

**PLANT 9 CONTAMINATED PERCHED WATER  
REMOVAL ACTION WORK PLAN MAY 1990**

**05/01/90**

**DOE-FMPC/USEPA  
55  
WORK PLAN**



THIS DOCUMENT APPLIES TO MORE THAN ONE  
OPERABLE UNIT OR REMOVAL ACTION, AND IS  
FILED IN THE REMOVAL ACTION FILE UNDER:

R-002-207.10

PLANT 9  
CONTAMINATED PERCHED WATER

REMOVAL ACTION  
WORK PLAN

MAY 1990

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I. INTRODUCTION

This document provides a work plan describing the removal action which will be taken to address the uranium contaminated water found in Boring 1324 located near the southeast corner of Plant 9 at the Feed Materials Production Center (FMPC). This removal action is a component of Operable Unit #3. The work plan was prepared to satisfy the commitment to expand Removal Action No. 1 as stated in the Consent Agreement Under CERCLA Section 120 and 106(a) (hereafter called the "Consent Agreement") and is consistent with the requirements of 29 CFR 1910.120. A removal site evaluation has been generated and approved by the DOE which meets the requirements of the National Contingency Plan (NCP) Section 300.410 criteria for a time critical removal action. The scope of work herein delineates the plan which will be used to locate the source of water, the installation of a recovery well system and pumping of the extracted water to existing treatment facilities.

II. BACKGROUND

1.0 Summary of the Potential Threat

The Production and Additional Suspect Areas Work Plan of the Feed Materials Production Center (FMPC) Remedial Investigation and Feasibility Study (RI/FS) includes a comprehensive plan to sample and characterize the soil, and the extent of perched water in the upper 20 feet of the soil under the FMPC production area. This depth is intentionally confined to the space sufficiently above the aquifer that exists under the FMPC so that penetration through the cover soil does not occur. In addition to systematic borings at 250 foot intervals across the entire production site, one phase of the RI/FS involves "focused" borings to explore suspect areas of contamination under the individual plants.

As part of the Production and Additional Suspect Areas Work Plan, several borings were installed in and around Plant 9 (see Figure 1). A water sample taken from focused Boring 1324 on January 17, 1990, was found to contain a total uranium concentration of 696,000 micrograms per liter (ug/l). While taking a second water sample from Boring 1324 on February 8, 1990, it was observed that the water level in the well recovered within 4 minutes. This supports the concept that a pool of water exists under the secondary containment enclosure located just west of Boring 1324 (see Figures 1 & 2).

2.0 Related Actions

A time critical removal action was approved by the U. S. Department of Energy (DOE), U. S. Environmental Protection Agency (USEPA) and Ohio Environmental Protection Agency (OEPA) for the pumping and treating of uranium contaminated perched water from under FMPC buildings. The first action involved pumping water from under Plant 6. This action commenced on August 1, 1988 on a temporary basis and

a more permanent pumping system was placed in operation on November 6, 1989.

### 3.0 Roles of Participants

- A. The DOE is the lead agency for this removal action and will coordinate and execute this removal action. The state and local roles have been one of participation in the negotiations of the Consent Agreement and Technical Information Exchanges (TIE).
- B. USEPA and OEPA shall review, comment on the work plan, follow progress through TIE meetings and the Consent Agreement progress reports.
- C. Advanced Sciences, Inc. (ASI), as a subcontractor to DOE, is conducting the RI/FS program activities at the FMPC. ASI will also install a recovery well near Boring 1324.
- D. Westinghouse Materials Company of Ohio (WMCO), the Maintenance and Operations Contractor at the FMPC, will coordinate, manage, implement, monitor and prepare all reports associated with the removal action.

### 4.0 Proposed Removal Action

Install a recovery well near Boring 1324 to remove perched water and pump the water to existing FMPC wastewater treatment facilities. This effort will be undertaken to control the potential for vertical migration into the Great Miami Aquifer by reducing the hydrostatic head of the perched water.

## III. SUPPORT ACTIVITIES

Activities will be undertaken to provide planning, design, and management for the removal action.

### 1.0 Project Planning

Included in this activity will be the preparation of detailed task listings and delineation of responsibilities to support the schedule given in Attachment 1. Also, a training schedule will be generated to ensure that the personnel involved in the scope of work will be trained in accordance with the Occupational Safety and Health Administration (OSHA) standards found in 29 CFR 1910.120.

### 2.0 Pumping System Design

A detailed design for a submersible pumping system with a liquid level control that is capable of removing water from a four-inch casing will be prepared. The pumping system will include provisions for the monitoring/metering of pump discharge, automatic start/stop

control, manual override of automatic control, and a sampling port on the discharge line.

### 3.0 Management of Project

WACO personnel will manage the project using FMPC-2201 Topical Manual, Project Management Procedures.

## IV. FIELD REMOVAL ACTIONS

Actions will be taken to investigate the source of perched water in Boring 1324, install a recovery well adjacent to Boring 1324 and install a pumping system to remove and transfer the water to existing facilities for treatment before discharge to the Great Miami River.

### 1.0 Perched Water Source Detection

The objective of this activity is to determine the source of perched water found in Boring 1324. Possible sources include leakage or overflow from the sump located in the secondary containment enclosure at the south corner of Plant 9 or leakage from two gravity lines which discharge to the sump (see Figure 2). This will include actions such as hydrostatic testing, dye testing and visual observations.

### 2.0 Install Recovery Well

The objective of this activity is to provide a recovery well for removing the uranium contaminated water. Boring 1324 cannot be pumped because it only has a two-inch well casing designed for obtaining water samples and checking water levels. The recovery well will be installed adjacent to Boring 1324 (see Figure 1) consistent with the procedures of the RI/FS Work Plan. The well will penetrate the same perched water zone as Boring 1324.

### 3.0 Install Pumping System

The objective of this activity is to install a pumping system in the new recovery well.

### 4.0 Pump Contaminated Water

The objective of this activity is to pump the contaminated water. This effort will be undertaken to control the potential for vertical migration of the contamination by reducing the hydrostatic head of the perched water. The uranium contaminated water will be pumped from the new recovery well into the adjacent sump (see Figure 1). Prior to start of pumping, the integrity of the sump will be addressed. Existing facilities will transfer the water from the sump to FMPC wastewater treatment systems for processing.

**V. SAMPLING AND ANALYSIS PLAN**

Soil and water samples will be obtained during the boring of the recovery well by ASI for the parameters outlined in the Production and Additional Suspect Areas Work Plan of the FMPC RI/FS. Water samples from the pumping operation will be obtained by WMCO personnel according to FMPC Standard Operating Procedure (SOP) and sent to the FMPC Laboratory for analysis of total uranium, total thorium, nitrates and pH. The analytical procedures will be in accordance with the Analytical Laboratories Quality Assurance Plan L.C.N.-QAP, October 1987. Samples from the pumping operations will be obtained weekly for the first three months and monthly thereafter.

Split samples of the pumped water will be obtained by the WMCO Environmental Monitoring group. Samples will be taken monthly during the first quarter of the pumping operation and quarterly thereafter. The sampling will be performed according to the procedures and protocol specified in the RI/FS Work Plan. The split samples will be sent to a certified independent laboratory for correlation of the analysis performed by the FMPC laboratory. The results from the certified lab will become part of the Administrative Record File. The WMCO laboratory data will be used for process control information only.

**VI. HEALTH & SAFETY PLAN**

The work to be performed will be consistent with the Health and Safety Plan prepared for this removal action. A copy of this plan is provided as Attachment 2 of this Work Plan. The plan identifies, evaluates, and controls all safety and health hazards. In addition, it provides for emergency response for hazardous operations. The plan is consistent with 29 CFR 1910.120.

Additional safety documentation will be prepared as necessary according to FMPC-2116 Topical Manual "Implementing FMPC Policies and Procedures for System Safety Analysis." FMPC-2116 has been prepared to implement DOE Order 5481.1B - Safety Analysis and Review System and DOE/OR-901 - Guidance for Preparation of Safety Analysis Reports.

**VII. QUALITY ASSURANCE PLAN**

The overall quality assurance program at the FMPC is described in the site Quality Assurance Plan, FMPC 2139. The Quality Assurance Plan is based on the criteria specified in ASME NQA-1, Federal EPA Guideline QAMS-005/80 and DOE Orders 5700.6 and 5400.1. Specific quality assurance requirements will be incorporated into written and approved procedures and during personnel training. The Quality Assurance Department will conduct periodic surveillances to verify compliance.

**VIII. ASSUMPTIONS**

1. No new regulatory assessments or permits required.
2. Removal actions that are time critical are completed in an expeditious manner with the NEPA document being satisfied as a Categorical Exclusion with a Memo to File. There is a requirement to prepare a final report and Community Relations Plan of the action taken and to document the removal action in the FMPC Administrative Record File.
3. A water sample from Boring 1324 is presently being analyzed for organics and other chemical constituents on the Hazardous Substance List (HSL). The presence of significant levels of HSLs has not been addressed in this work plan and may therefore impact the system design and attached schedule.

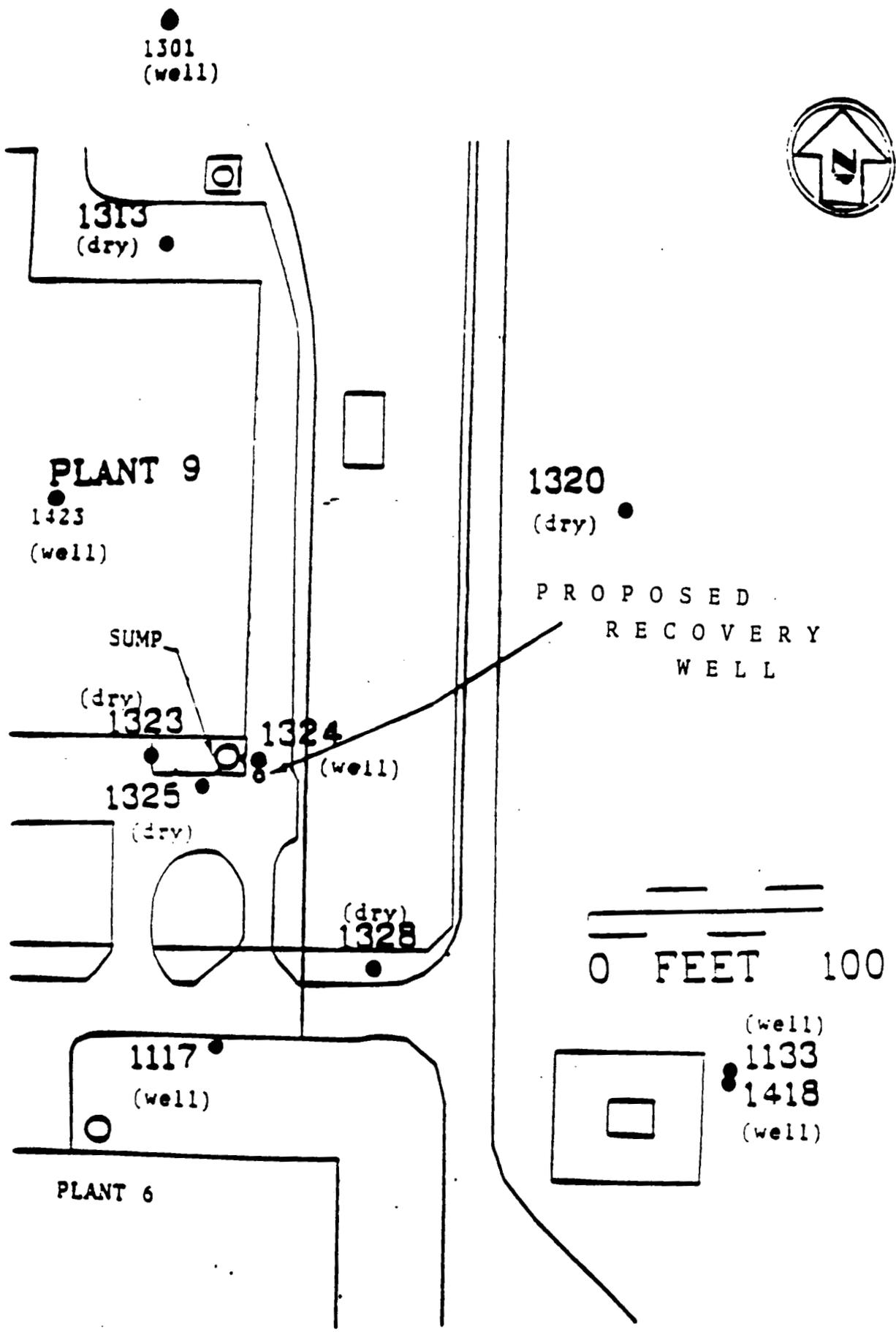


FIGURE 1



# Plant 9 Contaminated Groundwater Pumping

FMPC

Description	
Work Plan	(70 working days) <input type="text"/>
NEPA	(50 working days) <input type="text"/>
Design	(22 working days) <input type="text"/>
Contaminated Groundwater Source Detection	(85 working days) <input type="text"/>
Install Recovery Well	(44 working days) <input type="text"/>
Install Pumping System	(44 working days) <input type="text"/>
Pump Contaminated Water	(508 working days*) <input type="text"/>

\*Or longer if required NOTE 1: Pumping will continue until implementation of the Record of Decision (ROD) is completed for Operable Unit No. 3 or until concentration of hazardous substance in water becomes insignificant as compared to background.

