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TRADE

TRAINING RESOURCES AND DATA EXCHANGE

INSTRUCTIONAL MATERIALS FOR SARA/OSHA TRAINING VOLUME I

General Site Worker Training

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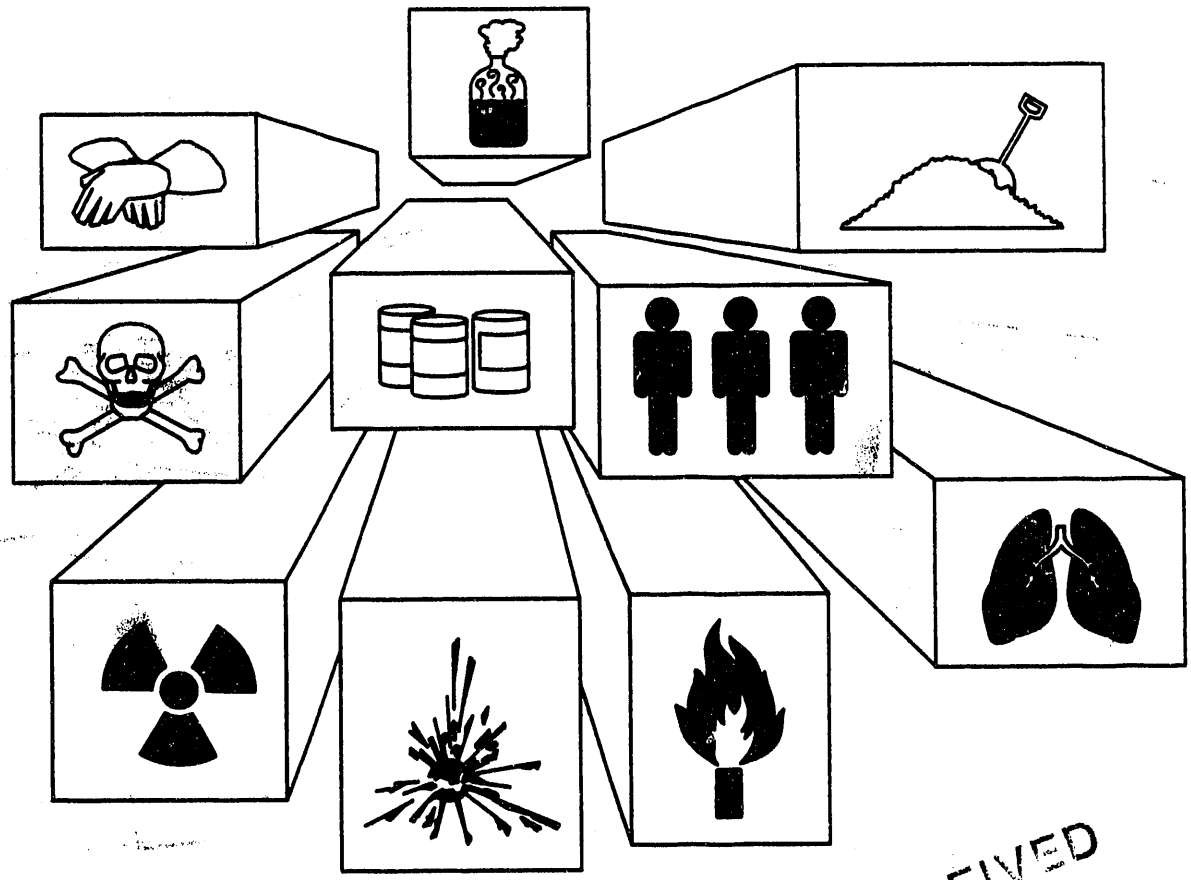
SARA/OSHA TRAINING FOR HAZARDOUS WASTE SITE ACTIVITIES

29 CFR 1910.120



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DEVELOPING AND IMPLEMENTING THE TRAINING REQUIRED BY SARA AND OSHA 29 CFR 1910.120

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BACKGROUND

There are currently several federal regulations requiring facilities that are involved in hazardous material activities to train employees concerning the hazards that surround them. Recently the Occupational Safety and Health Administration (OSHA), Department of Labor, in response to Title I, Section 126, of the Superfund Amendments and Reauthorization Act (SARA)[1] issued an interim final rule[2], 29 CFR 1910.120, which requires the training of hazardous waste workers in worker protection techniques and the health effects of hazardous materials. This regulation, intended primarily for those who are engaged in the cleanup of the many abandoned hazardous waste sites listed under the original Superfund (Comprehensive Environmental Response, Compensation, and Liability Act of 1980[3]-CERCLA), provides for appropriate health safeguards for all workers.

Unlike 40 CFR Part 26.516[4] implementing the Resource Conservation and Recovery Act (RCRA)[5], which was written by the EPA to train employees in hazardous waste management procedures and emergency response, the interim final rule 29 CFR 1910.120 promulgated by OSHA focuses on the recognition of health hazards to which workers may be exposed and on the appropriate work practices and methods of protection to minimize those hazards.

A review of the SARA regulation reveals there are various issues that must be interpreted in order to develop specific facility training curricula to meet the intent of the regulation.

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GENERAL WORKER TRAINING REQUIREMENTS

The interim final rule includes provisions for initial training of employees before they are allowed to work in hazardous waste operations. The training required for employees involved in operations at uncontrolled hazardous waste sites includes a minimum of 40 hours of initial instruction off the waste site, and minimum of 3 days of actual field experience under the direct supervision of a trained and experienced supervisor. Training must be provided at the time of job assignment and applies to employers and employees engaged in the following operations:

- Operations involving hazardous substances that are conducted under the Comprehensive Environmental Response, Compensation and Liability Act of 1980, including initial investigations of CERCLA sites before the presence or absence of hazardous substances has been ascertained;

- Clean-up operations involving major corrective actions conducted under the Resource Conservation and Recovery Act of 1976;

- Operations at hazardous waste sites that have been designated for clean-up by state or local government authorities.

A less detailed training provision is given for employees working in routine treatment, storage, and disposal operations such as facilities regulated under RCRA Section 3004. These sites will have more routine working conditions and the hazards will be better identified and controlled. The interim rule specifies 24 hours as the basic level of training appropriate to these working conditions.

Since waste sites contain many potential hazards, workers should be trained to recognize hazards, apply appropriate work practices to minimize the hazards, and properly use respirators and other personal protective equipment.

SUPERVISOR/MANAGER TRAINING REQUIREMENTS

Supervisors and managers directly responsible for waste site operations are to receive the same training as that of employees and at least eight additional hours of specialized training on managing hazardous waste operations. Since these people are responsible for directing others, it is necessary to enhance their ability to provide guidance and to make informed decisions. TRADE is developing a second volume of instructional materials for SARA/OSHA supervisor and manager training.

EMERGENCY RESPONSE TRAINING

The interim final rule covers emergency responses to releases of hazardous substances at all work sites including non-CERCLA and non-RCRA sites.

Emergency response personnel for hazardous waste clean-up site operations must have the same basic training as the other employees involved in hazardous waste clean-up operations plus the training needed to develop and retain the necessary skills for anticipated emergency response activities. CERCLA sites, major corrective actions at RCRA sites, sites designated for clean-up by state and local governments, and other similar hazardous waste clean-up sites require more training because there is the potential of uncontrolled hazards.

When there is a reasonable potential that employees may be asked to respond to emergencies at sites other than hazardous waste clean-up sites, 24 hours of training annually must be provided with training sessions at least monthly. As an alternative, demonstration of competency by the employee may be certified at least quarterly. Workers in this category would include employees in fire departments, emergency medical and first-aid squads, hazardous material teams, spill response teams, and other groups with responsibility for emergency response. While emergency response training is likely already in place at many DOE sites, emergency response personnel can be included in the general site worker training course.

The interim final rule clarifies that training need be given only to those employees who will actually be engaged in emergency response activities such as controlling toxic chemical fires and containing spills. Employees who may be first on the scene, but not expected to engage in response activities, may be trained only in hazard recognition if they are instructed to call others to control hazardous substance spills and fires.

Employees who will be consulted for technical advice or assistance concerning specific hazardous materials in the event of a spill or hazardous substance release incident must have 24 hours of training annually or demonstrate competency in their area of specialization. However, training sessions for these workers need not be held on a monthly basis.

If skilled support personnel from outside of the organization are needed to perform immediate emergency support work, 29 CFR 1910.120 does not require 24 hours of training or demonstration of competency. It is the responsibility of the employer to provide an initial briefing for outside support personnel before they become involved in an emergency situation. The briefing should include information regarding duties to be performed, chemical hazards involved, and instruction in wearing the proper personal protective equipment.

RETRAINING

Employees at hazardous waste operations need to be reminded that they face the potential for serious health and safety risks. The interim final rule requires eight hours of annual retraining on relevant matters such as review of health hazards and the use of personal protective equipment.

In all areas of training, whether it be for general site employees, supervisors at the site, or for the use of specific equipment, the level of training should be consistent with each worker's job function and responsibilities. Refresher training would be supplied to reemphasize the initial training and to update employees on any new policies and procedures.

Once an employee has received the required training, the employee need not be retrained to work at subsequent sites, even if a different employer is involved. The above training requirements and specific time constraints are summarized in Table 1.

Table 1. SARA Training Requirements

	Basic (24 hrs)	Basic (40 hrs)	Mgt. (8 hrs)	On-Site Field Exper. (24 hrs)	Annual Refresher (8 hrs)
Remedial Action General Site Workers		X		X	X
Remedial Action Supervisors/ Managers		X	X	X	X
CERCLA Facility Workers		X		X	X
CERCLA Facility Supervisors/ Managers		X	X	X	X
RCRA Facility Workers	X			X	X
RCRA Facility Supervisors/ Managers	X		X	X	X
Emergency Response Personnel	X				X

ORNL FACILITY COMPLIANCE

Oak Ridge National Laboratory has several organizations which have responsibilities in the area of hazardous waste substances and hazardous wastes. Within each of these organizations are various categories of workers who may be potentially exposed to a wide variety of hazardous/radioactive materials through various treatment, storage, and disposal operations. Because of the complexity in developing training curricula to meet the specific needs of workers supporting a multi-functional laboratory, the Technical Resources and Training Program, in conjunction with these organizations, has done a needs analysis focusing on 29 CFR 1910.120.

The first step undertaken by our organization in deciding what training curriculum was needed involved an in-depth review of several related regulations, particularly SARA and RCRA, to determine if and how ORNL must comply with the regulations. The Laboratory has hazardous waste treatment, storage, and disposal (TSD) facilities that are currently under interim status or permitted under RCRA. Although ORNL has sites that fall under the jurisdiction of CERCLA/SARA, these sites are currently being addressed under RCRA 3004(u). Both RCRA and SARA training regulations cover corrective actions undertaken under the authority of RCRA Section 3004(u) as well as interim status or permitted TSD facilities, thereby placing these facilities under dual regulatory control. Therefore, in addition to the RCRA training program[6] already in existence, the need for additional training to meet 29 CFR 1910.120 was established.

ORNL SARA/OSHA TRAINING PROGRAM

In order to meet the specific training requirements established by OSHA for different categories of workers, the ORNL SARA/OSHA training curriculum is being structured into three separate courses. Because ORNL is currently involved only in treatment, storage, and disposal operations permitted under RCRA, most ORNL hazardous waste workers will require the SARA/OSHA training curriculum consisting of 24 hours of classroom and field exercises. For those employees who may engage in remedial waste clean-up operations, 16 additional hours or 40 total hours of training will be provided. Managers and supervisors involved in hazardous waste operations will receive 8 hours of training relevant to their responsibilities in addition to the training offered the hazardous waste workers. The structure of this training program is outlined below; the category of worker determines to what level in the progression the training proceeds:

- Basic SARA/OSHA Training (24 hours)
- Remedial Action Training (16 hours)
- Supervisors/Managers Training (8 hours)

At the request of numerous DOE offices and facilities, we are making some of the resources we have developed available across the DOE system through the TRADE network. Our intent is to share our experience with other DOE facilities and we hope that these materials will be useful to others in meeting SARA training requirements.

The proposed ORNL SARA/OSHA training curriculum emphasizes health and safety concerns in hazardous waste operations as well as methods of worker protection. Consistent with guidelines for hazardous waste site activities developed jointly by National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, U.S. Coast Guard, and the Environmental Protection Agency,[7] the program material will address the following topics:

1. Basic Training for General Site Workers

   ORNL Site Safety Documentation
   Safe Work Practices
   Nature of Anticipated Hazards
   Handling Emergencies and Self-Rescue
   Employee Rights and Responsibilities
   Demonstration of Use, Care, and Limitations of Personal Protective Clothing and Equipment
   Demonstration of Monitoring Equipment and Sampling Techniques

The basic training courses includes major fundamentals of industrial hygiene presented to the workers in a format that encourages them to assume responsibility for their own safety and health protection. Basic course development has focused on the special needs of ORNL facilities. Because ORNL generates chemical wastes, radioactive wastes, and mixed wastes, we have added significant modules on radiation protection in general, as well as modules on radiation toxicology and on radiation protective clothing and equipment.

2. Remedial Action Training Course

For those workers engaged in remedial action activities at ORNL we are developing an additional 16-hour course to cover in more depth such topics as site characterization, use and decontamination procedures of protective clothing and equipment, and safe handling of drums and other containers. TRADE will develop a third volume of instructional materials for this course.

Because ORNL, like many other DOE sites, is embarking upon some large scale remedial activities, we anticipate that much of the remedial site cleanup will be performed by outside contractor personnel. Prior to arriving on site, contractor personnel must receive 40 hours of SARA/OSHA training with clearly defined training plans and auditable documentation. Training requirements are being written into the contracts, and provision is made for our review of this type of outside training. Additionally, these contractor personnel will also receive from ORNL a site-specific orientation.

3. Supervisors/Managers Training Course

An additional 8-hour course is being developed for supervisors and managers of waste facilities and waste cleanup activities. This course will focus on management and problem solving skills related to waste site operations; on how to effectively use the ORNL support organizations such as environment, safety, health, and laboratory protection; selection of personal clothing and equipment; and on-site control. Much of this material will be included in the second volume of TRADE instruction materials.

SUMMARY

This tri-level approach should provide the appropriate level of SARA/OSHA training to all DOE employees subject to SARA and OSHA 29 CFR 1910.120. Once the Final Rule is published by OSHA, the ORNL training plan will be reviewed and revised as necessary. All DOE facilities will need to review their level of compliance with SARA/OSHA training requirements. We hope these materials will assist them in addressing these new training needs.

ACKNOWLEDGMENTS

The Technical Resources and Training Program personnel work closely together and team teach in many courses. Those participating in the development, delivery, and documentation of SARA/OSHA training include Michael Moreland, Steven Abercrombie, Kennie Edwards, Edith Jones, Jean Thorpe, Mary Wilson, and Mary Benton. In addition, we have received extensive reviews and/or active teaching/participation from Joe Inman and K. F. (Butch) Edgemon on emergency response and hazardous materials disposal; Roger Lankford, Randy Ogle, Brian Jerome, Ray Monk, Betty Wilson, Charlie Satterwhite, and Teresa Presley on industrial hygiene; Don Kennedy on radiation protection clothing and equipment; and Frank G. Tauxe on self-contained breathing equipment. Cathy Long played a key role in obtaining commercially available materials. The combined technical talents of this wide-ranging team has contributed much to the course and this document. We would like to thank our Division Director, Dennis C. Parzyck, our Laboratory Executive Director, Raymond S. Wiltshire, and other directors of ORNL operations, for providing the resources and support to develop the training program.

The materials reprinted here in black and white have been prepared and generated in color by our training staff using a versatile business graphics computer software.[8] Beckie Heatherly and Allen Bratten have assisted us in the installation and maintenance of the appropriate computer equipment.

REFERENCES

1 Superfund Amendments and Reauthorization Act of 1986 (SARA). Public Law 99-499, October 17, 1986, 100 Stat. 1613.

2 Hazardous Waste Operations and Emergency Response, 29 CFR 1910.120. 52 Federal Register 29620, August 10, 1987.

3 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund"). Public Law 96-510, December 11, 1980, 94 Stat. 2795.

4 Personnel Training, 40 CFR Part 265.16. 50 Federal Register 4514, January 31, 1985.

5 Resource Conservation and Recovery Act of 1976 (RCRA). Public Law 94-580, October 21, 1976, 90 Stat. 2795.

6 B. D. Barkenbus. 1987. "Resource Conservation and Recovery Act (RCRA) New-Employee Training Manual for the Operations Division RCRA Personnel," ORNL/TM-10311. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

7 Occupational Safety and Health Guidance Manual For Hazardous Waste Site Activities. 1985. National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), United States Coast Guard (USCG), and Environmental Protection Agency (EPA), DHHS (NIOSH) Publication 85-115.

A summarized, non-technical booklet form of this document is available from the Environmental Protection Agency. It is entitled "Protecting Health and Safety at Hazardous Waste Sites: An Overview." 1985. EPA/625/9-85/006.

8 DIAGRAPH. Business Graphics Software by Computer Support Corporation, Carrollton, Texas.

REVIEW OF REGULATIONS

SCOPE

This module introduces the regulations upon which the SARA/OSHA worker health and safety training program is based. Specific mention will be made of the training requirements of the Superfund Amendments and Reauthorization Act (SARA) as interpreted in the Occupational Safety & Health Administration, Department of Labor, Interim Final Rule 29 CFR 1910.120. Compliance with this regulation requires that all workers who are involved in hazardous material/waste treatment, storage, disposal/cleanup, and emergency response activities receive classroom and field exercise training.

This module will also introduce the topics which will be covered during the training course and the criteria which will be used to demonstrate or evaluate the participants' understanding of the material presented.
(Suggested time - 1 hour)

PARTICIPANT GOALS

1) Gain an understanding of the requirements of SARA Title I, Section 126, "Worker Protection Standards."

2) Gain an understanding of the requirements of OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."

3) Learn how these regulations apply to actual work and work sites.

4) Receive a list of the topics to be covered during the training course.

5) Recognize the criteria which will be used to demonstrate the training course participants' understanding of the material presented.

CHEMICAL TOXICOLOGY

SCOPE

This portion of the Toxicology module presents information about the harmful effects of chemicals on biological systems. The information presented included definitions of toxicology terminology, basic principles of toxicology, the dose-response relationship, routes of entry, pathways of excretion, and general types of adverse responses to toxic chemical exposure.

PARTICIPANT GOALS

1) Learn the definitions of some important toxicology terms.

2) Gain an understanding of the basic principles of toxicology including the dose-response relationship.

3) Learn the three primary routes by which toxicants enter the body.

4) Gain an understanding of the pathways of excretion by which toxicants are removed from the body.

5) Learn some of the general types of adverse responses to toxic chemical exposure.

