SAFETY PLAN AND TRAINING PLAN FOR REMEDIAL INVESTIGATION OF EXCESSED LAND AT TRUMAN ANNEX NAS KEY WEST FL

5/1/1988

GERAGHTY AND MILLER INC

Safety Plan and Training Plan

REMEDIAL INVESTIGATION
EXCESSED LAND OF TRUMAN ANNEX
KEY WEST, FLORIDA

Prepared for

DEPARTMENT OF THE NAVY
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina

Contract No. N62467-87-C-0026

G&M Project No. TO290TA01

May 1988

Prepared by

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GENERAL INFORMATION

Client: Department of the Navy Job No. T0290TA01
Naval Facilities Engineering Command
Southern Division

Project Manager: Ms. Jean A. Hebert

Site: Excessed Land at the Truman Annex

Site Location: Key West, Florida

Purpose of Site Investigation: A section of the NAS Key West property (formerly know as the Truman Annex) was purchased for purposes of redevelopment. During the demolition of two buildings and subsequent regrading of the underlying ground surface, a yellow discoloration of the soils was observed. The analysis of soil samples collected at the site from selected depth intervals reported chromium concentrations in excess of 5 milligrams per liter by the EP toxicity test procedure.

As a result of the soil sampling and analysis program, an investigation is being undertaken to evaluate the extent of soil containing chromium.

Duration of Site Investigation: After notice to proceed, approximately 1 week.

Overall Hazard Summary:

Serious	_____	Moderate	_____
Low	X	Unknown	_____

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INTRODUCTION

This Safety Plan and Training Plan (STP) has been prepared by Geraghty & Miller, Inc., (G&M) as a supporting document to an investigation of soil and ground-water contamination at property excessed from Truman Annex in Key West, Florida. This STP is being submitted to the Navy to support an investigation of excessed land of the Truman Annex at NAS Key West. Chromium containing soils at the site were discovered during the removal of old naval buildings in preparation for new construction. The objective of this work will be to determine if complete removal of chromium contaminated soil by the present land owner has been achieved.

ORGANIZATION AND RESPONSIBILITIES

Staffing and Lines of Authority

The project Safety and Health Organization Chart (Table 1) shows the relationship and responsibilities of members of the investigative team listed below.

Department of the Navy, Project Manager: Mr. Robert Moser

- The Project Manager is responsible for coordinating the review of the STP.

Activity Coordinator: Mr. Steve Covell

- The Activity Coordinator is the local Navy Representative for the G&M Project Manager and will be notified in case of emergencies and when changes are anticipated in the STP.

A-E Project Manager: Ms. Jean A. Hebert

- The A-E Project Manager is responsible for overseeing the preparation of the STP and the enforcement of the provisions specified in the STP.

Site Safety and Health Officer (SSHO): Dr. Ralph E. Moon

- The SSHO, who reports to the A-E Project Manager, is responsible for the preparation of the STP. In addition, the SSHO is responsible for all aspects of

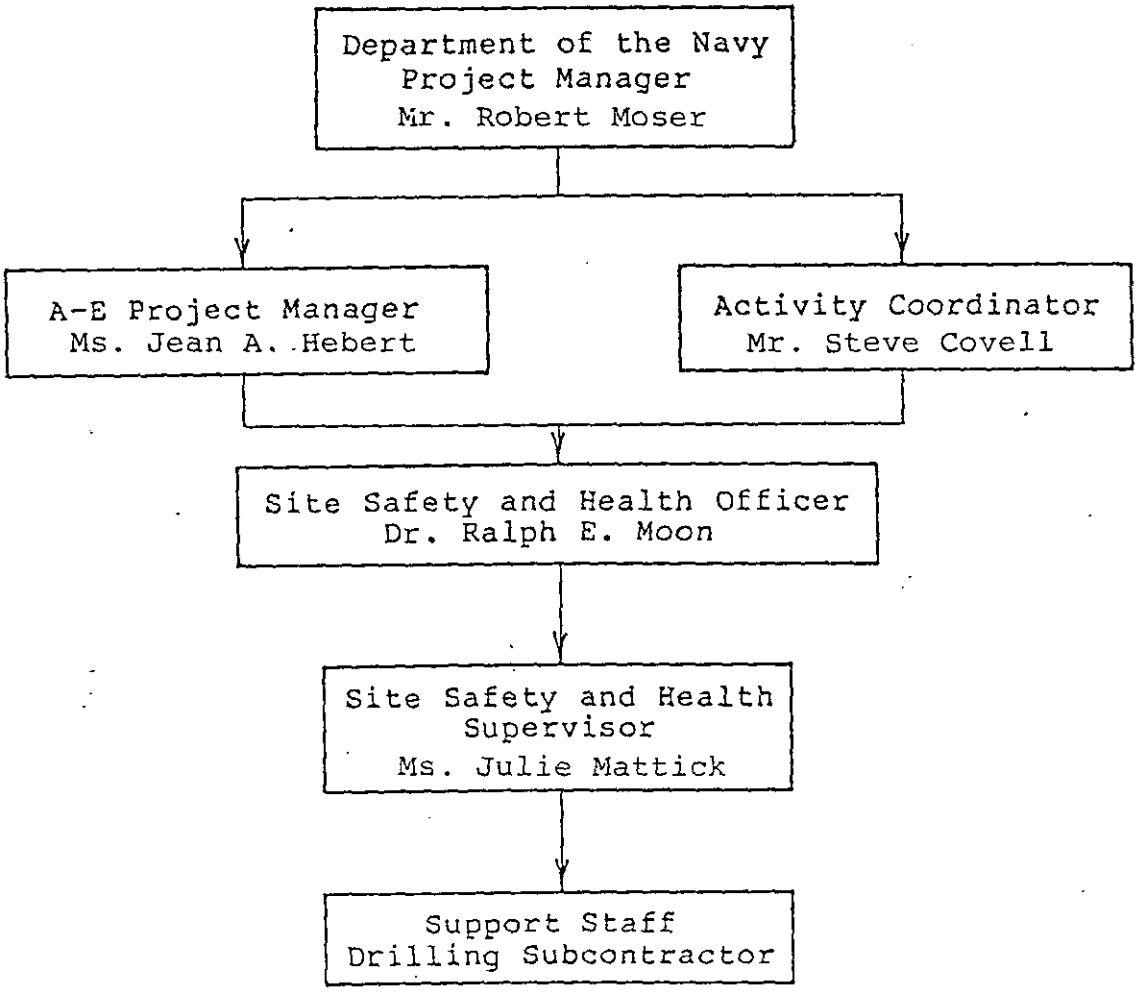

Table 1. Project Safety and Health Organization Chart.

safety and health as described in the plan including training and medical monitoring.

Site Safety and Health Supervisor (SSHS): Ms. Julie Mattick

- The SSHS helps assure compliance with all provisions of the STP. The SSHS controls the entry and exit of all personnel at each boring and monitor-well installation location, performs the tasks necessary to evaluate the air quality in the breathing zone, and carries out decontamination procedures described in the STP. The SSHS has the highest health and safety authority at the site and is responsible to notify the SSHO of hazardous working conditions not described in the plan and of changes in ambient conditions that require an upgrade or downgrade in personnel protection level.

Support Staff: Drilling Contractor

- All support staff must comply with the provisions of the STP.

SITE DESCRIPTION AND WASTE CHARACTERISTICS

A description of each waste site, disposal procedures, and a generic list of substances have been assembled along with G&M's recommendations for personnel protection. Toxicological data for each of the chemicals suspected at the NAS may be found in Appendix B.

Site Name: Truman Annex Excessed Land

Site Description: The parcel of property purchased from the Navy is approximately 103 acres. The site supported approximately 60 buildings which were leased by the federal government or to third parties for use as warehouses and/or businesses. Following demolition of one of the Quonset huts and regrading of the soils, discoloration of the surface and subsurface soils was observed. Approximately sixty (60) cubic yards of soil was removed to eliminate the discolored soil. Four ground-water monitor wells will be installed and ground-water and soil samples collected.

Substances of Safety and Health Concern:

Waste Solvents and Degreasing Agents		Sludge Disposal	
Radioactive Wastes		Corrosive Liquids	
Treated Industrial Wastes		Plating Wastes	
Liquid Waste/Free Product Potential		Metal Wastes	x
Asbestos Disposal		Cleaning Solutions	
		PCB Disposal	

Level of Personal Protection

Level A		Monitoring Parameters	
Level B		Total Ionizable Pollutants	x
Level C	x	Explosion Potential	x
Level D		Radiation	

WORKER TRAINING AND SAFETY AND HEALTH REQUIREMENTS

Site Preparation

The support area and decontamination corridors will be prepared for foot and vehicular traffic by removal of all obstructions at the soil-boring and monitor-well installation site. In addition, the site SSHS will visually inspect the immediate support area for sharp objects, wildlife (bees, wasps, snakes, etc.), and holes.

Worker Training

G&M will provide training during a 2-hour session with all subcontractor and service personnel assigned to or regularly entering the site for any investigation-related function. The purpose of the training session will be to acquaint all persons with the field investigation and the safety and health considerations of the site. The training session will include all of the provisions of the STP listed below and emergency instructions in case of chemical exposure or release, fire or explosion, and personal injury. Employees and subcontractors who have not been fitted for a respirator during the past six months will be fit tested using the Qualitative Fit Test Protocol described in Appendix C.

- STP.
- Physical health hazards including acute and chronic effects of chromium wastes.

- Personal hygiene requirements while working at the site.
- Proper use and fitting of respirators, if required.
- Work zones (exclusion zone, decontamination zone, and support zone) established at the site.
- Prohibitions while working in contaminated areas:
  (1) Beards and long sideburns.
  (2) Eating, smoking, chewing.
  (3) Personal articles, e.g., watches and rings.
  (4) Working when ill.
- Medical surveillance requirements prior to job start.
- Heat stress monitoring (when appropriate).

Following completion of the training session, an examination and discussion will be administered to all session participants to evaluate their comprehension of the STP (see Appendix D for a sample examination). The SSHS will allow only those personnel who have successfully completed the training session to enter the site.

In accordance with the Occupational Safety and Health Regulation Part IV, 29 CFR Part 1910, all employees will produce evidence of completion of a 40-hour safety and health training course (Appendix E).

Recordkeeping

G&M will establish and maintain records of all monitoring required as described below and shown in Table 2:

Table 2. DAILY INSTRUMENT LOG SHEET

Date: _____ Action Levels: _____

Analyst: _____ Threshold Levels: _____

Site: _____ Level of Personal Protection: _____

TIME	Photovac Tip	Draeger Tube	Draeger Tube	Explosion Meter	WEATHER CONDITIONS Temperature	Wind Direct.	Wind Speed

1. The dates, number, duration, and results of air samples taken during the investigation. These data will be written in an instrument log book that will be available for inspection at all times.

2. A description of the sampling and analytical methods used.

3. Type of respiratory protective devices worn.

Complaints

Employees are encouraged to report to the SSHS, either directly or through their authorized employee representative, any conditions or practices which they consider detrimental to their health or safety or which they believe are in violation of applicable safety and health standards. Such complaints may be made orally and then described in written form. Each subcontractor will also provide a form to be used in reporting violations (Appendix F).

