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SITE-SPECIFIC HEALTH AND SAFETY PLAN

BUILDING 121 REMEDIATION
U.S. NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

Prepared for:

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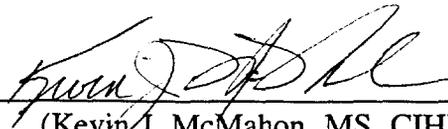
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1.0 INTRODUCTION

OHM Remediation Services Corp. (OHM) is pleased to present this Health and Safety Plan (HASP) which has been developed for the U.S. Naval Station, Roosevelt Roads, Ceiba, Puerto Rico.

This HASP documents the policies and procedures which protect workers and the public from potential hazards posed by work at this site. OHM considers safety the highest priority during work at a site containing potentially hazardous materials and has established a standard policy of zero exposure which must be upheld on all projects. All project activities will be conducted in a manner that minimizes the probability of injury, accident, or incident occurrence. The Site Safety Plan Acknowledgment (Appendix A) will be signed by all who actively participate at this project.

Although the plan focuses on the specific work activities planned for this site, it must remain flexible because of the nature of this work. Conditions may change and unforeseen situations may arise that require deviations from the original plan. This flexibility allows modification by the OHM supervisors and health and safety officials.

1.1 SITE HISTORY

Building 121 is located at the U.S. Naval Station Roosevelt Roads about 40 miles east of San Juan, Puerto Rico. The building is a windowless, one-story concrete block building with poured concrete floor and is approximately 20 feet wide by 30 feet long. Access to the building consists of a single 5-foot-wide door and there are two wall vents; one with a louvered cover, the other with an exhaust fan. The building was used to store pesticides until 1980 when the bulk pesticides were removed. Residual contamination exists on the interior building surfaces and in a 30-foot-square area of soil immediately adjacent to the building. Contaminants of concern include Arsenic, 2,4-D, Calcium Cyanide, Chlordane (5%), Copper Arsenite, Ethylene Bromide, Zinc, and Zinc Phosphide.

1.2 SCOPE OF WORK

The remediation of building 121 includes the following general tasks:

- Site mobilization and set-up
- Decontamination of building interior
- Scabbling of building floor (if necessary based on sample results)
- Impacted soil removal (if necessary based on sample results)
- Equipment decontamination

- Sampling and analysis of perimeter and personal work zone air, soil and water, wipe samples and chip samples of cement
- Transportation and disposal of generated wastes
- Site teardown and demobilization.

2.0 KEY PERSONNEL AND MANAGEMENT

The Project Manager (PM), Site Superintendent (SS), Certified Industrial Hygienist (CIH) and Site Safety Officer (SSO) are responsible for formulating and enforcing health and safety requirements, and implementing the HASP.

2.1 CERTIFIED INDUSTRIAL HYGIENIST

The CIH will be responsible for the contents of this HASP and will ensure that the HASP complies with all federal, state and local health and safety requirements. If necessary, the CIH can modify specific aspect of the HASP to adjust for on-site changes that affect safety. The CIH will coordinate with the SSO on all modifications to the HASP and will be available for consultation when required. The CIH will not necessarily be on site during OHM activities.

2.2 SITE SAFETY OFFICER

The SSO has primary responsibility for administering the HASP relative to site activities, and will be in the field full-time while site activities are in progress. The SSO's primary operational responsibilities will be monitoring, including personal and environmental monitoring, personal protective equipment maintenance, and assignment of protection levels. The SSO will be the main contact in any on-site emergency situation. The SSO will direct all field activities involved with safety and be responsible for stopping work when unacceptable health or safety risk exists. The SSO is responsible for assuring that all on-site personnel understand and comply with all safety requirements.

2.3 PROJECT MANAGER

The PM has the overall responsibility for the project and to assure that the goals of the construction remedial action are attained in a manner consistent with the HASP requirements. The PM will coordinate with the SS and the SSO to assure that the remedial action goals are completed in a manner consistent with the HASP.

2.4 SITE SUPERINTENDENT

The SS is responsible for field implementation of the HASP. The SS will establish and ensure compliance with site control areas and procedures and coordinate these supervisory responsibilities with the site SSO.

2.5 EMPLOYEE SAFETY RESPONSIBILITY

Each employee is responsible for personal safety as well as the safety of others in the area. The employee will use all equipment provided in a safe and responsible manner as directed by the SS. All OHM personnel will follow the policies set forth in OHM's Employee Safety Guide and the OHM Health and Safety Procedures.

2.6 OSHA RECORDS

Required records including the OSHA 200 log are maintained at the OHM Divisional offices.

2.7 KEY SAFETY PERSONNEL

The following individuals share responsibility for health and safety at the site:

- Site Superintendent - Brien Kilkenny
- Emergency Coordinator - Brien Kilkenny
- Site Safety Officer - Robert Brooks
- Project Manager - Larry Stearns 412/963-2300 or 800/284-6462 (office)
- NER Health and Safety Director - Kevin McMahon, M.S., CIH 609/243-7271 (office); 609/421-7523 (pager)
- Vice President, Health and Safety - Fred Halvorsen, Ph.D., P.E., CIH 800/231-7031 (office).

3.0 JOB HAZARD ANALYSIS

This section outlines the potential chemical and physical hazards which workers may be exposed to during work on this project.

3.1 CHEMICAL HAZARDS

CHEMICAL HAZARDS			
CHEMICAL	EXPOSURE ROUTES	PEL/TLV	HEALTH HAZARDS/ PHYSICAL HAZARDS
Arsenic	Inhalation, ingestion	0.01 mg/m ³ (CA)	Causes ulceration of nasal septum, dermatitis, GI disturbances, respiratory irritation, and hyperpig of skin
			Hydrogen gas can form with inorganic arsenic to form highly toxic gas arsene
Zinc	Inhalation, ingestion	1.0 mg/m ³	A corrosive irritant to eyes, skin and mucous membranes; some salts may cause sensitization of the skin; abdominal pains and vomiting from ingestion
			Thermal decomposition may produce toxic fumes
Calcium cyanide	Inhalation, ingestion	5 mg/m ³	Inhalation or ingestion causes headache, nausea, vomiting and weakness
			Releases very poisonous hydrogen cyanide gas slowly on contact with water. Release is rapid if acid is also present
Chlordane	Inhalation, ingestion, skin	0.5 mg/m ³	Exposure may cause shaking, blurred vision, irritability, confusion, delirium, staggering, convulsions, and death. Swallowing chlordane may also cause nausea, vomiting, and diarrhea
			Absorption through the skin is rapid and has caused death

CHEMICAL HAZARDS			
CHEMICAL	EXPOSURE ROUTES	PEL/TLV	HEALTH HAZARDS/ PHYSICAL HAZARDS
2,4-D	Inhalation, ingestion, eyes, skin	10 mg/m ³	May cause weakness, stupor, muscle twitching, and convulsions. Contact with material may cause skin rash
			Incompatible with strong acids
Ethylene Dibromide	Inhalation, ingestion, eyes, skin	20 ppm	May cause vomiting, irritation of the eyes, nose, throat, and skin. It may also cause drowsiness.
			Incompatible with chemically active metals such as sodium, potassium, calcium, hot aluminum, and magnesium; liquid ammonia, strong oxidizers
Zinc Phosphide	Skin, eye, inhalation, ingestion	LD 50 at 40 mg/m ³	When inhaled or ingested, compound releases phosphine, which causes faintness, weakness, vomiting, nausea, dypsea, fall in blood pressure, change in pulse rate, diarrhea, intense thirst, convulsions, paralysis, and coma. Contact with eyes or skin causes irritation.
			Reacts slowly with water, more rapidly with dilute acid, to form phosphine gas, which is toxic and spontaneously flammable.
Copper Arsenite	Inhalation, ingestion	0.5 mg/m ³	Causes ulceration of nasal septum, GI disturbances, and respiratory irritation
			Hydrogen gas can react too for highly toxic gas arsene

Personnel will be removed from the work site and placed under observation immediately if the following symptoms occur:

- Dizziness or stupor
- Nausea, headaches, or cramps
- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns.

3.2 PHYSICAL HAZARDS

To minimize physical hazards, OHM has developed standard safety protocols which will be followed at all times. Failure to follow safety protocols will result in expulsion of a crew member from the site.

All OHM personnel are familiar with the field activities which will be conducted at the site. They are trained to work safely under various field conditions. The SS and SSO will observe the general work practices of each crew member and equipment operator, and enforce safe procedures to minimize physical hazards. Also, hard hats, safety glasses, and steel-toe safety boots are required in all areas of the site.

3.3 ENVIRONMENTAL HAZARDS

Environmental factors such as weather, wild animals, insects, and irritant plants always pose a hazard when performing outdoor tasks. The SSO and SS will make every effort to alleviate these hazards should they arise.

3.3.1 Heat Stress

The combination of warm ambient temperature and protective clothing increases the potential for heat stress. In particular:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke.

Heat stress is covered in detail during our 40-hour OSHA 29 CFR 1910.120 training. In addition, this information is discussed during safety meetings before each workday. Workers are encouraged to increase consumption of water and electrolyte-containing beverages such as Gatorade.

At a minimum, workers will break every 2 hours for 10- to 15-minute rest periods. In addition, workers are advised to take rests whenever they feel any adverse effects that may be heat-related. The SSO and SS will monitor rest breaks and increase the frequency as required to prevent symptoms.

A work/rest schedule can be calculated based on heat stress monitoring results. Monitoring consists of taking the radial pulse of a worker for 30 seconds immediately after exiting the work area. The frequency of monitoring is provided below.

AMBIENT TEMPERATURE	LEVEL D PPE	LEVEL C PPE/ MODIFIED LEVEL D
90° F or above	After 45 minutes of work	After 15 minutes of work
87.5 F-90° F	After 60 minutes of work	After 30 minutes of work
82.5-87.5° F	After 90 minutes of work	After 60 minutes of work
77.5-82.5° F	After 120 minutes of work	After 90 minutes of work
72.5-77.5° F	After 150 minutes of work	After 120 minutes of work

If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by 1/3 and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, increase the following rest period by 1/3. The initial rest period should be at least 5 minutes.

Monitoring for heat stress will begin when the ambient temperature reaches or exceeds 70 degrees Fahrenheit, when wearing Level C PPE, or 80 degrees Fahrenheit for site activities performed in Level D.

3.3.2 Biological Hazards

- POISON IVY (Rhus Radicans)

Poison Ivy may exist at the site. All personnel entering into an area with poison ivy shall wear Tyvek coveralls and gloves, to avoid skin contact.

The majority of skin reactions following contact with offending plants are allergic in nature and characterized by:

- General symptoms of headache and fever
- Itching
- Redness
- A rash.

Some of the most common and most severe allergic reactions result from contact with plants of the poison ivy group, including poison oak and poison sumac. Such plants produce severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim may develop a high fever and feel very ill. Ordinarily, the rash begins within a few hours after exposure, but may be delayed 24 to 48 hours.

Distinguishing Features of Poison Ivy Group Plants

The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets each. Both plants have greenish-white flowers and berries that grow in clusters.

First Aid

- Remove contaminated clothing; wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.
- Apply calamine or other soothing lotion if rash is mild.
- Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

3.4 TASK-SPECIFIC RISK ASSESSMENT

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Clearing/Grubbing	Struck By/Against Heavy Equipment	<ul style="list-style-type: none"> ● Use reflective warning vests worn when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Understand and review hand signals
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear, walkways of equipment, tools, vegetation, excavated material, and debris ● Mark, identify, or barricade other obstructions
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	Insect/Snake Bites	<ul style="list-style-type: none"> ● Review injury potential and types of snakes with workers ● Avoid insect nests areas, likely habitats of snakes outside work areas ● Emphasize The Buddy System where such injury potential exists ● Use insect repellent, wear PPE to protect against sting/bite injuries
	Contact Dermatitis	<ul style="list-style-type: none"> ● Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants ● Identify and review poisonous plants with workers
	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Clearing/Grubbing (Continued)	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual
Grading	Struck By/Against Heavy Equipment	<ul style="list-style-type: none"> ● Use reflective warning vests worn when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Understand and review hand signals
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	Insect/Snake Bites	<ul style="list-style-type: none"> ● Review injury potential and types of snakes with workers ● Avoid insect nests areas, likely habitats of snakes outside work areas ● Emphasize The Buddy System where such injury potential exists ● Use insect repellent, wear PPE to protect against sting/bite injuries.
	Contact Dermatitis	<ul style="list-style-type: none"> ● Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants ● Identify and review poisonous plants with workers
	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Equipment/Facility Set-up	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear walkways work areas of equipment, tools, vegetation, excavated material and debris ● Mark, identify, or barricade other obstructions
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR AIR, SOIL, CHIP AND WIPE SAMPLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Air, Soil, Chip and Wipe Sampling	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use ● Wear proper eye protection during chip sampling (face shield)
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear walkways, work areas of equipment, tools, vegetation, excavated material, and debris ● Mark, identify, or barricade other obstructions
	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review contaminant chemical MSDSs with workers before operations begin
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat/Cold stress in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR SOIL AND CONTAINER SAMPLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Air, Soil, Chip and Wipe Sampling	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear walkways, work areas of equipment, tools, vegetation, excavated material, and debris ● Mark, identify, or barricade other obstructions
	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review contaminant chemical MSDSs with workers before operations begin
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR DRUM AND CYLINDER HANDLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Staging/Drums and Cylinders	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear walkways, work areas of equipment, vegetation, excavated material, tools, and debris ● Mark, identify, or barricade other obstructions
	Fire/Explosion	<ul style="list-style-type: none"> ● Eliminate sources of ignition from the work area ● Prohibit smoking in work areas ● Provide ABC (or equivalent) fire extinguishers for all work, flammable storage areas; fuel powered generators and compressors ● Store flammable liquids in well ventilated areas ● Post "NO SMOKING" signs ● Store combustible materials away from flammables ● Store, all compressed gas cylinders upright, caps in place when not in use ● Separate Flammables and Oxidizers by 20 feet
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	Struck by, Against Heavy Equipment, Protruding Objects	<ul style="list-style-type: none"> ● Use reflective warning vests worn when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Understand and review hand signals

ACTIVITY HAZARD ANALYSIS FOR DRUM AND CYLINDER HANDLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Staging/Drums and Cylinders (Continued)	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present (see section 5 for Level [A,B,C,D] protection) ● Review contaminant chemical MSDSs with workers before operations begin
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR SCABBLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Scabbling Floor	Struck by, Against Heavy Equipment, Flying Debris, Protruding Objects	<ul style="list-style-type: none"> ● Use reflective warning vests when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Barricade or enclose the demolition area ● Restrict entry to the work area to heavy equipment operator(s) and signaler(s) during demolition ● Wear hard hats, safety glasses with side shields, and steel-toe safety boots ● Understand and review hand signals ● Cease operations for electrical storms, high winds
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear, walkways of equipment, vegetation, excavated material, tools and debris ● Mark, identify, or barricade other obstructions
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads

ACTIVITY HAZARD ANALYSIS FOR SCABBLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Scabbling Floor (Continued)	Fire/Explosion	<ul style="list-style-type: none"> ● Eliminate sources of ignition from the work area ● Prohibit smoking ● Provide ABC (or equivalent) fire extinguishers for all work and flammable storage areas, fuel powered generators and compressors
	Premature structural Collapse	<ul style="list-style-type: none"> ● Barricade or enclose the demolition area ● Restrict entry to the work area to heavy equipment operator(s) and signaler(s) during demolition ● Wear hard hats, safety glasses with side shields, and steel-toe safety boots ● Understand and review posted hand signals
	Electrical Shock	<ul style="list-style-type: none"> ● De-energize or shut off utility lines at their source before work begins ● Use double insulated or properly grounded electric power-operated tools ● Maintain tools in a safe condition ● Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters ● Use qualified electricians to hook up electrical circuits
		<ul style="list-style-type: none"> ● Inspect all extension cords daily for structural integrity, ground continuity, and damaged insulation ● Cover or elevate electric wire or flexible cord passing through work areas to protect from damage ● Keep all plugs and receptacles out of water ● Use approved water-proof, weather-proof type if exposure to moisture is likely ● Inspect all electrical power circuits prior to commencing work ● Follow Lockout-Tagout procedures in accordance with OHM Health and Safety Procedures Manual

ACTIVITY HAZARD ANALYSIS FOR SCABBLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Scabbling Floor (Continued)	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)
	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review contaminant chemical MSDSs with workers before operations begin

ACTIVITY HAZARD ANALYSIS FOR CLEANING AND DECON WATER HANDLING		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Cleaning and Decon Water Handling	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review contaminant chemical MSDSs with workers before operations begin
	Fire/Explosion	<ul style="list-style-type: none"> ● Eliminate sources of ignition from the work area ● Prohibit smoking ● Provide ABC (or equivalent) fire extinguishers for all work and flammable storage areas, fuel powered generators and compressors ● Store flammable liquids in well ventilated areas ● Post "NO SMOKING" signs ● Store combustible materials away from flammables ● Store all compressed gas cylinders upright, caps in place when not in use ● Separate Flammables and Oxidizers by 20 feet
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear, walkways of equipment, vegetation, excavated material, tools and debris ● Mark, identify, or barricade other obstructions
	Struck by, Against Heavy Equipment, Protruding Objects	<ul style="list-style-type: none"> ● Use reflective warning vests when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Barricade or enclose the work area ● Restrict entry to the work area to authorized personnel ● Wear hard hats, safety glasses with side shields, and steel-toe safety boots

ACTIVITY HAZARD ANALYSIS FOR EQUIPMENT DECONTAMINATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Heavy Equipment & Vehicles	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear, walkways of equipment, vegetation, tools, excavated material, and debris ● Mark, identify, or barricade other obstructions
	Struck By/Against Heavy Equipment, Protruding Objects	<ul style="list-style-type: none"> ● Use reflective warning vests when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Wear hard hats, safety glasses with side shields, or goggles with splash shields and steel-toe safety boots ● Understand and review hand signals
	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review contaminant chemical MSDSs with workers before operations begin
	Burns	<ul style="list-style-type: none"> ● Use proper gloves, face shield/safety goggles, shin and toe guards, and splash suits to protect workers from skin burns and injury when operating laser (high pressure washers)
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use

ACTIVITY HAZARD ANALYSIS FOR EQUIPMENT DECONTAMINATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Heavy Equipment & Vehicles (Continued)	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual
Roll-offs & Containers	Slips, Trips, Falls	<ul style="list-style-type: none"> ● Clear, walkways of equipment, vegetation, tools, excavated material, and debris ● Mark, identify, or barricade other obstructions
	Struck By/Against Heavy Equipment, Protruding Objects	<ul style="list-style-type: none"> ● Use reflective warning vests when exposed to vehicular traffic ● Avoid equipment swing areas ● Make eye contact with operators before approaching equipment ● Wear hard hats, safety glasses with side shields, or goggles with splash shields and steel-toe safety boots ● Understand and review hand signals
	Flammable, Toxic, Oxygen deficient Atmospheres	<ul style="list-style-type: none"> ● Test vessel atmosphere for flammable/toxic vapors, and oxygen deficiency ● Review contaminant MSDS with workers and observer before starting work ● Wear proper level of PPE for the type of atmospheric contaminants ● Use body harness, safety belt with tripod wench for possible rescue ● Obtain Confined Space Entry Permit signed by Supervisor/Safety Officer

ACTIVITY HAZARD ANALYSIS FOR EQUIPMENT DECONTAMINATION		
TASK BREAKDOWN	POTENTIAL HAZARDS	HAZARD CONTROL MEASURES
Roll-offs & Containers (Continued)	Inhalation and Contact with Hazardous Substances	<ul style="list-style-type: none"> ● Provide workers proper skin, eye and respiratory protection based on the exposure hazards present ● Review MSDS information before starting work
	Burns	<ul style="list-style-type: none"> ● Use proper gloves, face shield/safety goggles, shin and toe guards, and splash suits to protect workers from skin burns and injury when operating laser (high pressure washers)
	Handling Heavy Objects	<ul style="list-style-type: none"> ● Observe proper lifting techniques ● Obey sensible lifting limits ● Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads
	Sharp Objects	<ul style="list-style-type: none"> ● Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects ● Maintain all hand and power tools in a safe condition ● Keep guards in place during use
	High Noise Levels	<ul style="list-style-type: none"> ● Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period)
	High Ambient Temperature	<ul style="list-style-type: none"> ● Monitor for Heat stress in accordance with OHM Health and Safety Procedures Manual

4.0 WORK AND SUPPORT AREAS

To prevent migration of contamination caused through tracking by personnel or equipment, work areas and personal protective equipment will be clearly specified prior to beginning operations. OHM has designated work areas or zones as suggested by the NIOSH/OSHA/USCG/EPA'S document titled, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." Each work area will be divided into three zones as follows:

- An Exclusion or "Hot" Zone (EZ)
- A Contamination-Reduction Zone (CRZ)
- A Support Zone (SZ).

*NOTE: The actual work zones will be outlined on a site working map upon mobilization to the site by the SSO. As a preliminary, the area approximately three feet out from the fenceline of Building 121 and the soil contamination inward will be considered the EZ. A field personnel decontamination station will be set up on the edge the EZ and will serve as the CRZ. All other areas of the working site area will be considered the SZ unless otherwise directed by the SSO or SS. This field personnel decontamination station is distinct from the equipment decontamination pad discussed in the Equipment Decontamination Plan.

4.1 EXCLUSION ZONE

The EZ is the area suspected of contamination and presents the greatest potential for worker exposure. Personnel entering the area must wear the mandated level of protection for that area. In certain instances, different levels of protection will be required depending on the tasks and monitoring performed within that zone.

4.2 CONTAMINATION-REDUCTION ZONE

The CRZ or transition zone will be established between the EZ and SZ. In this area, personnel will begin the sequential decontamination process required to exit the EZ. To prevent off-site migration of contamination and for personnel accountability, all personnel will enter and exit the EZ through the CRZ.

4.3 SUPPORT ZONE

The SZ serves as a clean, control area. Operational support facilities are located within the SZ. Normal work clothing and support equipment are appropriate in this zone. Contaminated equipment, or clothing will not be allowed in the SZ. The support facilities should be located upwind of site activities. There will be a clearly marked controlled access point from the SZ into the CRZ and EZ that is monitored closely by the SSO and the SS to ensure proper safety protocols are followed.

4.4 GENERAL

The following items are requirements to protect the health and safety of workers and will be discussed in the safety briefing prior to initiating work on the site.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand to mouth transfer and ingestion of contamination is prohibited in the EZ and CRZs.
- Hands and face must be washed upon leaving the EZ and before eating, drinking, chewing gum or tobacco and smoking or other activities which may result in ingestion of contamination.
- A buddy system will be used. Hand signals will be established to maintain communication.
- During site operations, each worker will consider himself as a safety backup to his partner. Off-site personnel provide emergency assistance. All personnel will be aware of dangerous situations that may develop.
- Visual contact will be maintained between buddies on site when performing hazardous duties.
- No personnel will be admitted to the site without the proper safety equipment, training, and medical surveillance certification.
- All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy, as established by the SSO or the SS, will be immediately dismissed from the site.
- Proper decontamination procedures must be followed before leaving the site.
- All employees and visitors must sign in and out of the site.

5.0 PROTECTIVE EQUIPMENT

This section addresses the various levels of personal protective equipment (PPE) which are or may be required at this job site. OHM personnel are trained in the use of all PPE utilized.

5.1 ANTICIPATED PROTECTION LEVELS

TASK	PROTECTION LEVEL	COMMENTS/MODIFICATIONS
Site mobilization and set-up	D	
Decontamination of building interior	C/B	Based on air monitoring results
Soil excavation and relocation	C/B	Based on air monitoring results
Chip sampling	C	
Waste Transport and Disposal	D	
Site tear-down and demobilization	D	
SZ Workers	D	

5.2 PROTECTION LEVEL DESCRIPTIONS

This sections lists the minimum requirements for each protection level. Modification to these requirements will be noted above.

5.2.1 Level D

Level D consists of the following:

- Safety glasses with side shields
- Hard hat
- Steel-toed work boots
- Work clothing as prescribed by weather.

5.2.2 Modified Level D

Modified Level D consists of the following:

- Safety glasses with side shields
- Hard hat

- Steel-toed work boots
- Nitrile, neoprene, or PVC overboots or vinyl booties
- Outer nitrile, neoprene, or PVC gloves over latex sample gloves
- Face shield (when projectiles or splashes pose a hazard)
- Tyvek coverall [poly-coated or Saranex Tyveks (Sarans) and PVC acid gear will be required when workers have a potential to be exposed to contaminated liquids or sludges.]

5.2.3 Level C

Level C consists of the following:

- Full-face, air-purifying respirator with GMC-H cartridges
- Hooded Tyvek coveralls and poly-coated or Saranex Tyveks (Sarans)
- Hard hat
- Steel-toed work boots
- Nitrile, neoprene, or PVC overboots
- Nitrile, neoprene, or PVC gloves over latex sample gloves
- Face shield (when projectiles or splashes pose a hazard).

5.2.4 Level B

Level B protection consists of the items required for Level C protection with the exception that an air-supplied respirator is used in place of the air-purifying respirator.

5.2.5 Level A

Level A protection consists of the items required for Level B protection with the addition of a fully-encapsulating, vapor-proof suit capable of maintaining positive pressure.

5.3 SUPPLIED-AIR RESPIRATORS

If air monitoring shows that Level B protection is needed, OHM personnel will wear Survivair 9881-02 Hippack Airline respirators with 5-minute egress bottles. Personnel requiring Level "B" protection and high mobility will wear Survivair Mark 2 SCBA units.

5.4 BREATHING-AIR QUALITY

Code of Federal Regulations 29 CFR 1910.134 states breathing air will meet the requirement of the specification for Grade D breathing air as described in the ANSI/CGA Specification G-7.1-1989. OHM requires a certificate of analysis from vendors of breathing air in order to show that the air meets this standard.

5.5 AIR-PURIFYING RESPIRATORS

OHM's air-purifying respirators are the MSA "Ultra-Twin" full-face respirators.

5.6 RESPIRATOR CARTRIDGES

The crew members working in Level C will wear respirators equipped with MSA GMC-H air-purifying cartridges, unless otherwise noted. The GMC-H cartridge holds approval for:

- Organic vapors <1,000 ppm
- Chlorine gas <10 ppm
- Hydrogen chloride <50 ppm
- Sulfur dioxide <50 ppm
- Dusts, fumes and mists with a TWA <0.05 mg/m³
- Asbestos-containing dusts and mists
- Radon daughters
- Radionuclides
- Pesticides.

5.7 CARTRIDGE CHANGES

All cartridges will be changed a minimum of once daily. However, water saturation of the HEPA filter or dusty conditions may necessitate more frequent changes. Changes will occur when personnel begin to experience increased inhalation resistance or breakthrough of a chemical warning property.

5.8 INSPECTION AND CLEANING

Respirators are checked periodically by a qualified individual and inspected before each use by the wearer. All respirators and associated equipment will be decontaminated and hygienically cleaned after use.

5.9 FIT TESTING

Annual respirator fit tests are required of all personnel wearing negative-pressure respirators. The test will use isoamyl acetate or irritant smoke. The fit test must be for the style and size of the respirator to be used.

5.10 FACIAL HAIR

No personnel who have facial hair which interferes with the respirator's sealing surface will be permitted to wear a respirator and will not be permitted to work in areas requiring respirator use.

5.11 CORRECTIVE LENSES

Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the respirator's sealing surfaces. For workers requiring corrective lenses, special spectacles designed for use with respirators will be provided.

5.12 CONTACT LENSES

Contact lenses will not be worn with any type of respirator.

5.13 MEDICAL CERTIFICATION

Only workers who have been certified by a physician as being physically capable of respirator usage will be issued a respirator. Personnel unable to pass a respiratory fit test or without medical clearance for respirator use will not be permitted to enter or work in areas on site that require respiratory protection. Employees receive a written physicians opinion that they are fit for general hazardous waste operations as per 29 CFR 1910.120(f)(7).

5.14 SITE-SPECIFIC RESPIRATORY PROTECTION PROGRAM

The OHM Respiratory Protection Program complies with 29 CFR 1910.134. The primary objective of respiratory protection is to prevent atmospheric contamination. When engineering measures to control contamination are not feasible, or while they are being implemented, personal respiratory protective devices will be used.

The criteria for determining respirator need are contained in Section 7.0 of this HASP. The GMC-H cartridges will protect employees from the hazardous substances specific to this site. All respirator users are OSHA trained in proper respirator use and maintenance. The SS and SSO will observe workers during respirator use for signs of stress and will monitor air levels of contaminants to ensure that respiratory protection is sufficient. The SS, CIH, and SSO will also evaluate this HASP weekly to determine its continued effectiveness.

All respirators and cartridges used will provide adequate protection against the hazards for which they were designed in accordance with applicable standards. All persons assigned to use respirators will have medical clearance to do so.

6.0 DECONTAMINATION PROCEDURES

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination when they leave the work site.

6.1 PERSONNEL DECONTAMINATION

Decontamination procedures will ensure that material which workers may have contacted in the EZ does not result in personal exposure and is not spread to clean areas of the site. This sequence describes the general decontamination procedure. The specific stages will vary depending on the site, the task, the protection level, etc.

1. Go to end of EZ
2. Wash and remove outer boots
3. Remove outer gloves
4. Cross into CRZ
5. Wash splash suit
6. Remove splash suit and let dry
7. Remove inner booties and discard
8. Remove sample gloves and discard
9. Remove Saranex Tyvek suit and discard
10. Remove sample gloves and discard
11. Remove and wash respirator
12. Rinse respirator and hang to dry
13. Remove sample gloves and discard
14. Remove Tyvek and discard
15. Remove booties and discard
16. Remove sample gloves and discard

6.1.1 Suspected Contamination

Any employee suspected of sustaining skin contact with chemical materials will first use the emergency shower. Following a thorough drenching, the worker will proceed to the decontamination facility. Here the worker will remove clothing, shower, don clean clothing, and immediately be taken to the first-aid station.