ATTACHMENT 2

HEALTH AND SAFETY PLAN FOR THE PLANT 9  
CONTAMINATED PERCHED WATER REMOVAL ACTION

FEED MATERIALS PRODUCTION CENTER

May 1990

APPROVED by:

*for* DE Jmes 5/4/90  
J. J. Volpe

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1.0 TASKS TO BE PERFORMED

The work to be performed involves determining the source of the perched water found in Boring 1324, providing a pumping system for removing the uranium contaminated perched water from the boring, and the actual operation of the pumping system.

The work to be performed will be at a well boring which will be provided by Advanced Sciences Incorporated/International Technology (ASI/IT). A separate Health and Safety Plan has been developed by ASI/IT for the actual drilling and completion of the well (ASI/IT, "Site Specific Hazard Assessment for Plant 9 - Boring 1311, 1312, 1315, 1319, 1322, January 2, 1990").

The contaminant source detection will:

- |            |                              |            |                       |
|------------|------------------------------|------------|-----------------------|
| <u>no</u>  | Disturb Surface Soil         | <u>yes</u> | Sample Surface Water  |
| <u>no</u>  | Disturb Subsurface Soil      | <u>no</u>  | Sample Lagoons        |
| <u>no</u>  | Use Heavy Equipment          | <u>no</u>  | Use Boat              |
| <u>yes</u> | Enter Confined Space         | <u>yes</u> | Involve Radioactivity |
| <u>yes</u> | Disturb Containerized Matter | <u>no</u>  | Involve Trenches      |

The installation of the pumping system will:

- |            |                              |            |                       |
|------------|------------------------------|------------|-----------------------|
| <u>yes</u> | Disturb Surface Soil         | <u>no</u>  | Sample Surface Water  |
| <u>yes</u> | Disturb Subsurface Soil      | <u>no</u>  | Sample Lagoons        |
| <u>no</u>  | Use Heavy Equipment          | <u>no</u>  | Use Boat              |
| <u>no</u>  | Enter Confined Space         | <u>yes</u> | Involve Radioactivity |
| <u>no</u>  | Disturb Containerized Matter | <u>yes</u> | Involve Trenches      |

The operation of the system for pumping the contaminated water will:

- |           |                              |            |                       |
|-----------|------------------------------|------------|-----------------------|
| <u>no</u> | Disturb Surface Soil         | <u>yes</u> | Sample Surface Water  |
| <u>no</u> | Disturb Subsurface Soil      | <u>no</u>  | Sample Lagoons        |
| <u>no</u> | Use Heavy Equipment          | <u>no</u>  | Use Boat              |
| <u>no</u> | Enter Confined Space         | <u>yes</u> | Involve Radioactivity |
| <u>no</u> | Disturb Containerized Matter | <u>no</u>  | Involve Trenches      |

## 2.0 SITE HISTORY

The task will be performed at Plant 9 which is located within the FMPC property lines area. At present, the Plant 9 is routinely occupied. The production facility is not actively refining uranium at this time. Soils and groundwater near Plant 9 have the potential to be contaminated with uranium, its daughter products and thorium as a result of contaminant migration.

Plant 9 has been used for the purification of thorium metal (approximately 1955), production of thorium derbies and ingots (1955-1957), molten salt cleaning of uranium derbies (1965-1986), and decladding of uranium fuel cores. In addition to uranium, uranium compounds, thorium, and thorium compounds, chemicals that were possibly used, or believed to be present, in or around Plant 9 include asbestos (pipe and tank insulation and transite), hydrofluoric acid, nitric acid, lithium carbonate, magnesium oxide, potassium carbonate, potassium hydroxide, and sodium hydroxide. Other materials that are, or have been present, in and around Plant 9 include cleaners, cutting oils, lubricants, solvents, glues, paints, etc. These later materials are, or were, present in small quantities and should prove little potential hazard to the personnel involved in the work.

## 3.0 TASK SPECIFIC HAZARD ASSESSMENT

A walk-through survey of the tank area (see Figure 1) in Plant 9 indicated the potential hazards identified below. Prior to the initiation of the activities, a reassessment of the conditions will be conducted to ensure that conditions have not changed through the issuance of work permits. All newly identified hazards will be addressed with the Industrial, Radiological, Safety and Training (IRS&T) representative(s) to determine the degree of hazard and if any changes to the safety plan are needed.

### 3.1 Physical Hazards

- o Noise
- o Overhead Hazards
- o Underground Utilities

### 3.2 Radiation Hazards

The potential radiation hazard are from uranium (depleted to 2% enriched in U-235) and short lived decay products. Thorium content in affected areas is expected to be very low relative to uranium content. Therefore, the hazard potential from thorium is minimal.

3.3 Chemical Hazards

<u>Contaminant</u>	<u>Primary Hazard</u>	<u>Limit</u>	<u>Action Level</u>
Nitrogen Dioxide <sup>(1)</sup>	Inhalation	1 ppm (Note 3)	0.5 ppm
Asbestos <sup>(2)</sup>	Inhalation	0.2 f/cc (Note 4)	0.1 f/cc
Hydrofluoric Acid	Contact Skin/Eyes	3 ppm (Note 4)	
		6 ppm (Note 3)	
Nitric Acid	Contact Skin/Eyes	2 ppm (Note 4)	
		4 ppm (Note 3)	
Sodium Hydroxide	Contact Skin/Eyes	2 mg/M <sup>3</sup> (ceiling)	
Uranium	Inhalation/Ingestion		Note 5

Data Sheets have been provided as attachments to this plan to provide additional information on these chemicals.

- (1) NO<sub>2</sub> may be produced if residual nitric acid is present in lines or sump.
- (2) No asbestos hazard present unless insulated lines or transite is damaged or disturbed (special permit required for asbestos work.)
- (3) Based on a 15 minute short term exposure limit.
- (4) Based on 8 hour time weighted average.
- (5) The action level for uranium is  $5 \times 10^{-12}$  uCi/ml which is based on the DOE derived air concentration limit of  $2 \times 10^{-11}$  uCi/ml

4.0 **MONITORING**

4.1 Goals

During the contaminant source detection task, air monitoring will be performed as determined to be necessary at the time of issuance of the work permit(s) to ensure that exposure levels do not exceed established exposure limits.

4.2 Monitoring Equipment and Frequency of Monitoring

4.2.1 Airborne Radioactivity

During the contaminant source detection and installation of the pumping system tasks, air samples will be taken in the general area of the work inside Plant 9 daily while work is in progress. Local or breathing zone samples will be taken in the vicinity of possible leaks of fluid systems as they are air-pressurized for hydrostatic testing.

4.2.2 Radioactive Surface Contamination

During the contaminant source detection and installation of the pumping system tasks, weekly surveys for removable radioactive surface contamination will be performed in Plant 9 and the south sump area near

the boring. Contamination surveys will be performed on potentially contaminated fluid systems, as they are opened, to ensure that adequate protective clothing is being worn and to verify radiological postings.

4.2.3 Radiation Surveys

Area radiation surveys will be taken monthly in Plant 9.

4.2.4 Chemical Hazard

Direct reading monitoring devices will be used to determine the concentration of NO<sub>2</sub> and/or other gases and vapors at the time of issuance of the work permit and thereafter as determined to be necessary by the Industrial Hygiene representative.

A HNu may be used periodically to test for organic vapors as determined to be necessary by the Industrial Hygiene representative. If organic vapors are detected, they will be treated as unknowns. The Breathing Zone action levels are listed in Section 4.3.

4.2.5 Thermoluminescent Dosimetry (TLD)

TLDs will be worn by all workers.

4.3 Action Levels

<u>Measurement</u>	<u>Level</u>	<u>Action</u>
Removable contamination on open surfaces	20,000 dpm/100 cm <sup>2</sup> (average)	Note 1
Airborne radioactivity (long lived)	5 x 10 <sup>-12</sup> uCi/ml	Note 1
HNU Meter (Breathing Zone)	Detection to 10 ppm (Note 2)	Note 1
	10-25 ppm	Supplied Air Respirator (SAR)
	>25 ppm	Withdraw
Nitrogen Dioxide (Breathing Zone)	0.5 ppm	Withdraw

Notes

- 1 Full-face air purifying respirators with combination HEPA filter and organic vapor, acid gas, fume cartridges.
- 2 1 ppm above background.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

All employees in the task exclusion area will wear the following personal protective equipment while performing the required tasks.

5.1 Contaminant Source Detection

<u>ITEM</u>	<u>NEED</u>	<u>APPLICABILITY</u>
Air purifying respirator	No (Yes)	Required if action levels are exceeded or as specified by IRS&T representative
Cartridges: HEPA Combination Radiological/OV/AG	No (Yes)	Required if action levels are exceeded or as specified by IRS&T representative
Hard Hat	No	
Hearing Protection	No	
Inner Gloves	No	
Rubber/Latex Boots	Yes	As needed to prevent contact with liquids (e.g., sump & drains)
Leather-Palm Gloves	Yes	
Rubber/Nitrile Gloves	Yes	As needed to prevent contact with liquids (e.g., sump & drains)
Plain Tyvek	No	
PE Tyvek	No	
Process Coveralls	Yes	
PVC Gloves	No	
SAR	No	
Safety Glasses	Yes	Minimum Requirement
Safety Goggles/Face Shield	Yes	During hydrostatic testing, as needed to prevent contact with splash or particulates (e.g., cleaning/grinding on chemically contaminated drain lines)
Safety Shoes	Yes	Minimum Requirement
Saranex Tyvek	No	
Shoe Covers	No	

5.2 Installation of Pumping System

<u>ITEM</u>	<u>NEED</u>	<u>JUSTIFICATION</u>
Air purifying respirator	No (Yes)	Required if action levels are exceeded or as specified by the IRS&T representative.
Cartridges: HEPA Combination Radionuclide/organic vapor/acid gas	No (Yes)	Required if action levels are exceeded or as specified by the IRS&T representative.
Hard Hat	Yes	As needed for overhead work
Hearing Protection	Yes	During concrete breaking/cutting
Inner Gloves	No	
Rubber/Latex Boots	Yes	As needed to prevent contact with liquids (e.g., sumps, drains, pumping)
Leather-Palm Gloves	Yes	
Rubber/Nitrile Gloves	Yes	As needed to prevent contact with liquids (e.g., sumps, drains, pumping)
Plain Tyvek	No	
PE Tyvek	No	
Process Coveralls	Yes	
PVC Gloves	No	
SAR	No	
Safety Glasses	Yes	Minimum Requirement
Safety Goggles/Face Shield	Yes	During pump testing and as needed
Safety Shoes	Yes	Minimum Requirement
Saranex Tyvek	No	
Shoe Covers	No	

5.3 Operation of the Pumping System

<u>ITEM</u>	<u>NEED</u>	<u>JUSTIFICATION</u>
Air purifying respirator	No (Yes)	Required if action levels are exceeded or as specified by the IRS&T representative.
Cartridges: HEPA Combination Radionuclide/organic vapor/ acid gas	No (Yes)	Required if action levels are exceeded or as specified by the IRS&T representative.
Hard Hat	Yes	As needed for overhead work
Hearing Protection	No	
Inner Gloves	No	
Rubber/Latex Boots	Yes	As needed to prevent contact with liquids (e.g., sumps, drains, pumping)
Leather-Palm Gloves	Yes	
Rubber/Nitrile Gloves	Yes	As needed to prevent contact with liquids (e.g., sumps, drains, pumping)
Plain Tyvek	No	
PE Tyvek	No	
Process Coveralls	Yes	
PVC Gloves	No	
SAR	No	
Safety Glasses	Yes	Minimum Requirement
Safety Goggles/Face Shield	Yes	During initial testing and as needed
Safety Shoes	Yes	Minimum Requirement
Saranex Tyvek	No	
Shoe Covers	No	

## 6.0 SITE CONTROL

### 6.1. Access

The work associated with this removal action will be within the FMPC controlled area. In addition, the work area related to this removal action will be posted as "RWP Required for Entry". This will establish the Exclusion Zone per 29 CFR 1910.120.