An employee, or representative of employees, who believes that an imminent danger exists that may threaten or cause serious physical harm, is encouraged to bring the matter to the immediate attention of the SSHS for resolution. In the event of inadequate corrective action, the employee and/or authorized representative may also contact the SSHO or the Department of the Navy Project Manager.

Restrictions

A worker under age 18 will neither be employed in nor be allowed to enter controlled areas in such a manner that may be potentially injurious to his/her health.

Internal Audits

G&M will conduct internal safety and health audits to ensure compliance with the requirements of this plan. An audit will be conducted by the SSHO approximately one week after commencing the waste-characterization sampling and will provide follow-up actions if there is any violation of safety and health standards.

Controlled Areas

Controlled areas will be established to protect the workers from unnecessary exposure to toxic materials and to prevent the spread of contamination. Controlled areas include, but are not limited to, any work areas that meet the following condition:

- The potential exists for significant dispersal of contaminated material from a work area through personnel or equipment transfer.

Access to these areas will be controlled for people, vehicles, and equipment by fencing or other methods to prevent inadvertent exposure to contaminated material. While working near any military installation, controlled areas may

also include storage facilities for ordinances, fuel depots, access to landing strips, or any other area restricted to authorized personnel. A map will be provided to workers delineating controlled areas. Smoking, drinking, and eating are prohibited in controlled areas.

Posting

Controlled areas at the soil boring sites will be conspicuously marked at points of potential access with an appropriate sign or signs according to applicable posting and labeling requirements.

At times when it is necessary to barricade or "rope off" an area, all barricades, ropes, and warning signs, whether used in roadway or not, shall be placed in positions to limit visitor access and confine the size of the exclusion zone.

OCCUPATIONAL MONITORING AND SITE MANAGEMENT

Medical Surveillance

G&M has contracted the services of an occupational physician to provide medical examinations to all G&M employees involved with the investigation. Upon request, G&M will provide representatives of the Department of the Navy with medical evidence that each on-site person is in good health and is capable of wearing the appropriate dermal and respiratory protective clothing/equipment necessary during the investigation. All employees of G&M, Inc., and the drilling company associated with the on-site investigation will have undergone a physical examination within 12 months prior to the start date. Medical parameters to be included in the physical examination are described in Appendix G.

An occupational health physician will be in verbal contact with the SSHO to report and provide professional health recommendations during the course of the work and at any other time when adverse exposure to toxic chemical substances or physical agents is suspected.

At the conclusion of the project, G&M will provide the Department of the Navy with the results of the on-site surveillance program upon request. Any on-site person(s) contracting any conditions or symptom of conditions will be required to undergo examination(s) by an occupational physician prior to returning to the site.

Determination of Work Areas

The SSHS will define and identify the following areas at each drilling site and specify the equipment and personnel in the areas as defined below (See Figure 1).

Zone 1: Exclusion Zone -- The exclusion zone is the zone where contamination exists or could occur. All people entering the exclusion zone will wear the prescribed level of protection (see Personnel Protection Zone Requirements). An entry and exit check point will be visually defined at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone.

Zone 2: Contamination Reduction Zone -- The area between the exclusion zone and the support zone is the contamination reduction zone. This zone provides a transition between the contaminated area and the support zone. Zone 2 serves as a buffer to further reduce the possibility of the support zone becoming contaminated. It provides additional assurance that the physical transfer of contaminating substances on people, equipment, or in the air is limited through a combination of decontamination, distance between exclusion and support zones, air dilution, zone restrictions, and work functions. At the boundary between the exclusion and contamination reduction zones, decontamination stations will be established, as described in the decontamination procedures.

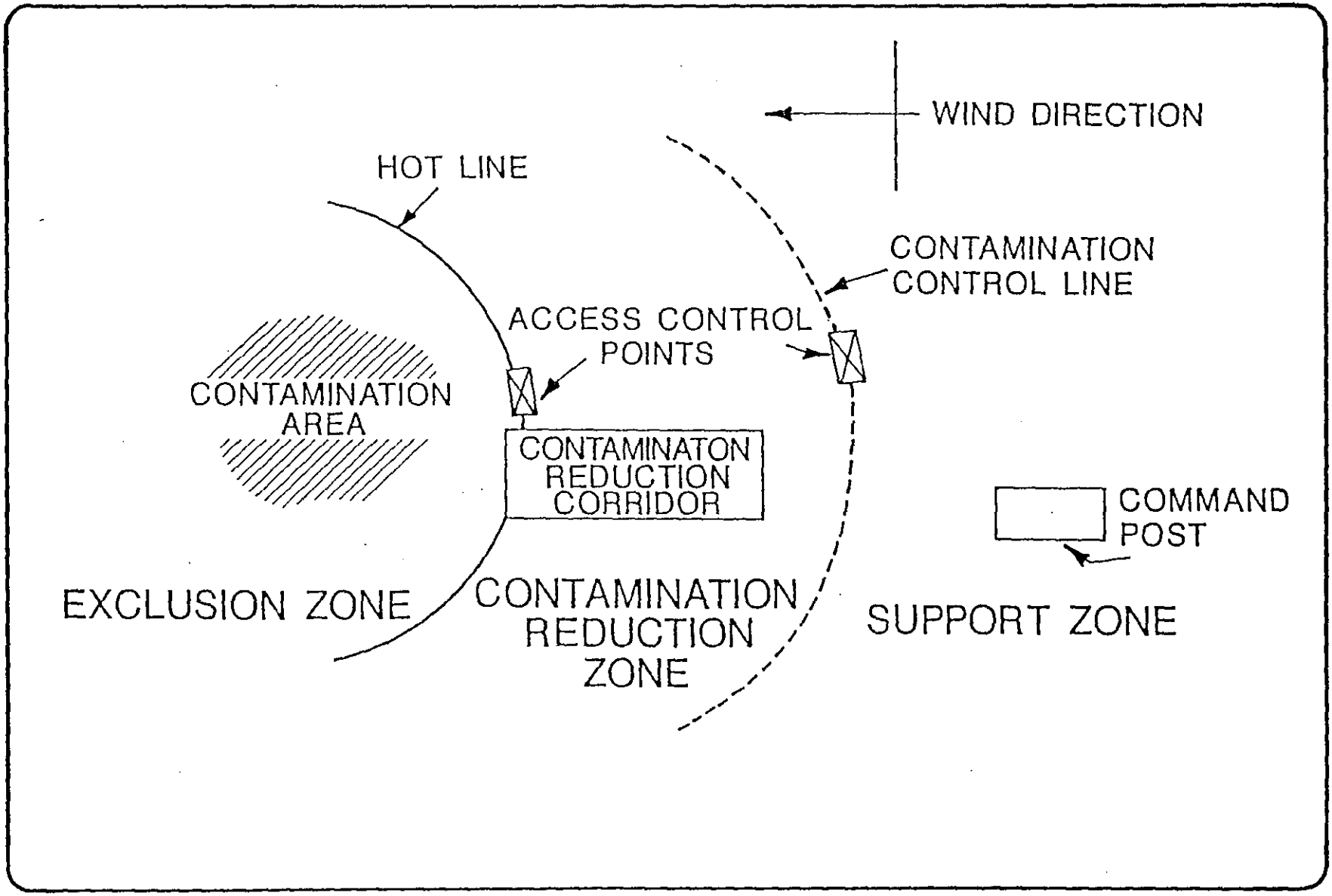

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Figure 1. Diagram of Site Work Zones.

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BAY REPROGRAPHICS

Zone 3: Support Zone -- This area is the area outside Zones 1 and 2. The support zone will be marked and will be protected against contamination from Zone 1 (work/sampling site). The area includes:

a. An entry area for personnel, materials, and equipment.

b. An exit area for decontaminated personnel, materials, and equipment.

c. A storage area for clean safety and work equipment.

d. An area for rest breaks, the consumption of food and beverages, and similar activities.

Personnel Protection Program

G&M has established, and will maintain as part of the STP, a Personnel Protection Program for all personnel working at the site. The level of protection required at each site has been determined to be Level C, based on a hazard evaluation and previously documented information (see Site Description and Waste Characteristics). The hazards associated with the site will differ slightly as a function of the specific sample locations and climatic conditions. All areas of investigation initially will be required to have Level C personal protection; the results of air monitoring may require repositioning of soil borings should Level C air monitoring criteria be exceeded. The measured air concentrations that may allow this judgment are described later in this document (Permissible Exposure Limit Provisions).

Personnel Protection Zone Requirements

The on-going level of personnel protection will be determined by criteria described in "Permissible Exposure Limit Provisions." Therefore, the level of personnel protection may change throughout the course of the field investigative activities.

Level C Equipment

The protective items to be worn under Level C conditions are:

a. Hard hat (face shield optional).

b. Half-face piece, air-purifying, organic vapor cartridge equipped respirator.

c. Tyvek chemical-resistant clothing, long sleeves, one or two pieces.

d. Gloves (neoprene, chemical-resistant).

e. Steel toe and shank neoprene boots/shoes (chemical-protective).

f. Options as required:

   (1) Hearing protection

   (2) Inner gloves.

Level C Decontamination Procedures (Figure 2)