OVERVIEW OF SARA

REG2

INSTRUCTIONAL ACTIVITY

- Introduce the subject and discuss the federal regulations which protect the health and safety of hazardous waste site workers:

  Overview of SARA and other EPA regulations;
  (REG 2, 4, 1, SARA 23)

  Growth of Health and Environmental Protection Laws;
  (ORNL-DWG 87C-16938)

  SARA contents;
  (SARA 1-6)

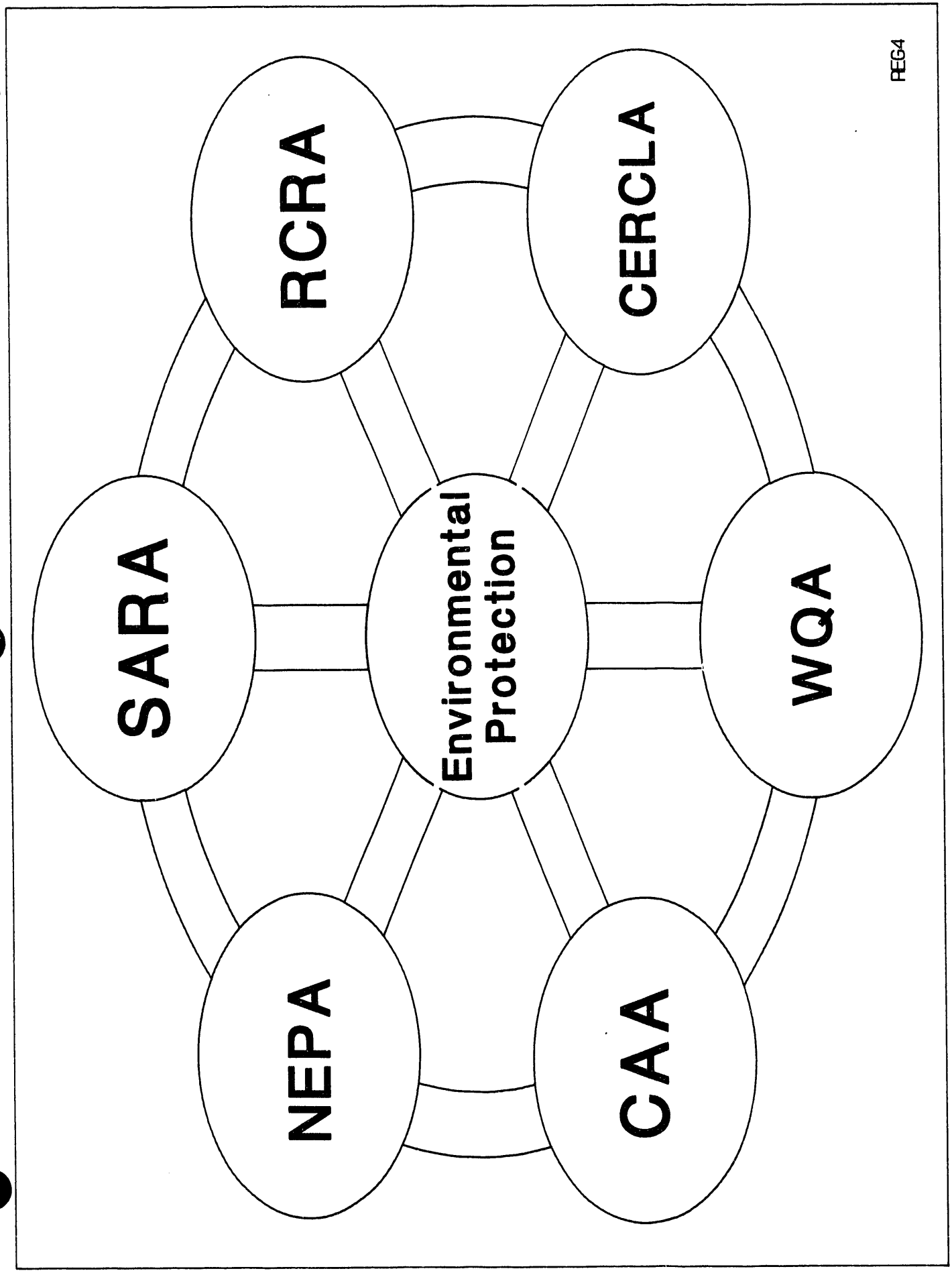
  OSHA Interim Final Rule 29 CFR 1910.120 contents;
  (SARA 7-8; REG 13A, 6A; SARA 9A, 10A; REG 9; SARA 11, 12A; REG 11A; SARA 18A-B, 19; REG 8A; SARA 20, 21; REG 5A, 12; SARA 22)

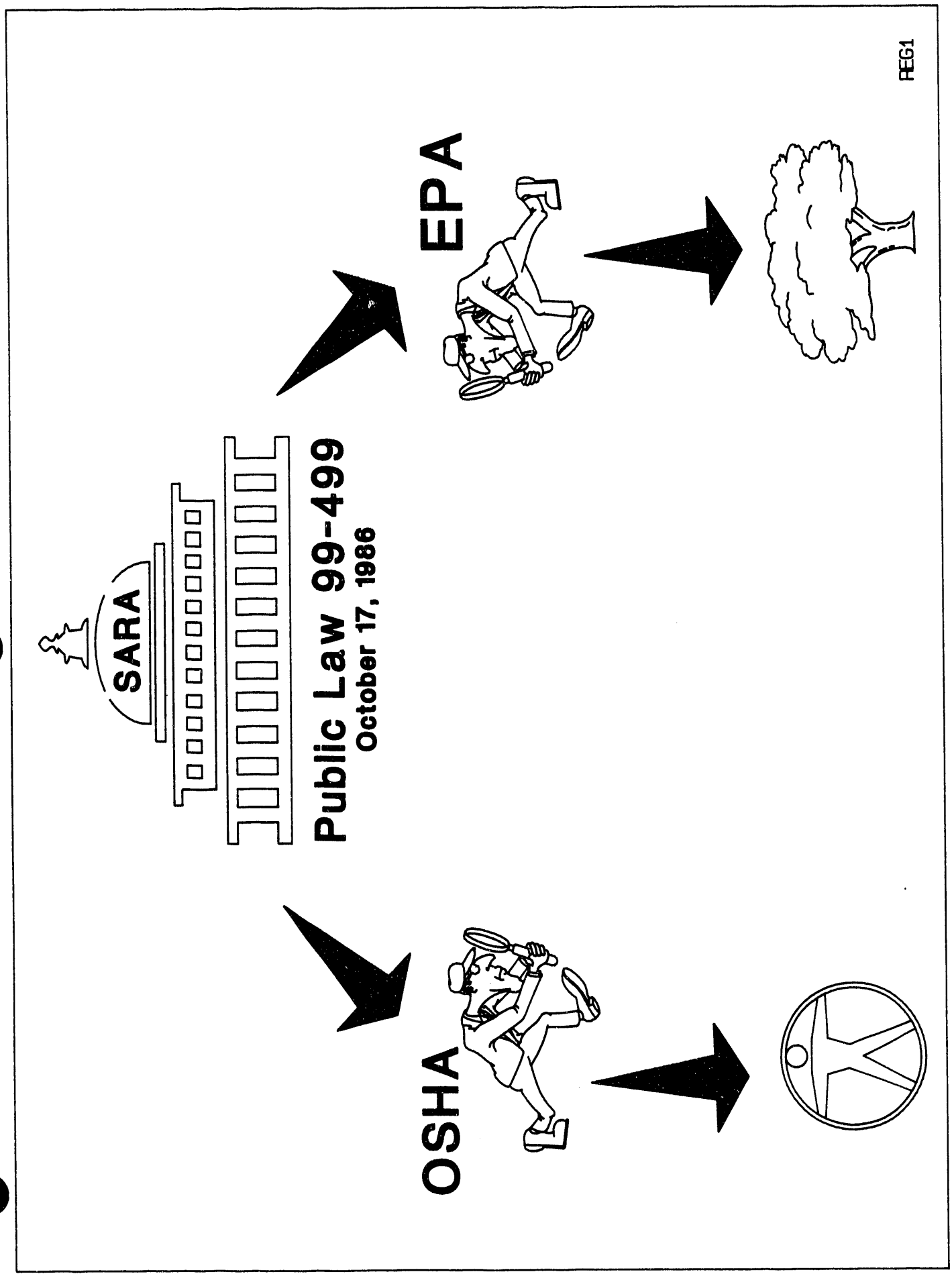
  SARA additional training requirements for selected employees.
  (SARA 14, 13)

- Distribute course topics outline and present overview of the topics to be covered by this training course.
  (SARA 25)

- Discuss the criteria which will be used to demonstrate or evaluate the participants' understanding of the material presented.

- Distribute and oversee completion of worksheet or exam.


RCRA
CERCLA
SARA
Environmental Protection
WQA
NEPA
CAA
REG4


SARA
Public Law 99-499
October 17, 1986
EPA
OSHA
REG1

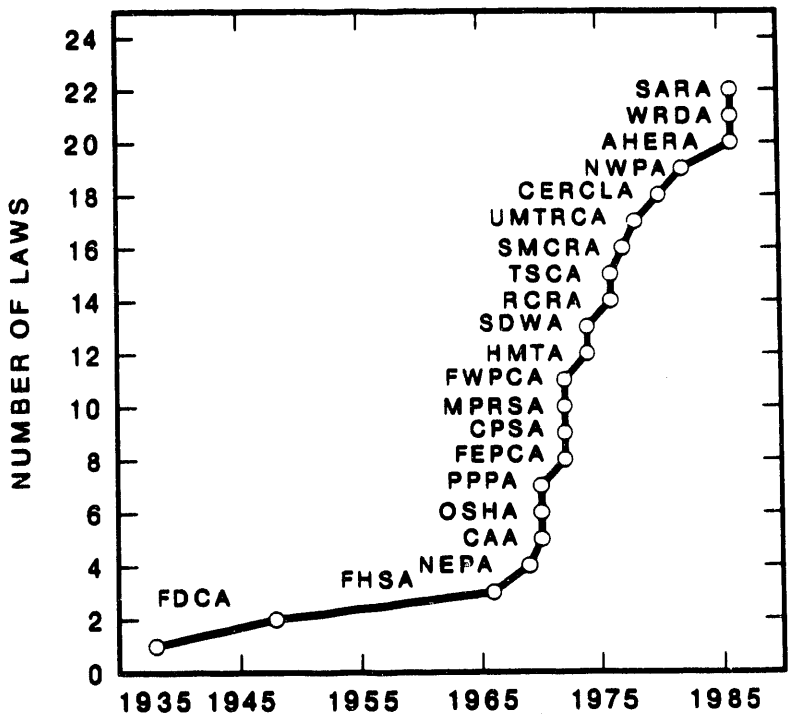
OPERATIONS UNDER RCRA

RCRA TSD FACILITIES

- IMPLEMENT 29 CFR 1910.1200
- MEDICAL SURVEILLANCE
- SAFETY AND HEALTH PROGRAM
- DECONTAMINATION PROCEDURE
- TRAINING PROGRAM (24 HOURS/8 HOURS REFRESHER)

SARA23

GROWTH OF HEALTH AND ENVIRONMENTAL PROTECTION LAWS



FDCA - FEDERAL DRUG AND COSMETICS (1938)
FIFRA - FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE (1948,1972, 1975, 1983)
FHSA - FEDERAL HAZARDOUS SUBSTANCES (1966)
NEPA - NATIONAL ENVIRONMENT POLICY (1969)
PPPA - POISONIOUS PACKAGING PREVENTION (1970)
OSHA - OCCUPATIONAL SAFETY AND HEALTH (1970)
CAA - CLEAN AIR (1970, 1977)
FWPCA - FEDERAL WATER POLLUTION CONTROL (CLEAN WATER) (NOW WATER QUALITY) (1972, 1977, 1987)
MPRSA - MARINE PROTECTION, RESEARCH, AND SANCTUARIES (1972)
CPSA - CONSUMER PRODUCT SAFETY (1972)
FEPCA - FEDERAL ENVIRONMENTAL POLLUTION CONTROL (1972)
SDWA - SAFE DRINKING WATER (1974,1977, 1986)
HMTA - HAZARDOUS MATERIALS TRANSPORTATION (1974, 1984)
RCRA - RESOURCE CONSERVATION AND RECOVERY (1976, 1979)
TSCA - TOXIC SUBSTANCE CONTROL (1976)
SMCRA - SURFACE MINE CONTROL AND RECLAMATION (1977)
UMTRCA - URANIUM MILL TAILINGS RADIATION CONTROL (1978)
CERCLA - COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (1980)
NWPA - NUCLEAR WASTE POLICY ACT (1982)
AHERA - ASBESTOS HAZARD EMERGENCY RESPONSE ACT (1986)
WRDA - WATER RESOURCES DEVELOPMENT ACT (1986)
SARA - SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (EXTENSION OF CERCLA) (1986)

SUPERFUND AMENDMENT REAUTHORIZATION ACT (SARA) CONTENTS

Title I: Provision Relating Primarily To Response and Liability

Title II: Miscellaneous Provisions

Title III: Emergency Planning and Community Right-to-Know Act

Title IV: Radon Gas and Indoor Air Quality Research

Title V: Superfund Financing

SARA1

WORKER PROTECTION STANDARDS
(Title I, Section 126)

- Promulgation
- Proposed Standards
- Final Regulations
- Specific Training Standards
- Interim Regulation
- Coverage of Certain State and Local Employees
- Grant Program

SARA2

PROPOSED STANDARDS
(Title I, Section 126B)

- Site Analysis
- Training
- Medical Surveillance
- Protective Equipment
- Engineering Controls
- Maximum Exposure Limits

SARA3

PROPOSED STANDARDS
(Title I, Section 126B)

- Information Program
- Handling
- New Technology Program
- Decontamination
- Emergency Response

SARA4

SPECIFIC TRAINING STANDARDS
(Title I, Section 126D)

- 40 hours on site*, 3 days in field
- 8 additional hours for managers
- Certification for general site workers, on-site managers
- Prohibition of untrained workers from engaging in hazardous waste operations
- 24 hours for emergency response personnel

*24 hours sufficient for RCRA facilities

SARA5

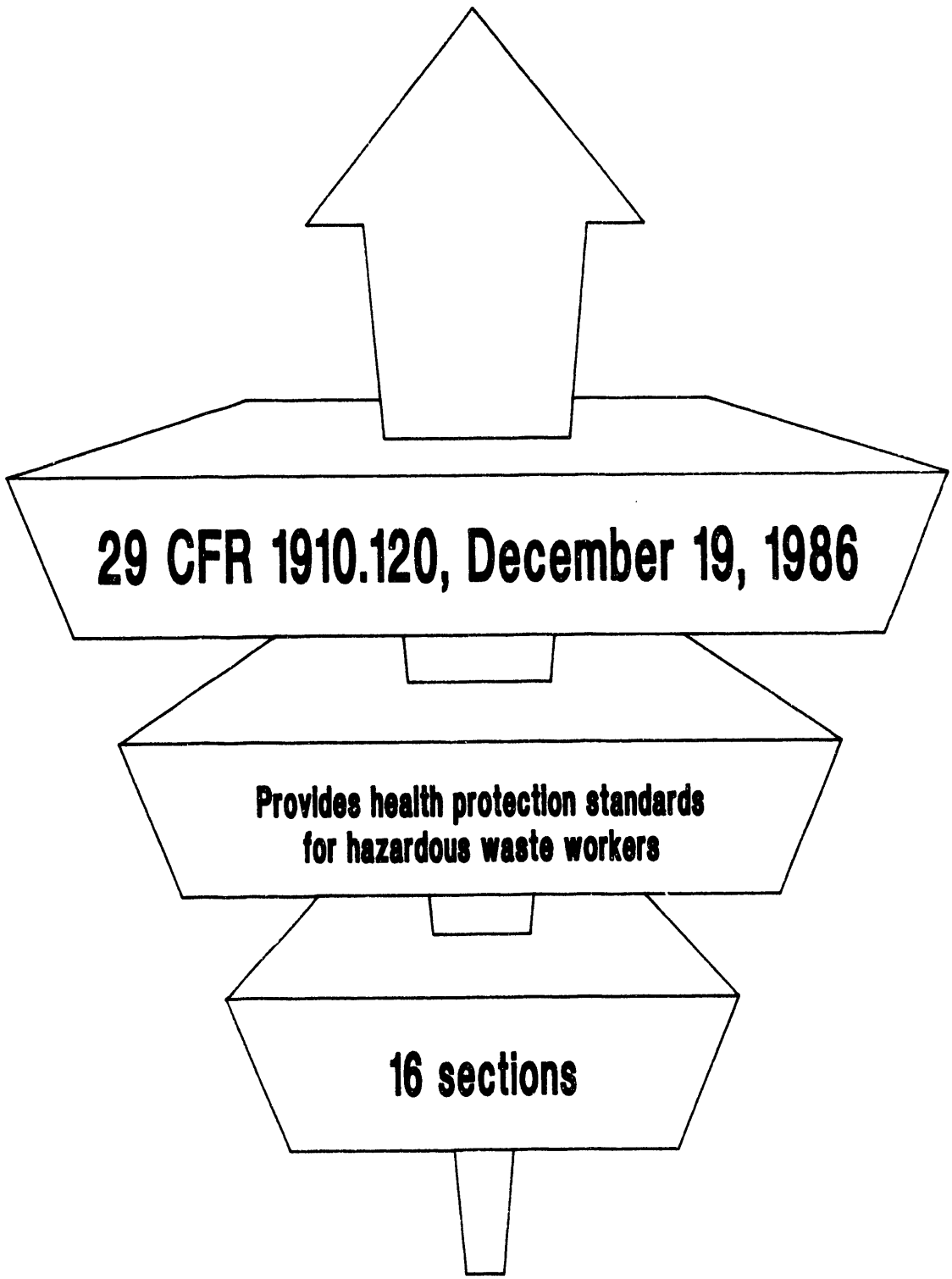
DEADLINE

(Title I, Section 126E)

Secretary of Labor to issue interim final regulations within 60 days, which was December 19, 1986

SARA6

OSHA INTERIM FINAL STANDARD

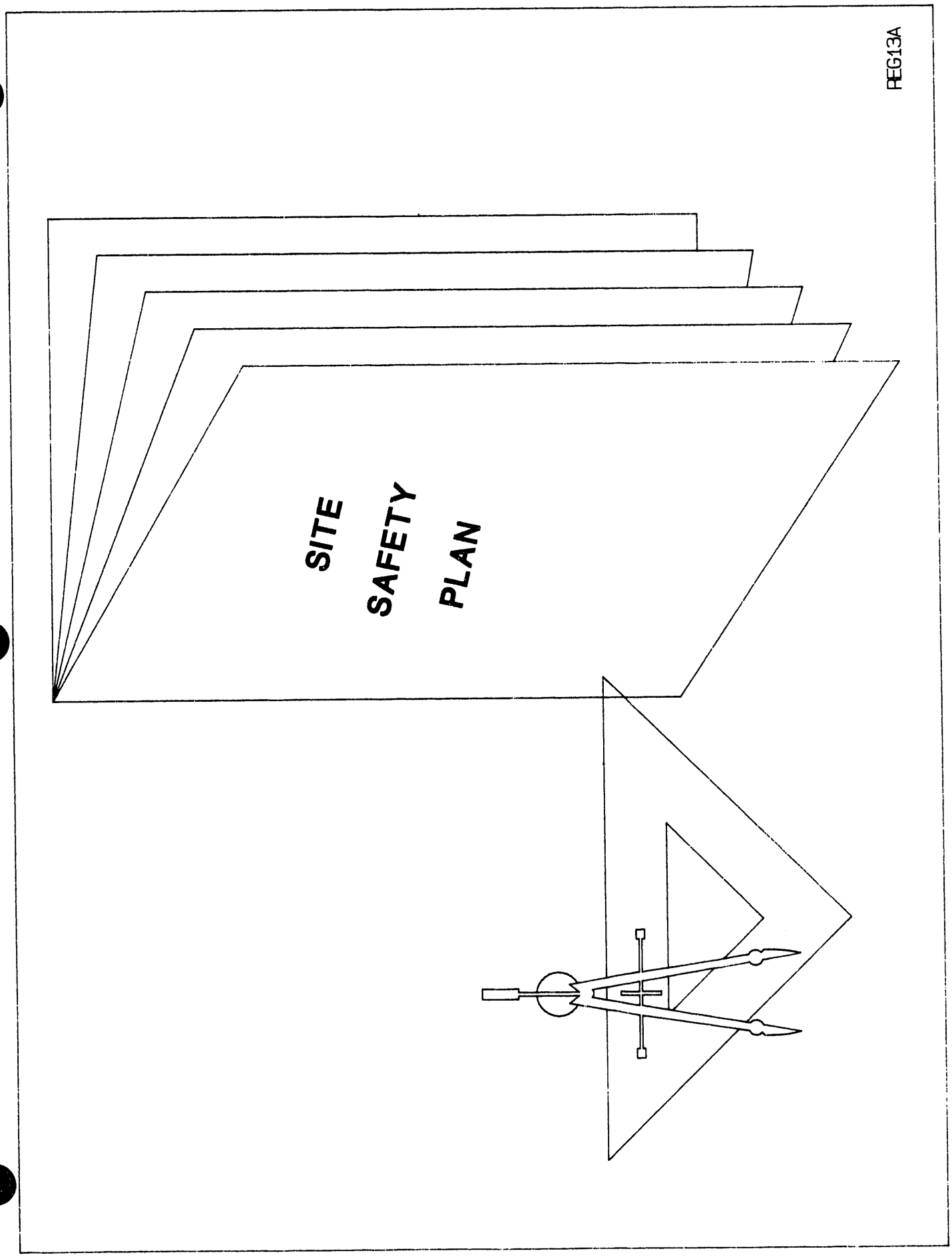


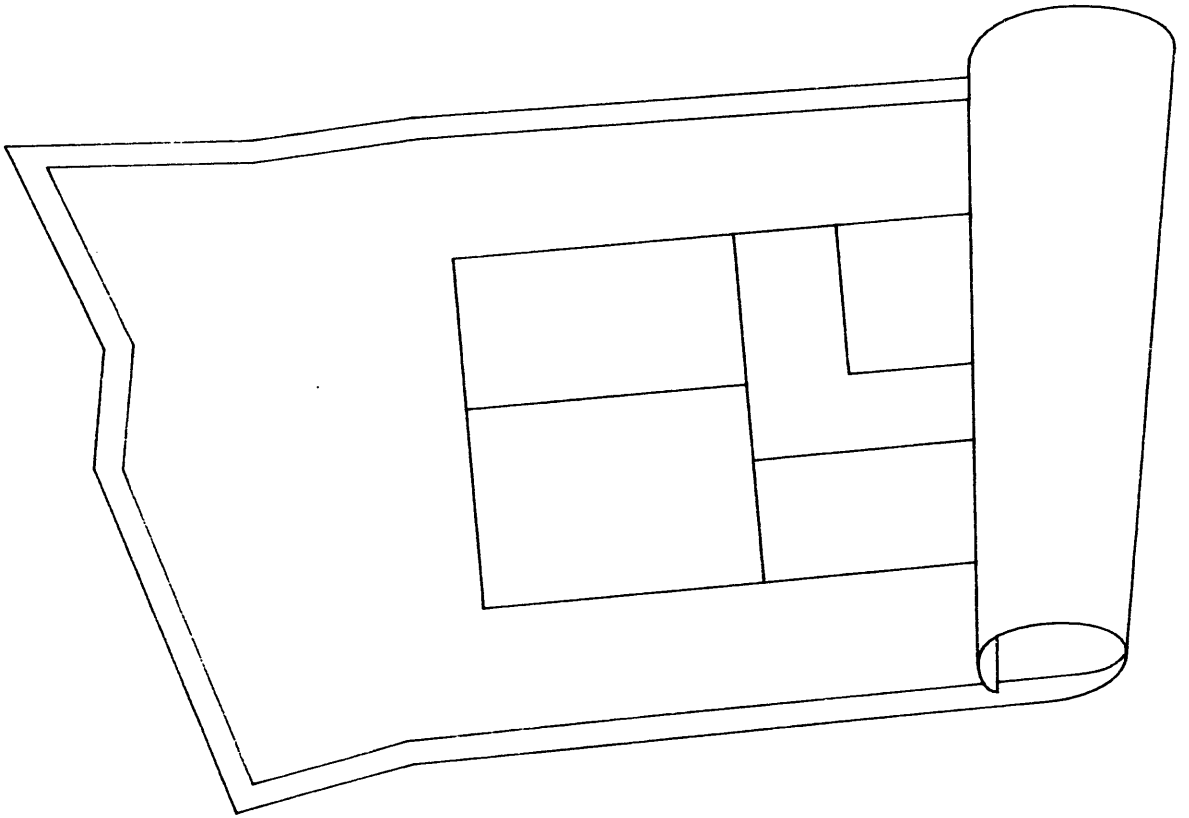
SARA7

29 CFR 1910.120
CONTENTS

A. Scope, application, and definition
B. General requirements
C. Site characterization and analysis
D. Site control
E. Training
F. Medical surveillance
G. Engineering controls, work practices, and personal protective equipment for employee protection
H. Monitoring
I. Information programs
J. Handling drums and containers
K. Decontamination
L. Emergency response
M. Illumination
N. Sanitation at temporary workplaces