The Exclusion Zone is the zone of high potential hazard due to physical or chemical dangers. Access to the Exclusion Zone will be restricted by Radiological Safety to trained and certified employees, as regulated by 29 CFR 1910.120, who are required to enter in order to perform their job functions. There will be different Exclusion Zones for the various tasks. The Exclusion Zone will be marked with barrier tape or other easily recognizable devices. The zone may be expanded if airborne hazards are detected. All areas requiring the use of respiratory protection are included in the exclusion zone. Entrance shall be limited to one area and controlled by the supervisor in charge.

If necessary, Radiological Safety will establish a Contamination Reduction Zone, consisting of step-off pads, at the exit to the Exclusion Zone. This zone will be used for removal of disposable PPE and for cleaning of contaminated equipment.

#### 6.1.1 Radiological Postings

Radiological areas will be posted in accordance with DOE Order 5480.11. The following is a brief summary of posting requirements based on uranium:

Regulated Area	> 1000 dpm/100 cm <sup>2</sup> removable > 5000 dpm/100 cm <sup>2</sup> fixed and removable
Contaminated Area	> 10,000 dpm/100 cm <sup>2</sup> removable > 50,000 dpm/100 cm <sup>2</sup> fixed and removable
Airborne Radioactivity Area	> 2 x 10 <sup>-12</sup> uCi/ml
Respirator Area	> 5 x 10 <sup>-12</sup> uCi/ml

In addition, special postings may be added for access to areas: "RWP Required for Entry" or "Contact HP for Entry."

### 6.2 Bioassay Samples

WMCO personnel involved in this project are required to participate in a routine periodic urine assay program. Any suspected exposure to hazardous substances shall be reported and require additional sampling. Personnel are also required to wear a TLD at all times for radiological purposes.

6.3 Medical Monitoring

In accordance with 29 CFR 1910.120 OSHA requirements, all WMCO and WMCO subcontractor personnel are required to participate in a medical monitoring program which includes:

- o A baseline medical examination
- o Annual medical examination
- o Medical examinations may be required after exposures
- o WMCO respirator clearance for respirator users

Prior to the start of work, personnel involved in this project shall be identified by name and badge number. Each individual shall be subject to a medical surveillance approval by the Director, Medical Services. The approval statement shall certify that each individual is medically qualified to perform the work and is physically fit to wear PPE.

6.4 Training Requirements

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

- o Review of this health & safety plan for this work including site specified hazards and procedures. (This safety meeting(s) will be documented.)
- o WMCO radiation safety training
- o WMCO respiratory training and fit test or equivalent approved by WMCO Industrial Hygiene
- o 40-hour OSHA training
- o 8-hour annual refresher training
- o 8-hour supervisory training (for supervisors)
- o 24-hour supervised field experience

6.5 Safety Meetings

A safety meeting, which must be documented, shall be conducted prior to start of each day's work during the perched water source detection and the installation of the pumping system tasks. The meeting will cover the following applicable subjects:

- work operations
- personnel protective equipment
- all monitoring data
- hazard communications
- monitoring tests and results
- decontamination
- task organization
- physical stress
- emergency procedures
- communications
- general safety
- housekeeping

## 7.0 EXPOSURE SYMPTOMS

Exposure to low levels of radioactivity does not produce acute exposure symptoms. Such exposures may cause delayed effects such as cancer. Since biological effects from radiation exposures are cumulative, exposures are to be kept as low as achievable. No treatment is anticipated for the predicted contaminants and concentrations. See Section 11 for contingency plans.

Exposure symptoms for inhalation of nitrogen dioxide (NO<sub>2</sub>) and for skin/eye contact with hydrofluoric acid, nitric acid, and sodium hydroxide are described on the attached data sheets.

## 8.0 SITE ENTRY PROCEDURES

During the perched water source detection and installation of pumping system tasks, the following procedures apply:

- o Identify exclusion zone, contamination reduction zone, and break area.
- o Perform daily safety meeting to familiarize team with site specific hazards.
- o Discuss alternate communications signals (if applicable).
- o Perform respirator check out and fit test prior to use.
- o Use buddy system. Teams of at least two individuals will be used for all activities within an exclusion zone.

Prior to the initiation of these work tasks, the following permits are required:

- Radiation Work Permit
- Penetration Permit
- Chemical/Hazardous Material Permit
- Work Permit

All personnel entering the Exclusion Zone shall be trained and certified to perform their assigned task as defined by 29 CFR 1910.120.

Entrance to the Exclusion Zone shall be controlled and at the approval of the supervisor in charge.

## 9.0 DECONTAMINATION

Equipment for decontamination of radiological or chemical hazards shall be kept available in the area surrounding the exclusion zone if such is determined necessary by supervisor or by either Radiation Safety or Industrial Hygiene prior to the initiation of the activity. As a minimum, the location of the nearest water for decontamination and eye washing shall be identified and its operability verified prior to start of work.

## 10.0 WASTES

Wastes include, but are not limited to:

- o Disposable PPE
- o Excess materials such as soil or concrete

All potentially contaminated waste materials resulting from site activities will be collected and placed in drums or other containers. Disposable protective clothing will be placed in plastic bags and disposed of as compactible, potentially contaminated waste.

Drums or containers shall meet DOE 49 CFR Parts 171-178, EPA, 40 CFR Parts 264-265 and 300, and OSHA requirements. Hazard warning label shall be immediately applied to all drums as specified by WMCO management/supervisors and Solid Waste Compliance.

## 11.0 CONTINGENCY PLANS

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

See statement on submission of urine samples for radiation exposures in Standard Operating Procedure (SOP) No. 11-C-245.

See HF Exposure statement in SOP No. 11-C-245.

Incidents or injuries involving potential intake of other hazardous substances shall be reported to supervisor and the WMCO Medical Section by the involved employee and an Incident Investigation Report completed by the involved employee.

### 11.2 Pre-Emergency Planning

During the training and pre-work safety meetings, all employees involved in this task shall be trained and reminded of the provisions of the plant emergency procedure, alarm signals and communications, evacuation routes and emergency reporting.

11.3 Lines of Authority

The supervisor in charge has the primary responsibility for the prevention of emergency conditions. In the event that an emergency does occur, the individual involved or observing the condition shall immediately notify a supervisor, the communication center or the Assistant Emergency Duty Officer (AEDO). The AEDO is responsible for ensuring that corrective actions have been implemented, the appropriate personnel notified, and reports completed as required.

11.4 Evacuation

In the event of an emergency which necessitates an evacuation of the Exclusion Area, the 2-2, 2-2 shall be sounded over the plant alarm system; a voice message will follow over the Emergency Message System instructing employees to go to their designated Rally Point (see Figure 2). Personnel shall immediately proceed to the Rally Point and participate in the accountability process. Personnel will follow instructions given by the Rally Point Coordinator. When an all-clear condition has been achieved, personnel will be released from the Rally Point.

11.5 Emergency Equipment

The following safety equipment, locations to be identified at safety meetings, is available for employee usage:

- |  |   |
|--|---|
| <input type="checkbox"/> fire extinguisher | <input type="checkbox"/> manual fire alarm      |
| <input type="checkbox"/> eye wash          | <input type="checkbox"/> two-way radio          |
| <input type="checkbox"/> safety shower     | <input type="checkbox"/> emergency SCBA units   |
| <input type="checkbox"/> telephone         | <input type="checkbox"/> respirators            |
| <input type="checkbox"/> spill drums       | <input type="checkbox"/> clean-up materials     |
| <input type="checkbox"/> absorbent         | <input type="checkbox"/> local evacuation alarm |
| <input type="checkbox"/> other - List      |   |

11.6 Emergency Notification

All emergencies shall be reported immediately. Emergencies can be reported by telephone dialing 6511; by contacting the communications center via two-way radio; or by pulling a manual fire alarm.

11.7 Fire, Explosion, or Medical Emergency

In the event of a fire, explosion or medical emergency, the communication center shall be notified immediately by manual fire alarm, two-way radio, or by calling 6511. The communication center operator will activate the emergency response team and dispatch them to your location. Personnel in the immediate area should evacuate to a safe position and await instructions.

11.8 Additional Information

11.8.1 Hospitals

The WMC0 Medical Facility (Building 53) is the primary choice for on-site injuries. The WMC0 ambulance will transport the injured to the nearest hospital if necessary. WMC0 maintains an emergency response capability which includes an ambulance and Emergency Medical Technicians.

11.8.2 Emergency Telephone Numbers

Ambulance:	6511 or 6512
Hospital:	6511 or 6512
Fire:	6511 or 6512

<u>Name</u>	<u>Work</u>	<u>Radio</u>
<b>EMERGENCY RESPONSE</b>	<b>6511</b>	
Industrial Hygiene	6207	357
Radiation Safety	6889	355
Fire and Safety	6235	303
Leo Singleton	8908	709
Assistant Emergency Duty Officer (AEDO)	6431 or 6295	202

12.0 **CONFINED SPACE ENTRY**

A Confined Space Entry permit will be required for the perched water source detection task. A Confined Space Entry Permit will be obtained and its requirements followed. Permits will not be required for the installation of the pumping system and for the pumping of the contaminated water.

13.0 APPROVAL AND COMPLIANCE STATEMENT

This Health and Safety Plan was produced for the use of WMCO employees and WMCO subcontractors. It is intended for the FMPC and specifically for the following activities related to the Plant 9 removal action:

- Contaminant Source Detection
- Installation of Pumping System
- Pumping of the Contaminated Water

The undersigned person have read and understood this Health and Safety plan and agree to follow its provisions (See Note 1):

Name (lettered)	Signature	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

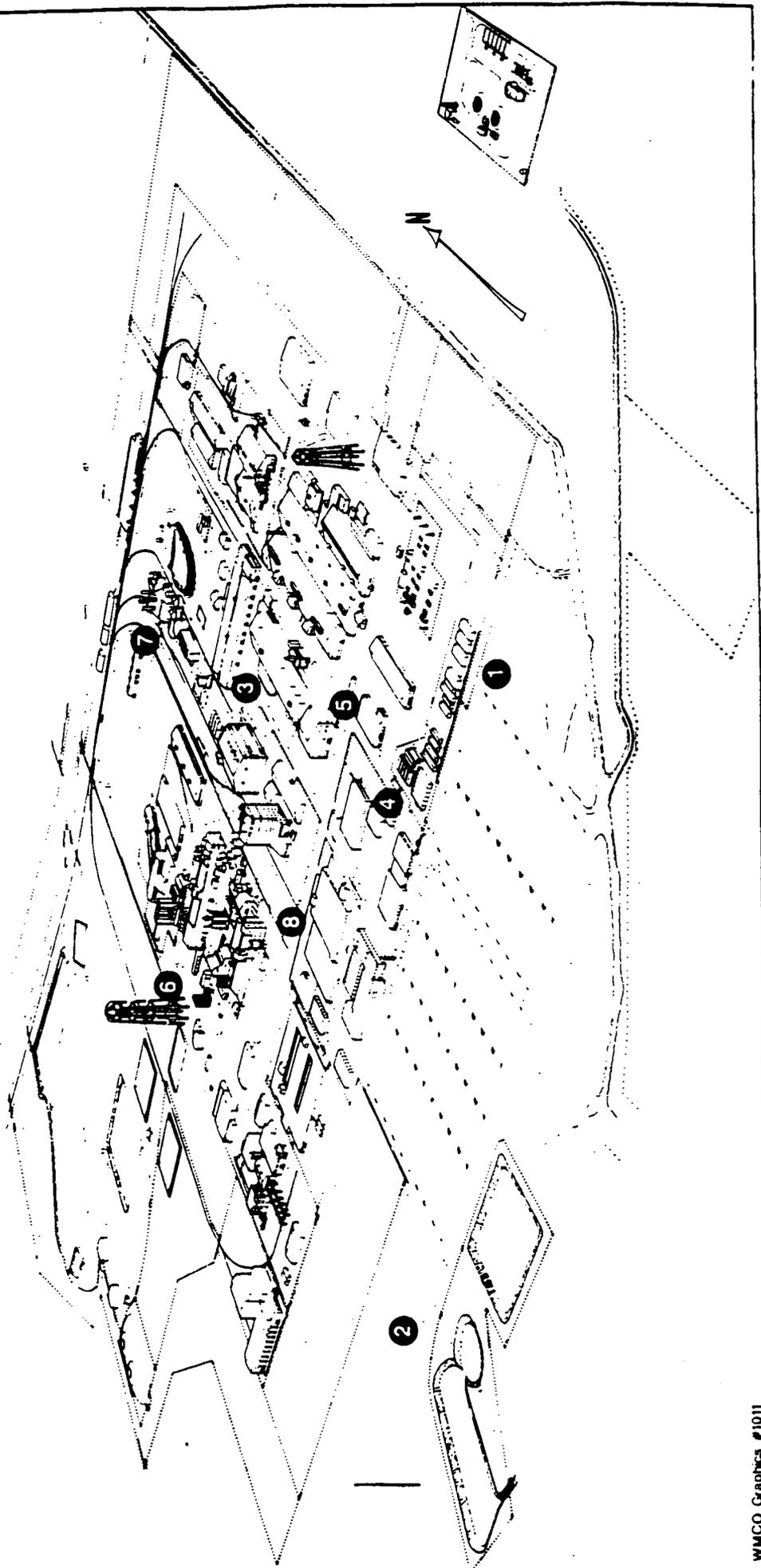
Note 1: Compliance with the provisions of this HASP may be audited through announced or unannounced site visits. Be sure that you are implementing the provisions of the safety plan and documenting the reasons for field actions/changes when they are necessary. Site visits may be performed:

\_\_\_ By WMCO

\_\_\_ By DOE



# FMPC RALLY POINTS



WMCO Graphics #1011

FIGURE 2

**ATTACHMENTS**

12313

SELF-CONTAINED BREATHING APPARATUS.