Station 1: Segregated Equipment

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards,

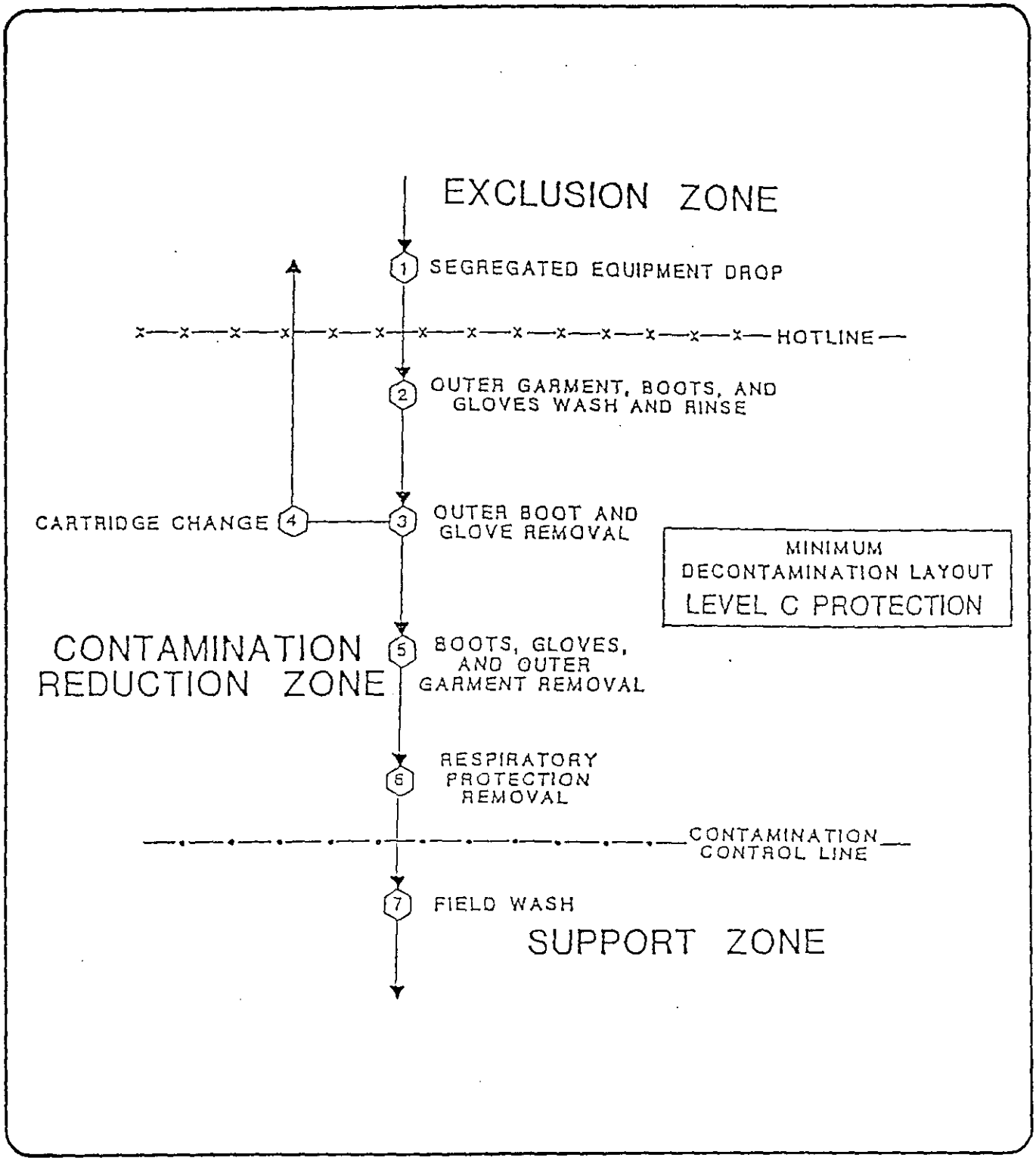

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Figure 2. Level C Decontamination Procedures.

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etc.) on plastic drop cloths or in different containers with plastic liners.

Equipment: Various size containers
Plastic liners
Plastic drop cloths

Station 2: Outer Garments, Boots and Gloves, Wash and Rinse

Scrub outer boots and gloves with decon solution or detergent/water. Rinse gloves, boots and garments with hand pump spray device into plastic bucket.

Equipment: 2 containers (30-50 gallon)
Hand pump spray device
Water
Detergent
Scrub brushes

Station 3: Outer Garments, Boots and Gloves Removal

Remove outer boots and gloves and place outside the decontamination zone. Inner gloves and Tyvek suits are deposited in separate containers lined with plastic.

Equipment: Containers (30-50 gallon)
Plastic liners

Station 4: Cartridge Change

If a worker leaves the exclusion zone to change a canister on his/her respirator, this is the last step in the decontamination procedure. Once the worker's cartridges are exchanged, the worker may then return to the exclusion zone. Workers may choose to change cartridges at their own

descretion but the longest period between cartridge changes shall be 24 hours regardless of the number of hours the protective device is used.

Equipment: Respirator cartridges
Extra gloves
Boot covers (if worn)

Station 5: Respiratory Protection Removal

Remove the face piece respirator, deposit used cartridges in a plastic lined container, and wipe the face piece with clean water and paper towels.

Equipment: Container (30-50 gallon)
Plastic liners
Paper towels
Detergent solution
Water

Station 6: Field Wash

Wash hands and face.

Equipment: Water
Soap
Wash basins/buckets

Exposure Monitoring

Measurements of total ionizable pollutants and explosive potential described previously (Site Description and Waste Characteristics) provide quantitative limits of exposure and action levels that may require the use of higher levels of personnel protection.

Initial Monitoring

All employees will be assigned work functions within a singular personnel protective level. Personnel within the exclusion zone (Zone 1) will receive monitoring (30-minute interval) of the respiratory parameters described below. Visitors and employees in a service capacity that remain in the support zone will not receive periodic exposure monitoring (for ionizable pollutants) nor will they be required to wear Level C items.

Selection of Respiratory Equipment

G&M will provide respirators for its employees from those approved by the National Institute for Occupational Safety and Health under provisions of 30 CFR Part II. Subcontractors will be required to provide similar respirators for their employees throughout the duration of the project.

G&M will require all members of the investigative team wearing a respirator to wash their faces and respirator face pieces to prevent skin irritation associated with the use of a respiratory device. In addition, all workers are responsible for the cleanliness of their respirators as described in the Respiratory Protection Plan (Appendix H).

Permissible Exposure Limits Provisions

G&M will limit employee or subcontractor exposure to an airborne concentration of total ionizable pollutants no greater than 10 ppm for extended periods of time (greater than 5 minutes) within the breathing zone. This limit of exposure shall be evaluated by Photovac TIP equipment capable of measuring very low concentrations of air contaminants. When the Photovac TIP reports concentrations of contaminants that exceed 10 ppm continuously for 5 minutes or more, all personnel will be required to upgrade to the Level C protection level when working in the exclusion zone. Use of a cartridge-equipped respirator will necessitate disposal and replacement of fresh cartridges each day.

A TIP will be calibrated prior to use each morning to an isobutylene standard (100 ppm) to provide comparable readings during the day and to provide a source of comparison during the investigation. Under no circumstances will site personnel enter the exclusion zone without the use of a respirator where required.

When Level C protection is required, an action level of 100 ppm total ionizable pollutants has been assigned (based upon a 100-ppm 150 butylene standard) to determine the need to reevaluate the frequency of cartridge change and further upgrades in the level of protection. Complete removal of respirators (complete or incomplete) within the exclusion

zone is absolutely forbidden and may result in the dismissal of the employee from the project. Intermittent evaluation (every 30 minutes) of the breathing zone for organic vapors using a TIP will document and support the necessity of maintaining Level C protection. If emissions from the drilling operation are detected to be consistently less than 5 ppm for 30 minutes or more, then drilling can be completed at Level D upon notification of the SSHO. Intermittent evaluation of the breathing zone will be provided at Level D protection throughout the study as described above.

The detection of organic vapors at a concentration of 100 ppm for several minutes (5 minutes) at Level C will necessitate an immediate halt in all work until the vapors diminish to below 20 ppm for a period of 5 minutes. A decision to initiate work by the SHSS will require a phone call to the SSHO to discuss the monitoring results and to reach an agreement on start-up conditions. Should continued drilling result in concentrations that exceed 100 ppm total ionizable pollutants, the A-E Project Manager should be contacted by the SSHO to consider relocating the well.

Heat Stress Monitoring

If the SSHO requires personnel to wear chemically-impervious clothing, heat stress monitoring will be required. Monitoring by the SHSS will commence when the ambient temperature is 70°F or above. The frequency of monitoring

will increase as the ambient temperature increases, as described in Appendix G. When temperatures exceed 85°F, workers will be monitored for heat stress after every 30-to 60-minute work period.

- Heart rate will be measured by the radial-pulse method for 30 seconds as early as possible in the 10-to 15-minute resting period. The heart rate at the beginning of the rest period should not exceed 110 beats per minute. If the rate is higher, the next work period will be shortened. If the rate is 100 beats per minute at the beginning of the next rest period, the next work cycle will be shortened.

- Body temperature will be measured as early as possible in the resting period. Temperature at the beginning of the rest period should not exceed 99°F. If it does, the next work period will be shortened. However, if the temperature is 99.7°F at the beginning of the next rest period, the following work cycle will be further shortened. Temperature will be measured again at the end of the rest period to make sure that it has dropped below 99°F.

Notification of Emergencies

The SSHS will have access to several laminated copies of a list of telephone numbers to contact in case of an emergency (Figure 3). During the orientation session, specific reference will be made to the location of the nearest phones for emergencies. The emergency list will include:

Fire	919
Police	919
Ambulance	919
Poison Control	29-5531
Hospital (DePoo)	296-8526
Florida Keys Memorial	294-6666

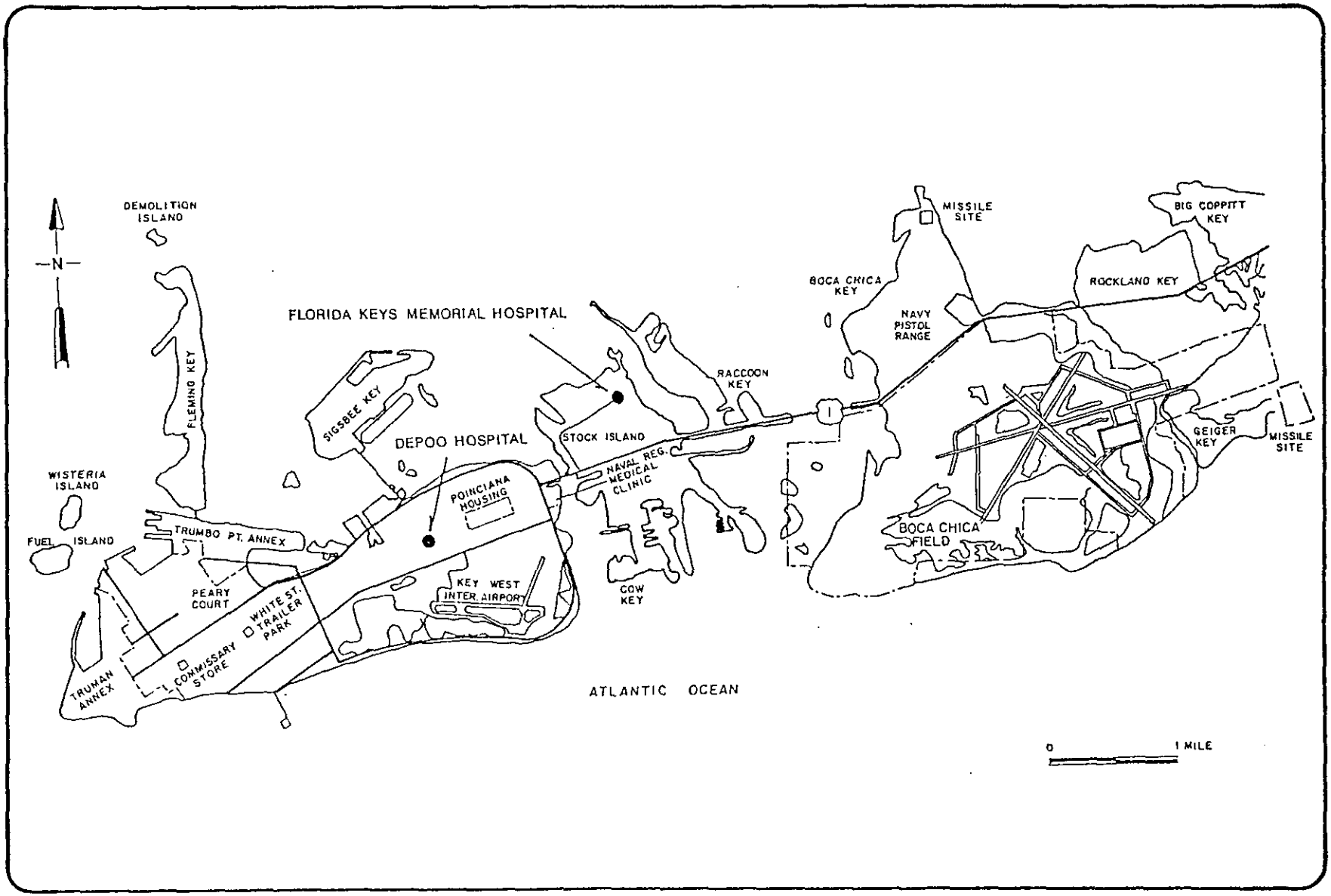

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Figure 3. Route to the Hospital.