SARA8


SITE
SAFETY
PLAN
REG13A



REQUIREMENTS FOR SITE CHARACTERIZATION

FEG6A

SITE CHARACTERIZATION AND ANALYSIS

Preliminary site evaluation (RFA documents)
---Facility RFA document
---Facility forms for disposal
---Monitoring data

IDLH identification

List of hazards

PPE selection
---Level B minimum

Site entry

Monitoring
---Radiation
---Explosivity
---Toxics

SARA9A

SITE CONTROL

Establish site maps
---Facility Atlas

Set up work zones
---Regulated
---Contamination

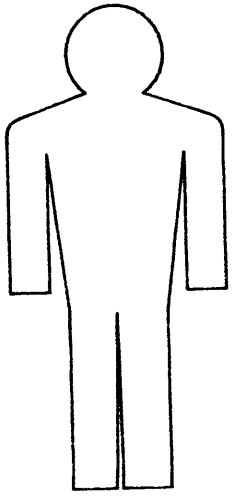
Establish "Buddy" system
---Work with Partner

Security

Provide Monitoring
---Air
---Water

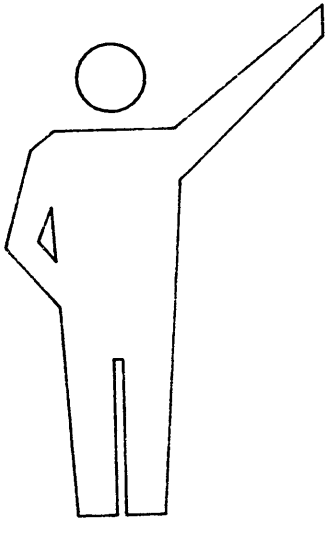
SARA10A

THE BUDDY SYSTEM:



Keep An Eye

On Each Other



REG9

TRAINING REQUIREMENTS

Names of ESH personnel

Safety, health and other hazards

Toxicology

Personal protective clothing

Hazard prevention

Engineering controls

Medical surveillance

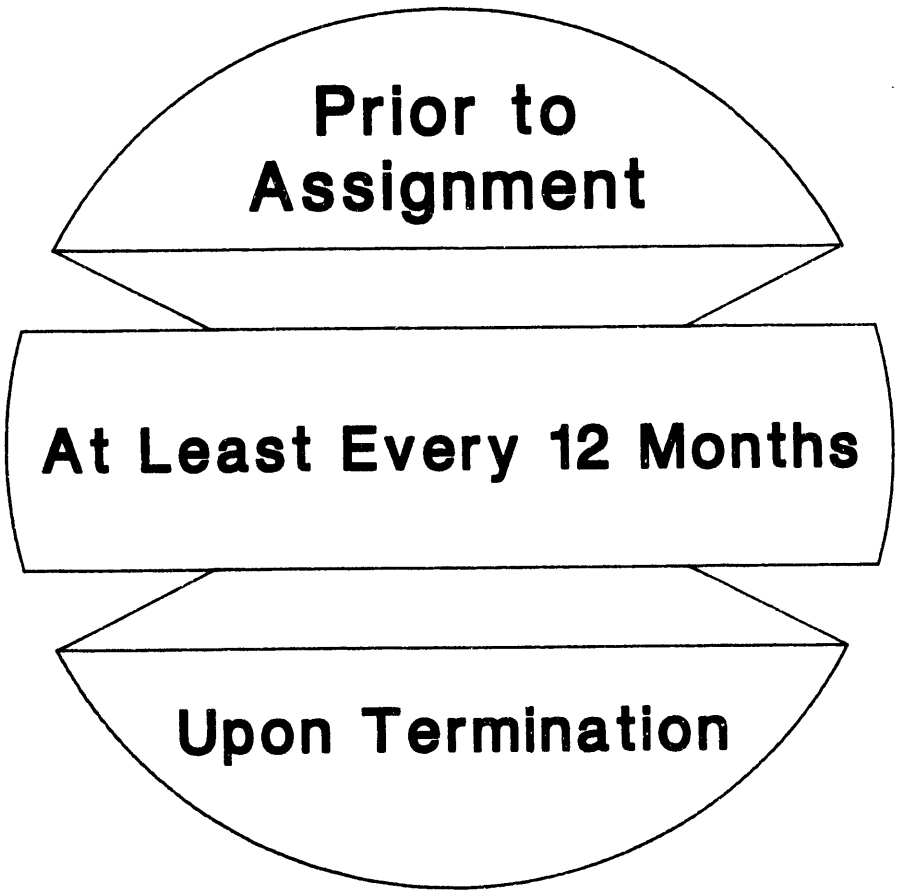
Site control

Decontamination

Emergency response

SARA11

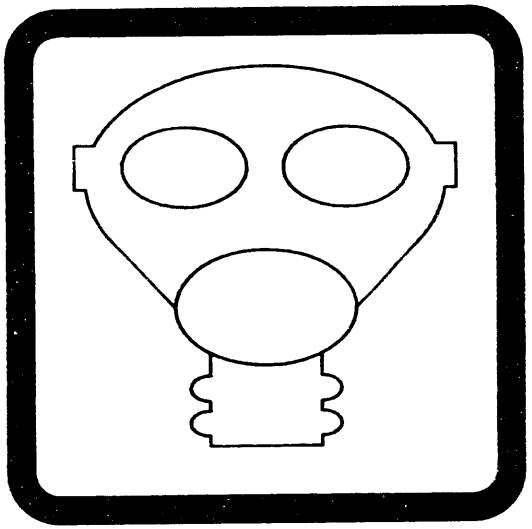
MEDICAL SURVEILLANCE

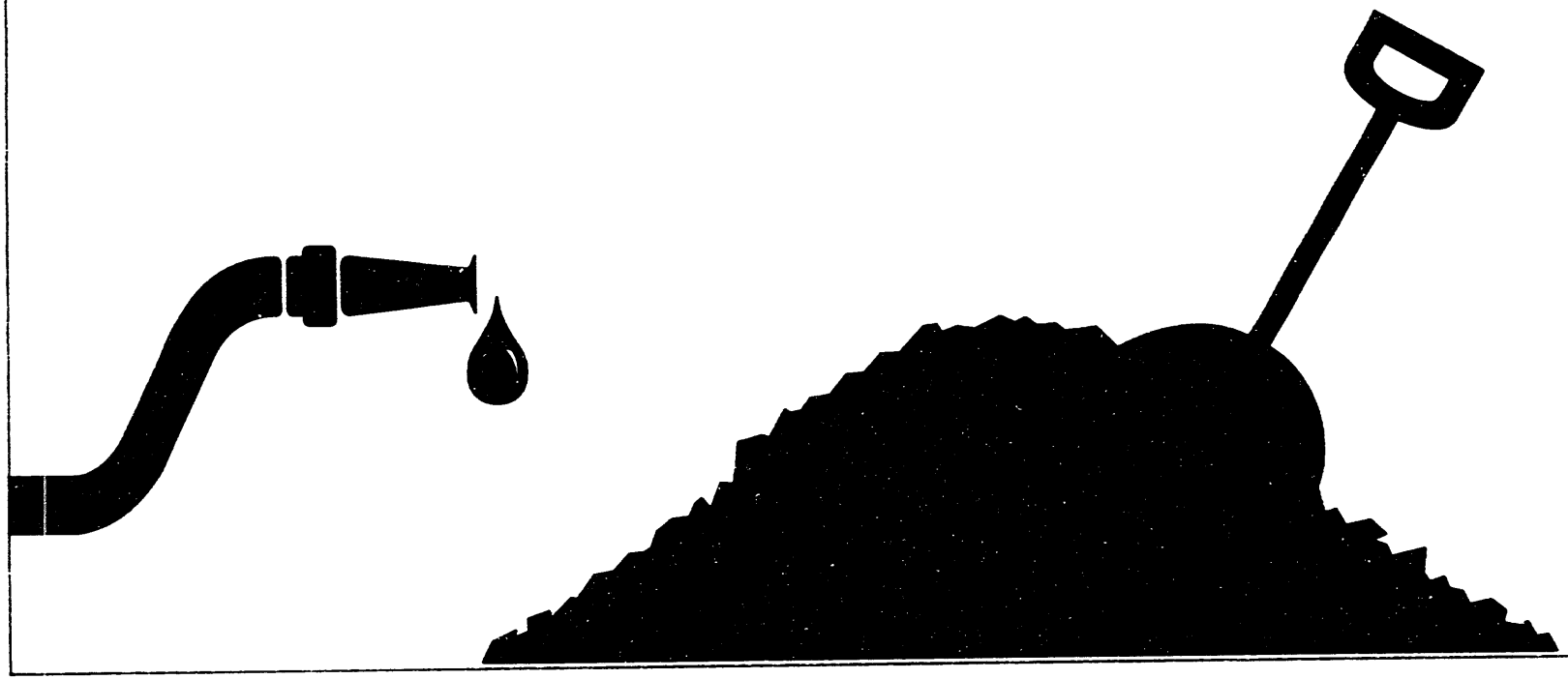


For employees exposed or potentially exposed to hazardous substances or who wear respirators:

SARA12A

ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT





REG11A

INFORMATIONAL PROGRAMS

SITE SAFETY AND HEALTH PLAN

- KEY SAFETY PERSONNEL
- SAFETY AND HEALTH RISK ANALYSIS
- EMPLOYEE TRAINING
- PPE FOR EACH TYPE OF TASK
- MEDICAL SURVEILLANCE
- MONITORING SURVEILLANCE
- SITE CONTROL
- CONFINED SPACE ENTRY PROCEDURES

SARA18A

HANDLING DRUMS AND CONTAINERS

- DOT, OSHA, EPA SPECIFICATIONS
- INSPECTION
- SPILL KITS
- OVERPACKING FOR NON-MOVABLE DRUMS
- DETECTION SYSTEM FOR UNDERGROUND DRUMS
- FIRE EXTINGUISHING EQUIPMENT
- OPENING DRUMS AND CONTAINERS
- RADIOACTIVE WASTE CONTAINERS

SARA18B

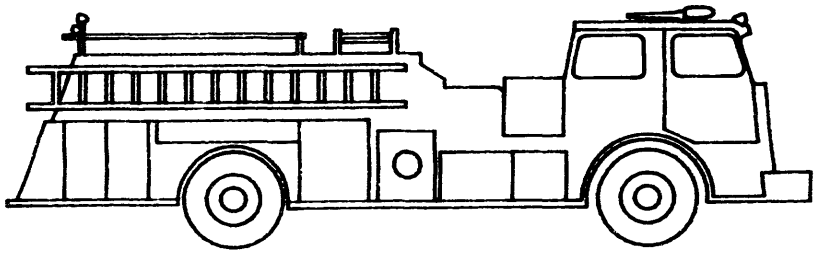
DECONTAMINATION

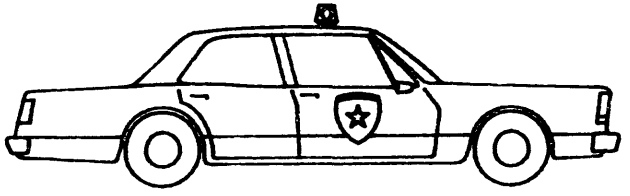
- DECONTAMINATION PROCEDURES
- INCLUDE IN SITE SAFETY PLAN
- DECONTAMINATION AREA
- METHODS AND CLEANING FLUIDS MATCHED TO EACH PARTICULAR HAZARD
- PROPER DISPOSAL PROCEDURES
- IF SHOWER/CHANGE ROOM REQUIRED MUST MEET 29 CFR 1910.141

SARA19

EMERGENCY

RESPONSE





REGBA

EMERGENCY RESPONSE

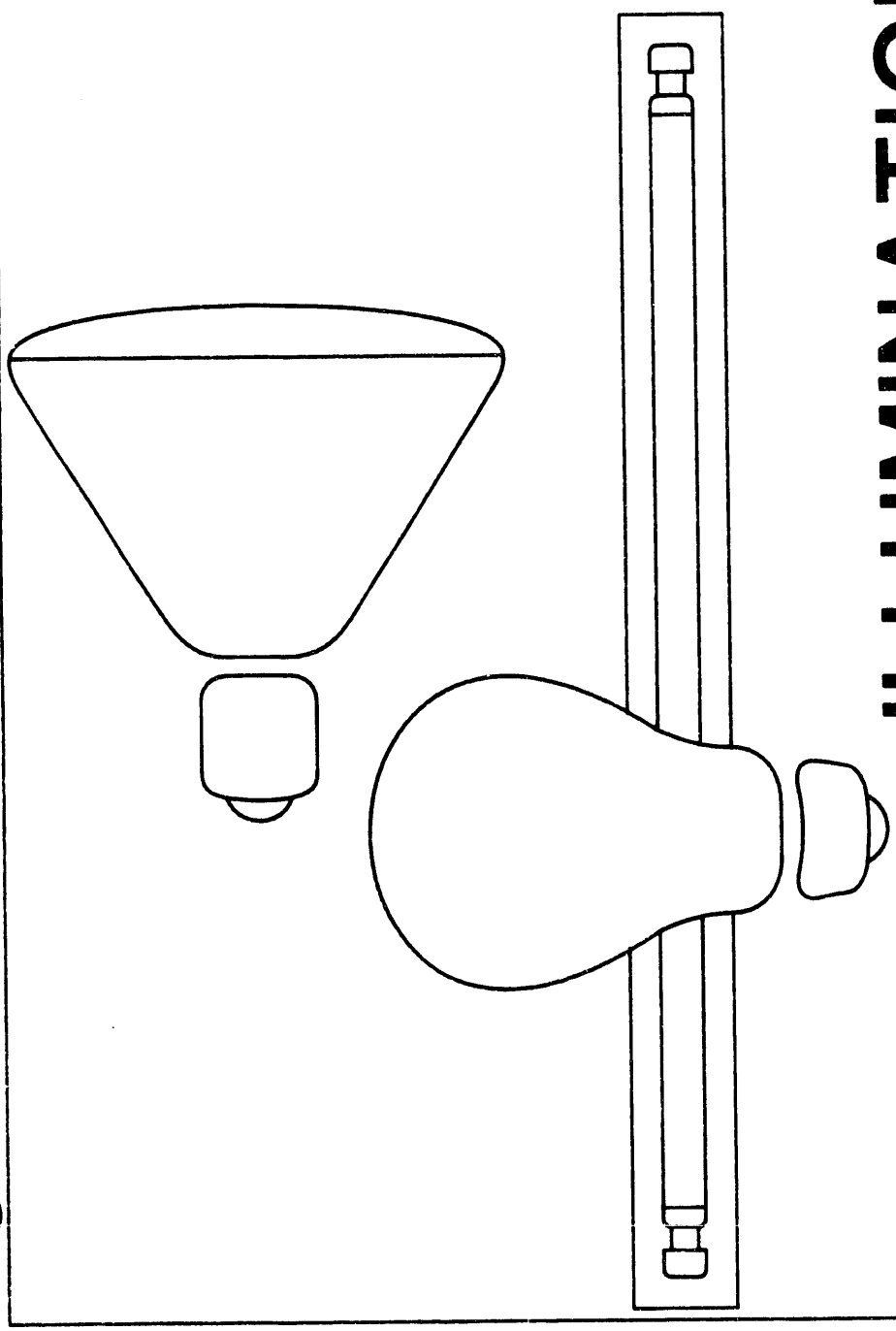
- EMERGENCY RESPONSE PLAN
  - COMMUNICATION SYSTEM
  - ALARM SYSTEMS
  - SECURITY
  - DECONTAMINATION
- SPILL RESPONSE
- TRAINING (24 HRS/ANNUAL)

SARA20

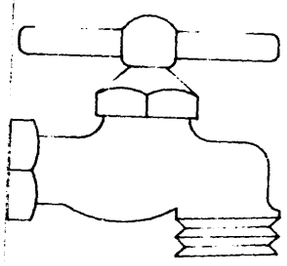
ILLUMINATION

SARA21

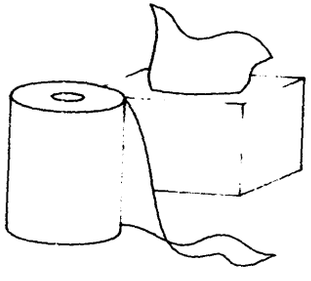
ILLUMINATION FOR OUTSIDE WORK

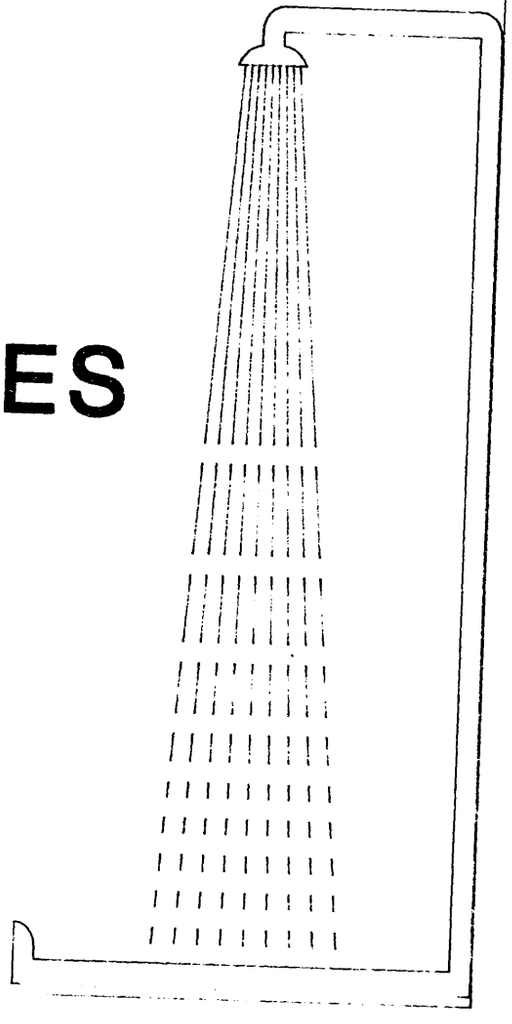


REGSA



TEMPORARY DRINKING WATER AND SANITATION FACILITIES





REG12

SANITATION REQUIREMENTS

- POTABLE WATER
- NON- POTABLE WATER (signs)
- TOILETS
- WASHING FACILITIES

SARA22

SARA REQUIREMENTS FOR ADDITIONAL TRAINING FOR ON-SITE MANAGERS OR SUPERVISORS

- Training for General Site Workers
- Training for Workers Exposed to Unique Hazards or Occasionally Supervise Others
- Management of Hazardous Waste Site Clean-up Operations
- Management of Site Work Zones
- How to Communicate with Press and Local Community

SARA14

SARA REQUIREMENTS FOR ADDITIONAL TRAINING FOR GENERAL SITE WORKERS EXPOSED TO UNIQUE HAZARDS OR OCCASIONALLY SUPERVISE OTHERS

- Training for General Site Workers
- Site Surveillance
- Site Safety Plan Development
- Use and Decontamination of Fully Encapsulating Personal Protective Clothing and Equipment
- Use of Instruments to Measure Explosivity, Radioactivity, etc.
- Use of Specialized Equipment
- Topics Specific to Identified Site Activities

SARA13

TRAINING SESSIONS COVERED

- REVIEW OF REGULATION
- TYPES OF HAZARDS
- PROTECTIVE EQUIPMENT
- FACILITY OVERVIEW
- SITE CONTROL AND CHARACTERIZATION
- DECONTAMINATION
- MEDICAL SURVEILLANCE
- EMERGENCY RESPONSE
- DRILL

SARA25

TOXICOLOGY

SCOPE

This two-part module presents a discussion of chemical toxicology and an overview of radiation toxicology. The chemical toxicology portion presents information about the harmful effects of chemicals on biological systems, including man. A discussion of the effects of ionizing radiation on human organ systems is presented in the radiation toxicology portion of the module.
(Suggested time - 2 hours)

CHEMICAL TOXICOLOGY

SCOPE

This portion of the Toxicology module presents information about the harmful effects of chemicals on biological systems. The information presented included definitions of toxicology terminology, basic principles of toxicology, the dose-response relationship, routes of entry, pathways of excretion, and general types of adverse responses to toxic chemical exposure.