SECTION V -- REACTIVITY INFORMATION

Conditions to Avoid:

THIS IS A STABLE MATERIAL AT ROOM TEMPERATURE IN A CLOSED CYLINDER. IT IS A VERY STRONG OXIDIZING AGENT. CONTACT WITH COMBUSTIBLES CAN CAUSE FIRE OR EXPLOSION. IF A MATERIAL BURNS IN AIR, IT WILL BURN IN NO2 BUT IT MIGHT ALSO EXPLODE MIXTURES WITH AMMONIA, ACETIC ANHYDRIDE, ALCOHOLS, TOLUENE PROPYLENE, ETC HAVE PRODUCED VIOLENT EXPLOSIONS. EXPLOSIVES CAN BE PREPARED BY MIXING NO2 WITH CARBON DISULFIDE OR WITH NITROBENZENE. IT FORMS EXPLOSIVE MIXTURES WITH INCOMPLETELY HALOGENATED HYDROCARBONS. REACTIVE WITH REDUCING AGENTS AND STRONGER OXIDIZING AGENTS. IT MUST BE HANDLED WITH COMPATIBLE MATERIALS AND EQUIPMENT. IT IS NOT CORROSIVE TO MILD STEEL WHEN DRY, BUT WILL REQUIRE A NITRIC ACID RESISTANT STAINLESS STEEL WHEN WET. ALUMINUM, NICKEL, PYREX, TEFLOX, AND ASBESTOS ARE AMONG THE COMPATIBLE MATERIALS.

SECTION VI -- HEALTH HAZARD INFORMATION

Toxicity and Exposure Limits:

Inhal. Toxicity: 88,000 PPM
Comments: LC-50
Oral Toxicity: No Info.
Exp. Limit: 3,000 PPM
Comments: TLV
Eye Toxicity: No Info.
Exp. Limit Max.: 5,000 PPM
Comments: STEL
Dermal Toxicity: No Info.

Health Effects and Symptoms:

INHALATION OF NO2 CAUSES LUNG DAMAGE WITH SEVERITY DEPENDENT ON THE TIME AND THE LEVEL OF EXPOSURE. SERIOUS RESULTS MAY NOT BE FELT UNTIL HOURS OR DAYS AFTER EXPOSURE. EVEN THOUGH HEAVY DAMAGE HAS OCCURRED. EXPOSURE AT 100PPM FOR EVEN A SHORT TIME IS DANGEROUS AND EXPOSURE TO OVER 200 PPM CAN BE FATAL EVEN WHEN TREATED. THE DISCOMFORT OR SLIGHT PAIN OCCURRING AT EXPOSURE MAY GO UNNOTICED. THE CYANOSIS AND PULMONARY EDEMA RESULTING FROM DAMAGED LUNG TISSUE BECOMES DISABLING AND CAN BE FATAL ESPECIALLY IF NOT PROMPTLY TREATED AFTER EXPOSURE. CHRONIC EXPOSURE AT 5-50PPM CAN PRODUCE A SLOWLY EVOLVING PULMONARY EDEMA WITH RESPIRATORY TRACT IRRITATION COUGH, HEADACHE, WEAKNESS, AND CORROSION OF THE TEETH. CONTACT WITH VAPORS IS IRRITATING TO THE EYES, NOSE, THROAT AND WET SKIN. CONTACT WITH LIQUID IS CORROSIVE. AN EIGHT HR TWA EXPOSURE LIMIT IS 3PPM WITH AN EXCURSION LIMIT OF 5PPM HAS BEEN RECOMMENDED BY ACGIH. THE CURRENT OSHA TLV IS 5PPM OR 9MG/M3. NIOSH (1976) RECOMMENDED A CEILING LEVEL OF 1PPM (15 MINUTE SAMPLE). PROVIDE PREPLACEMENT MEDICAL EXAMINATION OF EXPOSED PERSONNEL WITH SPECIAL ATTENTION TO PULMONARY FUNCTION TESTS AND DENTAL CARE. PRECLUDE INDIVIDUALS FROM EXPOSURE WITH CARDIAC OR PULMONARY DISEASE.

Emergency and First Aid Procedures:

IF EYE CONTACT OCCURS IMMEDIATELY FLUSH WITH PLENTY OF RUNNING WATER, INCLUDING UNDER EYELIDS. FOR AT LEAST 15 MINUTES. CONTACT PHYSICIAN OR OPHTHALMOLOGIST IF POSSIBLE. PROMPTLY. IF SKIN CONTACT OCCURS REMOVE CONTAMINATED CLOTHING

UNITED STATES DEPARTMENT OF ENERGY MATERIAL SAFETY DATA SHEET

Entry Date: 06/18/1980 Revised Date: 06/18/1980

SECTION I -- IDENTIFICATION

Chem. Name: NITROGEN DIOXIDE
Chem. Id: 010102-44-0
Formula: No Info.
Chem. Family: No Info.
Hazard Rating (Scale: 0-4): HEALTH-(3); FIRE-(0); REACTIVITY-(0)
Molecular Weight: 46.000

Synonyms: NITROGEN DIOXIDE
NITROGEN PEROXIDE
10102-44-0

SECTION II -- HAZARDOUS INGREDIENTS

Components CAS # PEL/TLV Percentage

NO COMPONENT INFORMATION ENTERED FOR THIS MATERIAL.

SECTION III -- PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: 21.150 C Specific Gravity: 1.450
Vapor Pressure: 720.000 MM HG Melting Point: -9.300 C
Vapor Density: 2.800 Solubility: No Info.
(AIR = 1.0) (REACTS IN WATER)
Evaporation Rate: No Info. Volatiles by Vol.%: No Info.

Physical Description:

IT IS A YELLOW-BROWN, FUMING LIQUID (BELOW 21 C) OR A REDDISH-BROWN GAS WITH A PUNGENT ACRID ODOR AT ABOUT 10-20PPM. AT -12C THIS MATERIAL IS A COLORLESS SOLID (ESSENTIALLY ALL N2O4). THIS MATERIAL IS AN EQUILIBRIUM MIXTURE OF NO2 AND ITS DIMER N2O4. IT IS SUPPLIED COMMERCIALY AS A LIQUID UNDER ITS OWN VAPOR PRESSURE IN STEEL CYLINDERS.

SECTION IV -- FIRE AND EXPLOSION HAZARD INFORMATION

Flash Point Auto-Ignition Temp. Flammable Limits
No Info. No Info. LEL: No Info. UEL: No Info.

Special Hazards:

THIS MATERIAL WILL NOT BURN, HOWEVER IT IS A VERY STRONG OXIDIZING AGENT WHICH IS ABLE TO CAUSE FIRE ON CONTACT WITH FLAMMABLE OR COMBUSTIBLE MATERIALS. FOR EXAMPLE, IT COULD CAUSE CLOTHING TO CATCH FIRE ON CONTACT. WATER SHOULD BE USED TO COOL FIRE- EXPOSED CYLINDERS (WHICH COULD EXPLODE FROM PRESSURE WHEN HEATED) AND A WATER SPRAY MAY BE USED TO DIRECT ESCAPING GAS AWAY FROM THOSE ATTEMPTING A SHUT OFF OF NO2 FLOW. FIREFIGHTERS REQUIRE FULL PROTECTIVE CLOTHING AND

\*\*NITRIC ACID\*\*  
\*\*NITRIC ACID\*\*  
\*\*NITRIC ACID\*\*  
\*\*NITRIC ACID\*\*

MATERIAL SAFETY DATA SHEET

10176

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100

EMERGENCY CONTACTS  
GASTON L. PILLORI  
(201) 796-7100

DATE: 03/02/86  
PO NBR: N/A  
ACCT: 878202-02  
INDEX: 12-8603-40259  
CAT NO: A2005212

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

SUBSTANCE: \*\*NITRIC ACID\*\*

TRADE NAMES/SYNONYMS: AQUA FORTIS; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; A-200; A-200C; A-200S; A-198; A-202; A-206-C

CHEMICAL FAMILY:  
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3 MOL WT 63.02

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

PERCENT: 70 COMPONENT: HYDROGEN NITRATE

PERCENT: 30 COMPONENT: WATER

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

2 PPM (5 MG/M3) OSHA TWA; 2 PPM NIOSH RECOMMENDED TWA;  
2 PPM ACGIH TWA; 4 PPM ACGIH STEL

PHYSICAL DATA

DESCRIPTION: COLORLESS FUMING LIQUID WITH AN ACRID ODOR; SUFFOCATING

FUMES. THE ODOR IS NOT CONSIDERED AN ADEQUATE WARNING PROPERTY.

BOILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5 VAPOR PRESSURE: 62 MMHG @ 25 C



# Asbestos

## SECTION I MATERIAL IDENTIFICATION

**Chemical Name** Asbestos **CAS#** 1332-21-4

**Synonyms**

Amosite	Anthrophyllite	<b>Possible Occupational Exposure</b>
Actinolite	Tremolite	Miners and millers of ore
Chrysotile	UN 2212 (DOT)	Manufacturers and users of asbestos-containing products such as brake shoes
Crocidolite	UN 2509 (DOT)	Repairers and demolishers of structures containing asbestos

**Manufacturer:** available from several sources.

## SECTION II INGREDIENTS AND HAZARDS

**Permissible Exposure Limit**

0.2 fiber/cc — OSHA TWA (all forms)	2.0 fibers/cc — ACGIH TWA (other forms)
0.5 fiber/cc — ACGIH TWA (Amosite)	0.1 fiber/cc — NIOSH-recommended TWA (all forms)
2.0 fibers/cc — ACGIH TWA (Chrysotile)	0.5 fiber/cc — NIOSH-recommended 15-minute ceiling (all forms)
0.2 fiber/cc — ACGIH TWA (Crocidolite)	Human Carcinogen (IARC, NTP, ACGIH); Animal Carcinogen (IARC)

**CERCLA Hazard Rating** — Toxicity 3 - Ignitability 0 - Persistence 3.

**Immediately Dangerous to Life and Health Concentration** — none specified

## SECTION III PHYSICAL DESCRIPTION

Fibrous solid, ranging from long flexible fiber down to dust-like filler powder.

Asbestos can be white, gray, brown or blue in color.

**Molecular Weight:** Varies **Specific Gravity:** 2.5

**Melting Point:** Decomposes **Flash Point:** Nonflammable

**Solubility in Water:** Insoluble (breaks down slowly in hot water)

**Upper Explosive Limit in Air, % by volume:** nonflammable

**Lower Explosive Limit in Air, % by volume:** nonflammable

## SECTION IV INCOMPATIBILITIES AND STORAGE

**Incompabilities:** None

Store asbestos in closed containers (dust-tight) in a clean, secure area. Protect containers from damage. Do not open without proper control measures. Ensure containers are properly labeled.