6.1.2 Personal Hygiene

Before any eating, smoking, or drinking, personnel will wash hands, arms, neck and face.

6.2 EQUIPMENT DECONTAMINATION

All contaminated equipment will be decontaminated before leaving the site. Decontamination procedures will vary depending upon the contaminant involved, but may include sweeping, wiping, scraping, hosing, or steaming the exterior of the equipment. Personnel performing this task will wear the proper PPE as prescribed by the SSO. Refer to the Equipment Decontamination Plan for additional details.

6.3 DISPOSAL

All spent PPE and disposable clothing will be treated as hazardous waste and disposed of properly.

7.0 AIR MONITORING

Air monitoring will be conducted in order to determine airborne contamination levels. Monitoring will consist of both direct reading and integrated air sampling. Results from direct reading instrumentation will be used to ensure that respiratory protection is adequate to protect personnel against the chemicals that are encountered. The following air monitoring efforts will be used at this site. Additional air monitoring may be conducted at the discretion of the SSO.

The following chart describes the air monitoring required and appropriate action levels.

MONITORING DEVICE	ACTION LEVEL	ACTION
LEL/O ₂	> 10% LEL < 20.8% O ₂	Evacuate area, ventilate, upgrade to Level B if necessary, continue to monitor
PID	1-5 ppm unknowns	Level C
	5-500 ppm unknowns	Level B
	> 500 ppm unknowns	Level A
Mini-Aerosol Monitor	> 0.1 mg/m ³	Level C
	> 5.0 mg/m ³	Level B

7.1 LOWER EXPLOSIVE LIMIT/OXYGEN (LEL/O₂) METER

Prior to entering a confined-space area or hot work involving welding, cutting, or other high heat-producing operations where flammable or combustible vapors may be present, LEL/O₂ measurements will be taken.

7.2 PHOTOIONIZATION DETECTOR (PID)

A PID will be used to monitor total ionizable organic content of the ambient air. A PID will prove useful as a direct reading instrument to aid in determining if respiratory protection needs to be upgraded and to define the EZ.

For known contaminants only, to determine a protection level from PID data, the SSO will multiply the TLV of the known compound by 25. This will be the limit for Level C protection for that compound. If PID readings exceed 25 times the TLV, Level B protection will be required. Also, regardless of the TLV, a PID reading of 1,000 ppm or more will indicate that the GMC-H cartridges may become overloaded and

will necessitate Level B protection. (Note: PID readings do not always indicate the actual air concentration of a compound. Consult the manual, HNU, or the CIH for clarification.)

The SSO will take measurements before operations begin in an area to determine the amount of organic compounds naturally occurring in the air. This is referred to as a background level.

Levels of volatile organic compounds will be measured in the air at active work sites once every hour and at the support zone once every hour when levels are detected above background in the exclusion zone. If levels exceed background at any time in the support zone, work in the exclusion zone will cease and corrective actions will be taken (e.g., cover soil with polyethylene sheeting). Work will not resume until levels reach background in the support zone.

7.3 MINI-AEROSOL MONITOR

Total suspended particulate concentrations will be monitored using an MIE-PDM3 mini-aerosol monitor during soil excavation and movement activities. The action levels for levels of protection are discussed in Section 7.0 above.

7.4 AIR MONITORING LOG

The SSO will ensure that all air-monitoring data is logged into a monitoring notebook/data sheets. Data will include instrument used, wind direction, work process, etc. The Regional OHM CIH will periodically review this data.

7.5 CALIBRATION REQUIREMENTS

The PID, LEL/O₂ meter and sampling pumps required with fixed-media air sampling will be calibrated daily prior to use. A separate log will be kept detailing date, time, span gas, or other standard, and name of person performing the calibration.

7.6 AIR MONITORING RESULTS

Air monitoring results will be posted for personnel inspection, and will be discussed during morning safety meetings.

7.7 INTEGRATED AIR SAMPLING

Integrated air sampling on this project will be conducted for Cyanide, 2,4-D, Arsenic and Zinc. Both personal and area samples will be collected. Laboratory analysis for these samples will be done utilizing NIOSH sampling methods. Area samples will be placed at one upwind and two downwind locations whenever building decontamination

and/or soil excavation activities take place. Personal samples will be taken on a representative sample of tasks and job functions. NIOSH methods that will be utilized will include NIOSH #7900 (Arsenic), NIOSH #7904 (Cyanide), NIOSH #5001 (2,4-D), and NIOSH #7502 (Zinc).

8.0 EMERGENCY RESPONSE AND CONTINGENCY PLAN

8.1 PRE-EMERGENCY PLANNING

Prior to engaging in construction/remediation activities at the site, OHM will plan for possible emergency situations and have available adequate supplies and manpower to respond. In addition site personnel will receive training during the site orientation concerning proper emergency response procedures.

The following situations would warrant implementation of the ERCP:

EMERGENCY SITUATION	POSSIBLE DANGERS
Fire/Explosion	<ul style="list-style-type: none"> • The potential for human injury exists. • Toxic fumes or vapors are released. • The fire could spread on site or off site and possibly ignite other flammable materials or cause heat-induced explosions. • The use of water and/or chemical fire suppressants could result in contaminated run-off. • An imminent danger of explosion exists.
Spill or Release of Hazardous Materials	<ul style="list-style-type: none"> • The spill could result in the release of flammable liquids or vapors, thus causing a fire or gas explosion hazard. • The spill could cause the release of toxic liquids or fumes in sufficient quantities or in a manner that is hazardous to or could endanger human health.
Natural Disaster	<ul style="list-style-type: none"> • A rain storm exceeds the flash flood level. • The facility is in a projected tornado path or a tornado has damaged facility property. • Severe wind gusts are forecasted or have occurred and have caused damage to the facility.
Medical Emergency	<ul style="list-style-type: none"> • Overexposure to hazardous materials. • Trauma injuries (broken bones, severe lacerations/bleeding, burns). • Eye/skin contact with hazardous materials. • Loss of consciousness. • Heat stress (Heat stroke). • Heart attack. • Respiratory failure. • Allergic reaction.

The following measures will be taken to assure the availability of adequate equipment and manpower resources:

- Sufficient equipment and materials will be kept on site and dedicated for emergencies only. The inventory will be replenished after each use.
- On-site emergency responders will be current in regards to training and medical surveillance programs. Copies of all applicable certificates will be kept on file for on-site personnel required to respond.
- It will be the responsibility of the emergency coordinator to brief the on-site response team on anticipated hazards at the site. The emergency coordinator shall also be responsible for anticipating and requesting equipment that will be needed for response activities.
- Emergency response activities will be coordinated with the Local Emergency Planning Committee (LEPC) in compliance with SARA Title III requirements.

Communications will be established prior to commencement of any activities at the remediation site. Communication will be established so that all responders on site have availability to all pertinent information to allow them to conduct their activities in a safe and healthful manner. The primary communication device will be two-way radios. Air horns may be used to alert personnel of emergency conditions.

Primary communication with local responders in the event of an emergency will be accomplished using commercial telephone lines.

8.2 EMERGENCY RECOGNITION AND PREVENTION

Because unrecognized hazards may result in emergency incidents, it will be the responsibility of the Site Supervisor and SSO, through daily site inspections and employee feedback (Safety Observation Program, daily safety meetings, and activity hazard

analyses) to recognize and identify all hazards that are found at the site. These may include:

TYPE OF HAZARD	POSSIBLE CAUSE
Chemical Hazards	<ul style="list-style-type: none"> • Materials at the site • Materials brought to the site
Physical Hazards	<ul style="list-style-type: none"> • Fire/explosion • Slip/trip/fall • Electrocution • Confined space • IDLH atmospheres • Excessive noise
Mechanical Hazards	<ul style="list-style-type: none"> • Heavy equipment • Stored energy system • Pinch points • Electrical equipment • Vehicle traffic
Environmental Hazards	<ul style="list-style-type: none"> • Electrical Storms • High winds • Heavy Rain • Temperature Extremes (Heat Stress) • Poisonous Plants/Animals

Once a hazard has been recognized, the Site Superintendent and/or the SSO will take immediate action to prevent the hazard from becoming an emergency. This may be accomplished by the following:

- Daily safety meeting
- Task-specific training prior to commencement of activity
- Lock-out/tag-out
- Personal Protective Equipment (PPE) selection/use
- Written and approved permits for hot work, confined space
- Trenching/shoring procedure
- Air monitoring
- Following all OHM standard operating procedures
- Practice drills for fire, medical emergency, and hazardous substances spills.

8.3 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATIONS

This section of the ERCP describes the various roles, responsibilities, and communication procedures that will be followed by personnel involved in emergency responses.

The primary emergency coordinator for this site is the SS. In the event an emergency occurs and the emergency coordinator is not on site, the Site Safety Officer or the highest ranking employee on site will serve as the emergency coordinator until he arrives. The emergency coordinator will determine the nature of the emergency and take appropriate action as defined by this ERCP.

The emergency coordinator will implement the ERCP immediately as required. The decision to implement the plan will depend upon whether the actual incident threatens human health or the environment. Immediately after being notified of an emergency incident, the emergency coordinator or his designee will evaluate the situation to determine the appropriate action.

8.3.1 Responsibilities and Duties

This section describes the responsibilities and duties assigned to the emergency coordinator.

It is recognized that the structure of the "Incident Command System" will change as additional response organizations are added. OHM will follow procedures as directed by the fire department, LEPC, State and Federal Agencies as required. OHM will defer to the local Fire Department chief to assume the role of Incident Commander upon arriving on site. Additional on-site personnel may be added to the Site Emergency Response Team as required to respond effectively.

8.3.2 On-site Emergency Coordinator Duties

The on-site emergency coordinator is responsible for implementing and directing the emergency procedures. All emergency personnel and their communications will be coordinated through the emergency coordinator. Specific duties are as follows:

- Identify the source and character of the incident, type and quantity of any release. Assess possible hazards to human health or the environment that may result directly from the problem or its control.
- Discontinue operations in the vicinity of the incident if necessary to ensure that fires, explosions, or spills do not recur or spread to other parts of the site. While operations are dormant, monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment, where appropriate.
- Notify local Emergency Response Teams if their help is necessary to control the incident. Table 1 provides telephone numbers for emergency assistance.

- Direct on-site personnel to control the incident until, if necessary, outside help arrives. Specifically:
 - Ensure that the building or area where the incident occurred and the surrounding area are evacuated and shut off possible ignition sources, if appropriate. The Emergency Response Team is responsible for directing site personnel such that they avoid the area of the incident and leave emergency control procedures unobstructed.
- If fire or explosion is involved, notify local Fire Department.
- Have protected personnel, in appropriate PPE, on standby for rescue.

If the incident may threaten human health or the environment outside of the site, the emergency coordinator should immediately determine whether evacuation of area outside of the site may be necessary and, if so, notify the Police Department and the Office of Emergency Management.

When required, notify the National Response Center. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of facility
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside of the facility.

The emergency telephone number for the National Response Center is 800/424-8802.

If hazardous waste has been released or produced through control of the incident, ensure that:

- Waste is collected and contained.
- Containers of waste are removed or isolated from the immediate site of the emergency.
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided.
- Ensure that no waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed.

- Ensure that all emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.
- Notify the USEPA Regional Administrator that cleanup procedures have been completed and that all emergency equipment is fit for its intended use before resuming operations in the affected area of the facility. The USEPA Regional Administrator's telephone number is included in the Emergency Contacts.
- Record time, date, and details of the incident, and submit a written report to the USEPA Regional Administrator. Report is due to USEPA within 15 days of the incident.

8.4 SAFE DISTANCES AND PLACES OF REFUGE

The emergency coordinator for all activities will be the SS. No single recommendation can be made for evacuation or safe distances because of the wide variety of emergencies which could occur. Safe distances can only be determined at the time of an emergency based on a combination of site and incident-specific criteria. However, the following measures are established to serve as general guidelines.

In the event of minor hazardous materials releases (small spills of low toxicity), workers in the affected area will report initially to the contamination reduction zone. Small spills or leaks (generally less than 55 gallons) will require initial evacuation of at least 50 feet in all directions to allow for cleanup and to prevent exposure. After initial assessment of the extent of the release and potential hazards, the emergency coordinator or his designee will determine the specific boundaries for evacuation. Appropriate steps such as caution tape, rope, traffic cones, barricades, or personal monitors will be used to secure the boundaries.

In the event of a major hazardous material release (large spills of high toxicity/greater than 55 gallons), workers will be evacuated from the building/site. Workers will assemble at the entrance to the site for a head count by their foremen and to await further instruction.

If an incident may threaten the health or safety of the surrounding community, the public will be informed and, if necessary, evacuated from the area. The emergency coordinator, or his designee will inform the proper agencies in the event that this is necessary. Telephone numbers are listed in Table 1.

Places of refuge will be established prior to the commencement of activities. These areas must be identified for the following incidents:

- Chemical release
- Fire/explosion
- Power loss

- Medical emergency
- Hazardous weather.

In general, evacuation will be made to the crew trailers, unless the emergency coordinator determines otherwise. It is the responsibility of the emergency coordinator to determine when it is necessary to evacuate personnel to off-site locations.

In the event of an emergency evacuation, all the employees will gather at the entrance to the site until a head count establishes that all are present and accounted for. No one is to leave the site without notifying the emergency coordinator.

8.5 EVACUATION ROUTES AND PROCEDURES

All emergencies require prompt and deliberate action. In the event of an emergency, it will be necessary to follow an established set of procedures. Such established procedures will be followed as closely as possible. However, in specific emergency situations, the emergency coordinator may deviate from the procedures to provide a more effective plan for bringing the situation under control. The emergency coordinator is responsible for determining which situations require site evacuation.

8.5.1 Evacuation Signals and Routes

Verbal communication, visual signals, and an air horn will be used to notify employees of the necessity to evacuate an area or building involved in a release/spill of a hazardous material. Total site evacuation will be initiated only by the emergency coordinator, however, in his absence, decision to preserve the health and safety of employees will take precedence. Evacuation routes will be posted in each outside work area. Signs inside buildings will be posted on walls or other structural element of a building. Periodic drills will be conducted to familiarize each employee with the proper routes and procedures.

8.5.2 Evacuation Procedures

In the event evacuation is necessary, the following actions will be taken:

- The emergency signal will be activated.
- No further entry of visitors, contractors, or trucks will be permitted. Vehicle traffic within the site will cease in order to allow safe exit of personnel and movement of emergency equipment.
- Shut off all machinery if safe to do so.

- ALL on-site personnel, visitors, and contractors in the support zone will assemble at the entrance to the site for a head count and await further instruction from the emergency coordinator.
- ALL persons in the exclusion zone and contamination reduction zone will be accounted for by their immediate crew leaders (e.g., foreman). Leaders will determine the safest exits for employees and will also choose an alternate exit if the first choice is inaccessible.
- During exit, the crew leader should try to keep the group together. Immediately upon exit, the crew leader will account for all employees in his crew.
- Upon completion of the head count, the crew leader will provide the information to the emergency coordinator.
- Contract personnel and visitors will also be accounted for.
- The names of emergency response team members involved will be reported to the emergency spill control coordinator.
- A final tally of persons will be made by the emergency coordinator or designee. No attempt to find persons not accounted for will involve endangering lives of OHM or other employees by re-entry into emergency areas.
- In all questions of accountability, immediate crew leaders will be held responsible for those persons reporting to them. Visitors will be the responsibility of those employees they are seeing. Contractors and truck drivers are the responsibility of the Site Superintendent. The security guard will aid in accounting for visitors, contractors, and truckers by reference to sign-in sheets available from the guard shack.
- Personnel will be assigned by the emergency coordinator to be available at the main gate to direct and brief emergency responders.
- Re-entry into the site will be made only after clearance is given by the emergency coordinator. At his direction, a signal or other notification will be given for re-entry into the facility.
- Drills will be held periodically to practice all of these procedures and will be treated with the same seriousness as an actual emergency.