PARTICIPANT GOALS

1) Learn the definitions of some important toxicology terms.

2) Gain an understanding of the basic principles of toxicology including the dose-response relationship.

3) Learn the three primary routes by which toxicants enter the body.

4) Gain an understanding of the pathways of excretion by which toxicants are removed from the body.

5) Learn some of the general types of adverse responses to toxic chemical exposure.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.

- Prepare lecture notes.

- Prepare participant worksheet or exam.
  (The worksheet developed and used by ORNL is included on pages II-6 to II-9.)

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives of this portion of the module.
  (TOX 47, 40)

- Discuss threshold of effect or "no effect" level; first measurable effect level as dose increases; define the toxic potency of a chemical as the relationship between the dose and the response.
  (TOX 8)

- Discuss the dose-response relationship; the differences between individual members of a population; the range of individual responses possible within a population.
  (TOX 9-10)

- Discuss TOX 25A - a fictional example of the graded dose-response expected from a population exposed to a chemical agent illustrating individual differences in response.
  Shots of 100-proof whiskey were added to a ten gallon tank containing ten goldfish.
  Measured response is swimming upside down.
  After 10 shots, 50% of fish swam upside down.
  After 18 shots, all the fish swam upside down.

- Discuss the normal distribution and dose-response curves; LD_{50} and LC_{50} definitions and usefulness.
  (TOX 21, 22, 18, 23, 29, 30)

- Define and discuss acute exposure, chronic exposure, and the effects of frequency of exposure and dose-fractionation upon the response.
  (TOX 19-20)

- Discuss routes of entry (TOX 1) and the general types of hazardous materials that enter by each route:

  1) inhalation;
  (TOX 31A, 5, 6, 41, 36, 2, 4, 26)

  2) skin absorption, how the skin acts as a barrier, the function of the skin layers; the mechanism of chemical penetration and damage to skin;
  (TOX 42, 37)

  3) ingestion.
  (TOX 43, 32A)

- Describe the pathways of excretion by which toxicants are removed from the body.
  (TOX 3, 39, 33)

- Define and discuss general types of adverse responses to toxic chemical agents, target organs, and possible toxicant interactions.
  (TOX 11, 12, 13, 38, 14)

- Define and discuss carcinogens, mutagens, and teratogens.
  (TOX 15, 35, 16, 27, 28, 17, 24, 34)

- Distribute and oversee completion of worksheet or exam.

Basic Elements of Toxicology: Worksheet

Employee Name:_____

Badge #:_____

Job Title:_____

1.)
The toxic potency of a chemical is ultimately defined by the relationship between the _____ of the chemical and the _____ that is produced in a biological system.

2.)
True or False: All members of a group of the same species of animals can be expected to respond to the same dose of a chemical in an identical manner.

3.)
From dose-response curves one may calculate what is commonly known as the _____, the lethal dose that produced death in 50% of a test group of animals.

4.)
Exposure to toxic chemical agents may be classified into two main categories:
_____ exposure is defined as a single exposure or multiple exposure occurring within a short time.
_____ exposure may be defined as a long-duration, low-level exposure in which the rate of exposure exceeds the body's capacity for detoxification.

5.)
True or False: In general, fractionation of the dose reduces the effect.

6.)
The three primary routes of entry into the body are _____, _____, and _____.

7.)
_____ is the most significant route of entry in the occupational environment.

8.)
_____ presents the most rapid and direct avenue of entry.

9.)
Airborne toxicants can be of two types:_____ or_____.

10.)
In the lungs the exchange of gases, which include gas or vapor toxicants, takes place through the thin membranes of the _____.

11.)
Gases which produce toxic effects by interfering with the supply of oxygen to the tissues are called _____.

12.)
The lungs protect themselves from foreign particles. Match these protective mechanisms with the function that they perform.

___ Mucus	a. Sweep and carry particles
___ Cilia	b. Traps particles
___ Phagocytic cells	c. Engulf particles

13.)
The layer of skin which is most effective at preventing entry of chemicals into the body is the _____.

14.)
_____ occurs as a route of exposure of workmen through eating or smoking with contaminated hands or in contaminated work areas.

15.)
True or False: Absorption of toxicants can take place along the entire length of the gastrointestinal tract.

16.)
Give three organs that are involved in the removal of toxicants from the body._____
_____
_____

17.)
The chief organ for excretion of toxicants in the blood is the _____.

18.)
The _____ metabolizes certain chemical toxicants so that they may be eliminated by the kidneys.

19.)
_____ toxicity occurs rapidly after a single exposure;
_____ toxicity occurs after the lapse of some time.

20.)
_____ effects refer to those that occur at the site of first contact with a chemical agent; _____ effects require absorption and distribution of the toxicant and are produced at a site that is removed from the point at which the toxicant entered the body.

21.)
Match these effects of toxicant interaction with the appropriate definition.

___ Additive effect	a. Situation in which the combined effect of two chemicals is much greater than the sum of the effect of each agent given alone.
___ Synergistic Effect	b. Situation in which the combined effect of two chemicals is equal to the sum of the effect of each agent given alone.
___ Potentiation	c. Situation in which two chemicals, when given together, interfere with each other's actions or one interferes with the action of the other chemical
___ Antagonism	d. Situation when one substance does not have a toxic effect on a certain organ or system, but when added to another chemical, it makes the latter much more toxic.

22.)
A _____ is a substance that will induce a cancerous growth in man following a reasonable exposure.

23.)
A _____ is a substance that causes transformation of the genetic material which may alter the characteristics of offspring.

24.)
A _____ is a substance that produces malformations of the fetus without inducing damage to the mother or killing the fetus.

Basic Elements of Toxicology: Worksheet Answers

1) dose; response

2) False

3) LD_{50}

4) Acute; Chronic

5) True

6) inhalation; ingestion; absorption through skin

7) inhalation

8) Inhalation

9) gases/vapors; particulates

10) alveoli

11) asphyxiants

12) b Mucus
    a Cilia
    c Phagocytic cells

13) epidermis

14) Ingestion

15) True

16) kidneys; liver; lungs

17) kidneys

18) liver

19) Immediate; Delayed

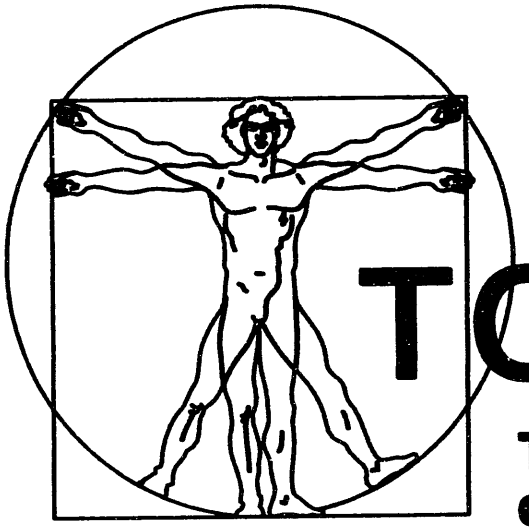
20) Local; systemic

21) b Additive effect
    a Synergistic effect
    d Potentiation
    c Antagonism

22) carcinogen

23) mutagen

24) teratogen



TOXICOLOGY

The study of the adverse effects of chemicals on living organisms

TOX7

OBJECTIVES

- Demonstrate the dose-response relationship.
- Identify and discuss the three primary routes by which toxicants enter the body.
- Examine pathways of excretion by which toxicants are removed from the body.
- Explain some of the general types of adverse responses to toxic chemical exposure.

TOX40

NO CHEMICAL AGENT IS ENTIRELY SAFE

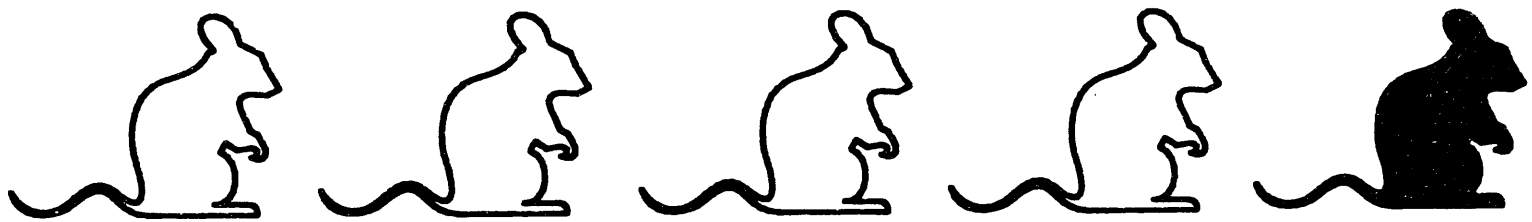
NO CHEMICAL AGENT IS ENTIRELY HARMFUL

TOX8

DOSE-RESPONSE RELATIONSHIP

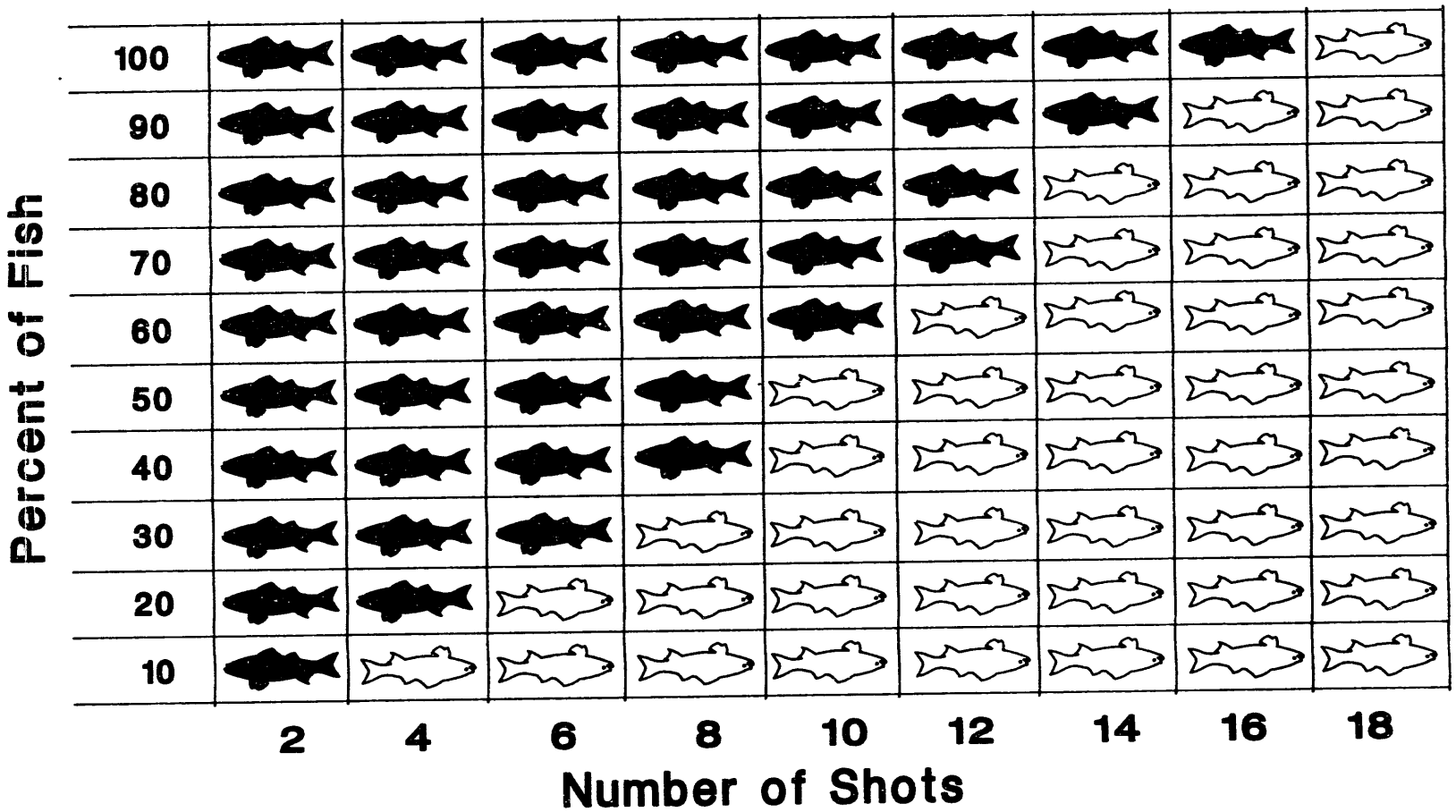
Relationship between the dose (the amount) of a chemical and the response that is produced by that chemical in a biological system.

TOX9



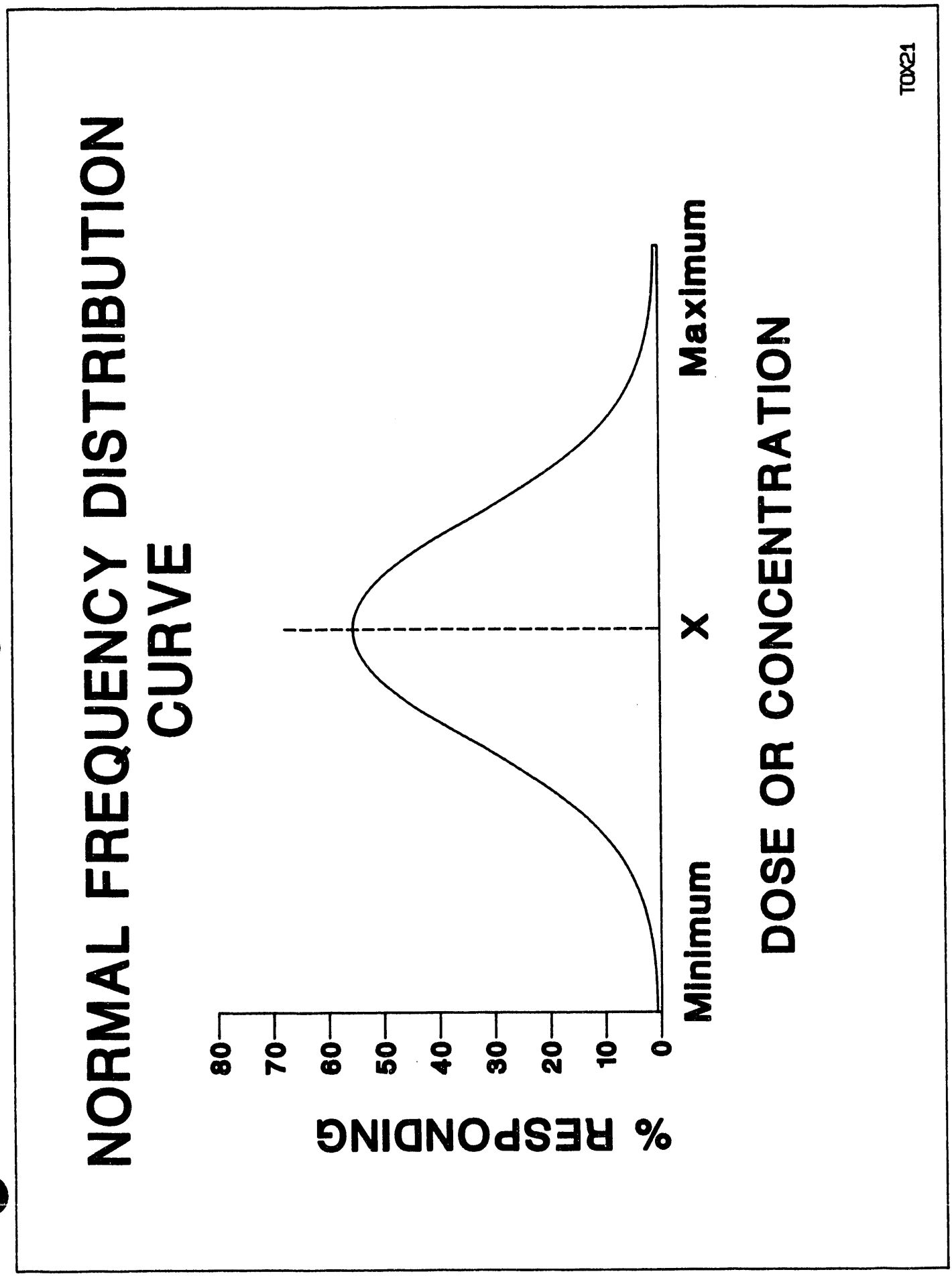
Not all members of a group respond to the same dose of a chemical in an identical manner.