## SECTION V HEALTH HAZARD AND PROTECTION DATA

<b>Target Organs</b>	<b>Route of Entry Into Body</b>			
Lungs	Inhalation			
Respiratory System	Ingestion			
Gastrointestinal	Skin or Eye Contact			

**Symptoms**

Coughing	Asbestosis	Mesothelioma	Respiratory Irritation	Pneumoconiosis
Cyanosis	Pleuritic Pain	Respiratory Cancer	Pleural Thickening	Finger Clubbing
Dyspnea	Skin Irritation	Respiratory Distress	Pulmonary Fibrosis	Weight Loss

**NOTE:** Acute exposure may cause irritation and coughing. Chronic exposure may cause pulmonary fibrosis, a terminal pneumoconiosis called asbestosis which may appear as early as 13 years after exposure, but typically develops over 20-40 years. The incidence of pulmonary fibrosis and lung cancer in asbestos-exposed workers is synergistically increased by smoking.

**Protective Equipment Requirements**

29 CFR 1910.1001 Asbestos

**Special clothing:** The employer shall provide, and require the use of, special clothing, such as coveralls or similar whole-body clothing, head coverings, gloves and foot coverings for any employee exposed to airborne concentrations of asbestos fibers.

Medical examinations are required for asbestos workers (preplacement, periodic and termination examinations), 20-year recordkeeping required.

Employers are required to provide and ensure that employees use and/or follow these protective devices and measures; employees are required to use and/or follow them:

- Posted warning signs.
- Face shields, vented goggles or other appropriate protective equipment that complies with 1910.133 of this part.
- Change rooms with two separate lockers or containers.
- Routine changing of work clothing if there is a possibility that clothing may be contaminated.\*

**Protective Equipment Requirements (continued)**

Employees who are required to shower do so before breaks, lunch or leaving the contaminated area.

Showering after each shift prior to leaving premises.

Not smoking, eating or drinking in the work area.

\*Contaminated clothing should be sealed in a labeled plastic bag and laundered. Commercial laundries should be notified of the asbestos contamination.

Employers are required to provide engineering controls, i.e., negative-pressure ventilation with high-efficiency particulate air (HEPA) filtration, sealed enclosures for removal projects. (See EPA regulations for guidance.)

**Respirator Selection**

2 fibers/cc	Half-mask air-purifying respirator with a high-efficiency filter.
10 fibers/cc	Full face-piece air-purifying respirator with a high-efficiency filter.
20 fibers/cc	Air-purifying respirators with a high-efficiency filter. Supplied-air respirator operated in continuous-flow mode.
200 fibers/cc	Supplied-air respirator with a full face-piece operated in pressure-demand mode.
Greater than 200 fibers/cc	Supplied-air respirator with a full face-piece operated in pressure-demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus.

**Firefighting**

Self-contained breathing apparatus with a full face-piece operated in pressure-demand or other positive-pressure mode.

Supplied-air respirator with full face-piece and operated in pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

**First Aid**

Skin Contact: Remove contaminated clothing and shoes immediately. Wash affected area with soap and water until no evidence of the substance remains. Get medical attention at once.

Eye Contact: Wash eyes immediately with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention at once.

Inhalation: Remove from area at once to fresh air. If breathing has stopped, perform artificial respiration. Get medical attention at once.

Ingestion: Get medical attention at once.

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**SECTION VI REGULATIONS/OSHA**

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OSHA Standard 29CFR1910.1200	Hazard Communication
OSHA Standard 29CFR1910.1001	Asbestos
OSHA Standard 29CFR1910.94	Ventilation
OSHA Standard 29CFR1910.134	Respiratory Protection
OSHA Standard 29CFR1910.20	Access to Employee Exposure and Medical Records
OSHA Standard 29CFR1910.132	Personal Protective Equipment
OSHA Standard 29CFR1910.141	Sanitation
OSHA Standard 29CFR1910.151	Medical Services and First Aid
OSHA Standard 29CFR1910.133	Eye and Face Protection

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**SECTION VII EMERGENCY HANDLING OF HAZARDOUS MATERIALS**

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**If Material Is On Fire or Involved in Fire:**

Extinguish fire using agent suitable for type of surrounding fire (material itself does not burn or burns with difficulty).

**If Material Is Not on Fire and Is Not Involved in Fire:**

Keep material out of water sources and sewers. Build dikes to contain flow as necessary.

**Personal Danger Situation Protection:**

Keep upwind. Wear boots, protective gloves and gas-tight goggles. Avoid breathing dust, vapors/fumes from material. Wash away any materials which may have contacted the body with copious amounts of water or soap and water.

---

**SECTION VIII SPILL, LEAK AND DISPOSAL PROCEDURES**

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Adequately wet or mix with water to form a slurry. Seal material in a leak-tight container. Label containers as specified in 1910.1001. The SARA Act of 1986 requires that a release equal to or greater than the reportable quantity for this substance must be reported to the Local Planning Commission, the State Emergency Response Commission, and the National Response Center.

Contact the Ohio EPA for Emergency Spill Information: 1-800-282-9378.

Effective 1/87. For further chemical information contact the Resource Center at 1-800-282-3045, Ext. 7388.

10160

## MATERIAL SAFETY DATA SHEET

### IDENTIFICATION

**NAME**

Hydrofluoric Acid-Anhydrous

**GRADE**

Technical

**CHEMICAL FAMILY**

Inorganic Acid

**SYNONYMS**

Hydrogen Fluoride; HF: AHF

**FORMULA**

HF

**CAS NAME**

Hydrofluoric Acid

**CAS REGISTRY NO.**

7664-39-3

**I.D. NOS./CODES**

NIOSH Registry No. MW 7875000

**PRODUCT INFORMATION**

Phone (800) 441-9442

Medical Emergency Phone

(800) 441-3637

**MANUFACTURER/DISTRIBUTOR**

E. I. du Pont de Nemours &amp; Co. (Inc.)

**TRANSPORTATION EMERGENCY PHONE**

CHEMTREC (800) 424-9300

**ADDRESS**

Wilmington, DE 19898

### PHYSICAL DATA

**BOILING POINT, 760 mm Hg**

19.5°C (67.1°F)

**MELTING POINT**

-83.5°C (118.3°F)

**SPECIFIC GRAVITY**

~1 at 0°C (32°F)

**VAPOR PRESSURE**

775 mm Hg at 20°C (68°F)

1525 mm Hg at 40°C (104°F)

**VAPOR DENSITY**

3.0 at 25°C (Air=1)

**SOLUBILITY IN H<sub>2</sub>O**

100%

**pH INFORMATION**

~ 2.0 (2% Aqueous Solution)

**EVAPORATION RATE (BUTYL ACETATE=1)**

&gt;1

**FORM**

Liquid

**APPEARANCE**

Clear, fuming

**COLOR**

Colorless

**ODOR**

Acrid

**HAZARDOUS COMPONENTS**

**MATERIAL(S)**  
Hydrogen Fluoride

**APPROXIMATE %**  
100%

**HAZARDOUS REACTIVITY**

**INSTABILITY**

Stable, if stored in proper (steel) container.

**INCOMPATIBILITY**

Reacts with most metals to give explosive hydrogen gas; with cyanides to give toxic hydrogen cyanide; with sulfides to give toxic hydrogen sulfide. Also corrodes glass and ceramics.

**DECOMPOSITION**

Will not occur

**POLYMERIZATION**

Non-hazardous endothermic polymerization may occur in both the liquid and gaseous phases.

**FIRE AND EXPLOSION DATA**

**FLASH POINT** Will not burn

**AUTOIGNITION TEMPERATURE**

Not applicable

**FLAMMABLE LIMITS IN AIR, % BY VOL.**

LOWER Not applicable

UPPER Not applicable

**AUTODECOMPOSITION TEMPERATURE**

Not applicable

**FIRE AND EXPLOSION HAZARDS**

HF (particularly in dilute aqueous solutions) will attack most metals, releasing potentially explosive hydrogen gas.

**EXTINGUISHING MEDIA**

Water, carbon dioxide (CO<sub>2</sub>) for fires in area.

**SPECIAL FIRE FIGHTING INSTRUCTIONS**

Keep upwind. If there is any possibility of direct contact, wear full acid suit with hood, boots and self-contained breathing apparatus. Do not get water into acid tanks - generates heat.

**HEALTH HAZARD INFORMATION**

**PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Over-Exposure)**

Inhalation: LC50, 1-hour (rats) = 1276 ppm

Extremely hazardous liquid and vapor. Causes severe burns. Anhydrous HF causes immediate and serious burns on contact; concentrations less than 50% may not produce symptoms for 8 hours or longer. Wearing clothing contaminated with HF (such as shoes, gloves) may result in painful delayed effects. HF vapor can cause skin irritation and delayed burns. Inhalation over-exposure may cause lung damage and pulmonary edema.

**CARCINOGENICITY**

HF is not listed as carcinogenic by IARC, NTP, OSHA, ACGIH or Du Pont.

**EXPOSURE LIMITS (PEL (OSHA), TLV<sup>o</sup> (ACGIH), AEL (DU PONT), ETC.)**

The OSHA Time Weighted Average (TWA) and ACGIH TLV<sup>o</sup>-TWA are 3ppm, 2.5 mg/m<sup>3</sup> (as F).

**SAFETY PRECAUTIONS**

- Do not get in eyes, on skin, on clothing.
- Do not breathe vapor.
- Keep container closed.
- Wash thoroughly after handling.

**FIRST AID**

Speed in removing exposed personnel from the contaminated area and in removing HF from the skin or eyes is of primary importance. First aid must be started immediately, within seconds, in all cases of contact with hydrofluoric acid in any form. All potentially exposed workers and supervisors should be informed of first aid care for HF burns. First aid actions should be planned before beginning work with HF.

Medical assistance should be obtained promptly for all affected persons. The doctor should be informed in detail of the accident.

HF differs from other acids in that the fluoride ion readily penetrates the skin causing destruction of deep tissue layers including bone. Unlike other acids, which are rapidly neutralized, this process may continue for days.

**Skin Contact:**

Immediately shower with large quantities of water within seconds after contact or suspected contact, and completely remove all clothing while in the shower. Stay in the shower until all traces of HF have been thoroughly removed. Examination and treatment by a physician is recommended as quick as feasible. It may be necessary to transport the victim to the nearest hospital emergency room. Remember also that concentrated HF causes immediate pain but dilute HF solutions may not cause redness, burning or pain until several minutes or even hours have elapsed.

**Eye Contact:**

Immediately flush the eyes with large quantities of water while holding the eyelids apart. Continue flushing for 15 minutes. Apply ice packs until a medical facility is reached. THE EYES WILL REQUIRE FURTHER TREATMENT--SEE NOTES TO THE PHYSICIAN - "EYE CONTACT", MAJOR and MINOR EXPOSURES.

**Vapor Inhalation:**

Immediately remove the victim to an uncontaminated atmosphere. Call a physician. Administer oxygen as soon as possible. Oxygen inhalation may

be repeated at half-hour intervals for a total of 3 or 4 hours or until no shortness of breath is present and the victim's normal skin color has returned. Keep the victim warm.

**Ingestion:**

Do not induce vomiting. Immediately drink a large quantity of milk or water with added milk of magnesia. Call a physician. Throat burns may cause severe swelling and require a tracheotomy (opening the windpipe). The victim should be admitted to the hospital and carefully attended.

**Medical Supplies:**

The following materials have been found to be useful and effective in the treatment of hydrogen fluoride burns, and should be on hand at the First Aid Station:

- Calcium gluconate gel--2.5%. This gel is prepared by mixing 3.5 grams of USP calcium gluconate powder with a 5 ounce tube of surgical water-soluble lubricant (e.g. K-Y Lubricating Jelly, Johnson & Johnson). The shelf life of the gel has not been determined. Storage of the gel has limitations and refrigeration may help.
- Calcium gluconate 10% for injection (standard ampule). Make 5% solution by mixing with an equal part of sterile physiological saline solution.
- One percent calcium gluconate in normal, sterile saline solution.
- Aqueous solution of benzalkonium chloride--0.13%. Benzalkonium chloride can be purchased as "Zephiran" (Winthrop) aqueous solution (1:750) or as "Zephiran" concentrate (17%) which must be diluted by mixing 1 fluid ounce (29.6 mL) of concentrate and 127 fluid ounces (3756 mL) of water to give 1 gallon (3785 mL) "Zephiran" solution (approximately 0.13%).
- Solution of 70% denatured ethyl alcohol
- Milk of magnesia powder
- 99% pure USP medical oxygen
- Ice cubes
- Gauze, compression dressing, eye patches
- Towels
- Basins of assorted sizes; shower facilities

NOTES TO THE PHYSICIAN

The choice of therapy following first aid measures is at the discretion of the attending physician. Selection of the best treatment will depend on the following factors:

- Concentration and temperature of the HF.

- Degree and extent of the burn.
- Areas of the body affected.
- First aid measures taken before physician's arrival.
- General condition of the victim.

