFYING RESPIRATOR USED: ☐ Purple ☐ Purple + Yellow ☐ Yellow ☐ Green ☐ Black

OTHER PROTECTIVE EQUIPMENT: ☐ Leather-Palm Gloves ☒ Rubber Gloves ☐ Chemical Goggles ☐ Rubber Suits/Aprons

HAVE YOU TAKEN ANY MEDICATIONS IN THE LAST 24 HOURS? IF YES, LIST DRUGS: ☐ Yes ☐ No

MEDICAL COMPLAINTS POSSIBLY RELATED TO INCIDENT:

Employee's Signature: _____ Date: _____

This Section to be Completed by Bio Assay

SAMPLE NUMBER	SAMPLE DATE	SAMPLE TIME (Military)	SAMPLE TYPE	URANIUM (mgU/L)	FLUORIDE (ugF/mL)	Sp. Gr.	OTHER? _____	CASTS	PROTEIN (mg/dL)

COMMENTS:

Investigated by _____ Date 7-0