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The SSHS is responsible for the initial telephone contacts necessary to protect the safety and health of all workers. The SSHS is also responsible to write an on-site report of all accidents requiring a break in work time as described in Table 3.

Emergency Situations

Written Plan: A written plan for emergency situations has been developed to address the needs of on-site emergency activities (Figure 4).

Alerting Employees

Alarms: Where there is a possibility of employee exposure to physical harm, the potential for an explosive situation, or elevated levels of organic vapors, the SSHS will be responsible for calling to the employee's attention the emergency situation by voice command (or horn where appropriate).

Evacuation: Employees not engaged in correcting the emergency will be restricted from the area and will not be permitted to return until the emergency is abated.

First Aid Requirements

G&M will prearrange for emergency medical care services at a nearby medical facility and establish emergency routes

Table 3. Emergency Report.

OCCUPATIONAL EXPOSURE GUIDE

OSHA No. 101
Case or File No. _____

Supplementary Record of Occupational Injuries and Illnesses

EMPLOYER

1. Name _____
2. Mail address _____
(No. and street) (City or town) (State)
3. Location, if different from mail address _____

INJURED OR ILL EMPLOYEE

4. Name _____ Social Security No. _____
(First name) (Middle name) (Last name)
5. Home address _____
(No. and street) (City or town) (State)
6. Age _____ 7. Sex: Male_____ Female_____ (Check one)
8. Occupation _____
(Enter regular job title, *not* the specific activity he was performing at time of injury.)
9. Department _____
(Enter name of department or division in which the injured person is regularly employed, even though he may have been temporarily working in another department at the time of injury.)

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

10. Place of accident or exposure _____
(No. and street) (City or town) (State)
If accident or exposure occurred on employer's premises, give address of plant or establishment in which it occurred. Do not indicate department or division within the plant or establishment. If accident occurred outside employer's premises at an identifiable address, give that address. If it occurred on a public highway or at any other place which cannot be identified by number and street, please provide place references locating the place of injury as accurately as possible.
11. Was place of accident or exposure on employer's premises? _____ (Yes or No)
12. What was the employee doing when injured? _____
(Be specific. If he was using tools or equipment or handling material, name them and tell what he was doing with them.)
13. How did the accident occur? _____
(Describe fully the events which resulted in the injury or occupational illness. Tell what happened and how it happened. Name any objects or substances involved and tell how they were involved. Give full details on all factors which led or contributed to the accident. Use separate sheet for additional space.)

OCCUPATIONAL INJURY OR OCCUPATIONAL ILLNESS

14. Describe the injury or illness in detail and indicate the part of body affected. _____
(e.g.: amputation of right index finger at second joint; fracture of ribs; lead poisoning; dermatitis of left hand, etc.)
15. Name the object or substance which directly injured the employee. (For example, the machine or thing he struck against or which struck him; the vapor or poison he inhaled or swallowed; the chemical or radiation which irritated his skin; or in cases of strains, hernias, etc., the thing he was lifting, pulling, etc.)
16. Date of injury or initial diagnosis of occupational illness _____
(Date)
17. Did employee die? _____ (Yes or No)

OTHER

18. Name and address of physician _____
19. If hospitalized, name and address of hospital _____

Date of report _____ Prepared by _____
Official position _____

REGULATIONS

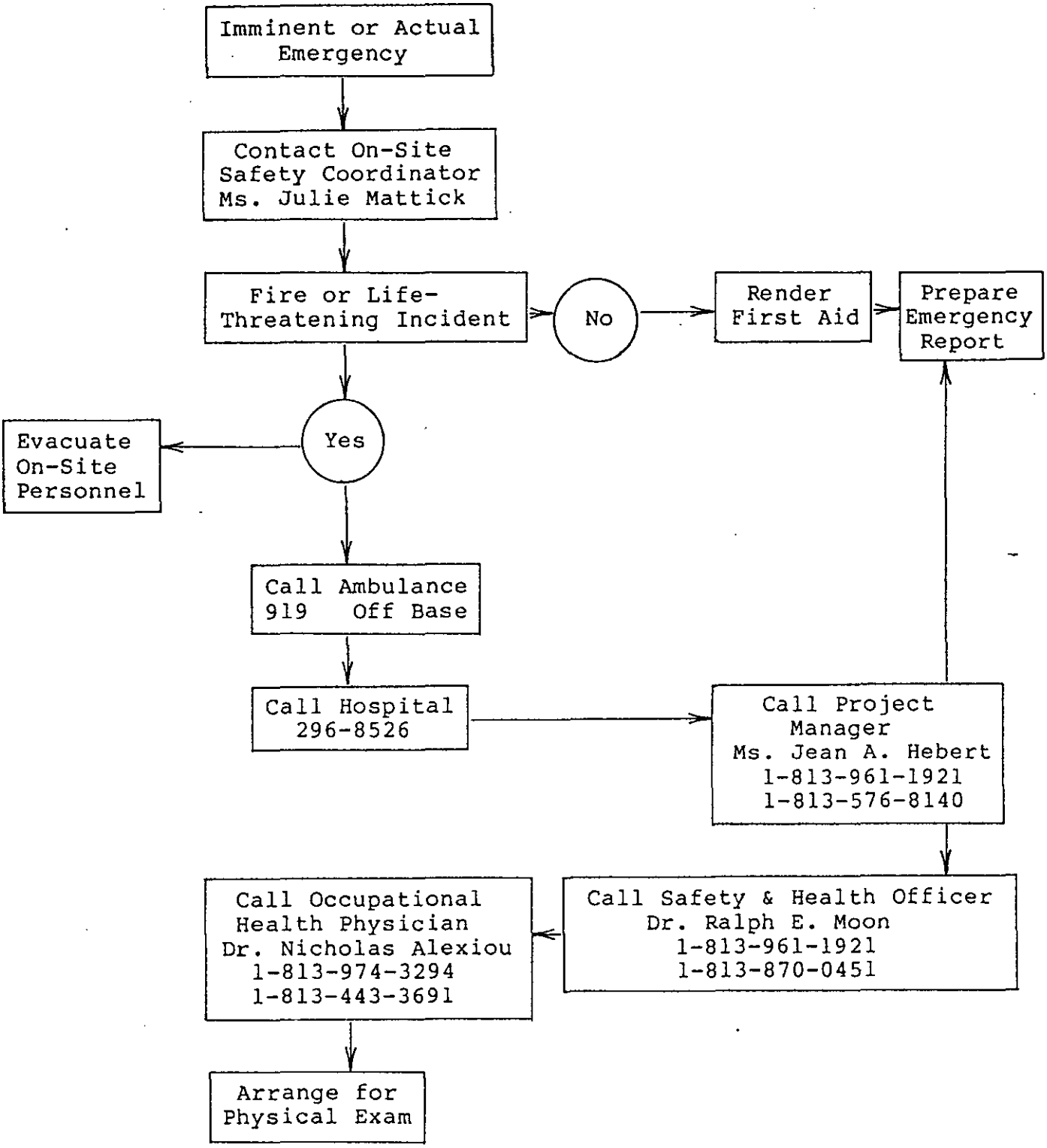

Figure 4. Emergency Action Plan.

(Figure 4). In the event of an emergency associated with or resulting from work at the site which, in the opinion of the SSHS, materially endangers life, property, or the environment, G&M will cease all sampling; take diligent action to remove or otherwise minimize the cause of the emergency; and institute appropriate measures to help any repetition of the conditions or actions leading to or resulting in the emergency.

Visitor Protection

All visitors to the drilling site will be instructed to stay outside the work zone and remain within the support zone during the extent of their stay. Visitors will sign a Visitor's Log Book (Appendix I) and record the information called for in the log.

Visitors will be cautioned to avoid skin contact with contaminated or suspected contaminated surfaces and hand-to-mouth transfers (eating, drinking, smoking, or chewing gum or tobacco).

The use of alcohol or medicine is prohibited. Visitors requesting observation of the work zone must wear all appropriate personnel protective wear prior to entering the work zone. Should respiratory protective devices be necessary (Level C), visitors who wish to enter the work zone must produce evidence that they have had a complete physical examination and respiratory protection training within the

previous 12 months. Visitor admittance to the work zone will be left to the discretion of the SSHS.

Housekeeping

General: G&M shall implement a housekeeping program to minimize the spread of contaminants beyond the work zone. The program will include:

1. Periodic scheduling to police the work area of debris, including paper products, cans, and other materials brought on site.

2. Periodic changing of wash water and rinse water for hand, face, and equipment.

3. Periodic removal (daily minimum) of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing (Tyvek).

Waste Disposal

General: G&M and its subcontractors will not remove material from the site that may potentially endanger the safety and health of on-site employees or the general public.

Reusable Protective Wear: All gloves, boots, hats, and protective outerwear that can be cleaned and reused will be scrubbed and cleaned in containers provided by G&M within the

decontamination zone prior to reuse and will be removed from the site at the end of each working day.

Waste Food Containers: During and following meal and break periods, all waste materials will be collected (by all individuals) and disposed of in waste containers provided by G&M.

Safety Equipment

- Emergency eye wash (1) (15 minute capacity)
- First aid kit (1)
- Fire extinguisher or equivalent (1) (Class ABC)
- Total ionizable pollutant meter
- Drinking cups
- Decontamination facilities
- Explosion meter detector
- Garbage bags
- Paper towels
- Garbage cans (1)
- Brushes
- Spray container
- Drop cloth (1)
- Safety cones (1)

(1) Equipment to be provided by drilling subcontractor.

Noise

Noise-suppression devices will be used where appropriate and the use of hearing protective devices will be encouraged.

HAZARD CONTROL

General Precautions

Personnel working at sites involving chemical and radiological substances may encounter conditions that are unsafe or potentially unsafe. In addition to danger due to the physical, chemical, and toxicological properties of the material(s) present, other types of hazards (electricity, water, heavy equipment, falling objects, or other hazards that could result in loss of balance or tripping) might have an adverse effect on the safety and health of personnel. The following sections describe the requirements to be implemented to minimize these potential adverse effects.