The following method, using materials listed under **MEDICAL SUPPLIES**, have been effective in the treatment of HF burns. The methods are broken down by extent of exposure. Minor exposures are limited exposures to HF liquid and vapor. Major exposures are extensive exposures to HF liquid and vapor.

**MINOR EXPOSURES**

**Skin Contact:**

Calcium Gluconate Gel (2.5%)--Topically applied gel must be rubbed in continuously until pain has completely subsided. Calcium gluconate gel should not be used until after thorough and complete washing of the skin with water.

Iced Solutions (As an alternate to the gel treatment above)--The burned area may be immersed in an iced aqueous solution of benzalkonium chloride, dissolved to a concentration of 0.13%. If immersion is not practical, compresses of the iced solution of benzalkonium chloride can be applied. (An iced solution of 70% denatured ethyl alcohol also may be used.) The treatment should be continued for intervals varying from 1-4 hours depending on pain and the appearance of the burn. Avoid freezing the tissues. Benzalkonium chloride and alcohol solution should not be used around the eyes since they may cause irritation and damage.

Topical Applications--After administering first aid, routine burn treatment including A&D Ointment, topical steroid cream or ointment may be applied.

**Eye Contact:**

Apply first aid measures as described, including immediate washing with large quantities of water. An eye specialist should be consulted immediately. A 1% calcium gluconate solution should be used to wash the eyes thoroughly for 5-10 minutes and then instilled every 2-3 hours as drops.

**Vapor Inhalation:**

Apply first aid measures. When in doubt, victim should be hospitalized and observed for signs of pulmonary edema or other respiratory distress. The hospitalization should cover a 48-hour period minimum and treatment with bronchial dilators, mechanical ventilation with Positive End-Expiratory pressure (PEEP) and supplemental oxygen, systemic steroids and antibiotics may be used as required. Beware of delayed onset of pulmonary edema.

**Ingestion:**

Apply first aid measures as described. Gastric lavage with lime water or milk may be performed, but only by a physician. Do not induce vomiting.

**MAJOR EXPOSURES**

**Skin Contact:**

All burned areas should have calcium gluconate 2.5% gel applied to them as a first aid measure. The application and massaging into the skin of HF burn jelly should be continued for 3 to 4 days, four to six times daily. Care should be taken to see that the personnel who apply the jelly, especially on the initial application, wear rubber gloves to prevent skin contamination with HF and the development of hand burns.

In cases of overexposure due to HF, as in skin burns of greater than approximately 25 square inches (160 cm<sup>2</sup>) in area, hypocalcemia may be present. Therefore, systemic administration of calcium gluconate may be necessary. Frequent monitoring of serum calcium, renal and hepatic functions is necessary.

Calcium Gluconate Topical Injections -When there is evidence of skin penetration as in second or third degree burns, a 5% calcium gluconate solution (the standard ampule is 10% for intravenous use) may be injected by infiltrating the skin and subcutaneous tissues in the same manner as the injection of a local anesthetic. Care should be taken to avoid over-dosing with calcium. All skin which has been exposed should be infiltrated including up to 1/4 inch (6 mm) around the area. This may prevent the development of severe burns.

Burns around the fingernail may require splitting the nail from the distal end in order to relieve pain and facilitate draining; prior to soaking with one of the above mentioned solutions.

Surgical Excision -Immediate excision of small areas burned with concentrated solutions of HF may prevent a painful, slow healing burn. Primary closure after excision or skin grafting if indicated, may provide more rapid healing and less scarring.

**Eye Contact:**

Immediate rapid washing of the eyes with large quantities of water for at least 15 minutes should be followed by ice packs. The ice pack should be used until a medical facility is reached. Here the eyes should be washed thoroughly with 1% calcium gluconate in normal, sterile saline for 5 to 10 minutes; thereafter, calcium gluconate in normal saline should be instilled every two to three hours for 48 to 72 hours. No oils or ointments should be used. Inflammation may be decreased by the use of corticosteroid solutions for ophthalmic use. An eye specialist should be consulted immediately.

**Vapor Inhalation:**

Persons exposed to HF by inhalation should immediately be given 100% oxygen by mask or catheter. As soon as possible, they should be given 2 1/2% to 3% calcium gluconate solution by inhalation, preferably by Intermittent Positive Pressure Breathing (IPPB) utilizing a nebulizer, or by nebulizer alone. The patient should be carefully watched for edema of the upper airway with respiratory obstruction and the airway maintained by tracheotomy or endotracheal intubation if necessary.

All those with a history of exposure who experience respiratory irritation should be immediately admitted to an intensive care unit and carefully watched for 24-48 hours. Delayed pulmonary edema is likely in patients with burns of the skin of face or neck.

If pulmonary edema develops, the patient should be placed in IPPB with Positive End-Expiratory Pressure (PEEP). The administration of respiratory care should be very closely supervised, including the continuing administration of calcium gluconate by inhalation.

Toxicity from pulmonary absorption of fluoride ion may rapidly develop in the liver and kidneys and may require more energetic measures of control, up to and including hemodialysis, if the blood urea nitrogen and potassium rise. Supportive care is necessary for all organ systems.

For more details on the handling of major Hf exposures, see the article: M. A. Trevino et al., J. Occ. Med., 25, p. 861 (1983).

## PROTECTION INFORMATION

### GENERALLY APPLICABLE CONTROL MEASURES

Use only with ventilation sufficient to keep vapor concentrations below the exposure limit. Use forced draft ventilation and scrubbers for fume control.

### PERSONAL PROTECTIVE EQUIPMENT

Have available and wear as appropriate: chemical splash goggles; full-length face shield; "Neoprene" or PVC plastic gauntlet gloves; rubber shoes or boots with PVC or "Neoprene" soles; long sleeve coveralls; hard hat with brim. If there is any possibility of direct contact, wear full acid-proof suit with hood, boots, and self-contained breathing apparatus.

Protective equipment should not be worn or carried outside of operating area.

## DISPOSAL INFORMATION

### AQUATIC TOXICITY

No definitive information is available. The estimated 96 hour LC 50 is 1-50 ppm.

### SPILL, LEAK OR RELEASE

Evacuate area and keep upwind until gas has dispersed. Enter contaminated area only with full protective equipment and self-contained breathing apparatus. Dike spill. Dilute with water fog (direct addition of water or alkali causes heat and violent spattering). Neutralize with lime. Do not flush to sewer. Comply with Federal, State and local regulations on reporting releases.

### WASTE DISPOSAL

Comply with Federal, State, and local regulations.

SHIPPING INFORMATION

DOT (172.101)

PROPER SHIPPING NAME Hydrogen Fluoride  
HAZARD CLASS Corrosive Material  
UN NO. 1052  
DOT LABEL(S) Corrosive  
DOT PLACARD (TT/TC) Corrosive

IMO (PAGE 8102-1)

PROPER SHIPPING NAME Hydrogen Fluoride, Anhydrous  
HAZARD CLASS 8  
UN NO. 1052  
IMO LABEL(S) Corrosive  
Poison

DOT/IMO (172.102)

PROPER SHIPPING NAME Hydrogen Fluoride  
HAZARD CLASS Corrosive Material, I  
UN NO. 1052  
SUBSIDIARY RISK Poison

IATA/ICAO

Forbidden to ship via air  
PROPER SHIPPING NAME Not applicable  
HAZARD CLASS Not applicable  
UN NO. Not Applicable  
SUBSIDIARY RISK Not applicable  
LABEL(S) Not applicable  
PACKAGING GROUP NO. Not applicable

OTHER INFORMATION

REPORTABLE QUANTITY 5.000 lb/2,270 kg  
SHIPPING CONTAINERS Tank cars, tank trucks, portable tanks  
STORAGE CONDITIONS Keep away from heat, sparks, and flame. Keep container tightly closed. Drainage facilities should be constructed for containment of small spills.

ADDITIONAL INFORMATION AND REFERENCES

For further information, see Du Pont's Hydrofluoric Acid "Data Sheet" and Properties, Uses, Storage, and Handling Bulletin.

DATE OF LATEST REVISION/REVIEW: 5/85  
PERSON RESPONSIBLE FOR MSDS: J. C. WATTS, Du Pont Co., C&P Dept., Chestnut Run, Wilmington, DE 19898, (302) 999-4946



EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: MISCIBLE PAGE 02 OF 06  
SOLVENT SOLUBILITY: ETHER ODDOR THRESHOLD: <5.0 PPM VAPOR DENSITY: 2.2

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FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:  
INCREASES THE FLAMMABILITY OF COMBUSTIBLES, ORGANIC MATERIAL, AND READILY OXIDIZABLE MATERIALS, CAUSING IGNITION OF SOME. SEVERE EXPLOSION HAZARD BY REACTION WITH MANY INCOMPATIBLES, INCLUDING METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, AND TURPENTINE. IN OR NEAR FIRE, MATERIAL EMITS TOXIC AND REACTIVE NITROGEN OXIDES AS GASES.

FLASH POINT: NONCOMBUSTIBLE

FIREFIGHTING MEDIA:  
WATER SPRAY

FIREFIGHTING:  
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH USING AGENTS INDICATED. IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND

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TOXICITY

430 MG/KG ORAL-HUMAN LDLO; 110 MG/KG UNKNOWN-MAN LDLO;  
CARCINOGEN STATUS: NONE.  
NITRIC ACID IS A SEVERE EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT.

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HEALTH EFFECTS AND FIRST AID

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INHALATION:

CORROSIVE. 100 PPM IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.  
ACUTE EXPOSURE- MAY CAUSE COUGHING, HEADACHE, DIZZINESS, AND WEAKNESS.  
DELAYED SYMPTOMS MAY INCLUDE DRYNESS OF THE THROAT AND NOSE, CHEST PAIN OR TIGHTNESS, DYSPNEA, FROTHY SPUTUM, HYPOTENSION AND CYANOSIS FOLLOWED BY PNEUMONITIS AND PULMONARY EDEMA, WHICH MAY BE FATAL. IF PATIENT RECOVERS, SCAR TISSUE MAY CAUSE STRICTURE OF THE PYLORUS OR ESOPHAGUS.

-----  
CHRONIC EXPOSURE-- REPEATED OR PROLONGED EXPOSURE CAUSES DENTAL EROSION FOLLOWED BY JAW NECROSIS, CHRONIC COUGH AND BRONCHITIS OR CHEMICAL PNEUMONITIS AND GASTROINTESTINAL DISTURBANCES.

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FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST.

SKIN CONTACT:  
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR CONCENTRATED VAPOR CAUSES IMMEDIATE SEVERE AND PENETRATING BURNS, STAINING THE SKIN YELLOW OR YELLOWISH-BROWN.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION.

EYE CONTACT:  
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE PAIN, PHOTOPHOBIA, TEARING, EDEMA, CORNEAL ULCERATION, SEVERE BURNS, AND NECROSIS OF THE DEEPER TISSUES WITH PERMANENT DAMAGE AND BLINDNESS IS POSSIBLE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN PRESENCE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION.

INGESTION:  
CORROSIVE.

ACUTE EXPOSURE- IMMEDIATE PAIN IN THE MOUTH, THROAT, AND STOMACH MAY BE FOLLOWED BY VOMITING, AND DIARRHEA OF DARK PRECIPITATED BLOOD. HYPOTENSION, OLIGURIA, ANURIA, SEVERE, POSSIBLY FATAL, CIRCULATORY COLLAPSE, AND ASPHYXIA FROM EDEMA OF THE GLOTTIS ARE POSSIBLE. BURNS OF THE GASTROINTESTINAL TRACT MAY BE SEVERE ENOUGH TO CAUSE PERFORATION OF THE ESOPHAGUS AND STOMACH WHICH MAY BE FOLLOWED BY MEDIASTINITIS OR PERITONITIS, INDICATED BY FEVER.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GIVE PATIENT 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

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REACTIVITY

REACTIVITY:

STABLE UNDER NORMAL TEMPERATURES AND PRESSURES. HOWEVER NITRIC VAPOR AND/OR NITRIC OXIDES ARE QUIETLY EVOLVED. ALSO SUNLIGHT CATALYSES THE FORMATION OF THE OXIDES AND THIS GIVES A YELLOW COLOR TO THE CONCENTRATED ACID.