TOX10

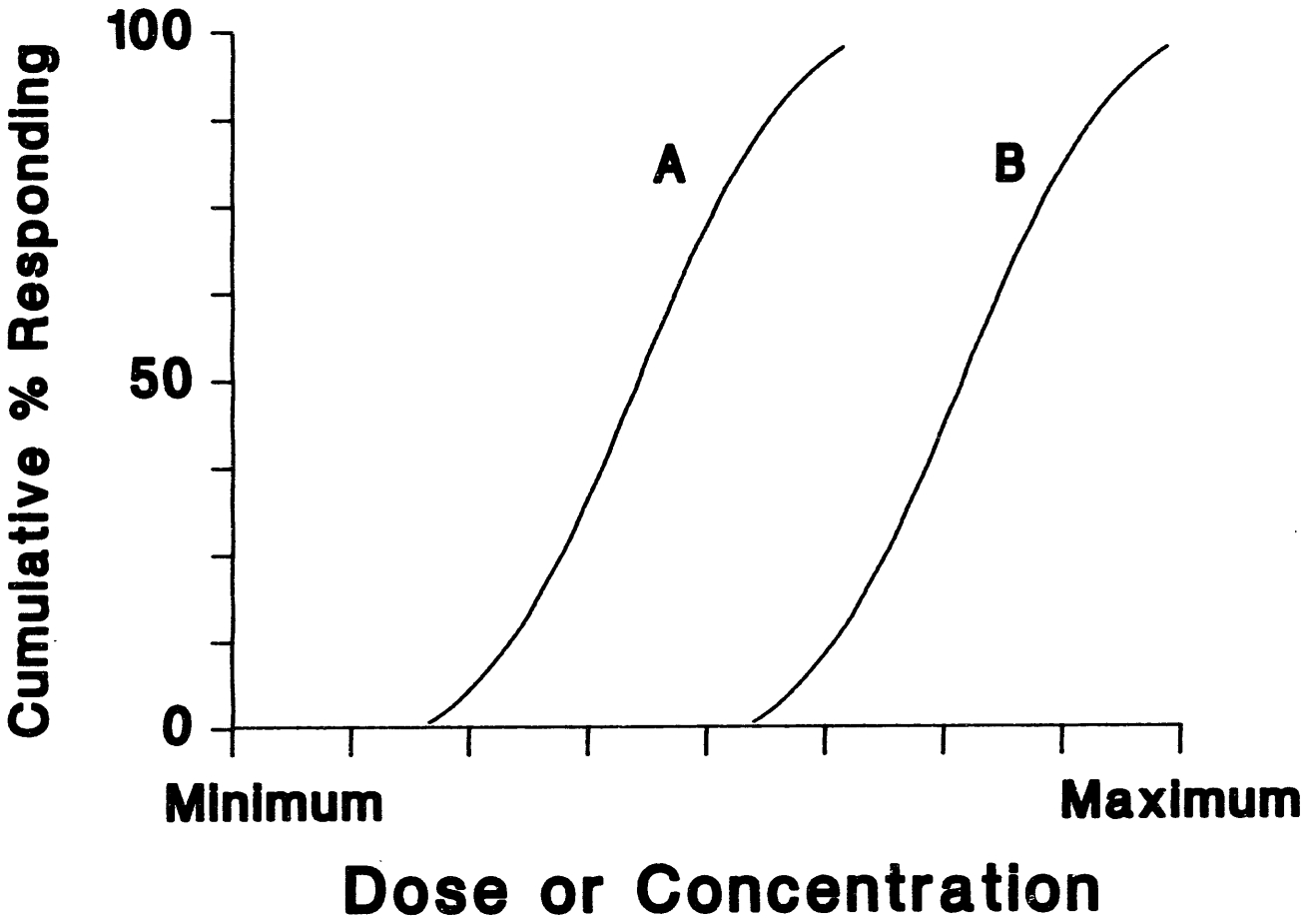


Shots of Whiskey Effective in Causing Fish to Swim Upside Down

TOX25A


NORMAL FREQUENCY DISTRIBUTION CURVE
% RESPONDING
80
70
60
50
40
30
20
10
0
Minimum
X
Maximum
DOSE OR CONCENTRATION
TOX21

DOSE-RESPONSE CURVES for Compounds A and B



TOX22

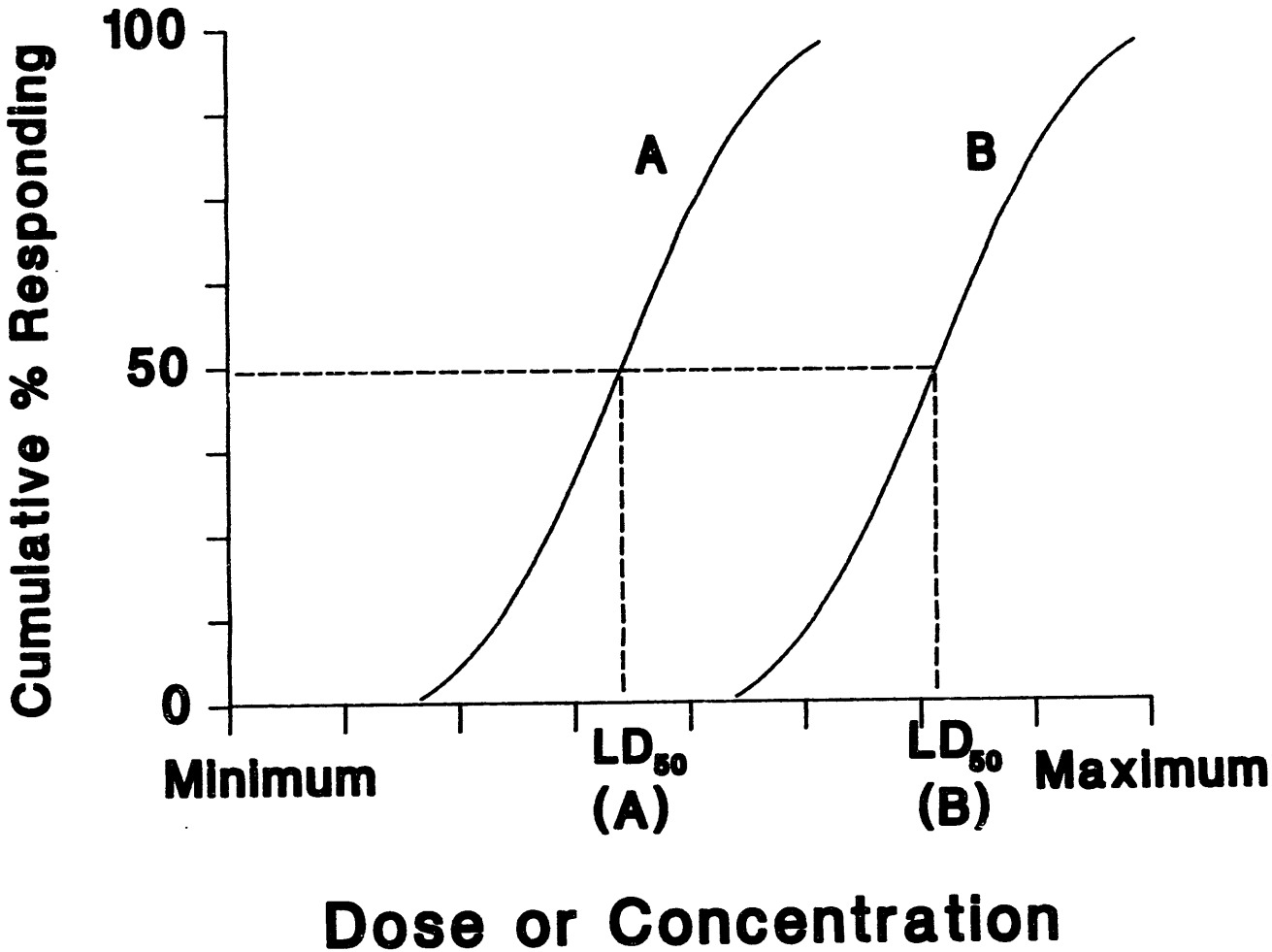
LD_{50}

The lethal dose that will produce death in 50% of the animals.

Provides a comparative index for location of the compound in the overall spectrum of toxic potency.

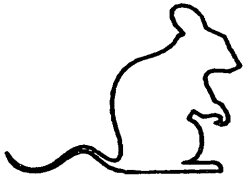
TOX18

DOSE-RESPONSE CURVES for Compounds A and B

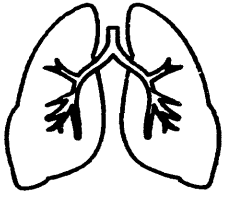


TOX23

The LD_{50} should always be accompanied by:



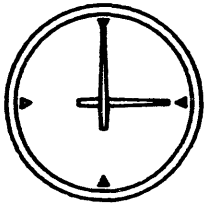
the experimental animal used



the route of administration

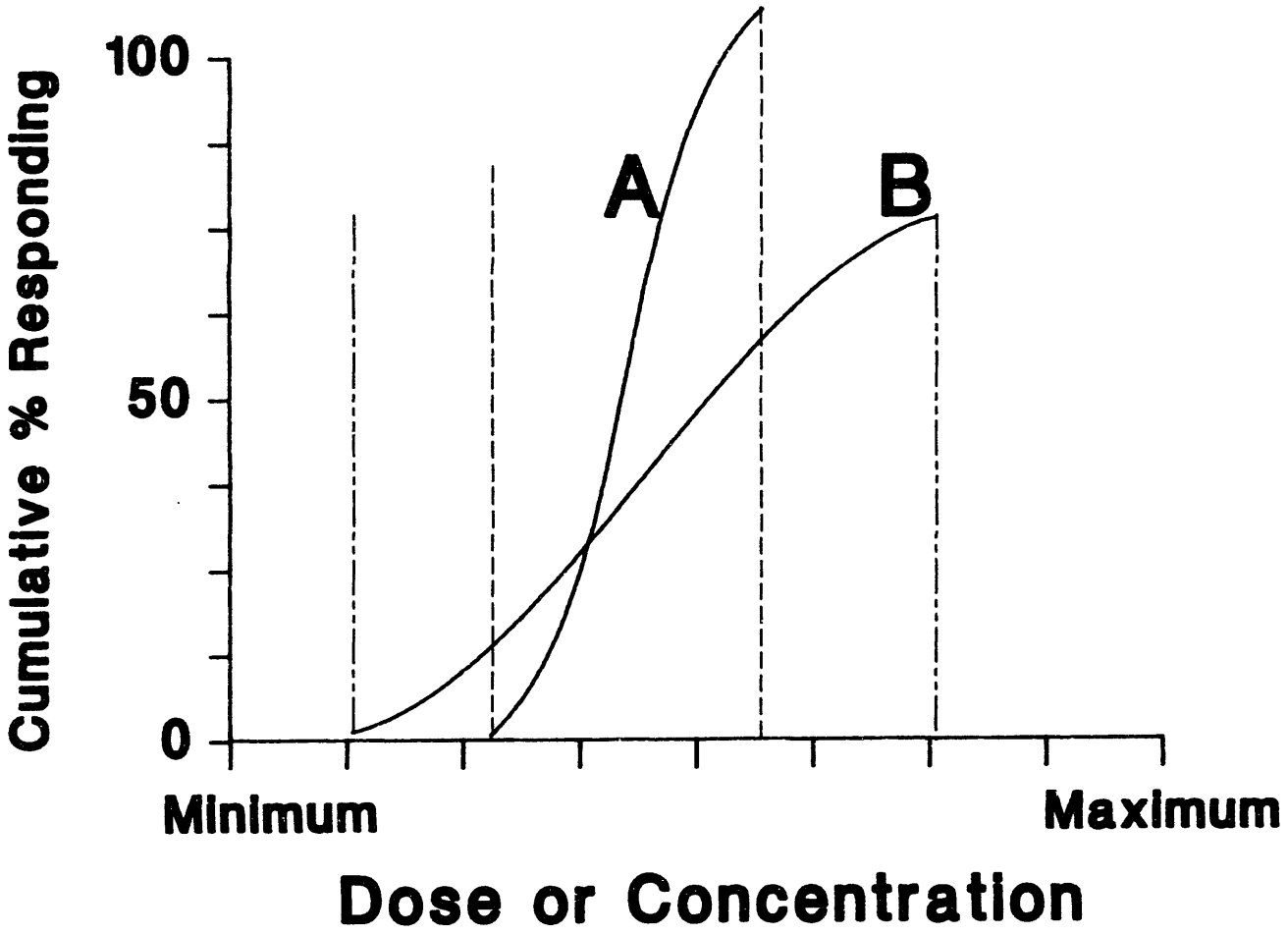
what was used to dissolve or suspend the chemical

the time period over which the animals were observed

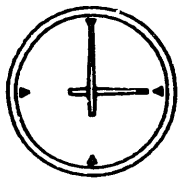


TOX29

The Slope of the Dose-Response Curve Provides an Index of the Margin of Safety

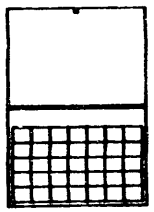


TOX30



ACUTE EXPOSURE

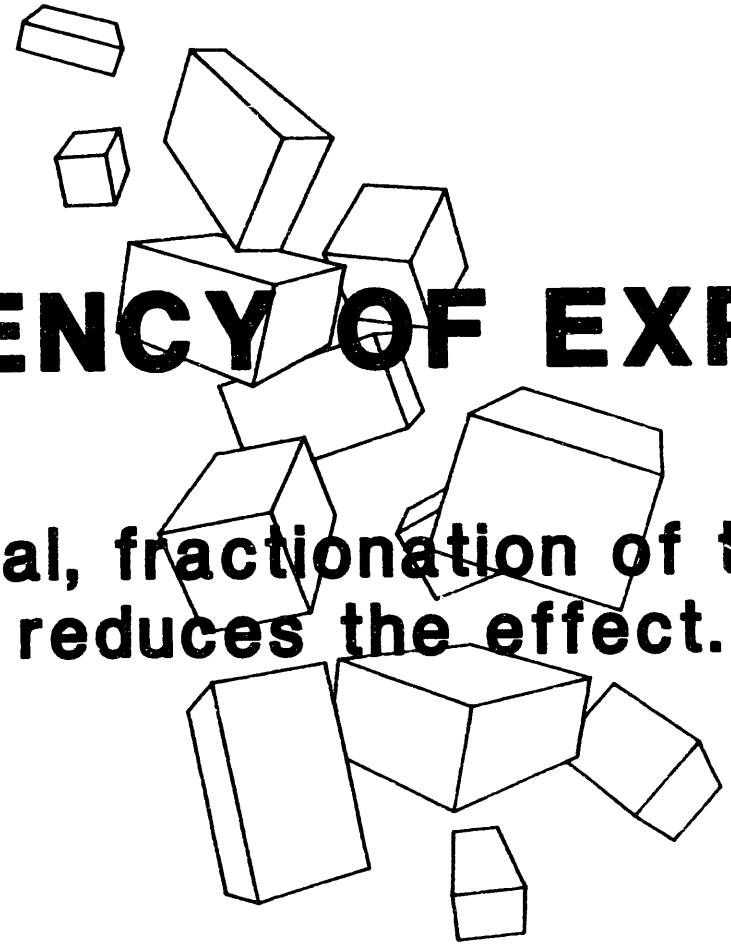
Single exposure or multiple exposure occurring within a short time (24 hours or less).



CHRONIC EXPOSURE

Long-duration, low-level exposure in which the rate of exposure exceeds the body's capacity for detoxification.

TOX19

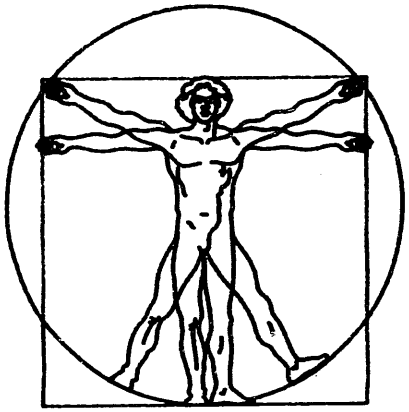


FREQUENCY OF EXPOSURE

In general, fractionation of the dose reduces the effect.

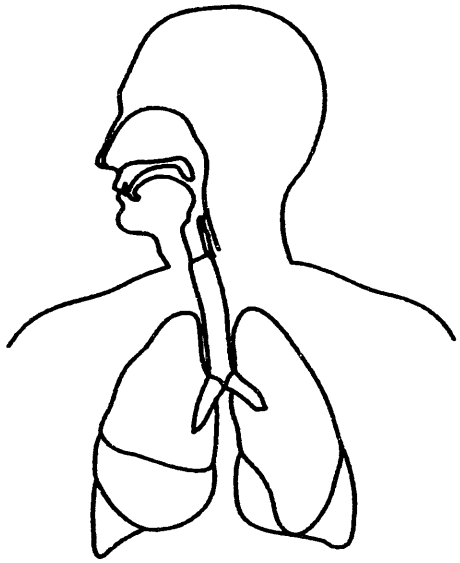
TOX20

ROUTES OF ENTRY



1. INHALATION
2. SKIN ABSORPTION
3. INGESTION

TOX1



Inhalation of toxicants presents the most rapid and direct avenue of entry.

TOX31A

TYPES OF AIRBORNE TOXICANTS

Gases and Vapors

Particulates

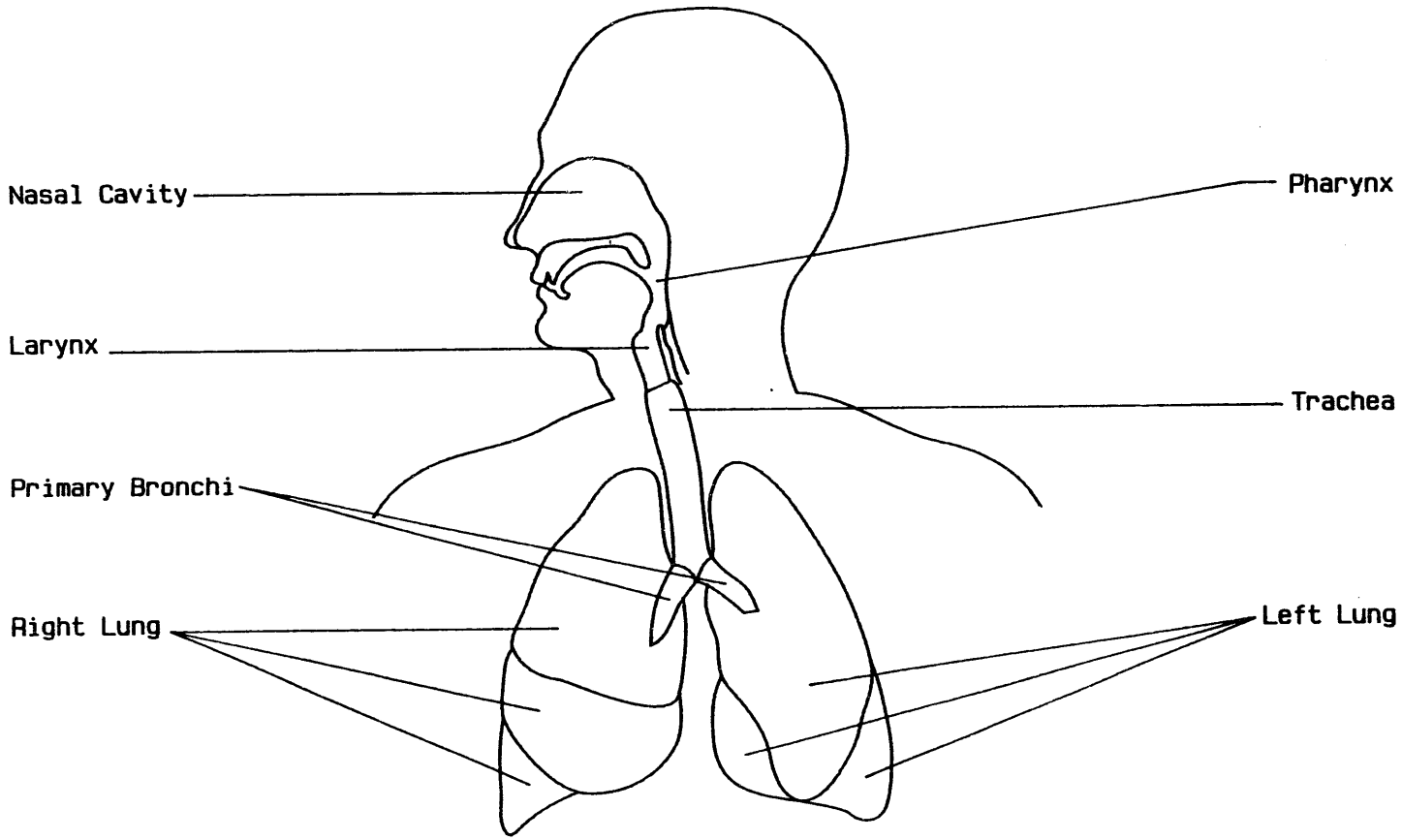
TOX5

Entry of gaseous toxicants into the circulatory system and distribution to the body tissues depends upon:

1. ***Concentration*** **of the toxicant in the air;**
2. ***Duration*** **of exposure;**
3. ***Solubility*** **of toxicant in blood and tissue;**
4. ***Reactivity*** **of the toxicant; and**
5. ***Respiration*** **rate;**

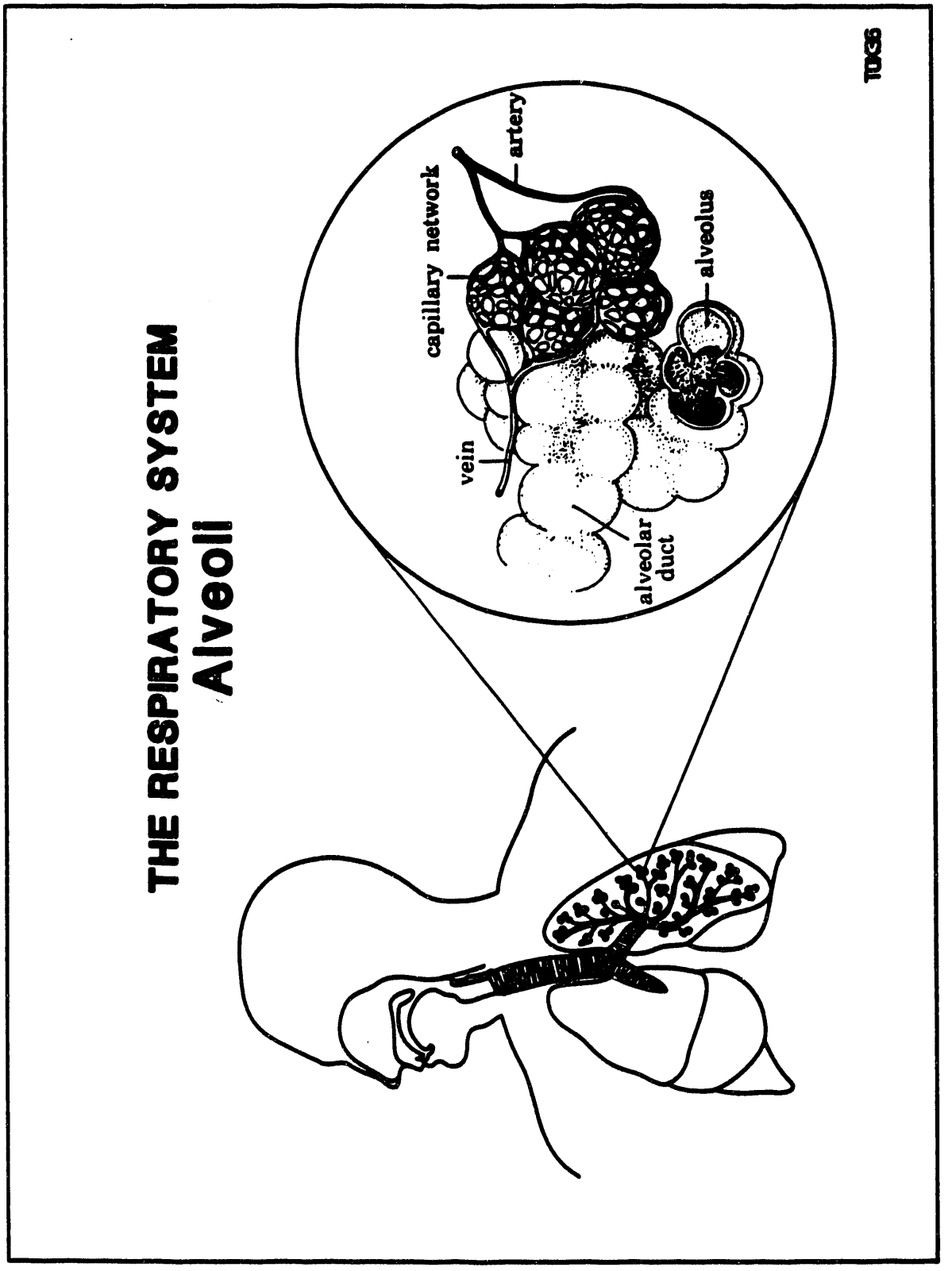
TOX6

RESPIRATORY SYSTEM
The General Scheme



THE RESPIRATORY TRACT

TDX 41


THE RESPIRATORY SYSTEM
Alveoli
capillary network
artery
vein
alveolus
alveolar duct
TUC36

ASPHYXIANTS

Interfere with the supply of oxygen to the tissues which may result in suffocation

SIMPLE ASPHYXIANTS

dilute the oxygen of the air below the concentration required to maintain normal levels of oxygen in the blood.

Carbon dioxide
Nitrogen

CHEMICAL ASPHYXIANTS

prevent uptake of oxygen by the blood, or interfere with the transport of oxygen from the lungs to the tissues.