Buddy System

For all on-site activities, the buddy system will be implemented to ensure safety of personnel. Workers will be required to perform all characterization activities with another individual. At no time will workers be permitted to wander around the site alone.

Fire and Explosion Prevention

G&M employees and employees of its subcontractors will be forbidden to smoke or produce an "open flame" in order to maintain a fire and explosion prevention and control effort appropriate for the special needs of the site.

Safety Precautions Near Utility Lines

While in use, a crane or drilling rig will be no less than:

- 10 feet from a 50-KV line.
- 20 feet from a 345-KV line.
- 34 feet from a 750-KV line.

In transit, with the boom on a derrick lowered, a crane or drilling rig will be no less than:

- 4 feet from a 50-KV line.
- 10 feet from a 50-345-KV line.
- 16 feet from a 345-750-KV line.

Safety personnel from the Navy will be consulted if drilling near buried power lines is necessary.

Safety Precautions When Drilling

All drillers will wear safety glasses, hard hats, protective clothing, steel-toed shoes, and respiratory protection as determined by the SSHO.

Sanitation

Toilet facilities and showers will be provided in accordance with 29 CFR 1926.51. The locations of these will be identified during the orientation meeting. Showering at the end of each work day at the facility will be required if at any time work was conducted at Level C personal

protection. Showering will be optional at the facility following the work day at Level D personal protection.

Potable water for drinking and washing will be provided for all employees.

APPENDIX A

RESUMES OF G&M PROJECT STAFF

JEAN A. HEBERT

Staff Scientist

CREDENTIALS/REGISTRATION

B.A., Geology, University of South Florida, 1980
B.A., Biology, University of South Florida, 1980
M.S., Geology, University of South Florida, 1985

PROFESSIONAL AFFILIATIONS

National Water Well Association

FIELDS OF SPECIALIZATION

- Contamination Assessment Studies
- Characterization of Karst Environments
- Marine Depositional Systems

EXPERIENCE SUMMARY

Prior to beginning graduate studies, Ms. Hebert was an environmental scientist with Southwest Florida Water Management District where she was responsible for District-wide water-quality investigations. While in graduate school at the University of South Florida, she was involved in the collection of geophysical data from the West Florida Shelf, sponsored by the U.S. Geological Survey and the National Science Foundation. These data were later used for her thesis research, which was concerned with the stratigraphy and paleo-karstification of the Shelf. While completing her thesis, Ms. Hebert was employed by Seaburn and Robertson, Inc., a ground-water consulting firm, and was involved in projects concerning surface-water basin delineation. Since joining Geraghty & Miller, Inc., she has organized and supervised many field programs which included monitor well and recovery well installation, water-quality and soil sampling, aquifer testing, and recovery system pilot studies. Ms. Hebert is currently managing several projects which involve assessment of contamination and evaluations of remedial alternatives.

KEY PROJECTS

- Supervised the installation of monitor wells and prepared a Contamination Assessment report concerning the environmental conditions at a RCRA site in central Florida.

- Managed several hydrocarbon projects requiring contamination assessments and remedial action.

- Organized and supervised a field program to evaluate the effects and efficiency of a large multi-well recovery system.

SELECTED PUBLICATIONS

Hebert, J. A., 1985. A Miocene Karst Drainage System: Seismic Stratigraphy of the West Florida Shelf, G.S.A. Abstracts and Programs, Vol. 17, No. 7.

Doyle, L. J., G. R. Brooks, and J. A. Hebert, 1985. Submarine Erosion and Karstification on the West Florida Continential Margin: Disparate Environments Yield Similar Features, G.S.A. Abstracts and Programs, Vol. 17, No. 7.

Dooris, P. M., J. A. Hebert, and J. M. Post, Jr., 1981. Chemical Characteristics of Medard Reservoir, Florida Scientist, Vol. 44.

JULIE L. MATTICK

Scientist

CREDENTIALS/REGISTRATION

B.S., Geology, Colorado State University, 1983
M.S., Hydrology, New Mexico Institute of Mining and Technology (NMIMT), 1986
Certified in Health and Safety for Hazardous Waste Site Activities, 1987

PROFESSIONAL AFFILIATIONS

Associate affiliate of the American Institute of Professional Geologists
Association of Ground Water Scientists and Engineers, National Water Well Association

FIELDS OF SPECIALIZATION

- Field supervisor for monitor-well installation
- Collection of water-quality/soil samples
- Coordination of operation and maintenance of ground-water recovery system
- Preparation of reports

EXPERIENCE SUMMARY

While attending NMIMT, Ms. Mattick received a Master's thesis research award from the U.S. Department of Energy. The award provided funding for her research, which involved quantification of ground-water recharge rates in an arid region using the isotopes chlorine-36 and tritium as soil-water tracers. She also developed a numerical model which simulated chlorine-36 transport through unsaturated soils. In 1986, she was employed by Daniel B. Stephens and Associates, Consulting Ground-Water Hydrologists, in Socorro, New Mexico, where she supervised drilling and installation of ground-water monitor wells and collected water-quality samples.

Since joining Geraghty & Miller, Inc., in December 1986, she has supervised field activities including drilling and installation of ground-water monitor wells, collected water-quality samples, and coordinated the operation and maintenance of a ground-water recovery system at a RCRA site. In addition, Ms. Mattick has written hydrogeologic assessments and reports on field operations and has assisted in the preparation of fee proposals and work plans for contamination sites.

KEY PROJECTS

- Field supervisor for the installation of monitor wells at contamination sites in Florida.

- Coordinator of the operation and maintenance of a ground-water recovery system at a RCRA site in Florida.

- Manager of monthly sampling programs at sites operating ground-water recovery systems.

PUBLICATION

Mattick, J.L., T.A. Duval, and F.M. Phillips, 1987, Quantification of Groundwater Recharge Rates in New Mexico Using Bomb ^{36}Cl, Bomb ^{3}H and Chloride as Soil-Water Tracers. New Mexico Water Resour. Res. Inst. Report No. 220, Las Cruces.

9/87

RALPH E. MOON

Senior Scientist

CREDENTIALS/REGISTRATION

B.S., Biology, Western Michigan University, 1972
M.S., Botany, University of South Florida, 1975
Ph.D., Biology, University of South Florida, 1980
Post Doctoral Fellowship, University of South Florida, Department of Chemistry, 1981.
Certified Hazardous Materials Manager, Master Level, 1985

PROFESSIONAL AFFILIATIONS

Sigma Xi
Chemical and Environmental Management Service (CHEMS) Board of Directors, University of South Florida
American Chemical Society
Institute of Hazardous Materials Management

FIELDS OF SPECIALIZATION

- Investigation and evaluation of ground-water contamination incidents
- Expert testimony at regulatory proceedings
- Health and safety at hazardous-waste sites
- Endangerment assessment reporting
- Geraghty & Miller, Inc., speaker

EXPERIENCE SUMMARY

Prior to joining Geraghty & Miller, Inc., Dr. Moon served as District Hydrologist for the Florida Department of Environmental Regulation (FDER), Southwest District. During his employment with the Florida Department of Environmental Regulation, Dr. Moon was a course instructor at the University of South Florida's School of Public Health and is currently appointed as a Clinical Assistant Professor in the Department of Comprehensive Medicine. Since 1983, Dr. Moon has served on the Board of Directors of the Chemical and Environmental Management Center in the Department of Chemistry.

KEY PROJECTS

- Project Manager responsible for conducting hydrogeological assessments and selecting an appropriate remedial action plan for a variety of ground-water and soil contaminants:

  Unleaded Fuel: Pensacola, Florida
  The accidental loss of unleaded fuel resulted in the installation of a ground-water recovery system that discharged recovered ground water to the municipal sewer system.

Aromatic Solvent: Lake City, Florida
An accidental loss of several thousand gallons of aromatic solvents adjacent to a railroad off-loading facility resulted in the installation of a ground-water recovery well and spray irrigation system coupled with biological treatment of contaminated soils.

Mercury: Clearwater, Florida
The fracture of a drum valve that dispensed a mercury additive for latex paint required a hydrogeological investigation to demonstrate the absence of a violation of ground-water standards.

Arsenic: Tampa, Florida
The long-term use of coal at a power plant resulted in the accumulation of arsenic and its eventual detection in the ground water. A hydrogeological investigation pinpointed the sources of arsenic and prompted the selection of the remedial action alternative.

Missile Fuel: Titusville, Florida
The unforeseen discharge of tetrahydrocyclomethyl-pentadiene at a missile facility resulted in the installation of a ground-water recovery system and discharge to the municipal sewer system via an existing permit.

- Project Manager responsible for the preparation of several land assessment reports requested prior to the purchase and sale of commercial property.

- Health and Safety Officer responsible for the preparation and implementation of numerous Health and Safety Plans and providing on-site orientation meetings prior to work start-up. Complex sites included:

Superfund Site, The Dalles, Oregon
The production of cyanide, a byproduct from a manufacturing facility, posed potential health risks to site workers.

Superfund Site, Oak Ridge, Tennessee
The historical production of enhanced uranium products resulted in the disposal of a variety of hazardous substances including radioactive compounds, solvents, and metal-containing substances.

Superfund Site, Jacksonville, Florida
A city landfill that accepted both industrial and municipal debris resulted in contamination of the surficial aquifer and the generation of gases that posed potential health risks to site workers.

Superfund Site, Brentwood, Tennessee
An unreclaimed strip mine area was used to dispose of drummed waste and liquids. The volatile organic compounds and organic sludges posed unique personal protection circumstances.

- Endangerment Assessment (EA) report preparation and review: The preparation of EA reports for Superfund sites in Florida and Massachusetts have provided guidance for the selection of the most appropriate and cost-effective remedial action alternatives.

SELECTED PUBLICATIONS

D. F. Martin, T. N. Krumrei, R. E. Moon. Comparison of Steroidal Agents Cytolytic Toward Florida Red Tide Organism (Gymnodinium breve, Ptychodiscus brevis). J. of Environmental Science and Health A15 (1), 37-44, 1980.

R. E. Moon and D. F. Martin. The Polyene Antibiotic Filipin and a Red Tide Cytolytic Agent "Aponin", A Comparative Study. Microbios Letters 10, 115-119, 1980.

R. E. Moon and D. F. Martin. The Cytolytic Substrate Aponin on Prymnesium parvum and Ptychodiscus brevis, A Comparative Study. Botanica Marina, Vol. XXIV, 1981.

R. E. Moon and D. F. Martin. Effects of 2- and 4-Hydroxy-biphenyl On Cultures of the Red Tide Organism Ptychodiscus brevis. J. of Environmental Science and Health. A16(4), 381-386, 1981.

R. E. Moon and D. F. Martin, Assay of Diverse Biological Activities of Material Elaborated by a Marine Blue-Green Alga, Gomphosphaeria aponina. Microbios letters 18, 103-110, 1981.

R. E. Moon and D. F. Martin. Studies on Utilization of Stack Gas. I. Preliminary Experiments. J. of Environmental Science and Health, A18(1), 19-28, 1983.