INCOMPATIBILITIES:  
EASILY OXIDIZED SUBSTANCES, EXAMPLES FOLLOW:

EXPLOSION: ACETONITRILE, CESIUM CARBIDE, CUPRIC NITRIDE, CYANIDES, 1,2-DIAMINOETHANE, BISTRIMETHYL GOLD, DINITROTOLUENE, EPICHLOROHYDRIN, 5-ETHYL-2-METHYL PYRIDINE, CYCLOPENTADIENE, BENZENE, TOLUENE, METALS, METAL CARBIDES, 4-METHYLCYCLOHEXANONE, NITROBENZENE AND WATER, NITROMETHANE, POLYBROMOSILANES, PHOSPHORUS TRICHLORIDE, POTASSIUM HYPOPHOSPHITE (ON EVAPORATION), RUBIDIUM CARBIDE, SELENIUM IODOPHOSPHIDE, SULFUR DIOXIDES, THIOCYANATES,

PROBABLE EXPLOSION: ACETONE AND ACETIC ACID, SULFURIC ACID AND GLYCERIDES, TRIAZINE AND TRIFLUOROACETIC ANHYDRIDE @ 36 C.  
 POSSIBLE EXPLOSION: ACETIC ACID, I-AMINOETHANOL AND SULFURIC ACID, CYANATES, 1,3-CYCLOPENTADIENE, FLUORINE, LACTIC ACID AND HYDROGEN FLUORIDE, MESITYLENE, ORGANIC SUBSTANCES AND SULFURIC ACID, ORGANIC SUBSTANCES AND PERCHLORATES, PHTHALIC ACID OR PHTHALIC ANHYDRIDE AND SULFURIC ACID, REDUCING AGENTS, SULFURIC ACID, TITANIUM ALLOY.  
 EXPLOSION BY FRICTION OR IMPACT: ACETIC ANHYDRIDE.  
 EXPLOSIVE OXIDATION: NON-METAL OXIDES - ARSINE, PHOSPHINE, OR TETRABORANE, DIPHENYLDISIBENE.

POSSIBLE EXPLOSION BY IMPACT : TITANIUM-MAGNESIUM ALLOY.  
 VIOLENT REACTION: ACRYLONITRILE, ALCOHOLS, ARSINE, CARBON (PULVERIZED), CHLORINE TRIFLUORIDE, CUPROUS NITRIDE, CYCLIC KETONES, CYCLOHEXANOL, ETHANOL, GERMANIUM, HYDRAZINE, SULFUR HALIDES, SULFURIC ACID AND TEREPHTHALIC ACID, THIOALDEHYDES OR THIOKETONES, URANIUM, URANIUM ALLOYS.  
 VIOLENT OXIDATION: ACETONE AND SULFURIC ACID, SULFAMIC ACID.  
 VIOLENT DECOMPOSITION: BUTANETHIOL, PHOSPHINE.  
 VIOLENT DECOMPOSITION RESULTING IN IGNITION: CROTONALDEHYDE, TETRAPHOSPHORUS TRIOXIDE.

POSSIBLE VIOLENT REACTION: ANTIMONY.  
 POSSIBLE VIOLENT EXOTHERMIC REACTION: ANION EXCHANGE RESIN.  
 INTENSE EXOTHERMIC REACTION: ACROLEIN, ALLYL ALCOHOL, ALLYL CHLORIDE, 2-AMINOETHANOL, AMMONIUM HYDROXIDE, BISMUTH, N-BUTYRALDEHYDE, CHLOROSULFONIC ACID, CRESOL, CUMENE, DIISOPROPYL ETHER, ETHYLENEDIAMINE, POLYALKENES, GLYOXAL, ISOPRENE, MESITYL OXIDE, 2-METHYL-5-ETHYLPYRIDINE, OLEUM, PROPYLENE OXIDE, PROPIOLACTONE (BETA-), PYRIDENE, SODIUM HYDROXIDE, VINYL ACETATE, VINYLIDENE CHLORIDE.

INTENSE REACTION: DIETHYLETHER, HYDRAZOIC ACID, P-XYLENE IN THE PRESENCE OF SULFURIC ACID, SELENIUM, SODIUM AZIDE, TOLUENE, TRIMETHYLTRIOXANE.  
 IGNITION WITH POSSIBLE EXPLOSION: HYDROGEN TELLURIDE.  
 IGNITION: ANILINE, BORON PHOSPHIDE, BROMINE PENTAFLUORIDE, N-BUTYLMERCAPTAN, CALCIUM HYPOPHOSPHITE, DIBORANE, DIPHENYL TIN, M-ETHYL ANILINE, ETHYL PHOSPHINE, FURFURYL ALCOHOL, HALOGEN PHOSPHIDES, HYDROGEN IODIDES, LITHIUM, METALS, PHOSPHONIUM IODIDE, PHOPHORUS, SELENIUM HYDRIDE, SODIUM, TERPENES, TOLUIDINE, TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX, UNS-DIMETHYLHYDRAZINE.  
 POSSIBLE IGNITION: AMMONIA, ANION EXCHANGE RESIN AND CHROMITES OR DICHROMATE, AROMATIC AMINES, DIVINYL ETHER, DIENE OR ACETYLENE DERIVATIVES, LITHIUM, REDUCING AGENTS.

INCANDESCENT REACTION: BORON, FERROUS OXIDE (POWDER), HYDROGEN SULFIDE, LITHIUM SILICIDE, SELENIUM HYDRIDE, MAGNESIUM PHOSPHIDE, MANGANESE, ZINC.  
 FORMATION OF HIGHLY EXPLOSIVE PRODUCTS: NITROAROMATIC HYDROCARBONS.  
 FORMATION OF EXPLOSIVE PRODUCTS: ACETYLENE, 4-CHLORO-2-NITROANILINE, CYCLOHEXANE, CYCLOHEXYLAMINE, 2,6-DI-T-BUTYL PHENOL, DICHLOROMETHANE, ETHANOL AND SILVER, 5-ETHYL-2-PICOLINE, HYDROGEN PEROXIDE AND KEITONES, HYDROGEN PEROXIDE AND MERCURIC OXIDE, HYDROGEN PEROXIDE AND THIOUREA, INDANE AND SULFURIC ACID, METAL SALICYLATES, PHENYLORTHOPHOSPHORIC ACID DISODIUM SALT, TITANIUM.  
 FORMATION OF POSSIBLY EXPLOSIVE PRODUCTS: BENZOTHIOPHENE DERIVATIVES.  
 FORMATION OF EASILY COMBUSTIBLE ESTER: CELLULOSE.  
 DETONATABLE MIXTURE (DEPENDING ON AMOUNT OF WATER PRESENT): NITROBENZENE.

DECOMPOSITION:  
 DECOMPOSES ON EXPOSURE TO AIR OR ORGANIC MATTER, OR WITH HEAT, TO RELEASE HIGHLY TOXIC FUMES OR OXIDES OF NITROGEN, INCLUDING NITRIC OXIDE AND NITROGEN DIOXIDE, AND HYDROGEN NITRATE. REACTS WITH THE FOLLOWING TO RELEASE TOXIC GASES: SULFIDES, CARBONATES, CYANIDES. VIOLENT REACTION WITH ALL CARBIDES, GAS MIXTURE EVOLVED (N2O4) REACTS STRONGLY WITH HYDROCARBONS, FLUORINE, OR



\*\*\*\*\* ACID\*\*

OF CONTACT WITH CHEMICAL.

GLOVES: WEAR IMPERVIOUS GLOVES AS NECESSARY TO AVOID ANY POSSIBILITY OF CONTACT WITH SUBSTANCE. PREFERRED MATERIALS: VITON OR SARANEX.

EYE PROTECTION: WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC  
REVISION DATE: 10/21/85  
CREATION DATE: 02/10/85

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10036

\*\*SODIUM HYDROXIDE\*\*  
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\*\*SODIUM HYDROXIDE\*\*

MATERIAL SAFETY DATA SHEET

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CHEMICAL DIVISION  
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FAJR LAWN NJ 07410  
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SUBSTANCE IDENTIFICATION

SUBSTANCE: \*\*SODIUM HYDROXIDE\*\*  
CAS-NUMBER 1310-73-2  
TRADE NAMES/SYNONYMS: CAUSTIC SODA; SODA LYE; LYE; WHITE CAUSTIC; CAUSTIC ALKALI; CAUSTIC SODA, BEAD; CAUSTIC SODA, DRY; CAUSTIC SODA, FLAKE; CAUSTIC SODA, GRANULAR; CAUSTIC SODA, SOLID; SODIUM HYDRATE; SODIUM HYDROXIDE, BEAD; SODIUM HYDROXIDE, FLAKE; SODIUM HYDROXIDE, DRY; SODIUM HYDROXIDE, SOLID; S-613 ASCARITE; S-318; S-320; S-612

CHEMICAL FAMILY:  
INORGANIC BASE

MOLECULAR FORMULA: NA-O-H MOL WT: 40.00

OSHA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

- PERCENT: 97 COMPONENT: SODIUM HYDROXIDE
- PERCENT: 0.50 COMPONENT: SODIUM CARBONATE
- PERCENT: .008 COMPONENT: SODIUM CHLORIDE
- PERCENT: <0.1 COMPONENT: SODIUM SULFATE
- PERCENT: 0.1 COMPONENT: POTASSIUM, CALCIUM, AND MAGNESIUM

OTHER CONTAMINANTS: SILICON DIOXIDE (0.03%) AND OTHER METALS (0.01%).

OTHER COMMENTS:

354  
1003

PHYSICAL DATA

DESCRIPTION: ODORLESS, WHITE OR OFF-WHITE HYGROSCOPIC SOLID.

BOILING POINT: 2534 F (1390 C) MELTING POINT: 605 F (318 C)

SPECIFIC GRAVITY: 2.1 VAPOR PRESSURE: 42 MMHG @ 1000 C

PH: 14 FOR A 5% AQ SOLN SOLUBILITY IN WATER: 42%

SOLVENT SOLUBILITY: ALCOHOL, GLYCEROL.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:  
NEGLECTIBLE FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: NON-FLAMMABLE

FIREFIGHTING MEDIA:  
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM  
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE FLOODING QUANTITIES OF WATER.

FIREFIGHTING:  
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES  
WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT (1984 EMERGENCY RESPONSE  
GUIDEBOOK, DOT P 5800.3).

TOXICITY

1%/24 HOURS EYE-MONKEY SEVERE IRRITATION; 50 MG/24 HOURS SKIN-RABBIT SEVERE  
IRRITATION; 1% EYE-RABBIT SEVERE IRRITATION; 50 UG/24 HOURS EYE-RABBIT SEVERE  
IRRITATION; 1 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION;  
CARCINOGEN STATUS: NONE.

SODIUM HYDROXIDE IS AN EYE AND MUCOUS MEMBRANE IRRITANT AND SEVERE SKIN  
IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:  
-CORROSIVE. 200 MG/M3 IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.  
ACUTE EXPOSURE- THE EFFECTS OF THE DUST OR MIST WILL VARY FROM MILD  
IRRITATION OF THE NOSE @ 2 MG/M3 TO SEVERE PNEUMONITIS DEPENDING ON THE  
SEVERITY OF EXPOSURE. LOW CONCENTRATIONS MAY CAUSE SORE THROAT, COUGHING,  
AND LABORED BREATHING. INTENSE EXPOSURES MAY RESULT IN DELAYED PULMONARY  
EDEMA.

CHRONIC EXPOSURE- PROLONGED EXPOSURE MAY CAUSE BRONCHIAL IRRITATION,  
COUGHING, BRONCHIAL PNEUMONIA, AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING

\*\*\*SODIUM HYDROXIDE\*\* PAGE 03 OF 06  
HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

SKIN CONTACT:  
CORROSIVE.

ACUTE EXPOSURE-- ON THE SKIN, SOLUTIONS OF 25 TO 50% MAY CAUSE THE SENSATION OF IRRITATION WITHIN ABOUT 3 MINUTES. WITH SOLUTIONS OF 4% THIS DOES NOT OCCUR UNTIL AFTER SEVERAL HOURS. IF NOT REMOVED FROM THE SKIN, SEVERE BURNS WITH DEEP ULCERATION MAY OCCUR. EXPOSURE TO THE DUST OR MIST MAY CAUSE MULTIPLE SMALL BURNS AND TEMPORARY LOSS OF HAIR.

CHRONIC EXPOSURE-- REPEATED EXPOSURE MAY RESULT IN DERMATITIS.

FIRST AID-- REMOVE CONTAMINATED CLOTHING WHILE RUNNING STREAMS OF WATER UNDER CLOTHING. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER (APPROXIMATELY 15-20 MINUTES) UNTIL NO EVIDENCE OF CHEMICAL REMAINS. FOR CHEMICAL BURNS, APPLY STERILE BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION.

EYE CONTACT:  
CORROSIVE.