Carbon monoxide
Hydrogen sulfide

TOX2

RESPIRATORY IRRITANTS

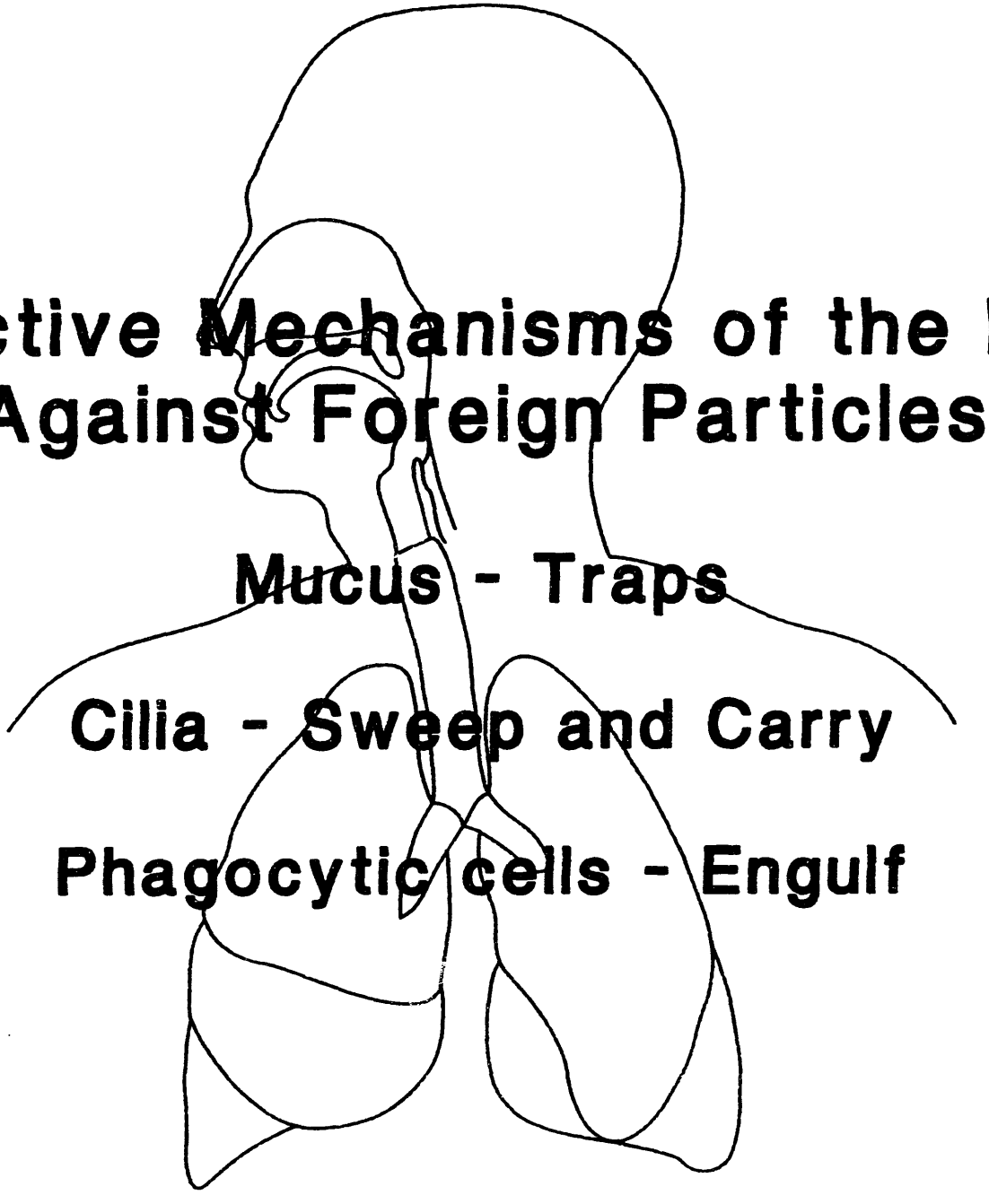
A. Affecting Upper Respiratory Tract
   1. Formaldehyde
   2. Ammonia
   3. Sulfur Oxides

B. Affecting Both Upper Respiratory Tract and Lung Tissues
   1. Chlorine
   2. Ozone

C. Affecting Primarily Lower Respiratory Tract
   1. Nitrogen Dioxide
   2. Phosgene

TOX4

Protective Mechanisms of the Lungs Against Foreign Particles



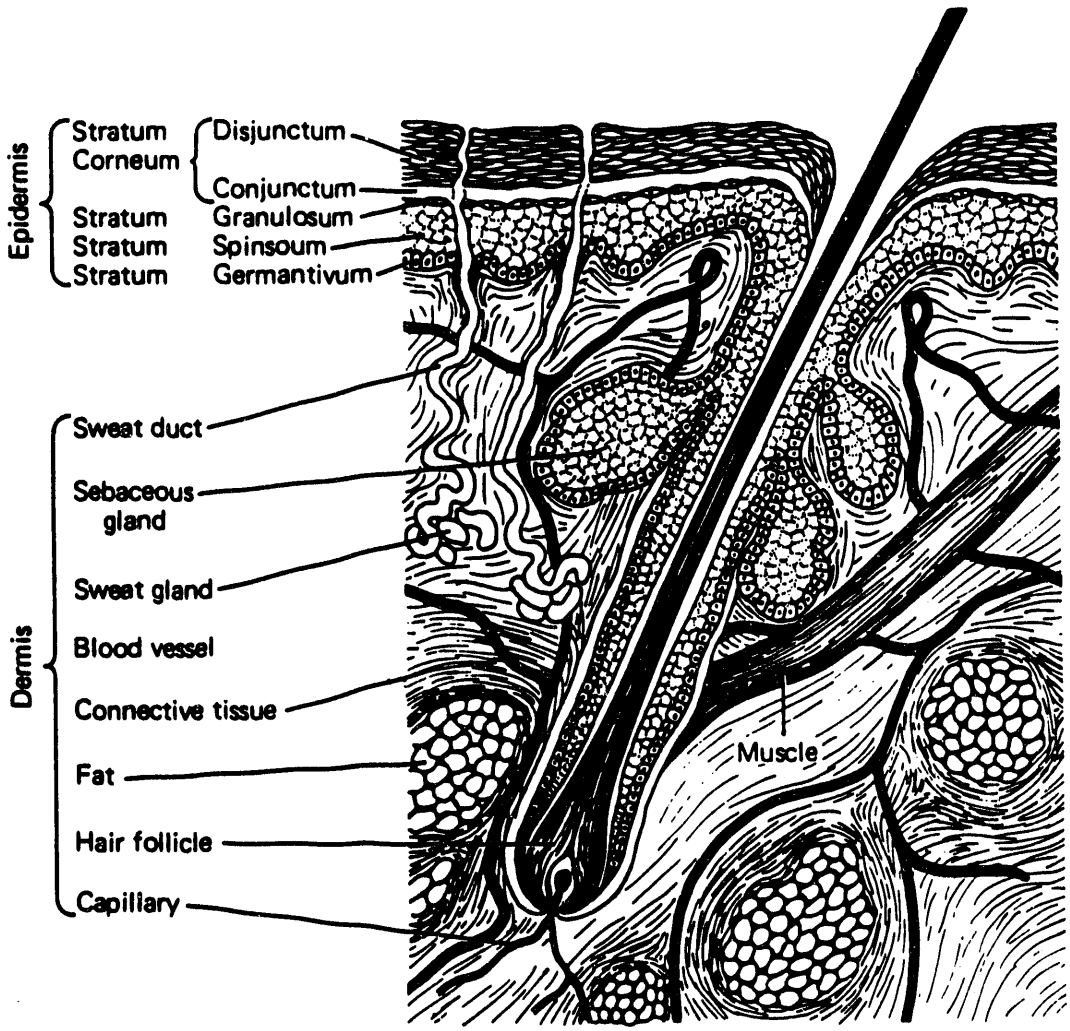
Mucus - Traps

Cilia - Sweep and Carry

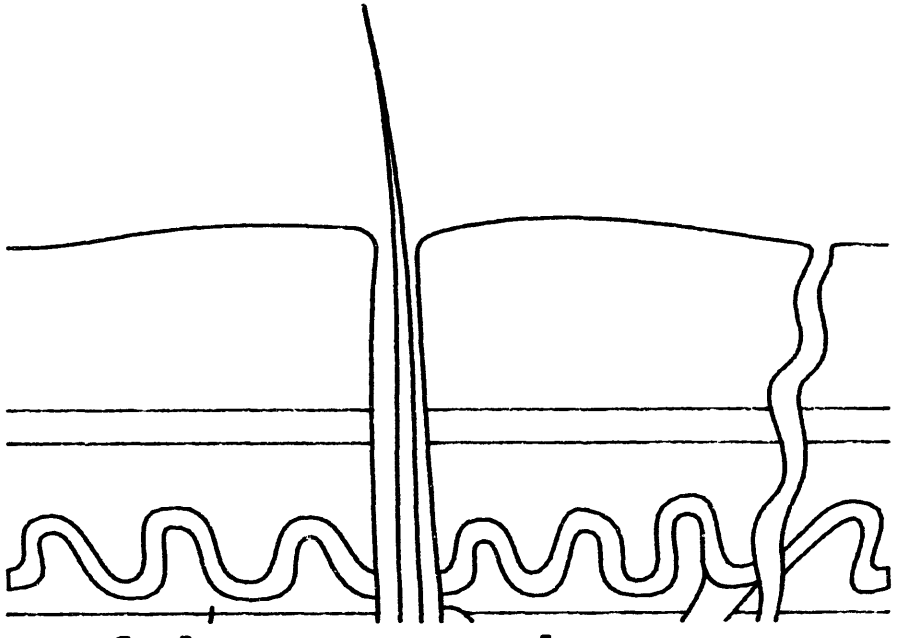
Phagocytic cells - Engulf

TOX26

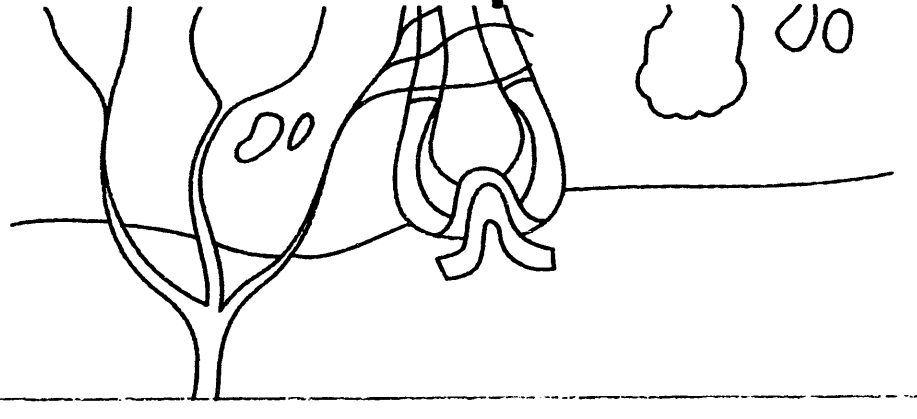
Cross-section of skin with hair.



TOX 42

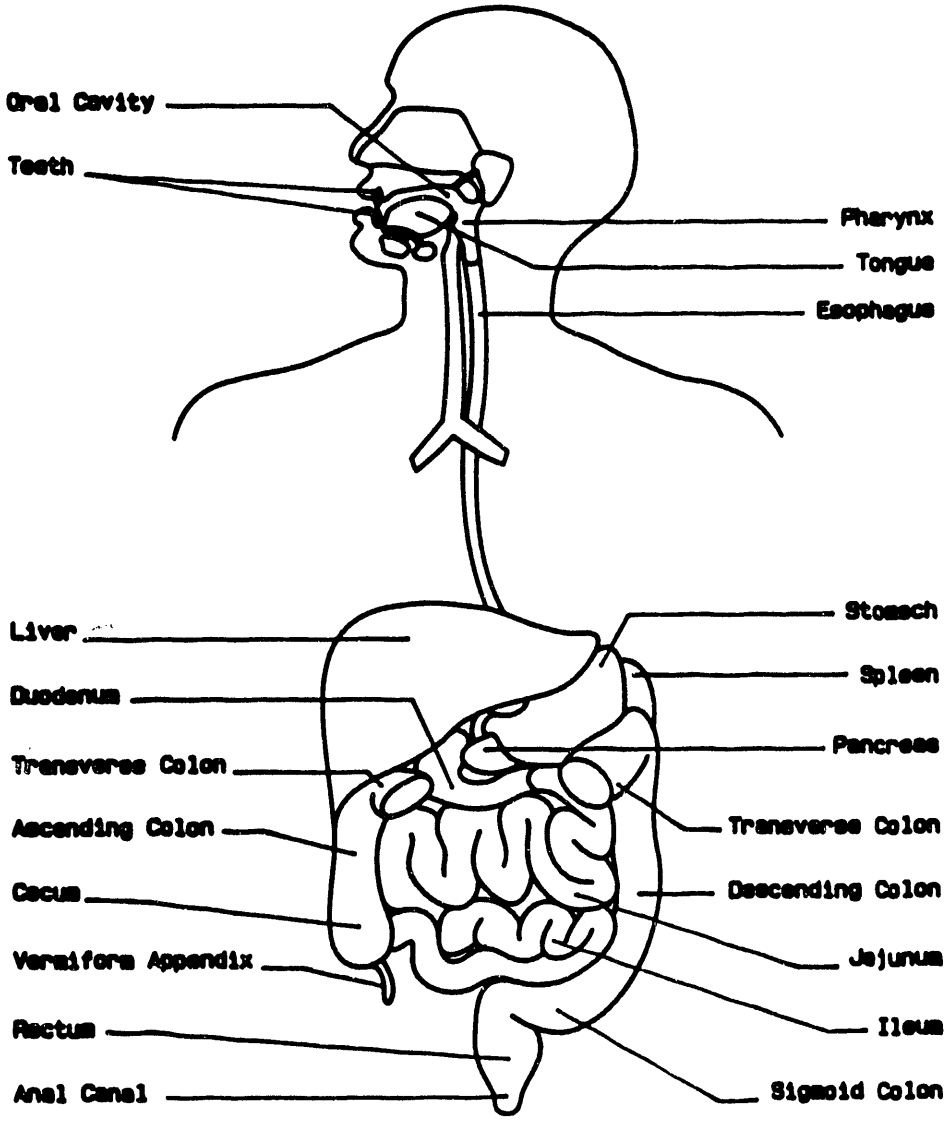


The rate of transport across the skin varies with the nature of the chemical and the thickness and condition of the skin at the point of contact.

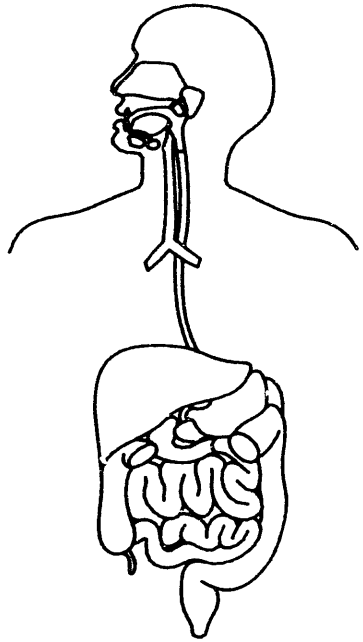


TOX37

DIGESTIVE SYSTEM
Scheme of the System



ALIMENTARY CANAL AND ACCESSORY ORGANS



Absorption of toxicants can take place along the entire length of the gastrointestinal tract.

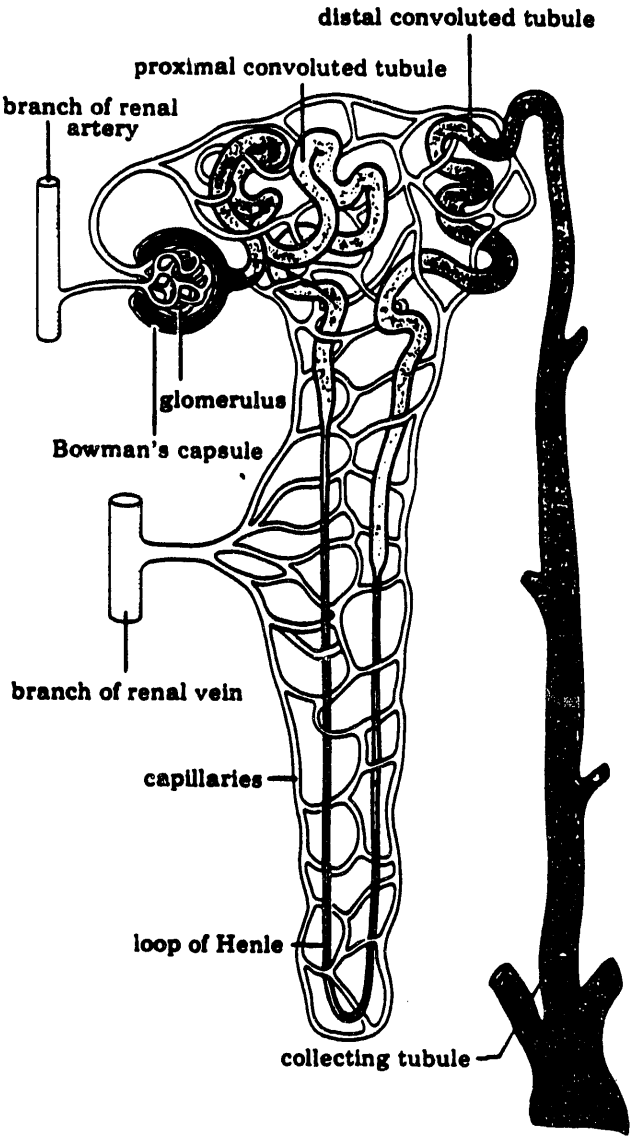
TOX32A

EXCRETION OF TOXICANTS

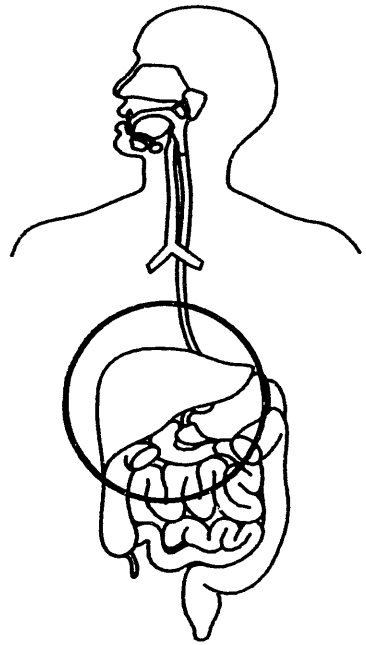
1. Kidneys
2. Liver
3. Lungs
4. Body secretions

TOX3

The functional unit of the human kidney.

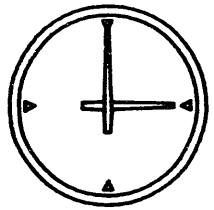


TOX 39



The liver metabolizes certain chemical toxicants so that they may be eliminated by the kidneys.

TOX33



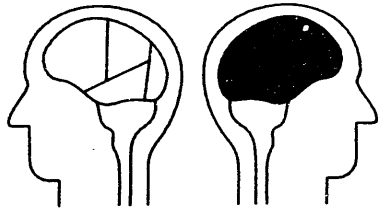
IMMEDIATE TOXICITY

Occurs rapidly after a single exposure.

DELAYED TOXICITY

Occurs after the lapse of some time.

TOX11



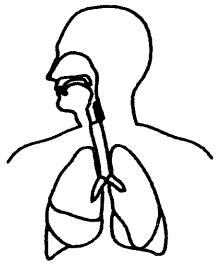
REVERSIBLE EFFECTS

Liver has a high ability to regenerate.

IRREVERSIBLE EFFECTS

Cells of the CNS cannot divide and be replaced.

TOX12



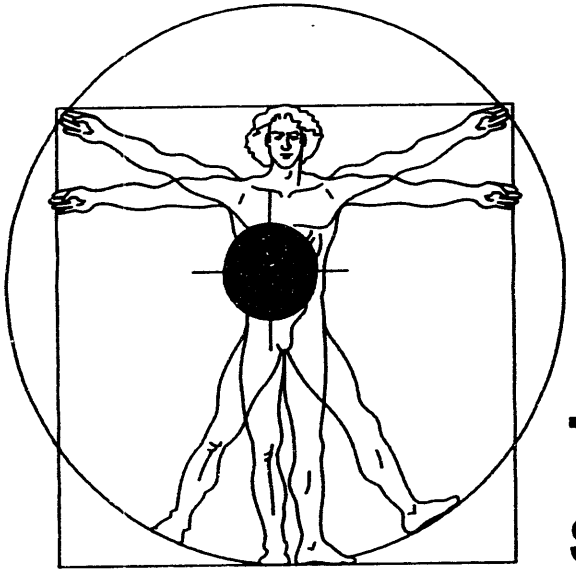
LOCAL TOXICITY

Effects occur at the site of first contact.

SYSTEMIC TOXICITY

Effects produced at a site removed from point of entry.

TOX13



Target Organs

Sites where major toxicity occurs

1. Central Nervous System
2. Circulatory System
3. Blood and Blood Formation System
4. Visceral Organs
   - Liver
   - Kidneys
   - Lungs
5. Skin
6. Muscle and Bone

TOX38

EFFECTS OF TOXICANT INTERACTION

- **Additive Effect** *2+3=5*
- **Synergistic Effect** *2+3=20*
- **Potentiation** *0+2=10*
- **Antagonism** *4+6=8, 4=(-4)=0, 4+0=1*

TOX14

CARCINOGEN

A substance that will induce a malignant tumor in man following a measurable exposure.