R. E. Moon. Domestic Sewage and Tampa Bay. The Overflow, May-June Issue, 22-23, 1983.

R. E. Moon. Bid Requirements Are Needed For Used Oil Dealers. The Florida Specifier, Vol. 5, No. 11, October 1984.

R. E. Moon and D. F. Martin. Study of Allelopathic Substances from a Marine Alga. American Chemical Society (ACS) Symposium Series Vol. 268, pp. 371-380, 1984.

R. E. Moon. Ground Water Monitoring in Florida--Living with Hydrologic and Regulative Peculiarities. National Water Well Association. Fifth Symposium and Exposition on Aquifer Restoration and Ground-Water Monitoring, 1985.

R. E. Moon. Point Source Discharge in the Tampa Bay Area. Proceedings Tampa Bay Area Scientific Information Symposium. Report Number 65, July 1985, Bellwether Press, 661 pages.

R. E. Moon and C. D. Henry. Hydrogeological Investigations of Pesticides. American Chemical Society Symposium Series 315, Evaluation of Pesticides in Ground Water, edited by Garner, W. Y., Honeycutt, R. C., and H. N. Nigg, 1986, American Chemical Society, 573 pages.

R. E. Moon. Ground-Water Monitoring: Objectives and Limitations. Proceedings of the Fourth Annual Hazardous Materials Management Conference, 1986, Tower Conference Management Company, Wheaton, Illinois, 617 pages.

SELECTED PAPERS PRESENTED

Study of Allelopathic Substances from a Marine Alga, Symposium on "The Chemistry of Allelopathy." Pesticide Division of the American Chemical Society, St. Louis, Missouri, April 8-13, 1984.

Ground Water Monitoring. Florida Association for Water Quality Control, Daytona Beach, Florida, May 20-22, 1984.

Waste Oil Generation and Use in the Tampa Bay Area. Florida Association of Governmental Purchasing Offices, 17th Annual Seminar and Workshop, Clearwater, Florida, May 21-25, 1984.

Analytical Data and Its Importance in Hydrological Studies. Florida Society of Environmental Analysis, October 20, 1984, Keynote Speaker.

Hazardous Waste Transport. American Society of Safety Engineers, Guest speaker, December 3, 1984.

Geochemistry and Ground-Water Monitoring. South Carolina Chamber of Commerce. Columbia, South Carolina, January 29, 1985.

Geochemistry and Ground-Water Monitoring. North Carolina Textile Association, Raleigh, North Carolina, January 30, 1985.

Field Methods-Drilling Techniques, Well Placement, Equipment. American Chemical Society, Division of Pesticide Chemistry, Miami, Florida, April 28-May 3, 1985, Invited speaker.

Ground-Water Monitoring in Florida--Living with Hydrologic and Regulative Peculiarities. Fifth Symposium and Exposition on Aquifer Restoration and Ground-Water Monitoring, Columbus, Ohio, May 21-24, 1985.

Health and Safety Plans, Quality Assurance, Quality Control Plans for Hydrogeological Investigations. Geraghty & Miller, Inc., Seminar, October 7, 1985, Orlando, Florida.

Hazardous Waste Management. Geraghty & Miller, Inc., Seminar, October 7 and 12, 1985, Orlando, Florida, and Baton Rouge, Louisiana.

Ground-Water Geochemistry. Geraghty & Miller, Inc., Seminar, October 12, 1985, Baton Rouge, Louisiana.

Behavior of Contamination/Geochemistry. Geraghty & Miller, Inc., Seminar, CF Industries, March 24, 25, 1986, Plant City, Florida.

Hazardous Waste Management Audit. Geraghty & Miller, Inc., Seminar, CF Industries, March 24, 25, 1986, Plant City, Florida.

Public Health and Its Role in Remediation. Florida Association for Water-Quality Control, May 20, 1986, Tampa, Florida.

Ground-Water Monitoring: Objectives and Limitations. HAZMAT 86, June 2-4, 1986, Atlantic City, New Jersey.

The Interpretation of Monitoring Data. The Fundamentals of Ground-Water Contamination Seminar, EPA Region II, June 25, 1986, New York, New York.

Behavior of Contamination/Geochemistry. The Fundamentals of Ground-Water Contamination Seminar, EPA Region IV, August 11, 12, 1986, Atlanta, Georgia.

The Interpretation of Monitoring Data. The Fundamentals of Ground-Water Contamination Seminar, EPA Region IV, August 11,12, 1986, Atlanta, Georgia.

Ground-Water Protection Strategy. The Fundamentals of Ground-Water Contamination Seminar, New Orleans, October 9, 19, 1986, Washington, D.C., October 23, 24, 1986, Chicago, November 6, 7, 1986.

Nature and Occurrence of Ground-Water Contamination. The Fundamentals of Ground-Water Contamination Seminar, October 9, 10, 1986, New Orleans, Louisianna.

Endangerment Assessments. Department of Comprehensive Medicine, College of Medicine, University of South Florida, March 26, 1987.

Risk Assessment. Tactical Air Command, IRP Focus '88, Washington, D.C., November 19-20, 1987.

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APPENDIX B

TOXICOLOGICAL DATA

CHROMIUM

Summary

Chromium is a heavy metal that generally exists in either a trivalent or hexavalent oxidation state. Hexavalent chromium (Cr VI) is rather soluble and is quite mobile in groundwater and surface water. However, in the presence of reducing agents it is rapidly converted to trivalent chromium (Cr III), which is strongly adsorbed to soil components and consequently is much less mobile. A number of salts of hexavalent chromium are carcinogenic in rats. In addition, an increased incidence of lung cancer was seen in workers occupationally exposed to chromium VI. Hexavalent chromium also causes kidney damage in animals and humans. Trivalent chromium is less toxic than hexavalent chromium; its main effect is contact dermatitis in sensitive individuals.

CAS Number: 7440-47-3

Chemical Formula: Cr

IUPAC Name: Chromium

Chemical and Physical Properties (Metal)

Atomic Weight: 51.996

Boiling Point: 2672°C

Melting Point: 1857 ± 20°C

Specific Gravity: 7.20 at 28°C

Solubility in Water: Insoluble; some compounds are soluble

Transport and Fate

Hexavalent Cr is quite soluble, existing in solution as a component of a complex anion. It is not sorbed to any significant degree by clays or hydrous metal oxides. The anionic form varies according to pH and may be a chromate, hydrochromate, or dichromate. Because all anionic forms are so soluble, they are quite mobile in the aquatic environment. Cr VI is efficiently

removed by activated carbon and thus may have some affinity for organic materials in natural water. Cr VI is a moderately strong oxidizing agent and reacts with reducing materials to form trivalent chromium. Most Cr III in the aquatic environment is hydrolyzed and precipitates as chromium hydroxide. Sorption to sediments and bioaccumulation will remove much of the remaining Cr III from solution. Cr III is adsorbed only weakly to inorganic materials. Cr III and Cr VI are readily interconvertible in nature depending on microenvironmental conditions such as pH, hardness, and the types of other compounds present. Soluble forms of chromium accumulate if ambient conditions favor Cr VI. Conditions favorable for conversion to Cr III lead to precipitation and adsorption of chromium in sediments.

In air, chromium is associated almost entirely with particulate matter. Sources of chromium in air include windblown soil and particulate emissions from industrial processes. Little information is available concerning the relative amounts of Cr III and Cr VI in various aerosols. Relatively small particles can form stable aerosols and can be transported many miles before settling out.

Cr III tends to be adsorbed strongly onto clay particles and organic particulate matter, but can be mobilized if it is complexed with organic molecules. Cr III present in minerals is mobilized to different extents depending on the weatherability and solubility of the mineral in which it is contained. Hexavalent compounds are not strongly adsorbed by soil components and Cr VI is mobile in groundwater. Cr VI is quickly reduced to CR III in poorly drained soils having a high content of organic matter. Cr VI of natural origin is rarely found in soils.

Health Effects

The hexavalent form of chromium is of major toxicological importance in higher organisms. A variety of chromate (Cr VI) salts are carcinogenic in rats and an excess of lung cancer has been observed among workers in the chromate-producing industry. Cr VI compounds can cause DNA and chromsome damage in animals and humans, and Cr (VI) trioxide is teratogenic in the hamster. Inhalation of hexavalent chromium salts causes irritation and inflammation of the nasal mucosa, and ulceration and perforation of the nasal septum. Cr VI also produces kidney damage in animals and humans. The liver is also sensitive to the toxic effects of hexavalent Cr, but apparently less so than the kidneys or respiratory system. Cr III is less toxic than Cr VI; its main effect in humans is a form of contact dermatitis in sensitive individuals.

Toxicity to Wildlife and Domestic Animals

Chromium is an essential nutrient and is accumulated in a variety of aquatic and marine biota, especially benthic organisms, to levels much higher than in ambient water. Levels in biota, however, usually are lower than levels in the sediments. Passage of chromium through the food chain can be demonstrated. The food chain appears to be a more efficient pathway for chromium uptake than direct uptake from seawater.

Water hardness, temperature, dissolved oxygen, species, and age of the test organism all modify the toxic effects of chromium on aquatic life. Cr III appears to be more acutely toxic to fish than Cr VI; the reverse is true in long term chronic exposure studies.

None of the plants normally used as food or animal feed are chromium accumulators. Chromium absorbed by plants tends to remain primarily in the roots and is poorly translocated to the leaves. There is little tendency for chromium to accumulate along food chains in the trivalent inorganic form. Organic chromium compounds, about which little is known, can have significantly different bioaccumulation tendencies. Little information concerning the toxic effects of chromium on mammalian wildlife and domestic animal species is available.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Cr VI:

Aquatic Life (Proposed Criteria)

Freshwater

Acute toxicity: 11 µg/liter
Chronic toxicity: 7.2 µg/liter

Saltwater

Acute toxicity: 1,200 µg/liter
Chronic toxicity: 54 µg/liter

Human Health

Criterion: 50 µg/liter

Cr III:

Aquatic Life (Proposed Criteria)

Freshwater

Acute toxicity: $e^{(0.819[\ln(\text{hardness})]+3.568)}$ µg/liter

Chronic toxicity: $e^{(0.819\ [\ln(\text{hardness})])+0.537)}$ µg/liter

Saltwater

The available data are not adequate for establishing criteria.

Human Health

Criterion: 170 mg/liter

CAG Unit Risk for inhalation exposure to CR VI (USEPA): 41 $(\text{mg/kg/day})^{-1}$

National Interim Primary Drinking Water Standard: 50 µg/liter

NIOSH Recommended Standards for CR VI: 1 $\mu g/m^3$ carcinogenic
25 $\mu g/m^3$ noncarcinogenic TW
50 $\mu g/m^3$ noncarcinogenic (15-min sample)

OSHA Standards: OSHA air standards have been set for several chromium compounds. Most recognized or suspected carcinogenic chromium compounds have ceiling limits of 100 $\mu g/m^3$.

ACGIH Threshold Limit Values: Several chromium compounds have TWAs ranging from 0.05 to 0.5 mg/m^3. Chromite ore processing (chromate), certain water insoluble Cr VI compounds, and chromates of lead and zinc are recognized or suspected human carcinogens and have 0.05 mg/m^3 TWAs.