ACUTE EXPOSURE-- CONTACT MAY CAUSE DISINTEGRATION AND SLOUGHING OF CONJUNCTIVAL AND CORNEAL EPITHELIUM, CORNEAL OPACIFICATION, MARKED EDEMA AND ULCERATION; AFTER 7 TO 13 DAYS EITHER GRADUAL RECOVERY BEGINS OR THERE IS PROGRESSION OF ULCERATION AND CORNEAL OPACIFICATION. COMPLICATIONS OF SEVERE EYE BURNS ARE SYMBLEPHARON WITH OVERGROWTH OF THE CORNEA BY A VASCULARIZED MEMBRANE, PROGRESSIVE OR RECURRENT CORNEAL ULCERATION AND PERMANENT CORNEAL OPACIFICATION.

CHRONIC EXPOSURE-- REPEATED OR PROLONGED VAPOR CONTACT AT LOW LEVELS OF EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID-- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:  
CORROSIVE.

ACUTE EXPOSURE-- SEVERE ABDOMINAL PAIN, CORROSION OF THE LIPS, MOUTH, TONGUE, AND PHARYNX, AND VOMITING OF LARGE PIECES OF MUCOSA. ASPHYXIA CAN OCCUR FROM SWELLING OF THE THROAT. PERFORATION OF THE ESOPHAGUS AND STOMACH CAN OCCUR. CASES OF SQUAMOUS CELL CARCINOMA OF THE ESOPHAGUS HAVE OCCURRED WITH LATENT PERIODS OF 12 TO 42 YEARS AFTER INGESTION; A RESULT TISSUE DESTRUCTION AND POSSIBLY SCAR FORMATION RATHER THAN THE RESULT OF DIRECT CARCINOGENIC ACTION.

FIRST AID-- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ALKALI. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:

THE SUBSTANCE IS A STRONG BASE. IT REACTS EXOTHERMICALLY WITH WATER RELEASING CORROSIVE FUMES OF SODIUM HYDROXIDE.

## INCOMPATIBILITIES:

ACETALDEHYDE: RESULTS IN VIOLENT POLYMERIZATION OF ACETALDEHYDE.  
ACETIC ACID: MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE  
ACETIC ANHYDRIDE: MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
ACROLEIN: RESULTS IN AN EXTREMELY VIOLENT POLYMERIZATION OF ACROLEIN.  
ACRYLONITRILE: VIOLENT POLYMERIZATION.  
ALLYL ALCOHOL: AS A BENZENE EXTRACT OF ALLYL BENZENESULFONATE WAS PREPARED FROM ALLYL ALCOHOL AND BENZENE SULFONYL CHLORIDE IN THE PRESENCE OF AQUEOUS SODIUM HYDROXIDE, UNDER VACUUM DISTILLATION TWO FRACTIONS CAME OFF, THEN THE TEMPERATURE ROSE TO 135 C, WHEN THE RESIDUE DARKENED AND EXPLODED.  
ALLYL CHLORIDE: IN CONTACT WITH DRY CAUSTIC SODA BEADS, HYDROLYSIS MAY TAKE PLACE PRODUCING ALLYL ALCOHOL.  
ALUMINUM: VIGOROUS REACTION WITH THE EVOLUTION OF FLAMMABLE HYDROGEN GAS.  
CHLORINE TRIFLUORIDE: VIOLENT REACTION.  
CHLOROFORM AND METHYL ALCOHOL: EXOTHERMIC REACTION.  
CHLOROHYDRIN: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
CHLORONITROTOLUENES: POSSIBLE EXPLOSION.  
CHLOROSULFONIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
1,2-DICHLOROETHYLENE: MAY FORM SPONTANEOUSLY FLAMMABLE MONOCHLOROACETYLENE.  
ETHYLENE CYANOHYDRIN: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
GLYOXAL: MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
HALOGENATED HYDROCARBONS: VIOLENT REACTION.  
HYDROCHLORIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
HYDROFLUORIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
HYDROQUINONE: RAPID DECOMPOSITION OF HYDROQUINONE WITH EVOLUTION OF HEAT.  
MALEIC ANHYDRIDE: EXPLOSIVE DECOMPOSITION.  
METALS: CORRODES METALS, REACTING TO FORM FLAMMABLE HYDROGEN GAS.  
NITRIC ACID: MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE  
NITROETHANE: FORMS AN EXPLOSIVE SALT.  
NITROMETHANE: FORMS AN EXPLOSIVE SALT.  
NITROPARAFFINS: THE NITROPARAFFINS, IN THE PRESENCE OF WATER, FORM DRY SALTS WITH ORGANIC BASES. THE DRY SALTS ARE EXPLOSIVE.  
NITROPROPANE: FORMS AN EXPLOSIVE SALT.  
OLEUM: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
PENTOL (3-METHYL-2-PENTEN-4-YN-1-OL): POSSIBLE EXPLOSION.  
PHOSPHORUS: PHOSPHORUS BOILED WITH ALKALINE HYDROXIDES YIELDS MIXED PHOSPHINES WHICH MAY IGNITE SPONTANEOUSLY IN AIR.  
PHOSPHORUS PENTOXIDE: EXTREMELY VIOLENT REACTION WHEN INITIATED BY LOCAL HEATING.  
B-PROPIOLACTONE: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
SULFURIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
TETRACHLOROBENZENE AND METHYL ALCOHOL: POSSIBLE EXPLOSION.  
TETRAHYDROFURAN: SERIOUS EXPLOSIONS CAN OCCUR.  
TRICHLOROETHYLENE: FORMATION OF EXPLOSIVE MIXTURES OF DICHLOROACETYLENE.  
WATER: CAUSTIC SODA BEADS IN CONTACT WITH WATER MAY GENERATE ENOUGH HEAT TO IGNITE ADJACENT COMBUSTIBLES.

DECOMPOSITION: MAY RELEASE TOXIC FUMES OF SODIUM OXIDE, WHICH CAN REACT WITH WATER OR STEAM TO PRODUCE HEAT AND FLAMMABLE HYDROGEN VAPORS.

POLYMERIZATION: NOT KNOWN TO OCCUR.

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CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. MAY IGNITE COMBUSTIBLES (WOOD, PAPER, OIL, ETC.).

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SPILL AND LEAK PROCEDURES

SOIL SPILL: DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

USE PROTECTIVE COVER SUCH AS A PLASTIC SHEET TO PREVENT MATERIAL FROM DISSOLVING IN FIRE EXTINGUISHING WATER OR RAIN.

WATER SPILL: ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

OCCUPATIONAL SPILL: DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

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PROTECTIVE EQUIPMENT

VENTILATION: PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMITS.

RESPIRATOR: 100 MG/M3- HIGH-EFFICIENCY PARTICULATE RESPIRATOR WITH A FULL FACEPIECE. SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD. SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

200 MG/M3- POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE FILTER AND A FULL FACEPIECE. TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

ESCAPE- DUST MASK, EXCEPT SINGLE-USE AND QUARTER-MASK RESPIRATORS. SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

- 1) CLOTHING: EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.
- 2) GLOVES: EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.
- 3) EYE PROTECTION: EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.
- 4) WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC  
- CREATION DATE: 01/21/85 REVISION DATE: 05/01/85

-ADDITIONAL INFORMATION-  
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FIRE HAZARD

MANY URANIUM COMPOUNDS ARE FLAMMABLE. IF IN FIRE, URANIUM COMPOUNDS ARE NOT COMBUSTIBLE. IF IN FIRE, URANIUM COMPOUNDS MAY EMIT TOXIC PRODUCTS. SOME COMPOUNDS ARE WATER REACTIVE. SEE SPECIFIC COMPOUND.

HEALTH HAZARD

HIGHLY TOXIC AND RADIOACTIVE. URANIUM COMPOUNDS ARE TOXIC IF THEY ARE INHALED, SWALLOWED, OR IF THEY COME IN CONTACT WITH THE EYES OR SKIN. URANIUM INSOLUBLE COMPOUNDS ARE LESS TOXIC THAN THE SOLUBLE COMPOUNDS. THEY ARE WEAKLY RADIOACTIVE AND ARE PRINCIPALLY ALPHA PARTICLE EMITTERS. THEY DO NOT CONSTITUTE A SIGNIFICANT EXTERNAL RADIATION AND CHEMICAL HAZARD. THEY MAY CAUSE AN INCREASE IN CANCER OF THE LYMPHATIC AND BLOOD-FORMING TISSUES IN MAN. PROLONGED CONTACT WITH THE SKIN MIGHT CAUSE RADIATION DAMAGE TO THE SKIN AND/OR SKIN RASH (DERMATITIS). PROLONGED INHALATION HAS CAUSED DAMAGE TO THE LUNGS OF ANIMALS. THEY ARE HIGHLY TOXIC TO THE KIDNEY AND LIVER.

CHEMICAL INCOMPATIBILITIES

VARIABLES WITH COMPOUND.

MEDICAL RECOMMENDATIONS

SPECIAL ATTENTION SHOULD BE GIVEN TO THE BLOOD, LUNGS, KIDNEY, AND LIVER IN PREEMPLOYMENT MEDICAL EXAMS. PERIODIC MEDICAL EXAM SHOULD INCLUDE A CHEST X-RAY, URINALYSIS, COMPLETE BLOOD COUNT AND CHEMISTRY

PHYSICAL DESCRIPTION

VARIABLES WITH COMPOUND.

PROTECTION MEASURES

GOOD ENGINEERING CONTROLS SHOULD BE USED TO REDUCE ENVIRONMENTAL CONCENTRATION TO THE PERMISSIBLE EXPOSURE LEVEL (PEL). ABOVE THE PEL, RESPIRATORY PROTECTION MUST BE WORN. AT A U CONCENTRATION OF 2.5 MG/L OR LESS WEAR ANY FUME RESPIRATOR OR HIGH EFFICIENCY PARTICULATE RESPIRATOR APPROVED FOR RADIONUCLIDES. A SUPPLIED-AIR RESPIRATOR, OR A SCBA. EMPLOYEES SHOULD WEAR IMPERVIOUS CLOTHING, GLOVES, AND BOGGIES TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH SOLIDS OR LIQUIDS URANIUM OR INSOLUBLE COMPOUNDS. SKIN THAT BECOMES CONTAMINATED WITH URANIUM OR INSOLUBLE COMPOUNDS SHOULD BE PROMPTLY WASHED WITH SOAP OR MILD DETERGENT AND WATER. EATING AND SMOKING SHOULD NOT BE PERMITTED IN AREAS WHERE SOLIDS OR LIQUIDS CONTAINING URANIUM OR INSOLUBLE COMPOUNDS ARE HANDLED, PROCESSED, OR STORED. EMPLOYEES WHO HANDLE SOLIDS OR LIQUIDS CONTAINING URANIUM OR INSOLUBLE COMPOUNDS SHOULD WASH THEIR HANDS THOROUGHLY WITH SOAP OR MILD DETERGENT AND WATER BEFORE EATING, SMOKING, OR USING TOILET FACILITIES.

SAMPLING METHODS

NO STANDARD MEASUREMENT METHODS FOR URANIUM COMPOUNDS HAVE BEEN PUBLISHED BY NIOSH. MAY BE SAMPLED USING A CELLULOSE ESTER FILTER AND ANALYZED BY ATOMIC ABSORPTION.

SHIPPING INFORMATION

SHIP AS RADIOACTIVE MATERIAL. OTHER REQUIREMENTS VARY WITH COMPOUND, LEVEL OF RADIOACTIVITY, PROPORTION OF FISSIONABLE ISOTOPES AND AMOUNT SHIP.

CHEMICAL CATEGORIES  
05/23/1986

CATEGORY	CLASS NAME	CLASS CODE
***		
* CHEMICAL	URANIUM COMPOUNDS	
* HAZARD CODE	HEALTH	3
* HEALTH HAZARD	KIDNEY	
* PHYSICAL HAZARD	RADIOACTIVE	
* TRANSPORTATION	RADIOACTIVE	
CHEM NAME	URANIUM COMPOUNDS	

ATTRIBUTE	VALUE	UNITS	QUALITY	COMMENTS
***				
* HALF LIFE	4.500	10E9 YEARS		
* EXPOSURE LIMIT	0.050	MG/CU.M	PEL	SOLUBLE U
* EXPOSURE LIMIT	0.200	MG/CU.M	TLV	AS U
* EXPOSURE LIMIT	0.250	MG/CU.M	PEL	AS INSOLUB

SELECTED MATERIALS THAT ARE RELATED TO OR CONTAIN THE SUBSTANCE  
05/23/1986

CHEM NAME\* URANIUM COMPOUNDS

- \*\*\*
- \* URANIUM
- \* URANIUM DICARBIDE
- \* URANIUM DIOXIDE
- \* URANIUM HEXAFLUORIDE
- \* URANIUM HYDRIDE
- \* URANIUM TETRAFLUORIDE
- \* URANYL NITRATE