A substance that will induce any cancerous growth in any animal at any dose by any method of administration given for as long as the lifetime of the animal.

TOX15

Examples of Confirmed Human Carcinogens

- Asbestos
- bis-(Chloromethyl) ether
- Chromium (VI), certain water insoluble compounds
- Coal tar pitch volatiles
- Nickel sulfide, fume and dust
- Vinyl chloride
- Zinc chromates
- Benzidine

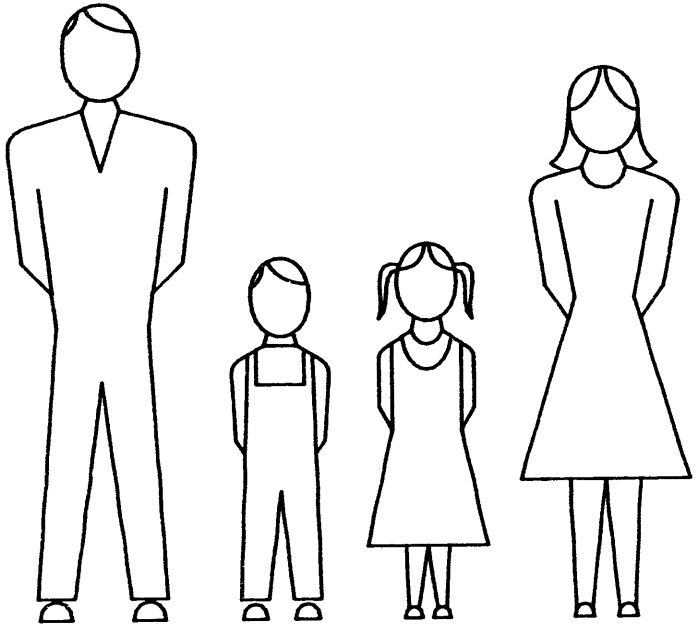
Source: ACGIH Threshold Limit Values for 1986-87

TOX35

MUTAGEN

A substance that causes transformation of the genetic material which may alter the characteristics of the offspring.

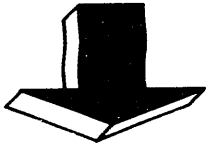
TOX16



Alteration or damage to sperm or egg DNA is reproduced in every cell of the offspring.

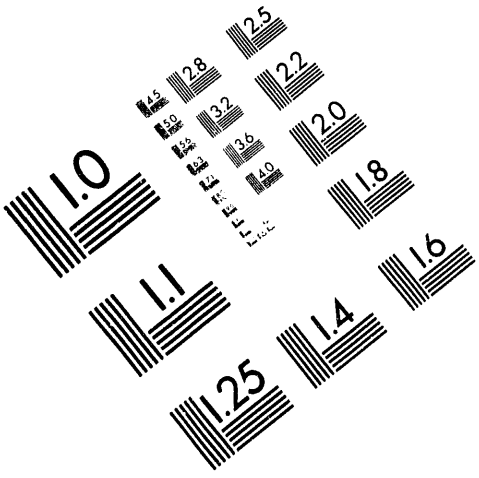
TOX27

A mutagen may have an effect on body cells, and not egg or sperm cells.



Abnormal or ineffective cell division

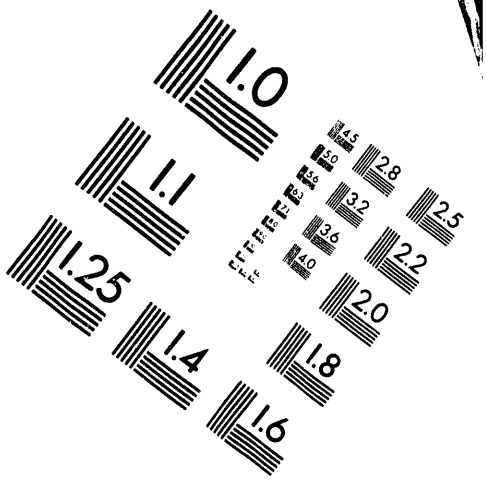
TOX28



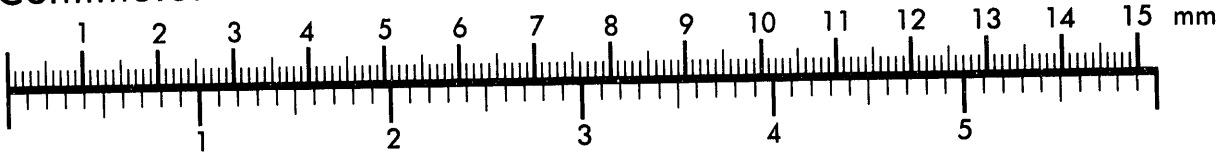
Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910

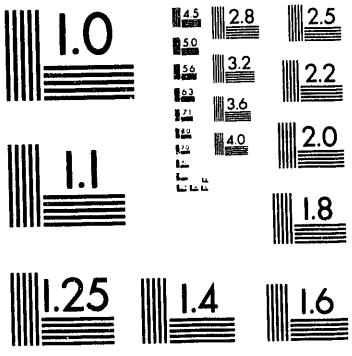
301/587-8202

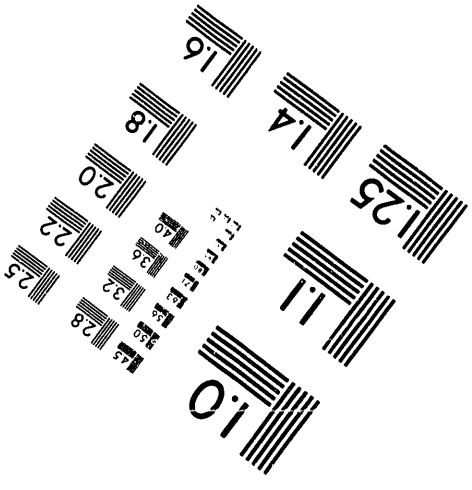


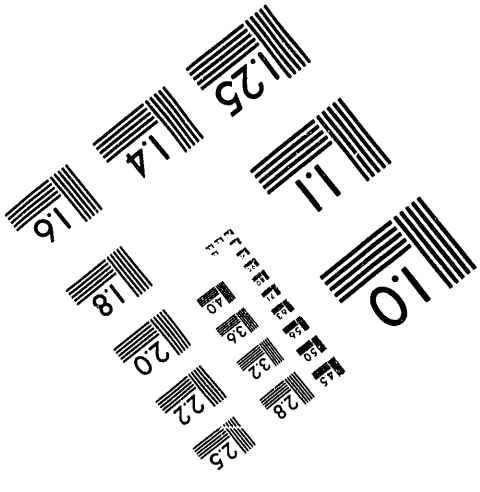
Centimeter



Inches







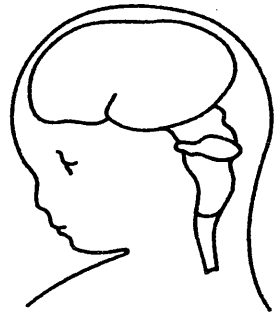
MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

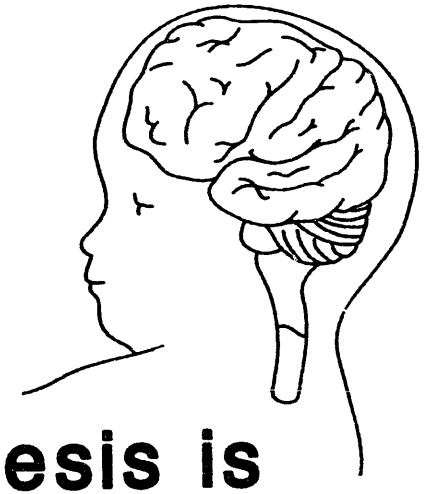
2 of 6

TERATOGEN

A substance that produces malformations of the fetus without inducing damage to the mother or killing the fetus.

TOX17





Teratogenesis is a difficult problem to handle

Normal rate of occurrence of birth defects is very high.

Relating the results of animal tests to humans is not dependable.

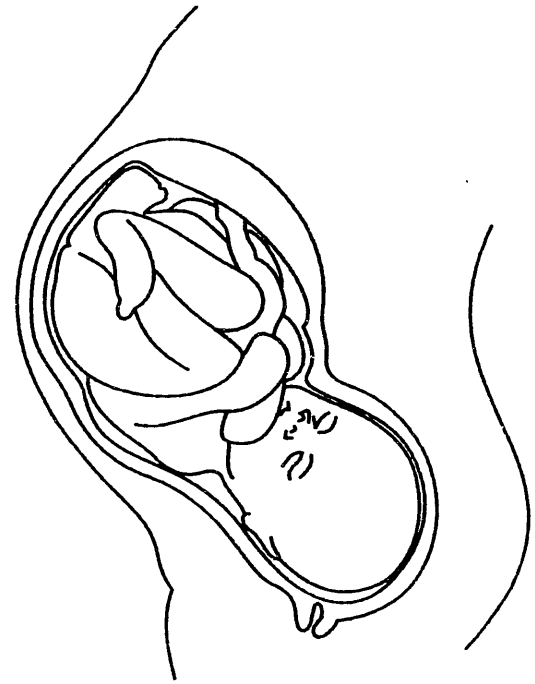
Human effects may not be suggested at all by animal studies.

Damage to fetus is most likely to occur early in pregnancy.

TOX24

Chemicals can be particularly hazardous to the unborn child.

- High rate of cell division
- Cells not yet specialized
- Detoxification system of liver not fully operational
- Blood-brain barrier not completely in place



TOX34

RADIATION TOXOCOLOGY

SCOPE

This portion of the Toxicology module presents an overview of the effects of ionizing radiation on single cells and the individual organ systems of the human body. This portion of the module will be required only for workers who will be dealing with radioactive or mixed wastes.

PARTICIPANT GOALS

1) Gain an understanding of the acute effects of ionizing radiation on single cells and the various organ systems of the human body.

2) Learn some of the chronic effects of exposure to low-level ionizing radiation.

3) Gain an understanding of the classification and distribution of radioactive materials that may enter the body.

INSTRUCTOR PREPARATION

- Determine the amount of radiation toxicology information which is covered in the radiation protection training program and therefore does not need to repeated here if all participants have received prior training. Participants must provide documentation of this previous training.

- Choose employee booklet(s) for distribution.
  (ORNL selected "Radiation - A Fact of Life", International Atomic Energy Agency, Wagramerstrasse 5, P. O. Box 100, A-1400 Vienna, Austria)

- Assemble viewgraphs.

- Prepare lecture notes.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Distribute employee information booklet.

- Introduce subject and objectives.
  (RADTOX 01, 16)

- Discuss free radical formation in irradiated water.
  (RADTOX 02, 03)

- Discuss the effects of radiation on cells and chromosomes.
  (RADTOX 04-06)

- Discuss the acute effects of ionizing radiation on human organ systems.
  Blood (RADTOX 07)
  Gastrointestinal system (RADTOX 08)
  Central nervous system (RADTOX 10)
  Reproductive system (RADTOX 09)
  Summary table (RADTOX 15)

- Explain the effects of ionizing radiation on the embryo and fetus.
  (RADTOX 13)

- Describe the genetic effects of ionizing radiation.
  (RADTOX 11)

- Discuss the chronic effects of exposure to ionizing radiation.
  (RADTOX 12)

- Classify and explain the distribution of radioactive contaminants that gain entry into the body including a discussion of clearance rates and organ deposition.
  (RADTOX 14)

- Distribute and oversee completion of worksheet or exam.

RADIATION TOXICOLOGY

RADTOX01

OBJECTIVES

- Examine acute radiation effects on
  Single Cells
  and
  Human Organ Systems.

- Discuss chronic effects of low-level ionizing radiation.

- Classify and explain the distribution of radioactive materials that gain entry into the body.

RADTOX16

Free radical formation in irradiated water:

$$H_2O \xrightarrow{\textit{radiation}} \dot{H} + O\dot{H}$$

RADTOX02

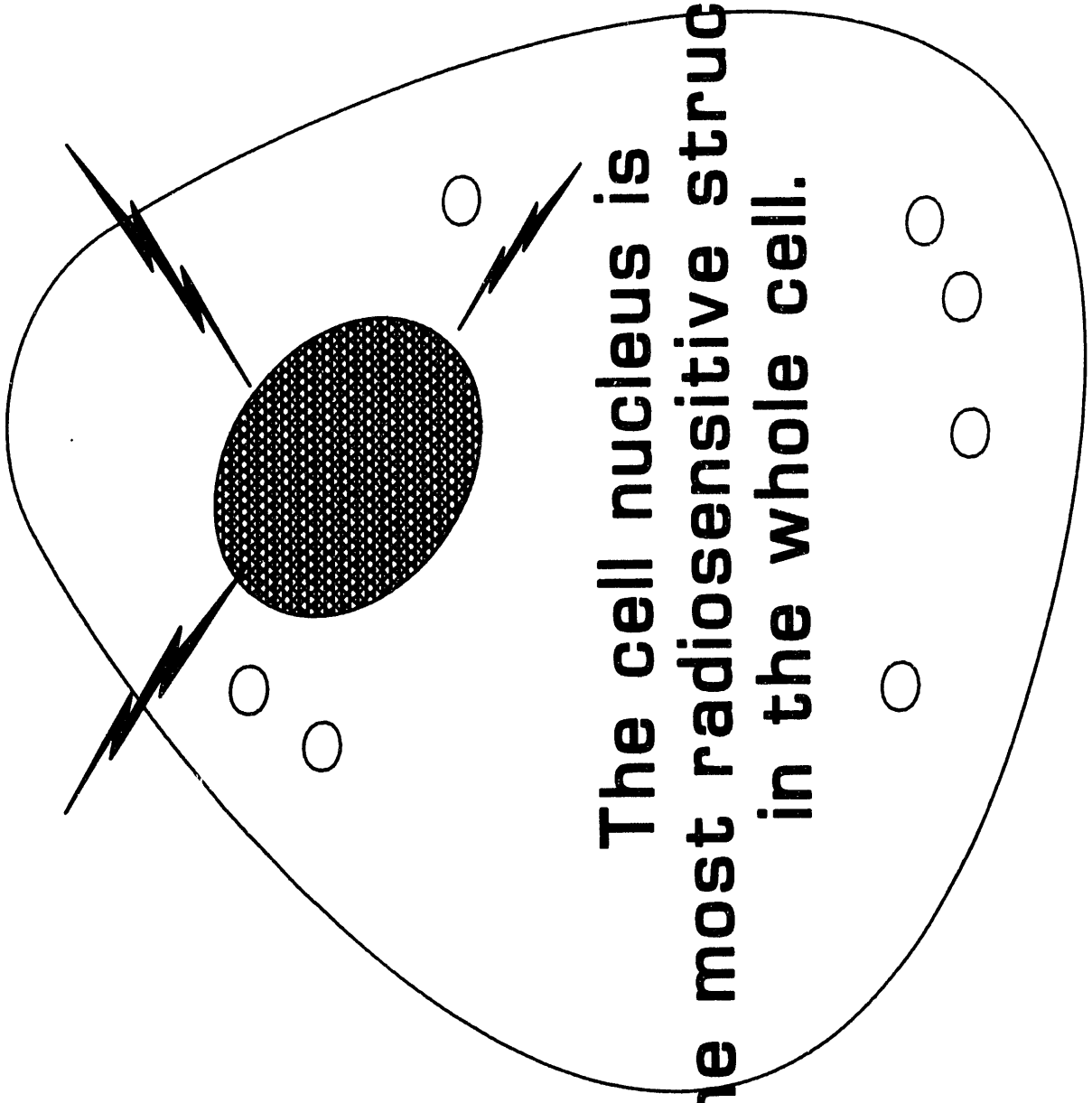
Secondary reactions involving free radicals in water:

$$\dot{H} + \dot{H} \longrightarrow H_2$$

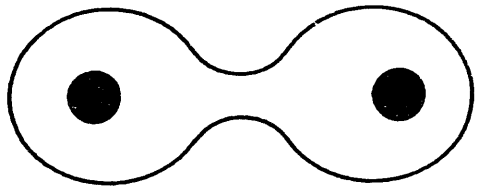
$$\dot{H} + \dot{O}H \longrightarrow H_2O$$

$$\dot{O}H + \dot{O}H \longrightarrow H_2O_2$$

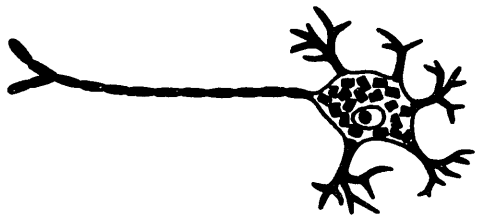
RADTOX03


The cell nucleus is
the most radiosensitive structure
in the whole cell.

RADTOX04

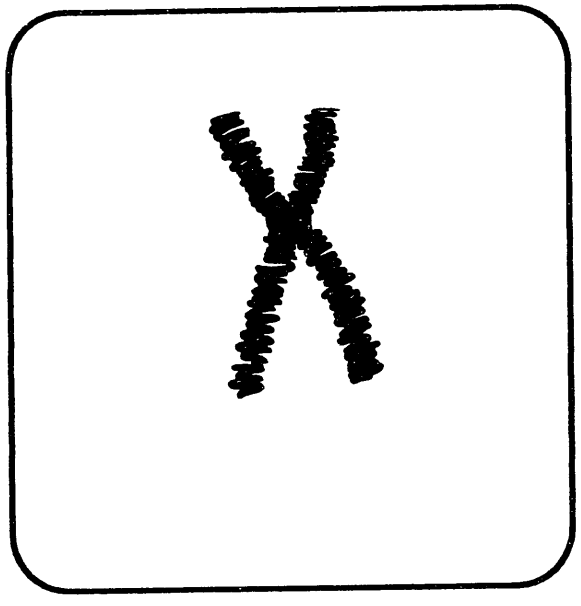


Radiosensitivity of cells is directly related to rate of cell division and inversely related to degree of specialization.

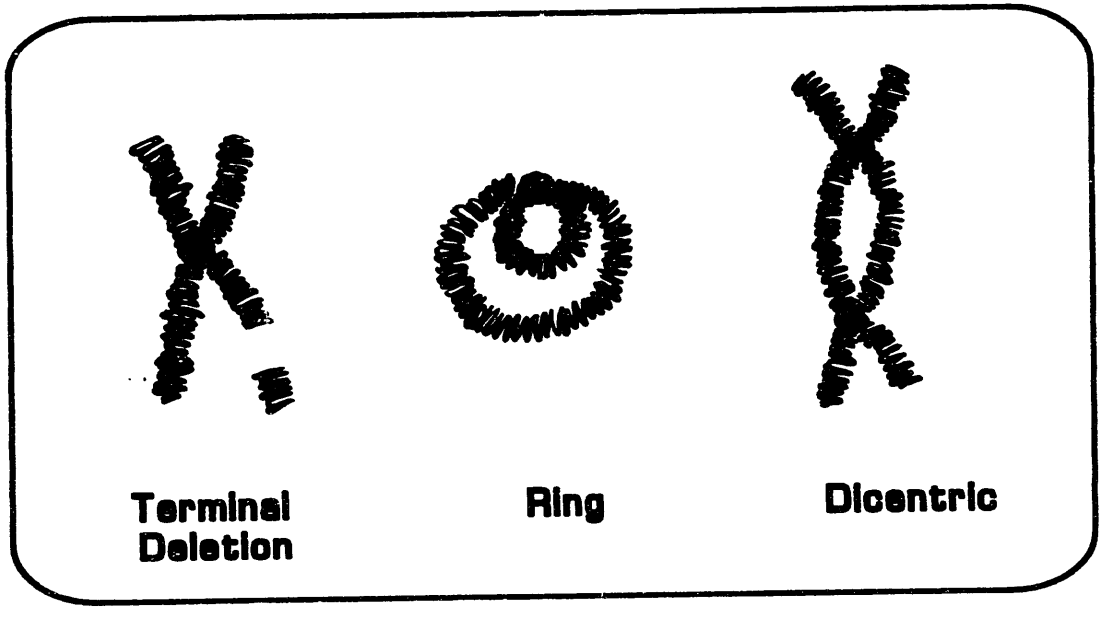


RADTOX05

Chromosome aberration is a clear indication of cell damage following irradiation.



A Typical Chromosome



Radiation Caused Aberrations

RADTOX06

Radiation Effects on Human Organ Systems

BLOOD SYSTEM

Erythrocytes - Transport oxygen to the cells.
Radioresistant.

Lymphocytes - Generate antibodies to fight infection.
May be most radiosensitive cell in body.

Granulocytes - Fight infection by engulfing foreign material.
Radiosensitive, but less so than lymphocytes.

Platelets - Important in formation of blood clots and to the integrity of the blood vessels.
Radioresistant.

RADTOX07

Radiation Effects on Human Organ Systems

GASTROINTESTINAL SYSTEM

The small intestine

- is the most radiosensitive organ in the GI tract.
- determines whether a person will survive a massive wholebody radiation dose.

The dose of 1000 rem represents the maximum survivable dose, with treatment.