8.6 EMERGENCY SPILL RESPONSE PROCEDURES AND EQUIPMENT

In the event of an emergency involving a hazardous material spill or release, the following general procedures will be used for rapid and safe response and control of the situation. Emergency contacts found in Table 1 provide a quick reference guide to follow in the event of a major spill.

8.6.1 Notification Procedures

If an employee discovers a chemical spill or process upset resulting in a vapor or material release, he or she will immediately notify the on-site emergency coordinator.

On-site Emergency Coordinator will obtain information pertaining to the following:

- The material spilled or released.
- Location of the release or spillage of hazardous material.
- An estimate of quantity released and the rate at which it is being released.
- The direction in which the spill, vapor or smoke release is heading.
- Any injuries involved.
- Fire and/or explosion or possibility of these events.
- The area and materials involved and the intensity of the fire or explosion.

This information will help the on-site emergency coordinator to assess the magnitude and potential seriousness of the spill or release.

8.6.2 Procedure for Containing/Collecting Spills

The initial response to any spill or discharge will be to protect human health and safety, and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response.

If for some reason a chemical spill is not contained within a dike or sump area, an area of isolation will be established around the spill. The size of the area will generally depend on the size of the spill and the materials involved. If the spill is large (greater than 55 gallons) and involves a tank or a pipeline rupture, an initial isolation of at least 100 ft. in all directions will be used. Small spills (less than or equal to 55 gallons) or leaks from a tank or pipe will require evacuation of at least 50 ft. in all directions to allow cleanup and repair and to prevent exposure. When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. If possible the area will be roped or otherwise blocked off.

If the spill results in the formation of a toxic vapor cloud (by reaction with surrounding materials or by outbreak of fire) and its release (due to high vapor pressures under ambient conditions), further evacuation will be enforced. In general an area at least 500 feet wide and 1,000 feet long will be evacuated downwind if volatile materials

are spilled. (Consult the DOT Emergency Response Guide for isolation distances for listed hazardous materials.)

If an incident may threaten the health or safety of the surrounding community, the public will be informed and possibly evacuated from the area. The on-site emergency coordinator will inform the proper agencies in the event this is necessary. (Refer to Table 1)

As called for in regulations developed under the Comprehensive Environmental Response Compensation Liability Act of 1980 (Superfund), OHM's practice is to report a spill of a pound or more of any hazardous material for which a reportable quantity has not been established and which is listed under the Solid Waste Disposal Act, Clean Air Act, Clean Water Act, or TSCA. OHM also follows the same practice for any substances not listed in the Acts noted above but which can be classified as a hazardous waste under RCRA.

Clean up personnel will take the following measures:

- Make sure all unnecessary persons are removed from the hazard area.
- Put on protective clothing and equipment.
- If a flammable material is involved, remove all ignition sources, and use spark and explosion proof equipment for recovery of material.
- Remove all surrounding materials that could be especially reactive with materials in the waste. Determine the major components in the waste at the time of the spill.
- If wastes reach a storm sewer, try to dam the outfall by using sand, earth, sandbags, etc. If this is done, pump this material out into a temporary holding tank or drums as soon as possible.
- Place all small quantities of recovered liquid wastes (55 gallons or less) and contaminated soil into drums for incineration or removal to an approved disposal site.
- Spray the spill area with foam, if available, if volatile emissions may occur.
- Apply appropriate spill control media (e.g. clay, sand, lime, etc.) to absorb discharged liquids.
- For large spills, establish diking around leading edge of spill using booms, sand, clay or other appropriate material. If possible, use diaphragm pump to transfer discharged liquid to drums or holding tank.

8.6.3 Emergency Response Equipment

The following equipment will be staged in the support zone and throughout the site, as needed, to provide for safety and first aid during emergency responses.

- ABC-type fire extinguisher
- First-aid kit, industrial size
- Eyewash/safety shower
- Emergency oxygen unit
- Emergency signal horn
- Self contained breathing apparatus (two)
- Stretcher/backboard.

In addition to the equipment listed above, OHM maintains direct reading instrumentation that may be used in emergency situations to assess the degree of environmental hazard. This equipment will only be used by the Site Safety Officer or other specially trained personnel. This equipment will be stored, charged and ready for immediate use in evaluating hazardous chemical concentrations. The equipment will be located at the OHM office trailer.

EQUIPMENT NAME	APPLICATION
Portable H-NU Photoionization Meter	Measures selected inorganic and organic chemical concentrations
MSA Oxygen and Combustible Gas Meter	Measures oxygen and combustible gas levels

8.6.4 Personal Protective Equipment

A supply of two (minimum) SCBAs will be located in the support zone for use in emergency response to hazardous materials releases. They will be inspected at least monthly, according to OSHA requirements. In addition, all emergency response personnel will have respirators available for use with cartridge selection determined by the Site Safety Officer based on the results of direct reading instruments. Emergency response personnel will also be provided with protective clothing as warranted by the nature of the hazardous material and as directed by the Site Safety Officer.

8.6.5 Emergency Spill Response Clean-Up Materials and Equipment

A sufficient supply of appropriate emergency response clean-up and personal protective equipment will be inventoried and inspected, visually, on a weekly basis.

The materials listed below will be kept on site for spill control, depending on the types of hazardous materials present on site. The majority of this material will be located

in the support zone, in a supply trailer or storage area. Small amounts will be placed on pallets and located in the active work areas.

- Sand or clay to solidify/absorb liquid spills.
- Lime (calcium oxide), soda ash (sodium carbonate), or baking soda (sodium bicarbonate) for neutralizing acid (pH <7) spills.
- Activated charcoal (carbon) to adsorb organic solvents (hydrocarbons) and to reduce flammable vapors.
- Citric acid for neutralizing caustic (pH >7) spills.
- Vapor-suppressing foam, if required by the Client, for controlling the release of volatile organic compounds.
- Appropriate solvents e.g. CITRIKLEEN, for decontamination of structures or equipment.

The following equipment will be kept on site and dedicated for spill cleanup:

- Plastic shovels for recovering corrosive and flammable materials.
- Sausage-shaped absorbent booms for diking liquid spills, drains, or sewers.
- Sorbent sheets (diapers) for absorbing liquid spills.
- Overpack drums for containerizing leaking drums.
- 55-gallon open-top drums for containerization of waste materials.

*NOTE: All contaminated soils, absorbent materials, solvents and other materials resulting from the clean-up of spilled or discharged substances shall be properly stored, labelled, and disposed of off-site.

8.7 EMERGENCY CONTINGENCY PLAN

This section of the ERCP details the contingency measures OHM will take to prepare for and respond to fires, explosions, spills and releases of hazardous materials, hazardous weather, and medical emergencies.

8.8 MEDICAL EMERGENCY CONTINGENCY MEASURES

The procedures listed below will be used to respond to medical emergencies.

8.8.1 Response

The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident. The work crew supervisor will be summoned.

The work crew supervisor will immediately make radio contact with the on-site emergency coordinator to alert him of a medical emergency situation. The supervisor will advise the following information:

- Location of the victim at the work site
- Nature of the emergency
- Whether the victim is conscious
- Specific conditions contributing to the emergency, if known.

The Emergency Coordinator will notify the Site Safety Officer. The following actions will then be taken depending on the severity of the incident:

- **Life-Threatening Incident**--If an apparent life-threatening condition exists, the crew supervisor will inform the emergency coordinator by radio, and the local Emergency Response Services (EMS) will be immediately called. An on-site person will be appointed who will meet the EMS and have him/her quickly taken to the victim.
- **Non Life-Threatening Incident**--If it is determined that no threat to life is present, the Site Safety Officer will direct the injured person through decontamination procedures (see below) appropriate to the nature of the illness or accident. Appropriate first aid or medical attention will then be administered.

***NOTE:** The area surrounding an accident site must not be disturbed until the scene has been cleared by the Site Safety Officer.

Any personnel requiring emergency medical attention will be evacuated from exclusion and contamination reduction zones if doing so would not endanger the life of the injured person or otherwise aggravate the injury. Personnel will not enter the area to attempt a rescue if their own lives would be threatened. The decision whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life-saving first aid. For others, decontamination may aggravate the injury or delay life-saving first aid. Decontamination will be performed if it does not interfere with essential treatment.

If decontamination can be performed, observe the following procedures:

- Wash external clothing and cut it away.

If decontamination cannot be performed, observe the following procedures:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.

- Alert emergency and off-site medical personnel to potential contamination, instruct them about specific decontamination procedures.
- Send site personnel familiar with the incident and chemical safety information, e.g. MSDS, with the affected person.

All injuries, no matter how small, will be reported to the SSO or the Site Supervisor. An accident/injury/illness report will be completely and properly filled out and submitted to the Regional Health and Safety Director/Project CIH, in accordance with OHM's reporting procedures.

A list of emergency telephone numbers is given in Table 1.

8.8.2 Notification

The following personnel/agencies will be notified in the event of a medical emergency:

- Local Fire Department or EMS
- On-site Emergency Coordinator
- Workers in the affected areas
- Client Representative (NTR - Ivan Rosado, 809/865-2050).

8.8.3 Directions To Hospital

Written directions to the hospital and a map will be posted in all trailers in the staging area. Directions to the hospital are as follows:

Go to the base of the hill from the site and turn left on to the paved road. Go approximately 1/4 mile and bear left into the hospital entrance. Then follow the signs to the emergency room which is off to the left.

8.9 FIRE CONTINGENCY MEASURES

Because flammable/combustible materials may be present at this site, fire is a potential hazard. OHM personnel and subcontractors are not trained professional firefighters. Therefore, if there is any doubt that a fire can be quickly contained and extinguished, personnel will notify the emergency coordinator by radio and vacate the structure or area. The emergency coordinator will immediately notify the local Fire Department.

The following procedures will be used to prevent the possibility of fires and resulting injuries:

- Sources of ignition will be kept away from where flammable materials are handled or stored.
- The air will be monitored for explosivity before and during hot work and periodically where flammable materials are present. Hot work permits will be required for all such work.
- "No smoking" signs will be conspicuously posted in areas where flammable materials are present.
- Fire extinguishers will be placed in all areas where a fire hazard may exist.
- Before workers begin operations in an area the foreman will give instruction on egress procedures and assembly points. Egress routes will be posted in work areas and exit points clearly marked.

8.9.1 Response

The following procedures will be used in the event of a fire:

- Anyone who sees a fire will notify their supervisor who will then contact the Emergency Coordinator by radio. The emergency coordinator will activate the emergency air horns and contact the local Fire Department.
- When the emergency siren sounds, workers will disconnect electrical equipment in use (if possible) and proceed to the nearest fire exit.
- Work crews will be comprised of pairs of workers (buddy system) who join each other immediately after hearing the fire alarm and remain together throughout the emergency. Workers will assemble at a predetermined rally point for a head count.
- When a small fire has been extinguished by a worker, the emergency coordinator will be notified.

8.10 HAZARDOUS WEATHER CONTINGENCY MEASURES

Operations will not be started or continued when the following hazardous weather conditions are present:

- Lightning
- Heavy Rains
- High Winds.

8.10.1 Response

- Excavation/soil stock piles will be covered with plastic liner.
- All equipment will be shut down and secured to prevent damage.
- Personnel will be moved to safe refuge, initially crew trailers. The emergency coordinator will determine when it is necessary to evacuate personnel to off-site locations and will coordinate efforts with fire, police and other agencies.

8.10.2 Notification

The emergency coordinator will be responsible for assessing hazardous weather conditions and notifying personnel of specific contingency measures. Notifications will include:

- OHM employees and subcontractors
- Client Representative (NTR - Ivan Rosado, 809/865-2050).

8.11 SPILL/RELEASE CONTINGENCY MEASURES

In the event of release or spill of a hazardous material the following measures will be taken.

8.11.1 Response

Any person observing a spill or release will act to remove and/or protect injured/contaminated persons from any life-threatening situation. First aid and/or decontamination procedures will be implemented as appropriate. First aid will be administered to injured/contaminated personnel. Unsuspecting persons/vehicles will be warned of the hazard. All personnel will act to prevent any unsuspecting persons from coming in contact with spilled materials by alerting other nearby persons. Attempt to stop the spill at the source, if possible. Without taking unnecessary risks, personnel will attempt to stop the spill at the source. This may involve activities such as uprighting a drum, closing a valve or temporarily sealing a hole with a plug.

Utilizing radio communications, the emergency coordinator will be notified of the spill/release, including information on material spilled, quantity, personnel injuries and immediate life threatening hazards. Air monitoring will be implemented by the emergency coordinator and SSO to determine the potential impact on the surrounding community. Notification procedures will be followed to inform on-site personnel and off-site agencies. The emergency coordinator will make a rapid assessment of the

spill/release and direct confinement, containment and control measures. Depending upon the nature of the spill, measures may include:

- Construction of a temporary containment berm utilizing on-site soils or clay, or absorbent earth
- Digging a sump and installing a polyethylene liner
- Diverting the spill material into the sump placing drums under the leak to collect the spilling material before it flows over the ground
- Transferring the material from its original container to another container.

The emergency coordinator will notify the Client Representative of the spill and steps taken to institute clean-up. Emergency response personnel will clean-up all spills following the spill clean-up plan developed by the emergency coordinator. Supplies necessary to clean up a spill will be immediately available on-site. Such items may include, but are not limited to:

- Shovel, rake
- Clay absorbent
- Polyethylene liner
- Personal safety equipment
- Steel drums
- Pumps and miscellaneous hand tools.

The major supply of material and equipment will be located in the Support Zone. Smaller supplies will kept at active work locations. The emergency coordinator will inspect the spill site to determine that the spill has been cleaned up to the satisfaction of the Client. If necessary, soil, water or air samples may be taken and analyzed to demonstrate the effectiveness of the spill clean-up effort. The emergency coordinator will determine the cause of the spill and determine remedial steps to ensure that recurrence is prevented. The emergency coordinator will review the cause with the Client Representative and obtain his concurrence with the remedial action plan.

9.0 TRAINING REQUIREMENTS

As a prerequisite to employment at OHM, all field employees are required to take a 40-hour training class and pass a written examination. This training covers all forms of personal protective equipment, toxicological effects of various chemicals, handling of unknown tanks and drums confined-space entry procedures, and electrical safety. This course is in full compliance with OSHA requirements in 29 CFR 1910.120. In addition, all employees receive annual 8-hour refresher training and supervisory personnel receive an additional 8-hour training in handling hazardous waste operations. Select employees also receive U.S. DOT HM126(F) training.