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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1975. Criteria for a Recommended Standard--Occupational Exposure to Chromium (VI). Washington, D.C. DHEW Publication No. (NIOSH) 76-129

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U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

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APPENDIX C

QUALITATIVE FIT TEST PROTOCOL

APPENDIX D— QUALITATIVE FIT TEST PROTOCOLS

This appendix specifies the only allowable qualitative fit test protocols permissible for compliance with paragraph (f)(3)(ii).

I. ISOAMYL ACETATE PROTOCOL

A. *Odor threshold screening.*

1. Three 1-liter glass jars with metal lids (e.g. Mason or Bell jars) are required.

2. Odor-free water (e.g. distilled or spring water) at approximately 25° C shall be used for the solutions.

3. The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1-liter jar and shaking for 30 seconds. This solution shall be prepared new at least weekly.

4. The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but may not be connected to the same recirculating ventilation system.

5. The odor test solution is prepared in a second jar by placing .4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. Shake for 30 seconds and allow to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution may be used for only one day.

6. A test blank is prepared in a third jar by adding 500 cc of odor free water.

7. The odor test and test blank jars shall be labelled 1 and 2 for jar identification. If the labels are put on the lids they can be periodically *dried off* and switched to avoid people thinking the same jar always has the IAA.

8. The following instructions shall be typed on a card and placed on the table in front of the two test jars (i.e. 1 and 2):

"The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

9. The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

10. If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA QLFT may not be used.

11. If the test subject correctly identifies the jar containing the odor test solution he may proceed to respirator selection and fit testing.

B. *Respirator selection.*

1. The test subject shall be allowed to select the most comfortable respirator from a large array of various sizes and manufacturers that includes at least three sizes of elastomeric half facepieces and units of at least two manufacturers.

2. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to assess a "comfortable" respirator. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This may not constitute his formal training on respirator use, only a review.

3. The test subject should unerstand that he is being asked to select the respirator which provides the most comfortable fit for him. Each respirator represents a different size and shape and, if fit properly, will provide adequate protection.

4. The test subject holds each facepiece up to his face and eliminates those which are obviously not giving a comfortable fit. Normally, selection will begin with a half-mask and if a fit cannot be found here, the subject will be asked to go to the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.)

5. The more comfortable facepieces are recorded; the most comfortable mask is donned and *worn at least five minutes* to assess comfort. Assistance in assessing comfort can be given by discussing the points in #6 below. If the test subject is not familiar with using a particular respirator, he shall be directed to don the mask several times and to adjust the straps each time, so that he becomes adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject:

- Chin properly placed.
- Positioning of mask on nose.
- Strap tension.
- Fit across nose bridge.
- Room for safety glasses.
- Distance from nose to chin.
- Room to talk.
- Tendency to slip.
- Cheeks filled out.
- Self-observation in mirror.
- Adequate tme for assessment.

7. The test subject shall conduct the conventional negative and positive-pressure fit checks (e.g. see ANSI Z88.2-1980). Before conducting the negative- or positive-pressure checks, the subject shall be told to "seat" his mask by rapidly moving the head side-to-side and up and down, taking a few deep breaths.

8. The test subject is now ready for fit testing.

9. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

10. The employee shall be given the opportunity to select a different facepiece and be retested if during the first two weeks of on-the-job wear the chosen facepiece becomes unacceptably uncomfortable.

C. *Fit test.*

1. The fit test chamber shall be substantially similar to a clear 55 gallon drum liner suspended inverted over a 2 foot diameter frame, so that the top of chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

2. Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

3. After selecting, donning, and properly adjusting a respirator himself, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well ventilated, as by an exhaust fan or lab hook, to prevent general room contamination.

4. A copy of the following test exercises and rainbow (or equally effective) passage shall be taped to the inside of the test chamber:

Test Exercises

i. *Normal breathing.*

ii. *Deep breathing.* Be certain breaths are *deep* and *regular.*

iii. *Turning head from side-to-side.* Be certain movement is complete. Alert the test subject not to bump the respirator on the shoulders. Have the test subject inhale when his head is at either side.

iv. *Nodding head up-and-down.* Be certain motions are complete and made about every second. Alert the test subject not bump the respirator on the chest. Have the test subject inhale when his head is in the fully up position.

v. *Talking.* Talk aloud and slowly for several minutes. The following paragraph is called the Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement. Alternative passages which serve the same purpose may also be used.

Rainbow Passage.

vi. *Normal breathing.*

5. Each test subject shall wear his respirator for at least 10 minutes before starting the fit test.

6. Upon entering the test chamber, the test subject shall be given a 6 inch by 5 inch piece of paper towel or other porous absorbent single ply material, folded in half and wetted with three-quarters of one cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

7. Allow two minutes for the IAA test concentration to be reached before starting the fit-test exercises. This would be an appropriate time to talk with the test subject, to explain the fit-test, the importance of his cooperation, the purpose for the head exercises, or to demonstrate some of the exercises.

8. Each exercise described in No. 4 above shall be performed for at least one minute.

9. If at any time during the test, the subject detects the banana-like odor of IAA, he shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

10. Upon returning to the selection room, the subject shall remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber, etc. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

11. If a person cannot be fitted with the selection of half-mask respirators, include full facepiece models in the selection process. When a respirator is found that passes the test, its efficiency shall be demonstrated for the subject by having him break the face seal and take a breath before exiting the chamber.

13. Persons who have successfully passed this fit test may be assigned the use of the tested respirator in atmospheres with up to 10 times the PEL of airborne lead. In other words this IAA protocol may be used to assign a protection factor no higher than 10.

12. When the test subject leaves the chamber he shall remove the saturated towel, returning it to the test conductor. To keep the area from becoming contaminated, the used towels shall be kept in a self-sealing bag. There is no significant IAA concentration buildup in the test chamber from subsequent tests.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

APPENDIX D

SITE SAFETY AND TRAINING PLAN EXAMINATION

352/21

HEALTH AND SAFETY ORIENTATION TEST

Name: _____

Date: _____

Project Site: _____

True or False

_____ 1. The support zone defines the area where hazardous working conditions may exist.

_____ 2. In case of a medical emergency, I should consult a phone book for the nearest hospital.

____ 3. I am required to carry out all the provisions described in the Health and Safety Plan.

____ 4. Long sideburns and beards must be removed in order to assure proper fit of the respiratory protection device.

____ 5. Normal body temperature and excessive perspiration can be symptoms of heat stroke.

____ 6. The Health and Safety Plan distributed at the orientation meeting should be discarded to avoid the accumulation of unnecessary information.

____ 7. The Site Safety and Health Officer is responsible for the periodic evaluation of air contaminants in the breathing zone.

____ 8. Although a work site may be contaminated, chemicals disposed into the ground are rendered harmless and pose no personal risk.

____ 9. Smoking, drinking, and eating are allowed at designated areas only.

____ 10. Should I feel drowsy or fatigued at work, I will tell no one so as not to appear foolish.

____ 11. Safety equipment other than coveralls, steel-toed boots, and a hard hat are not required when working under Level D conditions.

____ 12. While working in hot weather, ion replenishing fluids are better than carbonated liquids or water.

____ 13. Before drilling, all underground utilities should be identified.

____ 14. The decontamination process may differ depending upon the designated level of protection.

____ 15. Level A protection provides the lowest level of personnel protection.

____ 16. Workers are not allowed to request the results of the periodic air sampling analyses from the Site Safety and Health Officer.

____ 17. Should hazardous conditions exist that were not discussed in the Health and Safety Plan or acknowledged by the Site Health and Safety Officer, I should fill out a complaint form.

____ 18. Canister-equipped respirators generally have a longer "break through time" than cartridges.

____ 19. I am allowed to wear any additional protective equipment above the required protection level that I feel necessary to protect my health.

____ 20. Slightly soiled protective suits, gloves, and boots should be taken home and distributed among my friends and close relatives.

____ 21. During the decontamination process, all rinse water should be collected within appropriate containers.

____ 22. Should a health risk not previously considered in the Health and Safety Plan be encountered, workers should immediately notify the Site Health and Safety Officer.

____ 23. Proper distances between high tension wires and the drilling tower are essential to avoid possible shock and death.

____ 24. Cleaning the face piece of my respirator is unnecessary since it will probably get dirty the next time it is used.

____ 25. A skin rash or irritation detected during or after work should be reported immediately to the Site Health and Safety Officer.

____ 26. A shower after work each day is helpful in preventing prolonged skin contact with chemical contaminants.

____ 27. The emergency telephone numbers and map to the hospital should be kept safely away in my hotel room to avoid being lost.

____ 28. Skin absorption and inhalation are the most common routes of exposure to chemical hazards.

____ 29. An explosion meter will sound alarm when exposed to a gaseous mixture capable of explosion.

____ 30. White paper Tyvek suits are chemically resistant and will inhibit skin contact.

____ 31. Hearing protection should be used when noise levels exceed 85 decibels.

____ 32. Workers must wash hands prior to leaving the work site to avoid the possible ingestion of chemical contaminants.

____ 33. Dust, annoying gases, or unusual liquids in the exclusion zone should be ignored if not previously described in the Health and Safety Plan.

____ 34. Steel-toed leather boots are preferred when working in a chemically hazardous area since they are often more comfortable.

____ 35. Should I or one of my associates experience an accident of any magnitude, an accident report should be filled out immediately.

____ 36. Respiratory protection devices with gas canisters or cartridges supply sufficient oxygen for a normal man to breathe 4 to 6 minutes.

____ 37. Wind direction is not considered when setting up a hazardous waste drilling operation.

____ 38. Under Level C protection, complete removal of the respirator is required when entering the exclusion zone.

____ 39. Once a level of personal protection has been established, it cannot change.

____ 40. Visitors to the site must comply with all provisions of the Health and Safety Plan.

APPENDIX E

COMPLETION CERTIFICATES FOR G&M EMPLOYEES

Certificate of Achievement

THE
NATIONAL WATER WELL ASSOCIATION

recognizes

Jean Hebert

for completion of all course requirements

Safety at Hazardous Materials Sites: A Hands-On Safety Workshop

Parts I & II (40 Hrs. of Classroom & 90 Hrs. Hands-On Training)

March 24-28, 1986
(Date of Course)

Valhalla, New York
(Place of Course)

GERAGHTY & MILLER, INC.

GERAGHTY & MILLER, INC.
Ground-Water Consultants

Certificate of Completion

Presented To

Julie L. Mattick

In Recognition of Having Successfully Completed
the Prescribed Course of Study for
Hazardous Waste Site Activities
40-Hour Initial
Health and Safety Training

Andrew J. Baker
Corporate Safety Manager
Geraghty & Miller, Inc.

Geraghty & Miller, Inc.

GERAGHTY & MILLER, INC.

Miami-Dade Community College

MIAMI, FLORIDA U.S.A.