All personnel entering the exclusion zone will be trained in the provisions of this site safety plan and be required to sign the Site Safety Plan Acknowledgment in Appendix A.

10.0 MEDICAL SURVEILLANCE PROGRAM

All OHM personnel participate in a medical and health monitoring program. This program is initiated when the employee starts work with a complete physical and medical history and is continued on a regular basis. A listing of OHM's worker medical profile is shown below and summarized in Table 2. This program was developed in conjunction with a consultant toxicologist. Other medical consultants are retained when additional expertise is required.

The medical surveillance program meets the requirements of the OSHA Standard 29 CFR 1910.120 (f) and includes the following specific tests (as required): PCB blood or fat, urine mercury, urine arsenic, urine phenol, urine halomethanes, blood cyanide, cholinesterase-pseudo-cholinesterase, nerve conduction velocity tests, blood lead, urine lead.

10.1 EXAMINATION SCHEDULE

Employees are examined initially upon start of employment, annually thereafter, and may be examined upon termination of employment. Unscheduled medical examinations are conducted:

- At employee request after known or suspected exposure to toxic or hazardous materials
- At the discretion of the client, the CIH, SSO, or OHM occupational physician after known or suspected exposure to toxic or hazardous materials
- At the discretion of the OHM occupational physician.

All nonscheduled medical examinations will include, as a minimum, all items specified above for periodic surveillance examination, with the exception of the chest X-ray, which will be conducted at the discretion of the occupational physician performing the examination.

TABLES

TABLE 1**EMERGENCY TELEPHONE NUMBERS**

1. Local Agencies	
Fire Department	809/865-4333
Police	809/865-4123
Navy Technical Representative - Ivan Rosado	809/865-2050/4066
Regional Poison Control Center	800/962-1253
2. Federal Agencies	
EPA Region Branch Response Center	215/597-9800
National Response Center	800/424-8802
3. OHM Contacts	
Project Manager - Larry Stearns	800/284-6462
Director, Health and Safety - Kevin McMahon	609/588-6375
Program Director - George Krauter	800/562-2953
OHM Corporation (24 hours)	800/537-9540
Additional Phone Numbers are presented in Section 2.0 of this HASP	

TABLE 2
WORKER MEDICAL PROFILE

<i>Item</i>	<i>Initial</i>	<i>Annual</i>
Medical History	X	X
Work History	X	X
Visual Acuity and Tonometry	X	X
Pulmonary Function Tests	X	X
Physical Examination	X	X
Audiometry Tests	X	X
Chest X-Ray	X	X
Complete Blood Counts	X	X
Blood Chem. (SSAC-23 or equivalent)	X	X
Urinalysis	X	X
Dermatology Examination	X	X
Electrocardiogram/Stress Test	X	X (based on age)

FIGURES

DRAWING NUMBER 15591-A9

APPROVED BY

CHECKED BY

DRAWN BY A.C. Smith 1/17/94

OHM CORPORATION PITTSBURGH, PA

PLOT SCALE: 1" = 1'

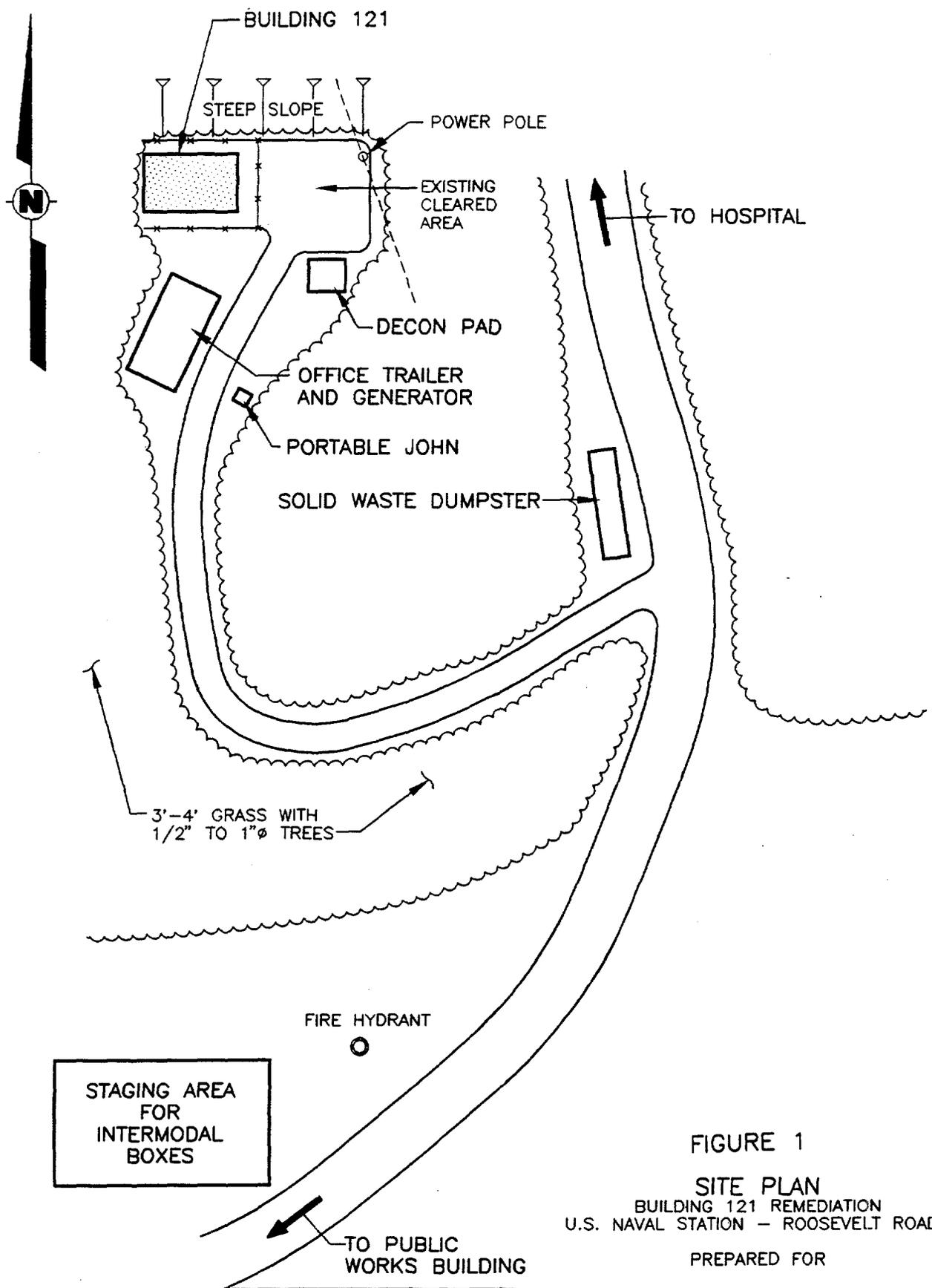


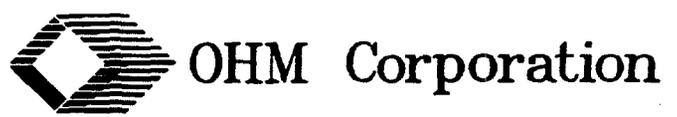
FIGURE 1

SITE PLAN

BUILDING 121 REMEDIATION
U.S. NAVAL STATION - ROOSEVELT ROADS

PREPARED FOR

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION - NAVFAC
NORFOLK, VIRGINIA



"THIS DRAWING NOT TO SCALE"

DRAWING NUMBER 15591-A13

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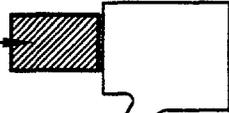
DRAWN BY
A.C. Smith 1/17/94

OHM CORPORATION
PITTSBURGH, PA

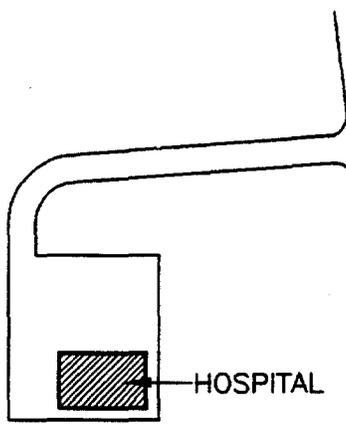
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BUILDING 121



HOSPITAL



APPROXIMATELY 1/4 MILE

FIGURE 2

MAP TO HOSPITAL
BUILDING 121 REMEDIATION
U.S. NAVAL STATION - ROOSEVELT ROADS

PREPARED FOR

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION - NAVFAC
NORFOLK, VIRGINIA



OHM Corporation

"THIS DRAWING NOT TO SCALE"

APPENDIX A

HEALTH AND SAFETY PLAN CERTIFICATION

APPENDIX B

OHM HAZARD COMMUNICATION PROGRAM

APPENDIX B OHM HAZARD COMMUNICATION PROGRAM

1.0 GENERAL

The following written hazard communication program has been established for OHM Corporation. The purpose of this program is to transmit information about the various chemical hazards in the work place to the workers using various media. The transmittal of information will be accomplished by means of a comprehensive hazard communication program, which will include container labeling and other forms of warning, material safety data sheets, and employee training in accordance with 29 CFR 1910.1200 and 29 CFR 1926.59.

The program will be available in corporate and regional Health and Safety Departments for reviews by all employees. It will also be available in the corporate library and clearly marked "Employee Right-to-Know" stations located within each individual shop and on each job site. OHM Corporation will accomplish the hazard communication requirements through formal safety training, departmental safety meetings, and job site safety meetings.

2.0 RESPONSIBILITIES

Purpose: Overall responsibility rests with all corporate officers of OHM Corporation. A brief outline of responsibilities for those persons directly involved with the program will follow. These responsibilities are not all inclusive, but are designed to give guidance in initial and long-term program development since each area is different. These responsibilities may vary.

Scope: This program is intended to cover those employees who are directly involved with the handling of hazardous materials or supervision of those activities.

2.1 Health and Safety Department Responsibilities

1. Review operations with supervisors to determine what tasks require hazard communication training.
2. Advise supervisory people as to which materials may need to be considered hazardous initially and eventually to ensure that hazard task determination is being done according to the written policy.
3. Follow up through safety meetings and safety audits to ensure that supervisors are carrying out prescribed company policy.
4. Notify supervisors of any operating changes affecting the hazardous materials being used.

5. Periodically audit the Hazard Communication Program's progress. Initially, this should be done biweekly, but later the audit may be done on a monthly or quarterly basis.

2.2 Training Department Responsibilities

1. Ensure that up-to-date records are maintained on training of all employees required to handle hazardous materials. The supervisor should keep copies of these records and should also send copies of the initial training to the corporate training secretary for the training file.
2. Educate personnel upon initial training to the requirements of the Hazard Communication Standard.

2.3 Supervisor Responsibilities

1. Identify jobs requiring the use of hazardous chemicals and provide lists of those jobs and chemicals to the Health and Safety Department.
2. Provide the training required by the Hazard Communication Standard and document training of employees in the safe handling of hazardous materials.
3. Inspect engineering controls and personal protective equipment before each use. Health and Safety can help determine a suitable inspection plan for each application as needed.
4. Make daily surveys of the work area to ensure that safe practices are being followed. Advise employees of unsafe work practices on the first occasion and consider further violations as disciplinary violations.
5. Ensure required labeling practices are being followed. Labeling should be affixed to the container when it arrives. If the contents are transferred to another container, then all label information (manufacturer, product name, and product number) must also be affixed to the new container, so that all containers of the material, regardless of size, are labeled.
6. Enforce all applicable safety and health standards through periodic audits.
7. Before ordering a material, determine if a Material Safety Data Sheet exist on file. Request an MSDS for any material without one.
8. Send all new MSDSs to the Health and Safety Department after making a copy for the Employee Right-to-Know file.

2.4 Employee Responsibilities

1. Obey established safety rules and regulations
2. Use all safety procedures and personnel protective equipment as required by company procedures
3. Notify supervisor of the following:
 - a. Any symptoms or unusual effects that may be related to the use of hazardous chemicals.
 - b. Any missing or unreadable labels on containers.
 - c. Missing, damaged, or malfunctioning safety equipment.
4. Use approved labels on containers; do not remove labels (labels will be located in the warehouse).
5. Do not use unapproved containers for hazardous materials. (Is material and container compatible?)
6. Know where emergency equipment and first-aid supplies are located before considering a possibly dangerous task.
7. Know location of Material Safety Data Sheets (MSDS). These will be located in the "Employee Right-to-know" station for the respective shop/job site.
8. Know what you are expected to do in case of an emergency. Before the commencement of any task, emergency considerations shall be made.

2.5 Shipping/Receiving Personnel Responsibilities

1. Ensure MSDS are received with initial shipment of a hazardous material; if not, contact purchasing to request the appropriate MSDS and also call the Health and Safety Department to determine if there is an MSDS available until the requested MSDS arrives.
2. Ensure labels are affixed to all containers.
3. Store hazardous materials in designated locations.
4. Use proper personal protective equipment when handling hazardous materials.

5. Report damaged containers or spills to the appropriate Health and Safety Department immediately.
6. Request an MSDS from the manufacturer for any hazardous material that arrives in Findlay from a job. Also, a MSDS shall accompany any hazardous material that is sent to a job.

3.0 HAZARD DETERMINATION

OHM Corporation will rely on Material Safety Data Sheets from hazardous chemical supplies to meet hazard determination requirements. Other relevant data from laboratory analyses, chemical reference materials, and chemical manufacturers', written evaluation procedures will be utilized when warranted. No other method shall be used to determine chemical hazard unless approved by the Regional Health and Safety Director.

4.0 LABELING

The shipping and receiving supervisors will be responsible for seeing that all containers arriving at OHM Corporation are properly and clearly labeled. Shipping and receiving supervisors shall also check all labels for chemical identity and appropriate hazard warnings. If the hazardous chemical is regulated by OSHA in a substance specific health standard, the supervisor or department manager shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard. Any container that is not labeled shall be immediately labeled correctly after initial discovery.

Each supervisor or department manager shall be responsible for seeing that all portable containers used in their work area are properly labeled with chemical identity and hazard warning.

Supervisors or department managers shall also ensure that labels on hazardous chemical containers are not removed or defaced unless the container is immediately marked with the required information and that all labels are legible in English and prominently displayed on the container or readily available in the work area throughout each shift.

If any container is found and the contents cannot be identified, the supervisor or manager shall be contacted immediately. When proper identification is made, a label shall be affixed to the container immediately. If it is discovered that no MSDS is available, the manufacturer and the Health and Safety Department shall be contacted to assist in locating the proper MSDS. If there is no way to identify the material in the container, the container should be set aside, away from all personnel until it can be tested by the Health and Safety Department or laboratory personnel. Supervisors and managers shall communicate their findings or awareness of such containers to all personnel in the area and to those who enter later.

5.0 MATERIAL SAFETY DATA SHEETS (MSDS)

Each supervisor or department manager at OHM Corporation will be responsible for maintaining a current MSDS relevant to the hazardous chemicals used in their area. The Health and Safety Department will be responsible for compiling the master MSDS file for the facility and aiding all shops/job sites with the completion and maintenance of their respective MSDS files.

All MSDS will be readily available for review by all employees during each work shift. Each shop/job site will designate a clearly marked "Employee Right-to-know" station where employees can immediately obtain a MSDS and the required information in an emergency.

Although manufacturers are required to provide employers with MSDSs on an initial chemical shipment, OHM Corporation purchasing agents (and supervisors purchasing their own material) shall request MSDSs and updates to MSDS on all purchase orders. Supervisors and department managers that are without proper MSDSs shall be responsible for requesting this information from manufacturers for chemicals. A file of followup letters shall be maintained for all hazardous chemical shipments received without MSDSs.

6.0 EMPLOYEE INFORMATION AND TRAINING

It is the responsibility of the supervisor in charge of each employee to ensure that the employee is properly trained. Training employees on chemical hazards and chemical handling is accomplished at the time of initial employment at OHM Corporation, whenever a new chemical (or physical) hazard is introduced into the work area, and through ongoing formal and informal training programs. Additionally, chemical hazards are communicated to employees through daily, morning, shop specific safety meetings, which shall be documented according to topic, major points discussed, and names of those attending (attendance is mandatory). Also, biweekly hazardous chemical safety meetings will be prepared by the Health and Safety Department using similar documentation for shop areas. Attendance is mandatory for these meetings also. Documentation for shop safety meetings will be available in the respective Employee Right-to-know stations and biweekly safety meeting documentation will be available in the Health and Safety Department to all employees for these meetings also. Documentation for shop safety meetings will be available in the respective Employee Right-to-know stations and biweekly safety meeting documentation will be available in the Health and Safety Department to all employees for further referencing and questioning. Records of all formal training conducted at OHM Corporation is coordinated and maintained by the Training Department secretary.

At a minimum, OHM Corporation will inform employees on the following:

- The requirements of 29 CFR 1910.1200--Hazard Communication--Evaluating the potential hazards of chemicals and communication information concerning hazards and appropriate protective measures to employees. This is accomplished in several different ways including, but not limited to 40-hour OSHA Hazardous Waste Worker Training (29 CFR 1910.120), Shop safety meetings, job site safety meetings, Health and Safety Department safety meetings, and formal and informal training about specific chemical hazards.
- The location and availability of the written hazard communication program, list of hazardous chemicals, and MSDS sheets--Notices will be periodically posted on the employee bulletin boards providing the location of the above material.
- Any operations in their work area where hazardous chemicals are present.
- What the company has done to lessen or prevent workers' exposure to these chemicals.

Employee training shall include at least:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area, (monitoring instruments, visual appearance or odor), and acute and chronic health effects.
- The physical and health hazards of the chemicals in the work area (accomplished through periodic physical and chemical hazard awareness sessions developed by the Health and Safety Department). These sessions shall serve as chemical hazards refreshers.
- The methods of preventing exposure to hazardous chemicals including the measures OHM Corporation has taken to protect the employees.
- Procedures to follow if OHM Corporation employees are exposed to hazardous chemicals (location of nearest phone, emergency eyewash, and shower will be included). These discussions shall include proper operating procedures for all emergency equipment.
- The details of the hazard communication program developed by OHM Corporation, including an explanation of the labeling system and the Material Safety Data Sheets, and how employees can obtain and use the appropriate hazard information.

- Standard operating procedures within each respective shop. OHM Corporation company policy determines what is considered standard operating procedures.
- Procedures for workers involved in non-routine tasks.

Each supervisor or department manager shall ensure that the above training is emphasized to OHM Corporation employees. The Health and Safety Department will ensure that each shop, department, and job site is properly informing and training all employees through daily group meeting and individual discussions. Whenever a new hazardous chemical is placed into use, the supervisor or department manager shall inform the employees of the hazards said chemical may pose. The supervisor or manager shall also be responsible for obtaining and making available a MSDS for the new chemical.

7.0 HAZARDOUS NON-ROUTINE TASKS

Occasionally, employees at OHM Corporation are required to perform tasks which are considered to be non-routine. All tasks considered to be non-routine shall be carefully discussed among the supervisor and those performing the task. This safety briefing shall include all possible hazards that may be encountered while completing the task, including:

- Hazard recognition
- Chemicals involved and their hazardous properties
- Physical hazards
- Methods of avoiding all hazards (technical instruments, proper personal protective equipment, etc.)

The following is list of some of the non-routine tasks which may occur at OHM Corporation together with some information needed to complete the tasks safely.

- Confined Space Entry
 - Obtain confined space entry procedure/permit from Health and Safety Department and follow all protocol before beginning task. Complete and have supervisor sign permit before any work begins.
 - Monitor atmosphere with explosimeter, oxygen meter, and any toxic gas meter as may be appropriate.
 - Discuss specific chemical hazards.

- Discuss protective/safety measures the employee can take (e.g., personal protective equipment and engineering controls) use of life lines, lock-out/tagout procedures, etc.
- Measures the company has taken to lessen the hazards including ventilation, respirator, presence of another employee, and emergency procedures.
- Excavation, Trenching, and Shoring
 - Obtain guidelines from Health and Safety Department before beginning task.
 - Comply with all requirements set forth for this activity in 29 CFR Subpart P(excavating, trenching, shoring).
 - Discuss specific chemical hazards.
 - Follow confined space entry procedure above if trench is above shoulder height.
 - Discuss protective/safety measures the employee can take.
 - Review appropriate accident prevention steps.
- Decontamination of Equipment
 - Determine possible contaminants and the hazards associated with them.
 - Determine personal protection needed by contacting the Health and Safety Department.
 - Alert all personnel in areas of contamination and decontamination
 - Contain and secure all contaminated materials and decontamination materials.
 - Contact the Health and Safety Department for proper disposal.

It is company policy that no OHM Corporation employee will begin work on any non-routine task without first receiving a safety briefing from their supervisor or a Health and Safety Department representative.

8.0 INFORMING CONTRACTORS

- Hazardous chemicals to which they may be exposed while performing a task including the following:
 - Chemical properties
 - Physical properties
 - Acute/Chronic health effects
- Location of "Employee Right-to Know" station which includes the following:
 - MSDS for work area
 - Hazard Communication Program
 - Other relevant safety material
- Precautionary measures to be taken to protect employees from chemical and physical hazards.
- Location of nearest emergency equipment (fire extinguisher, eyewash, shower, phone, first-aid kit, etc.)
- Procedures to follow in the event of employee exposure.
- Steps OHM Corporation has taken to reduce the risk of exposure to physical and chemical hazards including the following:
 - Safety meetings
 - Hazard Communication Program
 - Proper storage and labeling of hazardous chemicals
 - Health and Safety Department shop audits
- The methods used to label all hazardous chemicals.

The Health and Safety Department shall offer assistance in providing the above information to contractors working at OHM Corporation. On initial visit by a contractor to OHM Corporation, a "Contractor Right-to-Know" release form shall be completed. This form will state that the above information has been communicated to the perspective contractor.

APPENDIX C
MATERIAL SAFETY DATA SHEETS

CALCIUM CYANIDE

CCN

<p>Common Synonyms Cyanide of calcium Cyanocals Fumigant Cyanogas A dust</p>	<p>Solid Sinks and mixes with water.</p>	<p>White to gray or black Almond odor</p>
<p><small>DO NOT BREATHE DUSTS OR FUMES. KEEP AWAY FROM FIRE. Do not use near burning materials. Do not use in confined spaces unless approved.</small></p>		
Fire	<p>Not flammable POISONOUS GASES ARE PRODUCED WHEN HEATED. DO NOT USE NEAR BURNING MATERIALS OR IN ADJACENT AREAS.</p>	
Exposure	<p><small>SEE FIRST AID.</small></p> <p>DUST POISONOUS IF INHALED. Irritating to eyes, nose and throat. If inhaled, get victim fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>SOLID POISONOUS IF SWALLOWED. Irritating to skin and eyes. Remove outer clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF UNCONSCIOUS and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>	
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. MAY BE DANGEROUS IF IT ENTERS WATER INTAKES. Harmful to local health and wildlife critical. Harmful operations of nearby water intakes.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-poison, air contaminant, water contaminant Restrict access Evacuate area Should be removed Chemical and physical treatment</p>		<p>2. LABEL 2.1 Category: Poison 2.2 Class: 6</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: Ca(CN)₂ plus inert ingredients 3.3 IMO/UN Designation: 6.1/1575 3.4 DOT ID No.: 1575 3.5 CAS Registry No.: 592-01-8</p>		<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: White to gray to black 4.3 Odor: Compound reacts with moisture in air to form hydrogen cyanide gas, which has a characteristic almond-like odor.</p>
<p>5. HEALTH HAZARDS</p>		
<p>5.1 Personal Protective Equipment: Self-contained breathing apparatus and full protective clothing, including rubber footwear. 5.2 Symptoms Following Exposure: Inhalation or ingestion causes headache, nausea, vomiting and weakness, high concentrations are rapidly fatal. 5.3 Treatment of Exposure: Call a doctor immediately. INHALATION: break amyl nitrite pearl in cloth and hold lightly under nose for 15 sec.; repeat 5 times at 15-sec. intervals; use artificial respiration if breathing stops. EYES: flush with water for 15 min.; do not allow water to enter nose or mouth. SKIN: flush with water; do not allow water to enter nose or mouth. INGESTION: break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 sec.; if patient is conscious, induce vomiting and repeat until vomit is clear; repeat inhalation of amyl nitrite 5 times at 15 sec. intervals, use artificial respiration if breathing has stopped. 5.4 Threshold Limit Value: 5 mg/m³ (as cyanide) 5.5 Short Term Inhalation Limits: 5 mg/m³ for 30 min. 5.6 Toxicity by Ingestion: Grade 4, oral LD₅₀ = 39 mg/kg (rat) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 50 mg/m³ as cyanide</p>		

<p>6. FIRE HAZARDS</p>
<p>6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Use dry chemical, sand, or earth on adjacent fires 6.4 Fire Extinguishing Agents Not to be Used: Do not use water or carbon dioxide on adjacent fires. 6.5 Special Hazards of Combustion Products: Decomposes in fire to give very toxic gases, including hydrogen cyanide. 6.6 Behavior In Fire: Not pertinent 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available</p>
<p><i>(Continued)</i></p>

<p>7. CHEMICAL REACTIVITY</p>
<p>7.1 Reactivity With Water: Releases very poisonous hydrogen cyanide gas slowly on contact with water. Release is rapid if acid is also present. 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable if kept dry 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available</p>

<p>8. WATER POLLUTION</p>
<p>8.1 Aquatic Toxicity: 0.12 ppm/96 hr/sunfish/TL₅₀/fresh water >25 ppm/48 hr/cockle/LC₅₀/salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None</p>

<p>9. SHIPPING INFORMATION</p>
<p>9.1 Grades of Purity: 42% with 58% inert ingredients. May contain up to 3% calcium carbide, which releases flammable acetylene gas when wet. 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: well-sealed containers in ventilated area</p>

<p>6. FIRE HAZARDS (Continued)</p>
<p>6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>

<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) SS</p>

<p>11. HAZARD CLASSIFICATIONS</p>
<p>11.1 Code of Federal Regulations: Poison, B 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) 3 Flammability (Red) 0 Reactivity (Yellow) 0</p>

<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p>
<p>12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 92 12.3 Boiling Point at 1 atm: Decomposes 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.853 at 20°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: -264 Btu/lb = -147 cal/g = -6.14 X 10³ J/kg 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available</p>

COPPER ARSENITE

Common Synonyms	
Cupric arsenite Cuprous arsenite Cupric green Cuprous green Copper orthoarsenite	Solid Green Odorless Salty in taste
AVOID CONTACT WITH SKIN. AVOID GETTING PEOPLE AWAY Store upwind. Use water to clean up spills. Do not eat, drink, or smoke. Wash hands after use. Do not breathe dust. Do not get in eyes. Do not get on body or clothing. Do not get on skin.	
Fire	Not flammable. POISONOUS GASES MAY BE PRODUCED WHEN HEATED. Copper powder is not flammable.
 Exposure	HAZARD FOR MEDICAL AND DUST POISONOUS IF INHALED. Irritates to eyes, nose and throat. May irritate lungs. Inhalation: Both acute and chronic effects may be observed at 0.5 mg/m ³ for 14 days. POISONOUS IF INGESTED Irritating to skin and eyes. Respiratory irritation common and severe. Nausea, vomiting, and diarrhea may occur. If the dust is inhaled, it may irritate the lungs. If the dust is ingested, it may irritate the stomach and intestines. It may also irritate the mouth and throat. If the dust is inhaled, it may irritate the lungs. If the dust is ingested, it may irritate the stomach and intestines. It may also irritate the mouth and throat.
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be toxic to aquatic water systems. No data available on the effects of this chemical on the environment.
1. RESPONSE TO DISCHARGE Do not discharge into drain. Do not discharge into sewer. Do not discharge into water contaminated. Restrict access. Should be removed. Chemical and physical treatment.	2. LABEL 
3. CHEMICAL DESIGNATIONS 3.1 Synonyms: Cupric arsenite; Cuprous green; Cuprous arsenite; Cupric green; Copper orthoarsenite. 3.2 Coast Guard Compatibility Classification: Not applicable. 3.3 Chemical Formula: Cu ₃ As ₂ O ₇ . 3.4 IBC of United Nations Hazardous Designation: 2.7 (286).	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (at shipping): Solid. 4.2 Color: Green to light green. 4.3 Odor: None.
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Do not wear clothing which has been contaminated. 5.2 Symptoms Following Exposure: Irritation to eyes, nose and throat, nausea, vomiting, diarrhea, and respiratory irritation may occur. 5.3 Treatment for Exposure: Following ingestion, do not induce vomiting. Do not induce vomiting. Administer first aid as appropriate. If the dust is inhaled, it may irritate the lungs. If the dust is ingested, it may irritate the stomach and intestines. It may also irritate the mouth and throat. Do not get on body or clothing. Do not get on skin. 5.4 Toxicity by Inhalation: (Threshold Limit Value): 0.5 mg/m ³ (TWA). 5.5 Short-Term Inhalation Limit: 0.5 mg/m ³ (TWA). 5.6 Toxicity by Ingestion: Grade III, Dose 100 mg/kg. 5.7 Skin Toxicity: Acute poisoning. 5.8 Vapor (Gaseous Form) Characteristics: Not pertinent. 5.9 Liquid or Solid Irritant Characteristics: Data not available. 5.10 Odor Threshold: Not pertinent.	