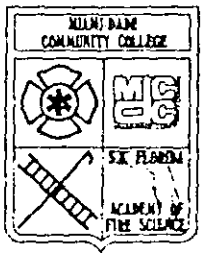
certificate of completion

For satisfactorily completing
INDUSTRIAL FIRE AND SPILL BRIGADE I (40 CLOCK HOURS)
29 CFR 1910.120
as prescribed by the Southeast Florida Academy of Fire Science
at the North Campus of Miami-Dade Community College, this certificate is bestowed upon:

DWAYNE CRIPPEN

this 2 day of DECEMBER 1987

J. Lorene Kelly
North Campus Vice President



Robert H McCabe
President

Miami-Dade Community College

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LEE PEARSON

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President

MIAMI-DADE COMMUNITY COLLEGE
SE. FLORIDA ACADEMY OF FIRE SCIENCE

Robert H McCabe
President

Miami-Dade Community College

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ED MOLLER

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President

Robert H McCabe
President

GERAGHTY & MILLER, INC.

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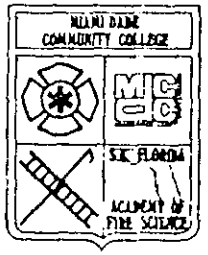
CHARLES MAGISTRO

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President



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President

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DAN LESTER

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President

Robert H McCabe
President

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ISMAEL PAGAN

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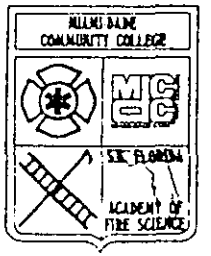
J. Terence Kelly
North Campus Vice President



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MARK JAMES

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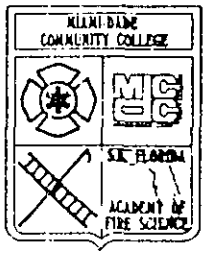
North Campus Vice President



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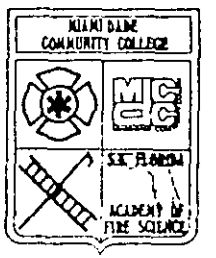
KEVIN IZZI

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President



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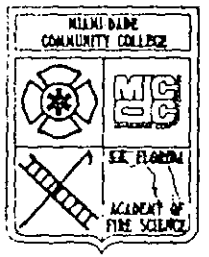

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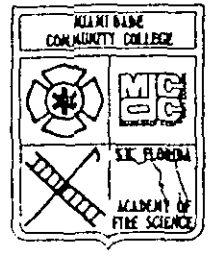

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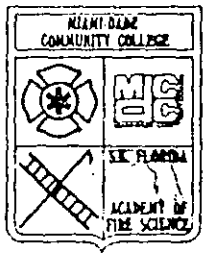
this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President



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this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President

Robert H McCabe
President

Miami-Dade Community College

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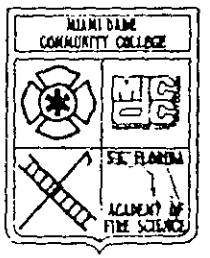
J. Terence Kelly
North Campus Vice President



Robert H. McCabe
President

Miami-Dade Community College

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this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President

Robert H McCabe
President

Miami-Dade Community College

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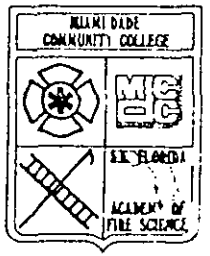
BIFF WATTS

this 2 day of DECEMBER 1987

J. Terence Kelly
North Campus Vice President



Robert H McCabe
President

APPENDIX F

SITE SAFETY AND HEALTH COMPLAINT FORM

SAFETY AND HEALTH COMPLAINT FORM

DATE: _____

SITE: _____

COMPLAINTANT _____

COMPANY AFFILIATION _____

SITE SAFETY AND HEALTH OFFICER _____

PLEASE CHECK APPROPRIATE AREAS OF CONCERN

o NATURE OF COMPLAINT: _____

_____

_____

_____

_____

WORK AREAS	_____	SANITATION	_____
"RIGHT-TO-KNOW"	_____	PERSONAL HYGIENE	_____
PERSONAL PROTECTION LEVEL	_____	EMERGENCY PROCEDURES	_____
SAFETY EQUIPMENT	_____	WASTE DISPOSAL	_____
EXPOSURE MONITORING	_____	RECORDKEEPING	_____
HEAT STRESS	_____	RESPIRATOR PROTECTION	_____
HOUSEKEEPING	_____	WORKER TRAINING	_____
NOISE	_____	PROTECTIVE CLOTHING	_____
SAFETY PRECAUTIONS	_____	OTHER _____	
DECONTAMINATION	_____	_____	

SIGNATURE _____

DATE _____

352/14

APPENDIX G

PHYSICAL EXAMINATION PARAMETERS

APPENDIX G

The following physical requirements have been evaluated by a qualified occupational health physician on all Geraghty & Miller, Inc., personnel associated with the investigation to assure that they are certified to perform work.

1. Compilation of a complete occupational health history.
2. Compilation of a complete family health history.
3. Blood analysis (SMAC-25)
4. Urine analysis
5. PCB level in the blood.
6. Chest X-ray (front only)
7. Hearing examination
8. Sight examination
9. Pulmonary function examination
10. Electrocardiogram examination
11. Complete physical examination

APPENDIX H

RESPIRATORY PROTECTION PLAN

223/27

RESPIRATORY PROTECTION PLAN

Prepared by

GERAGHTY & MILLER, INC..
Ground-Water Consultants
14310 North Dale Mabry Highway, Suite 200
Tampa, Florida 33618

TABLE OF CONTENTS

RESPIRATORY PROTECTION PLAN

Introduction

A respiratory protection plan has been written in compliance with the Occupation Safety and Health Administration requirements as described in 29CFR Section 1910.134.

Respiratory Protection Practices

It is the policy of Geraghty and Miller, Inc. to provide respiratory protection to all employees to avoid the breathing of air contaminated with dusts, fogs, fumes, mists, gases, smokes, sprays or vapors. This shall be accomplished through the use of respiratory protection, where appropriate, at all monitor well drilling and soil and ground-water sampling.

Respirators, described in the Safety and Health Plan, shall be supplied to all employees of Geraghty and Miller, Inc. Sub-contractors of Geraghty and Miller, Inc. shall supply their own employees with the appropriate respiratory protection as described in the site Safety and Health Plan. During the site Safety and Health Training Program, all staff and personnel associated with the subsurface investigation shall attend in order to understand the specific conditions and practices of the site investigation. The training course shall include a respirator fit test in accordance with the Occupational Exposure Guide, Appendix D, using the

qualitative Fit Test protocol with isoamyl acetate ampules (Appendix A).

In addition, course attendees shall be informed as to:

- Respirator limitations,
- Leak detection,
- Canister/cartridge removal frequencies,
- Appropriate respirator removal areas,
- Proper cleaning procedures,
- Uses of various types of respirators: half-face, full-face.

Respirator Selection

Respirators selected for "Level C" protection shall be selected following an evaluation of the site with air-monitoring equipment, and review of the site contamination history and climatic conditions. The selection of cartridges and canisters accompanying the respirator shall be based upon the presence of gases or airborne materials that may be detected or potentially released from the site during all aspects of the investigation (Table 1).

Respirator Cleaning and Storage

When in use, all respirators shall be cleaned prior to each working day and visually inspected by each worker after break periods. During canister/cartridge changes, the rubber face piece should be visually inspected to detect and remove dirt and dust that may have accumulated when in contact with

GERAGHTY & MILLER, INC.

OCCUPATIONAL EXPOSURE GUIDE

TABLE I—1

Atmospheric contaminants to be protected against	*Colors assigned**
Acid gases	White.
Hydrocyanic acid gas	White with ½-inch green stripe completely around the canister near the bottom.
Chlorine gas	White with ½-inch yellow stripe completely around the canister near the bottom.
Organic vapors	Black.
Ammonia gas	Green.
Acid gases and ammonia gas	Green with ½-inch white stripe completely around the canister near the bottom.
Carbon monoxide	Blue.
Acid gases and organic vapors	Yellow.
Hydrocyanic acid gas and chloropicrin vapor	Yellow with ½-inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases	Brown.
Radioactive materials, excepting tritium and noble gases.	Purple(Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors.	Canister color for contaminant, as designated above, with ½-inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants	Red with ½-inch gray stripe completely around the canister near the top.

*Gray shall not be assigned as the main color for a canister designed to remove acids or vapors.

NOTE: Orange shall be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

the face or hands. Wash/rinse stations used during decontamination may provide a source for cleaning materials for this purpose. It is recommended that respirators be assigned to individuals rather than arbitrarily passed among employees during the course of a project or between assignments. All respirators shall be returned to a clean storage area at the end of each work day and in a cool storage room during prolonged storage.

After inspection, cleaning, and necessary repair, respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be quickly accessible at all times and should be stored in canvas bags provided for this purpose. Respirators should not be stored in lockers or tool boxes unless they are in carrying cases or cartons.

Respirators should be packed or stored so that the face piece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

Qualifications for Respirator Use

The anticipated use of respirators by an employee shall require certification by a physician that the employee is suited to work under stressful circumstances. This decision should be based upon evaluations made during the annual

physical examination. Annual physical examinations are required prior to work at all investigative sites regardless of the anticipated use of a respiratory protective device.

Selection of Respirators

The proper selection of respirators shall be made in accordance to the guidance provided by The American National Standard Practices for Respiratory Protection.

Respirator Training and Fit Testing

Each employee shall be instructed in the proper use and maintenance of the devise to assure the safe use of the respirator. The training shall allow all on-site workers the opportunity to individually handle and properly fit each devise. During the test procedure, (see Occupational Fit Test protocol). The face piece to face seal will be tested in both normal and test atmospheres. Instruction shall also include a demonstration on how to adjust and determine proper fit. Respirators shall not be worn when conditions prevent a good face seal such as the growth of a beard, long sideburns, a hat that intercepts under the face piece or the temple piece of the glasses.

For employees wearing glasses, the temple bars may be removed or retracted and the glasses taped inside the face piece.

GERAGHTY & MILLER, INC.

APPENDIX I

NIOSH/OSHA/USCG/EPA GUIDANCE ON HEAT STRESS

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

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

Source: Reference [13].

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

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

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

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

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

[a]Source: Reference [6].

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

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

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

Physical Condition

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

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

Level of Acclimatization

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

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

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

Age

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

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

Gender

The literature indicates that females tolerate heat stress at least as well as their male counterparts [20]. Generally, a female's work capacity averages 10 to 30 percent less than that of a male [8]. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male [19]. However, a similar situation exists as with aging: not all males have greater work capacities than all females.

Weight

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

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

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APPENDIX J

VISITOR'S LOG BOOK

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VISITOR'S LOG BOOK

NAME AND AFFILIATION	DATE	SOCIAL SECURITY NUMBER	TIME IN	TIME OUT	REASON FOR SITE VISIT

•SPECIAL INSTRUCTIONS•

Please avoid contaminated surfaces and hand to mouth transfers (smoking,eating, chewing) while visiting the site.