6. FIRE HAZARDS 6.1 Flash Point: Not flammable. 6.2 Flammable Limits in Air: Not flammable. 6.3 Fire Extinguishing Agents: Not pertinent. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent. 6.5 Special Hazards of Combustion Products: Toxicous volatile arsenic oxides may be formed in fire. 6.6 Behavior in Fire: Not pertinent. 6.7 Ignition Temperature: Not pertinent. 6.8 Electrical Hazard: Not pertinent. 6.9 Burning Rate: Not pertinent.	8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available. 8.2 Waterway Toxicity: Data not available. 8.3 Biological Oxygen Demand (BOD): Data not available. 8.4 Food Chain Concentration Potential: Data not available.
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: No reaction. 7.2 Reactivity with Common Materials: No reaction. 7.3 Stability During Transport: Stable. 7.4 Neutralizing Agents for Acids and Bases: Not pertinent. 7.5 Polymerization: Not pertinent. 7.6 Inhibitor of Polymerization: Not pertinent.	9. SELECTED MANUFACTURERS 1. Gallard-Schering Chemical Manufacturing Co. 284 Minnola Avenue Carle Place, N. Y. 11514 2. Cerac, Inc. 13440 West Silver Spring Rd. Menomonee Falls, Wis. 53051
11. HAZARD ASSESSMENT CODE (See Table 4 Hazardous Materials Handbook, CG 44-2) II	10. SHIPPING INFORMATION 10.1 Grades or Purities: Commercial. 10.2 Storage Temperature: Ambient. 10.3 Inert Atmosphere: No requirement. 10.4 Venting: Open.
12. HAZARD CLASSIFICATIONS 12.1 Code of Federal Regulations: Poisonous, Class B. 12.2 HAS Hazard Rating for Bulk Water Transportation: Not listed. 12.3 HPL Hazard Classifications: Not listed.	13. PHYSICAL AND CHEMICAL PROPERTIES 13.1 Physical State at 25°C and 1 atm: Solid. 13.2 Molecular Weight: 277.4. 13.3 Boiling Point at 1 atm: Decomposes. 13.4 Freezing Point: Not pertinent. 13.5 Critical Temperature: Not pertinent. 13.6 Critical Pressure: Not pertinent. 13.7 Specific Gravity: (at 20°C) > 1.1 at 30°C (50°F). 13.8 Liquid Surface Tension: Not pertinent. 13.9 Liquid-Water Interfacial Tension: Not pertinent. 13.10 Vapor (Gas) Specific Gravity: Not pertinent. 13.11 Rate of Specific Heat of Vapor (Gas): Not pertinent. 13.12 Latent Heat of Vaporization: Not pertinent. 13.13 Heat of Combustion: Not pertinent. 13.14 Heat of Decomposition: Not pertinent. 13.15 Heat of Solution: Not pertinent. 13.16 Heat of Polymerization: Not pertinent.
(Continued on page 3 and 4)	
NOTES	

Occupational Health Guideline for Chlordane *

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{10}H_6Cl_8$ (approx.)
- Synonyms: 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane; 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene
- Appearance and odor: Thick amber liquid with a characteristic chlorine-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chlordane is 0.5 milligram of chlordane per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Chlordane can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.
- **Effects of overexposure**
Exposure to chlordane may cause shaking, blurred vision, irritability, confusion, delirium, staggering, convulsions, and death. Swallowing chlordane may also cause nausea, vomiting, and diarrhea. Chlordane exposure may cause kidney and liver damage. Absorption of chlordane through the skin is rapid and has resulted in death.
- **Reporting signs and symptoms**
A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to chlordane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to chlordane at potentially hazardous levels:

1. **Initial Medical Examination:**

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of convulsive disorders would be expected to be at increased risk from exposure. Examination of the nervous system, eyes, lungs, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Since kidney damage has been observed in humans exposed to chlordane, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. **Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Chlordane predominantly affects the central nervous system, causing irritability, tremors, and convulsions. Chronic effects are reported in animals. Repeated oral administration to rabbits indicated a cumulative action at daily doses above 5 mg/kg; autopsy revealed focal necrosis of the liver, degenerative changes in the proximal convoluted tubules, pulmonary exudates and gastrointestinal irritation. In humans, inhalation and skin absorption have resulted in blurred vision, cough, confusion, ataxia, and delirium; ingestion has caused abdominal pain, nausea, vomiting, and diarrhea; severe intoxication has caused irritability, tremor, convulsions, and death. A suicidal person who ingested 6 g (104 mg/kg) of chlordane in talc suffered burns of the mouth, severe gastritis, diffuse pneumonia, anuria, mania, and convulsions; death occurred after 9.5 days; autopsy findings were severe necrotizing bronchopneumonia

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

and degeneration of renal tubule epithelium. Skin absorption of chlordane is rapid; a worker who spilled a 25% suspension of chlordane on clothing, which was not removed, began having convulsions 40 minutes later and died shortly thereafter. Technical-grade chlordane is stated to be irritating to the skin and mucous membranes, but this may be due to the presence of unreacted chemical intermediates.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 409.8 (approx).
2. Boiling point (760 mm Hg): (Decomposes); 175 C (347 F) (at 2 mm Hg)
3. Specific gravity (water = 1): 1.57– 1.67
4. Vapor density (air = 1 at boiling point of chlordane): 14
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): 0.00001 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: Temperatures above 200 C (392 F) cause decomposition with formation of chlorine and hydrogen chloride gases.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, chlorine, phosphene, and carbon monoxide) may be released when chlordane decomposes.
4. Special precautions: Chlordane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

Since chlordane has such a low vapor pressure, warning properties are not considered. Grant describes certain effects produced by chlordane on the eyes, but these effects were caused by systemic poisoning. They were not local effects. Chlordane is not known to be an eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

An analytical method for chlordane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with chlordane.

• If employees' clothing has had any possibility of being contaminated with chlordane, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing which has had any possibility of being contaminated with chlordane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chlordane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chlordane, the person performing the operation should be informed of chlordane's hazardous properties.

• Where there is any possibility of exposure of an employee's body to chlordane, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

• Non-impervious clothing which becomes contaminated with chlordane should be removed immediately and not reworn until the chlordane is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where chlor-

dane may contact the eyes.

SANITATION

- Skin that becomes contaminated with chlordane should be immediately washed or showered with soap or mild detergent and water to remove any chlordane.
- Workers subject to skin contact with chlordane should wash with soap or mild detergent and water any areas of the body which may have contacted chlordane at the end of each work day.
- Eating and smoking should not be permitted in areas where chlordane is handled, processed, or stored.
- Employees who handle chlordane should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to chlordane may occur and control methods which may be effective in each case:

Operation	Controls
Application as an insecticide on pre-planting soil, fire ants, and harvester ants (banned by EPA in 1976)	Personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If chlordane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If chlordane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If chlordane soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of chlordane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When chlordane has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back

of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If chlordane is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Chlordane may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in sealed containers in a secured sanitary landfill.

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 20, 1979.

RESPIRATORY PROTECTION FOR CHLORDANE

Condition	Minimum Respiratory Protection* Required Above 0.5 mg/m ³
Particulate Concentration	
5 mg/m ³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus.
25 mg/m ³ or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. A chin-style or front- or back-mounted pesticide gas mask. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
500 mg/m ³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. A powered chemical cartridge respirator with an organic vapor cartridge and a high efficiency filter, including pesticide respirators which meet the requirements of this class.
Greater than 500 mg/m ³ ** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of chlordane; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 500 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

Occupational Health Guideline for Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cyanides. Physical and chemical properties of two specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Potassium cyanide

- Formula: KCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

Sodium cyanide

- Formula: NaCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyanide is 5 milligrams of cyanide per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 5 milligrams cyanide per cubic meter of air averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

• Effects of overexposure

1. Short-term Exposure: Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.

2. Long-term Exposure: Effects from chronic exposure to cyanide are non-specific and rare.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to cyanide at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders,

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

and those unusually susceptible to effects of anoxia or with anemia would be expected to be at increased risk from exposure. Examination of the cardiovascular, nervous, and upper respiratory systems, and thyroid should be stressed. The skin should be examined for evidence of chronic disorders.

—Skin disease: Cyanide is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—14" x 17" chest roentgenogram: Cyanide causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Cyanide is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

3. *First Aid Kits:* First aid kits should be readily available in workplaces where there is a potential for the release of cyanide. These kits should contain a minimum of 48 ampules, each of 0.3 ml amyl nitrate, and complete instructions for use. In addition, 2 physician's kits should be immediately available to trained medical personnel. These kits should contain the above quantity of amyl nitrate as well as sterile sodium nitrite solution (3%) and sterile sodium thiosulfate solution (25%). All of the above drugs should be replaced at least biannually to ensure their potency.

• Summary of toxicology

The dust of cyanide salts, a source of cyanide ion, is an asphyxiant due to an inhibitory action on metabolic enzyme systems and can be rapidly fatal. Cyanide exerts this effect because it inactivates certain enzymes by forming very stable complexes with the metal in them. Cytochrome oxidase is probably the most important of these, since it occupies a fundamental position in the respiratory process and is involved in the ultimate electron transfer to molecular oxygen. Since cytochrome oxidase is present in practically all cells that function under aerobic conditions, and since the cyanide ion diffuses easily to all parts of the body, it is capable of suddenly bringing to a halt practically all cellular respiration. In the presence of even weak acids, hydrocyanic acid (HCN) gas is liberated from cyanide salts; a few inhalations of higher concentrations of HCN may be followed by almost instantaneous collapse and cessation of respiration; 270 ppm HCN is immediately fatal to humans, 181 ppm is fatal after 10 minutes, 135 ppm after 30 minutes, and 110 ppm may be fatal in 1 hour. The ingestion by humans of 50 to 100 mg of sodium or potassium cyanide may also be fatal. At lower levels of exposure to HCN, the earliest symptoms of intoxication may include weakness, headache, confusion, and occasionally nausea and vomiting; respiratory rate and depth is usually increased initially and at later stages becomes slow and gasping; if cyanosis is present,

it usually indicates that respiration has either ceased or has been very inadequate for a few minutes. Humans tolerate 45 to 54 ppm for ½ to 1 hour without immediate or delayed effects, while 18 to 36 ppm may result in some symptoms after an exposure of several hours. Sodium cyanide dust is irritating to the eyes; in the presence of tears it may liberate HCN, which can be absorbed and cause systemic intoxication. Skin contact with dust may be irritating; strong solutions on the skin produce ulcers which are slow in healing. Cyanide is one of the few toxic materials for which an antidote exists; it functions as follows: First, amyl nitrite (inhalation) and sodium nitrite (intravenously) are administered to form methemoglobin, which binds firmly with free cyanide ions. This traps any circulating cyanide ions. The formation of 10 to 20% methemoglobin usually does not involve appreciable risk, yet provides a large amount of cyanide-binding substance. Second, sodium thiosulfate is administered intravenously to increase the rate of conversion of cyanide to the less toxic thiocyanate. Methylene blue should not be administered, because it is a poor methemoglobin former and, moreover, promotes the conversion of methemoglobin back to hemoglobin.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data—Potassium cyanide

1. Molecular weight: 65.1
2. Boiling point (760 mm Hg): Data not available
3. Specific gravity (water = 1): 1.55
4. Vapor density (air = 1 at boiling point of potassium cyanide): Not applicable
5. Melting point: 635 C (1175 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 71.6
8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Sodium cyanide

1. Molecular weight: 49
2. Boiling point (760 mm Hg): 1500 C (2732 F) (extrapolated)
3. Specific gravity (water = 1): 1.6
4. Vapor density (air = 1 at boiling point of sodium cyanide): Not applicable
5. Melting point: 560 C (1040 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 58
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None. Hazardous if kept in closed containers. It may form toxic concentrations of hydrogen cyanide gas when in prolonged contact with air in a closed area.
2. Incompatibilities: Contact with strong oxidizers such as nitrates and chlorates may cause fires and

explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.

4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the presence of moisture. The Manufacturing Chemists Association states that "although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

2. Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. However, according to Grant, HCN can produce eye irritation after chronic exposures.

3. Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. HCN does not have adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of cyanide with a cellulose membrane filter and an impinger containing sodium hydroxide, followed by analysis by direct potentiometry. An analytical method for cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the

Government Printing Office, Washington, D.C. 20402
(GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with cyanide or liquids containing cyanide.

- If employees' clothing has had any possibility of being contaminated with cyanide, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing which has had any possibility of being contaminated with cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the person performing the operation should be informed of cyanide's hazardous properties.

- Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with cyanide should be removed immediately and not reworn until the cyanide is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to cyanide or liquids containing cyanide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with cyanide should be immediately washed or showered with soap or mild detergent and water to remove any cyanide.
- Workers subject to skin contact with cyanide should wash with soap or mild detergent and water any areas of the body which may have contacted cyanide at the end of each work day.
- Eating and smoking should not be permitted in areas where cyanide or liquids containing cyanide are handled, processed, or stored.
- Employees who handle cyanide or liquids containing cyanide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to cyanide may occur and control methods which may be effective in each case:

Operation	Controls
Use as fumigants and pesticides in greenhouses, ships, mills, and warehouses; use of cyanogen chloride as a warning agent in fumigant gases	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in metal treatment in nitriding, tempering, and case hardening steel; coloring of metals by chemical or electrolytic process; cleaning and coating metals; welding and cutting of heat-resistant metals; liberation during ore extraction and metal purification	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Use of calcium cyanamid in fertilizer on soil; during chemical synthesis for manufacture of intermediates in pharmaceuticals, dyes, vitamins, plastics, and sequestering agents; preparation of nitriles, carbamides, cyano fatty acids, and inorganic cyanides

Use in cellulose technology; paper manufacture; in dyeing; as cement stabilizers; use in photography as fixatives, and in blueprinting and process engraving; liberation in blast furnace gases or in handling of illuminating gas

Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If cyanide gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with cyanides.

• Skin Exposure

If cyanide gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If cyanide penetrates through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of cyanide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When cyanide has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

- If cyanide is spilled, the following steps should be taken:

1. Ventilate area of spill.

2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment in a cyanide disposal system.

- Waste disposal method:

After treatment as in above, cyanide may be disposed of in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR CYANIDE

Condition	Minimum Respiratory Protection* Required Above 5 mg/m ³
Particulate Concentration	
50 mg/m ³ or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 50 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against hydrogen cyanide and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for 2,4-D *

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{Cl}_2\text{C}_6\text{H}_3\text{OCH}_2\text{COOH}$
- Synonyms: 2,4-Dichlorophenoxyacetic acid
- Appearance and odor: Colorless, odorless solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 2,4-D is 10 milligrams of 2,4-D per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

2,4-D can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

• Effects of overexposure

1. *Short-term Exposure:* Massive exposure to 2,4-D may cause weakness, stupor, muscle twitching, and convulsions. Contact of the material with the skin may cause a rash. It has caused minor liver and kidney damage in animals.

2. *Long-term Exposure:* Not known.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 2,4-D.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to 2,4-D at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 2,4-D exposure.

—Liver disease: 2,4-D causes liver damage in animals. The importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: 2,4-D causes kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Cardiovascular disease: 2,4-D causes ventricular fibrillation in animals. In persons with impaired cardiovascular function, the inhalation of 2,4-D might cause exacerbation of pre-existing disorder.

—Skin disease: 2,4-D can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Convulsive disorder or neuropathy: 2,4-D may cause convulsions in humans. Persons with a history of such disorders may be more susceptible to the effects of this agent. 2,4-D may also produce neuropathy by analogy to effects observed in experimental animals.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

2,4-D dust causes signs of both hypo- and hyperexcitation of the central nervous system in animals. In several species of animals given massive oral doses, sudden death has been ascribed to ventricular fibrillation. If death is delayed, myotonia, stiffness of the extremities, ataxia, paralysis, and coma are seen; autopsy findings have included minor liver and kidney injury. The myotonia characteristic of intoxication by 2,4-D in animals has not been reported in humans. Possibly the only recognized fatal case of poisoning involved a suicidal person who ingested not less than 6500 mg; the

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

person apparently experienced violent convulsions, although they were not actually observed; there were no significant findings at autopsy. A single dose of 3.6 g of 2,4-D administered intravenously to a patient for treatment of disseminated coccidiomycosis caused stupor, hyporeflexia, fibrillary twitching of some muscles, and urinary incontinence; 24 hours after the dose, the patient still complained of profound muscular weakness, which subsided after an additional 24 hours. Contact of the material with the skin may cause dermatitis; skin absorption is slight.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 221
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.1 (estimated)
4. Vapor density (air = 1 at boiling point of 2,4-D): 7.63
5. Melting point: 140 C (284 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, at 20 C (68 F): 0.07 ppm
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride and carbon monoxide) may be released in a fire involving 2,4-D.
4. Special precautions: None

- ### • Flammability
1. Flash point: Data not available
 2. Autoignition temperature: Data not available
 3. Flammable limits in air, % by volume: Data not available
 4. Extinguishant: Carbon dioxide, dry chemical, foam, water

• Warning properties

Since 2,4-D has a negligible vapor pressure, warning properties are not considered.

Grant states that "2,4-dichlorophenoxyacetic acid (2,4-D) is a herbicide for weed control, often used in the form of its salts or esters. Parenteral administration to dogs has caused sneezing, lacrimation, and rubbing of the eyes, along with gastrointestinal disturbances. In three human beings, absorption of an unspecified ester of dichlorophenoxyacetic acid through the skin caused polyneuritis, but with no disturbance of the eyes or vision." The above do not appear to be local effects on the eye. However, Stolman and Stecher note that this substance can cause irritation of the eyes.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

An analytical method for 2,4-D is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with 2,4-D or liquids containing 2,4-D.

• If employees' clothing may have become contaminated with 2,4-D, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing contaminated with 2,4-D should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 2,4-D from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2,4-D, the person performing the operation should be informed of 2,4-D's hazardous properties.

• Non-impervious clothing which becomes contami-

nated with 2,4-D should be removed promptly and not reworn until the 2,4-D is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where 2,4-D or liquids containing 2,4-D may contact the eyes.

SANITATION

- Skin that becomes contaminated with 2,4-D should be promptly washed or showered with soap or mild detergent and water to remove any 2,4-D.
- Eating and smoking should not be permitted in areas where solid 2,4-D is handled, processed, or stored.
- Employees who handle 2,4-D or liquids containing 2,4-D should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 2,4-D may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of herbicides	Process enclosure; local exhaust ventilation; personal protective equipment; washing facilities
Manufacture of 2,4-D	Process enclosure; local exhaust ventilation; personal protective equipment; washing facilities
Application on cereal crops, corn, sorghum, milo, sugar cane, pastures, range land, and lawns for use as an herbicide; use as a plant hormone on agricultural crops	Personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If 2,4-D or liquids containing 2,4-D get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If 2,4-D or liquids containing 2,4-D get on the skin, promptly wash the contaminated skin using soap or

mild detergent and water. If 2,4-D or liquids containing 2,4-D penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of 2,4-D, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When 2,4-D has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

- If 2,4-D is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dispose of by burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device, as in below or deposit in a secured sanitary landfill.

- Waste disposal methods:

2,4-D may be disposed of:

1. By making packages of 2,4-D in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving 2,4-D in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
3. By disposal in a secured sanitary landfill.

REFERENCES

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 15, 1977.

RESPIRATORY PROTECTION FOR 2,4-D

Condition	Minimum Respiratory Protection* Required Above 10 mg/m ³
Particulate Concentration	
100 mg/m ³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus.
500 mg/m ³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s), and dust filter(s), including pesticide respirators which meet the requirements of this class. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter, including pesticide respirators which meet the requirements of this class. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 500 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Ethylene Dibromide *

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CH}_2\text{BrCH}_2\text{Br}$
- Synonyms: 1,2-Dibromoethane; ethylene bromide
- Appearance and odor: Colorless liquid or solid with a mild, sweet odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethylene dibromide is 20 parts of ethylene dibromide per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 30 ppm and a maximum peak of 50 ppm for 5 minutes during an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling level of 1 mg/m³ (0.13 ppm) averaged over a 15-minute period. The NIOSH Criteria Document for Ethylene Dibromide should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Ethylene dibromide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

• Effects of overexposure

1. *Short-term Exposure:* Ethylene dibromide may cause vomiting, irritation of the eyes, nose, throat, and skin. It may also cause drowsiness. In addition, overexposure may cause damage to the lungs, liver, and kidneys.

2. *Long-term Exposure:* Prolonged or repeated exposure to ethylene dibromide may cause injury to the lungs,

liver, or kidneys. Adverse effects, including abnormalities in offspring, mutations, and stomach cancer, have been found in animals following exposure to ethylene dibromide. The relevance to humans of these findings has not yet been established.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to ethylene dibromide.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to ethylene dibromide at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the nervous and respiratory systems, heart, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Ethylene dibromide causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Ethylene dibromide is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

—Liver function tests: Ethylene dibromide may cause liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Kidney disease: Although ethylene dibromide is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Cardiovascular disease: Persons with cardiac disease may be at increased risk. An electrocardiogram should be performed on workers over 40 years of age and where indicated.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Operation	Controls
Liberation during production and handling of fumigant preparations	Local exhaust ventilation; general mechanical ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If ethylene dibromide gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If ethylene dibromide gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If ethylene dibromide soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of ethylene dibromide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When ethylene dibromide has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If ethylene dibromide is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.

2. If in the liquid form, collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

3. If in the solid form, collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Liquids containing ethylene dibromide should be absorbed in vermiculite, dry sand, earth, or a similar material.

• Waste disposal methods:

Ethylene dibromide may be disposed of:

1. If in the liquid form, by absorbing it in vermiculite, dry sand, earth, or a similar material and disposing in a secured sanitary landfill.

2. If in the solid form, by disposing in a secured sanitary landfill.

REFERENCES

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and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of ethylene dibromide vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure ethylene dibromide may be used. An analytical method for ethylene dibromide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid ethylene dibromide.
- Non-impervious clothing which becomes contaminated with liquid ethylene dibromide should be removed immediately and not reworn until the ethylene dibromide is removed from the clothing.
- Clothing contaminated with liquid ethylene dibromide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethylene dibromide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethylene dibromide, the person performing the operation should be informed of ethylene dibromide's hazardous properties.

- Where exposure of an employee's body to liquid ethylene dibromide may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Employees should be provided with and required to use splash-proof safety goggles where liquid ethylene dibromide may contact the eyes.

SANITATION

- Skin that becomes contaminated with ethylene dibromide should be immediately washed or showered with soap or mild detergent and water to remove any ethylene dibromide.
- Employees who handle ethylene dibromide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- Eating and smoking should not be permitted in areas where ethylene dibromide is handled, processed, or stored.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to ethylene dibromide may occur and control methods which may be effective in each case:

Operation	Controls
Use in fumigation operations in preplanting and on grains, fruits, and vegetables	Local exhaust ventilation; general mechanical ventilation; personal protective equipment
Use in production of antiknock fluids and fuels	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in production of water-proofing agents, fire extinguishing agents, and gauge fluids during manufacture of measuring instruments	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in organic synthesis in production of dyes, pharmaceuticals, and ethylene oxide; use as a specialty solvent for resins, gums, and waxes	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 15, 1977.

RESPIRATORY PROTECTION FOR ETHYLENE DIBROMIDE

Condition	Minimum Respiratory Protection* Required Above 20 ppm
Vapor Concentration	
400 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 400 ppm** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of ethylene dibromide; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 400 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

Occupational Health Guideline for Zinc Oxide Fume

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: ZnO
- Synonyms: None
- Appearance: White fume.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for zinc oxide fume is 5 milligrams of zinc oxide fume per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to 5 mg/m^3 averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 15 mg/m^3 averaged over a 15-minute period. The NIOSH Criteria Document for Zinc Oxide should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- Routes of exposure
Zinc oxide fume can affect the body if it is inhaled.
- Effects of overexposure
 1. *Short-term Exposure:* Zinc oxide fume causes a flu-like illness called metal fume fever. Symptoms of metal fume fever include headache, fever, chills, muscle aches, nausea, vomiting, weakness, and tiredness. The symptoms usually start several hours after exposure. The attack may last 6 to 24 hours. Metal fume fever is more likely to occur after a period away from the job (after weekends or vacations). High levels of exposure to zinc oxide fume may cause a metallic or sweet taste in

the mouth, dryness and irritation of the throat, and coughing at the time of exposure.

2. *Long-term Exposure:* None known.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to zinc oxide fume.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to zinc oxide fume at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system should be stressed.

—14" x 17" chest roentgenogram: Zinc oxide fume may cause respiratory impairment. Persons with pulmonary disease may be more susceptible to the effect of zinc oxide fume. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Persons with pre-existing pulmonary disease may be more susceptible to the effects of zinc oxide fume. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is considered necessary only when indicated by the results of pulmonary function testing. Determination of zinc in the urine may be helpful in evaluating the extent of absorption.

• Summary of toxicology

Inhalation of zinc oxide fume causes an influenza-like illness termed metal fume fever. Heavy human exposure to zinc oxide fume may cause an immediate dryness and irritation of the throat, a sweet or metallic taste followed by substernal tightness and constriction in the chest, and a dry cough. Several hours following exposure the subject develops fever, lassitude, malaise, fatigue, frontal headache, low back pain, muscle cramps, and occasionally blurred vision, nausea, and vomiting.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

Physical examination reveals fever, eventually followed by perspiration and chills, dyspnea, rales throughout the chest, and tachycardia; in some instances there has been a reversible reduction in pulmonary vital capacity; there is usually leukocytosis, which may amount to 12,000 to 16,000/MM³. An attack usually subsides after 6 to 12 hours but may last for up to 24 hours; recovery is usually complete. Most workers rapidly develop an immunity to these attacks, but it is as quickly lost; attacks tend to be more severe on the first day of the work-week. Only freshly formed fume causes the illness, presumably because flocculation occurs in the air; the larger particles that form are deposited in the upper respiratory tract and do not penetrate deeply into the lungs. Chills have been reported in workers from exposure to concentrations of zinc oxide fume below 5 mg/m³.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 81.37
2. Boiling point (760 mm Hg): Solid sublimes
3. Specific gravity (water = 1): 5.6 (solid)
4. Vapor density (air = 1 at boiling point of zinc oxide fume): Not applicable
5. Melting point: Greater than 1800 C (greater than 3272 F)
6. Vapor pressure at 20 C (68 F): Not applicable
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble (solid)
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Zinc oxide fume may react violently with chlorinated rubber.
3. Hazardous decomposition products: None
4. Special precautions: None

• Flammability

1. Not combustible

• Warning properties

Zinc oxide fume is not known to be an eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected

airborne concentrations of zinc oxide fume. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of zinc oxide on a cellulose membrane filter, followed by solublizing the zinc with nitric acid and analyzing by atomic absorption spectrophotometry. An analytical method for zinc oxide fume is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to zinc oxide fume may occur and control methods which may be effective in each case:

Operation

Controls

Liberation during brazing, welding, burning, and cutting of zinc and galvanized metals

Liberation from founding of brass, copper, and zinc, and galvanizing of iron and steel

Liberation from abrasive cleaning of galvanized metal surface

Liberating during use as a ceramic flux

Liberation during recovery of impure lead blast furnace slag; from manufacture of glass to increase brilliance and luster of glass

Liberation from use as an intermediate in manufacture of other zinc compounds; in manufacture of electronic devices

Liberation from use as a filler material in crushed stone industry

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Breathing

If a person breathes in large amounts of zinc oxide fume, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
- If potentially hazardous amounts of zinc oxide fume are inadvertently released, ventilate the area of the release to disperse the fume.

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RESPIRATORY PROTECTION FOR ZINC OXIDE FUME

Condition	Minimum Respiratory Protection* Required Above 5 mg/m ³
Particulate Concentration	
50 mg/m ³ or less	Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
250 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
2,500 mg/m ³ or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 2,500 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.

ZINC PHOSPHIDE

ZPP

Common Synonyms	Solid	Grey to black	Faint odor
Sinks in water.			
Avoid contact with solid and dust. Keep people away. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Not flammable. Irritating gases may be produced when heated.		
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>DUST Irritating to eyes, nose and throat. If inhaled will cause dizziness, difficult breathing, or loss of consciousness. If in eyes, hold eyelids open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>SOLID POISONOUS IF SWALLOWED. Irritating to skin and eyes. If swallowed will cause dizziness, nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS, OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>		
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-poison, water contaminant, air contaminant Restrict access Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Poison 2.2 Class: 6	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: Zn ₃ P ₂ 3.3 IMO/UN Designation: 6.1/1714 3.4 DOT ID No.: 1714 3.5 CAS Registry No.: 1314-84-7		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Solid 4.2 Color: Gray or gray-black 4.3 Odor: Faint phosphorus	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust mask or self-contained breathing apparatus; goggles or face shield; protective gloves 5.2 Symptoms Following Exposure: When inhaled or ingested, compound releases phosphine, which causes lightheadedness, weakness, nausea, vomiting, dyspnea, fall in blood pressure, change in pulse rate, diarrhea, intense thirst, convulsions, paralysis, and coma. Contact with eyes or skin causes irritation. 5.3 Treatment of Exposure: INHALATION: move to fresh air; give artificial respiration if required; get medical attention for phosphine poisoning. INGESTION: give one tablespoonful of mustard in a glass of warm water; repeat until vomit fluid is clear; avoid use of all oils; call physician immediately; have patient lie down and keep warm. EYES: flush with water for at least 15 min. SKIN: flush with water, wash with soap and water. 5.4 Threshold Limit Value: Data not available 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 4; oral LD ₅₀ = 40 mg/kg (rat) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Use water, foam, or dry chemical on adjacent fires. 6.4 Fire Extinguishing Agents Not to be Used: Any agent with an acid reaction (e.g., carbon dioxide or halogenated agents) will liberate phosphine, a toxic and spontaneously flammable gas. 6.5 Special Hazards of Combustion Products: Irritating oxides of phosphorus may be formed in fires. 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: Not pertinent 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available <i>(Continued)</i>	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: Reacts slowly with water, more rapidly with dilute acid, to form phosphine gas, which is toxic and spontaneously flammable. 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Stable unless exposed to moisture; toxic phosphine gas may then be released and collect in closed spaces. 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Poison, B 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: 1,285 ppm LC ₅₀ 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: Zinc is accumulated by some organisms but is not considered to be bioconcentrative.	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: 258.10 12.3 Boiling Point at 1 atm: 2,012°F = 1,110°C = 1,373°K 12.4 Freezing Point (sublimes): 788°F = 420°C = 693°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 4.55 at 15°C (solid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: -4,100 Btu/lb = -2,270 cal/g = -95 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available
9. SHIPPING INFORMATION 9.1 Grades of Purity: Technical, 94 + % 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum	
6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	

APPENDIX D
JOB HAZARD ANALYSIS REVISIONS

(To be provided.)