RADTOX08

Radiation Effects on Human Organ Systems

CENTRAL NERVOUS SYSTEM

- The cells of the CNS have a high radiotolerance; neurons and associated cells are highly differentiated and do not divide.

- Radiation doses in excess of 5,000 REM are required to produce CNS effects.

RADTOX10

Radiation Effects on Human Organ Systems

REPRODUCTIVE SYSTEM

MALES

- Mature sperm are radioresistant.
- Production of immature sperm is reduced or disrupted at low doses.

  Temporary sterility: 25-600 rads

  Permanent sterility: 500-600 rads

FEMALES

- Permanent or reduced fertility results if egg cells are killed by the radiation dose.

  Reduced fertility: 300-400 rads

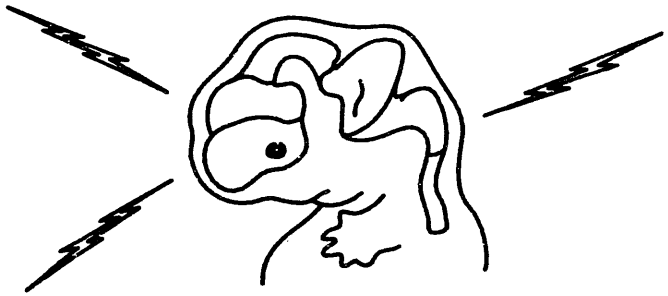
  Permanent infertility: 600 rads
- There is no return to normal fertility.

RADTOX09

Immediate Clinical Effects of an Acute Radiation Dose to Humans

Range	Subclinical Range 0 to 100 rem	Therapeutic Range 100 to 1,000 rem			Lethal Range Over 1,000 rem	
		100 to 200 rem	200 to 600 rem	600 to 1,000 rem	1,000 to 5,000 rem	Over 5,000 rem
INCIDENCE OF VOMITING	None	100 rem: 5% 200 rem: 50%	300 rem: 100%	100%	100%	
DELAY TIME	----	3 hr.	2 hr.	1 hr.	30 min.	
LEADING ORGAN	None	Bone Marrow			Gastrointestinal Tract	Central Nervous System
CHARACTERISTIC SIGNS	None	Moderate Leukopenia	Severe leukopenia, hemorrhage, infection, purpura, epilation above 300 rem		Diarrhea, Fever, Electrolyte Loss	Convulsions, tremor, ataxia
THERAPY	Reassurance	Blood Surveillance	Blood Transfusion Antibiotics	Possible marrow transplant	Maintain electrolytes	Sedatives
PROGNOSIS	Excellent	Excellent	Good	Guarded	Hopeless	
INCIDENCE OF DEATH	None	None	0 to 80%	80 to 90%	90 to 100%	

RADTOX15



Embryologic and Fetal Effects of Ionizing Radiation

Embryonic development can be divided into three stages of varying radiosensitivity.

1. **Preimplantation: Irradiation at this time can result in prenatal death.**
2. **Organogenesis: Irradiation at this time can cause malformation of organs.**
3. **Fetal period: Irradiation during this phase may result in growth retardation and/or mental retardation.**

RADTOX13

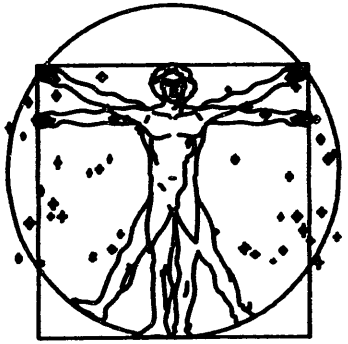
Genetic Effects of Ionizing Radiation

- Ionizing radiation produces gene mutations and chromosome aberrations.

- Little is known about genetic mutations from ionizing radiation in man due to:
  a. the complexity of genetic damage
  b. the time necessary for expression of the eventual genetic effect on future generations.

- Most information on genetic effects of irradation is derived from experiments with fruit flies and mice.

RADTOX11



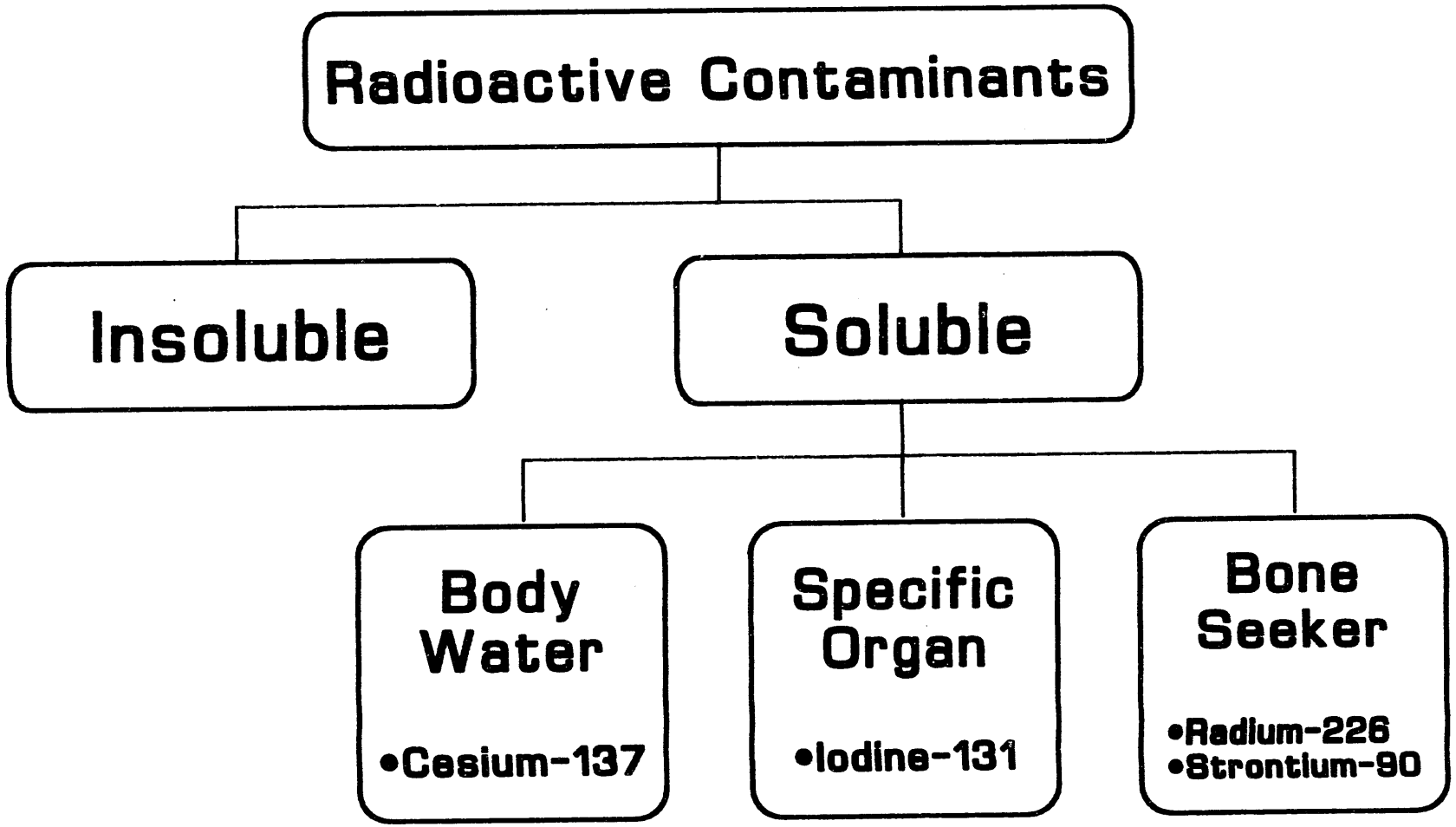
Chronic Effects of Low-level Ionizing Radiation

CARCINOGENESIS

LIFE-SPAN SHORTENING

RADTOX12

Classification Scheme for Internally Deposited Radioactive Contamination



RADTOX14

SOURCES OF HAZARD INFORMATION

SCOPE

This module describes the sources of hazard information available to hazardous waste site workers and explains when and how to use them. The sources of information include exposure limits, labels, Material Safety Data Sheets (MSDS), and the supervisor's knowledge.
(Suggested time - 1 hour)

PARTICIPANT GOALS

1) Gain an understanding of the types of exposure limits and how they are used to control health hazards.

2) Learn where to find and how to use MSDSs.

3) Be able to recognize and understand the information presented on:
   Department of Transportation (DOT) labels and placards;
   National Fire Prevention Association (NFPA) 704 labels and placards;
   Facility-specific labels;
   Chemical manufacturer's labels.

4) Learn to recognize and understand the terms used for the facility hazard rating system.

5) Be able to list the names of individuals in the organization from whom additional hazard information is available.

INSTRUCTOR PREPARATION

- Assemble Threshold Limit values (TLVs) viewgraphs.

- Prepare viewgraph(s) explaining OSHA PELs (permissible exposure limits), NIOSH RELs (recommended exposure limits), and IDLH (immediately dangerous to life and health) limits.

- Collect current copies of the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values booklet for participants to use during class.

- Determine if the MSDS and Labeling modules of the facility Hazard Communication (HC) Training Program are appropriate for use in hazardous waste site worker training.

- Determine if all participants have received HC training. Participants must provide documentation of this prior training.

- Choose videotape for labeling and MSDSs, if desired.
  (Some DOE contractors have used videotapes from ITS Corporation and Tel-E-Train)

- Choose source of employee booklets on labels and MSDSs to use as handouts, if desired.
  (ORNL chose "The MSDS - Your Guide to Chemical Safety", Business & Legal Reports, 64 Wall Street, Madison, CT 06443-1513)

- Assemble examples, either in the form of handouts or viewgraphs, or both, of the MSDS formats which participants will be expected to use and understand.

- Prepare glossary of MSDS terms for a participant handout.
  (Section VI of the TRADE Hazard Communication Training Resources Guide is a glossary of MSDS terms)

- Assemble examples, either in the form of handouts or viewgraphs, or both, of all container labels and placards which participants will be expected to use and understand such as:
  DOT labels and placards;
  (ORNL chose the chart "Hazardous Materials Warning Labels", U.S. DOT, Research and Special Programs Administration, Washington, D.C. 20590)
  NFPA labels and placards;
  Facility-specific labels;
  Chemical manufacturer's labels.

- Assemble viewgraphs explaining the UN hazard classes, identification numbers, and hazard symbols required by DOT.

- Assemble copies of the DOT Emergency Response Guidebook for participant's use.

- Prepare an explanation of the NFPA 704 Label Codes as a handout or viewgraph, or both.

- Prepare handouts and viewgraphs describing and explaining the facility-specific hazard rating system.

- Determine the names of individuals to whom participants should go to receive additional information about hazards and prepare handouts listing these names, if desired.

- Prepare lecture notes.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Define the different categories of TLVs.
  (TLV 01-06)

- Discuss the basis upon which TLVs are established.
  (TLV 07A, 08)

- Distribute copies of the ACGIH TLV booklet and explain the ways in which participants will be expected to use the TLV information.
  (TLV 09)

- Discuss other exposure limits - PELs, RELs, IDLH.
  (TLV 10, other viewgraphs as desired)

- Present HC training modules covering MSDSs and labeling, if appropriate, and participants have not already received this training.
  (Show videotape, if desired)

- Present review of MSDS and labeling information if all participants have completed HC training.
  (Show videotape, if desired)

- Distribute MSDS and labeling employee information booklet(s), examples of MSDS formats, and MSDS glossary of terms.

- Distribute examples and discuss all labeling and placarding systems that the hazardous waste site workers will come into contact with on the job.
  (LABEL 1a, 3A, 2A, 4A, 5, 6, 11, other viewgraphs as desired)

- Discuss the facility-specific hazard rating system.

- Discuss the NFPA 704 Label Codes and explain how and why these differ from the chemical hazard rating system which is in use at the facility.
  (Viewgraphs or handout)

- Distribute copies of the DOT Emergency Response Guidebook and discuss when and how the workers will use it.

- Distribute list of names of persons from whom participants can get more hazard information.

- Distribute and oversee completion of worksheet or exam.

ACGIH

TLVs

Threshold Limit Values

TLV01

Threshold Limit Values

~~refer to airborne concentrations of substances, and~~

represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect.

TLV02

Three categories of Threshold Limit Values

- Time-weighted average
- Short-term exposure limit
- Ceiling value

TLV03

TLV-TWA
Time-weighted average

Concentration given
for a normal 8-hour workday
or 40-hour workweek.

TLV04

TLV-STEL
Short-term Exposure Limit

Maximal concentration to which workers may be exposed for a period up to 15 minutes.

TLV05

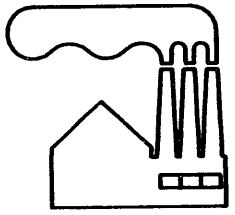
TLV-C
Ceiling

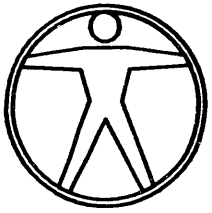
Concentration that should not be exceeded even instantaneously.

TLV06

Threshold limits are based on the best available information from

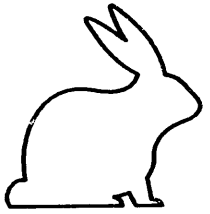
Industrial experience





Human studies

Experimental animal studies



TLV07A

Threshold Limit Values are expressed in either

ppm

Parts per Million
(Gases and Vapors)

or

mg/m^3

Milligrams per Cubic Meter
(Particulate Suspensions)

TLV08

TLVs should not be used

- as fine lines between safe and dangerous concentrations
- in the evaluation or control of community air pollution
- in estimating the toxic potential of continuous exposure
- as proof of an existing disease or physical condition

TLV09

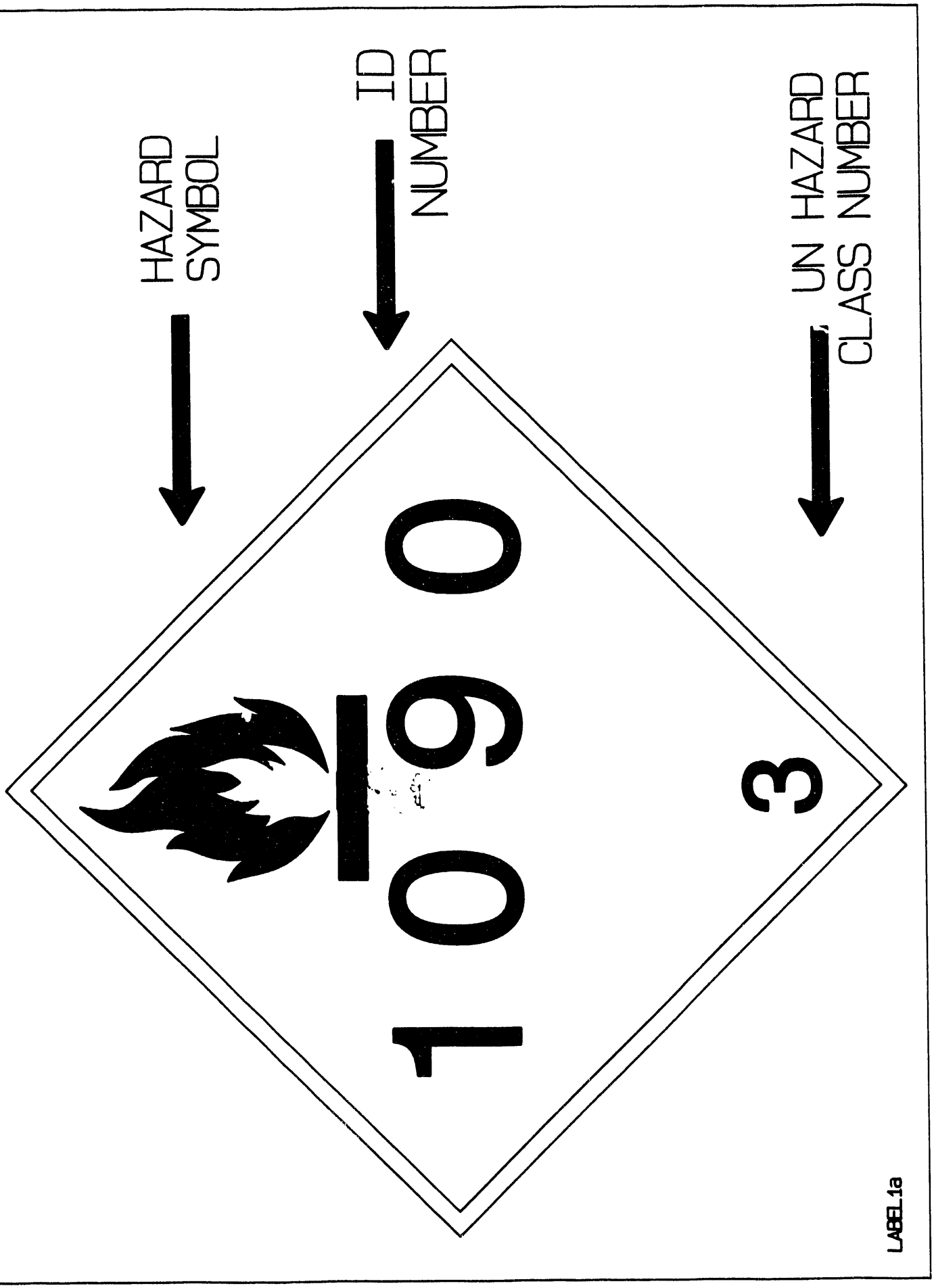
OSHAct of 1970 included most all of the 1968 TLV list as standards which were called

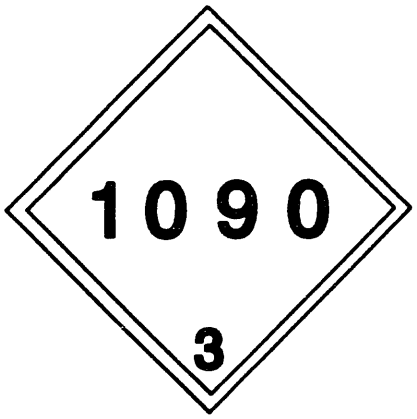
P Permissible

E Exposure

L Limits

TLV10


HAZARD SYMBOL
ID NUMBER
UN HAZARD CLASS NUMBER
1090
3
LABEL 1a

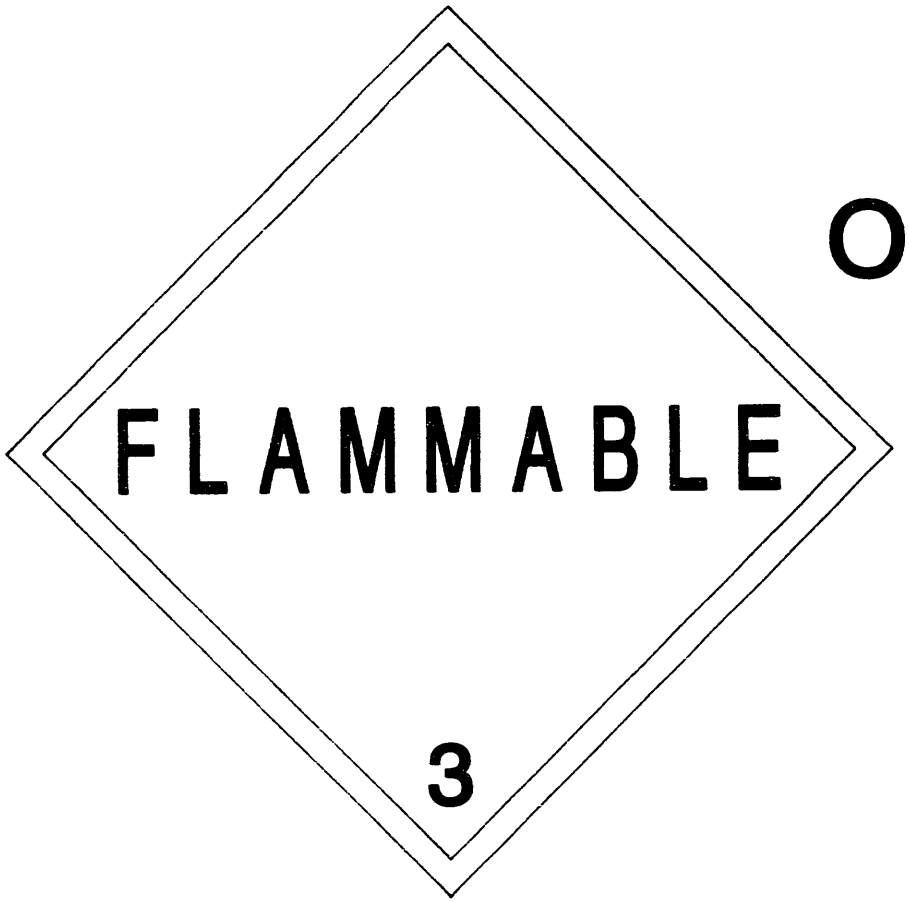


UNITED NATIONS CLASSIFICATIONS SYSTEM

CLASS	HAZARD
1	Explosives
2	Gases
3	Flammable Liquids
4	Flammable Solids; Spontaneously Combustible Materials; and, Materials Dangerous When Wet
5	Oxidizers and Organic Peroxides
6	Poisonous and Etiologic (Infectious) Materials
7	Radioactive Materials
8	Corrosives
9	Miscellaneous Hazardous Materials

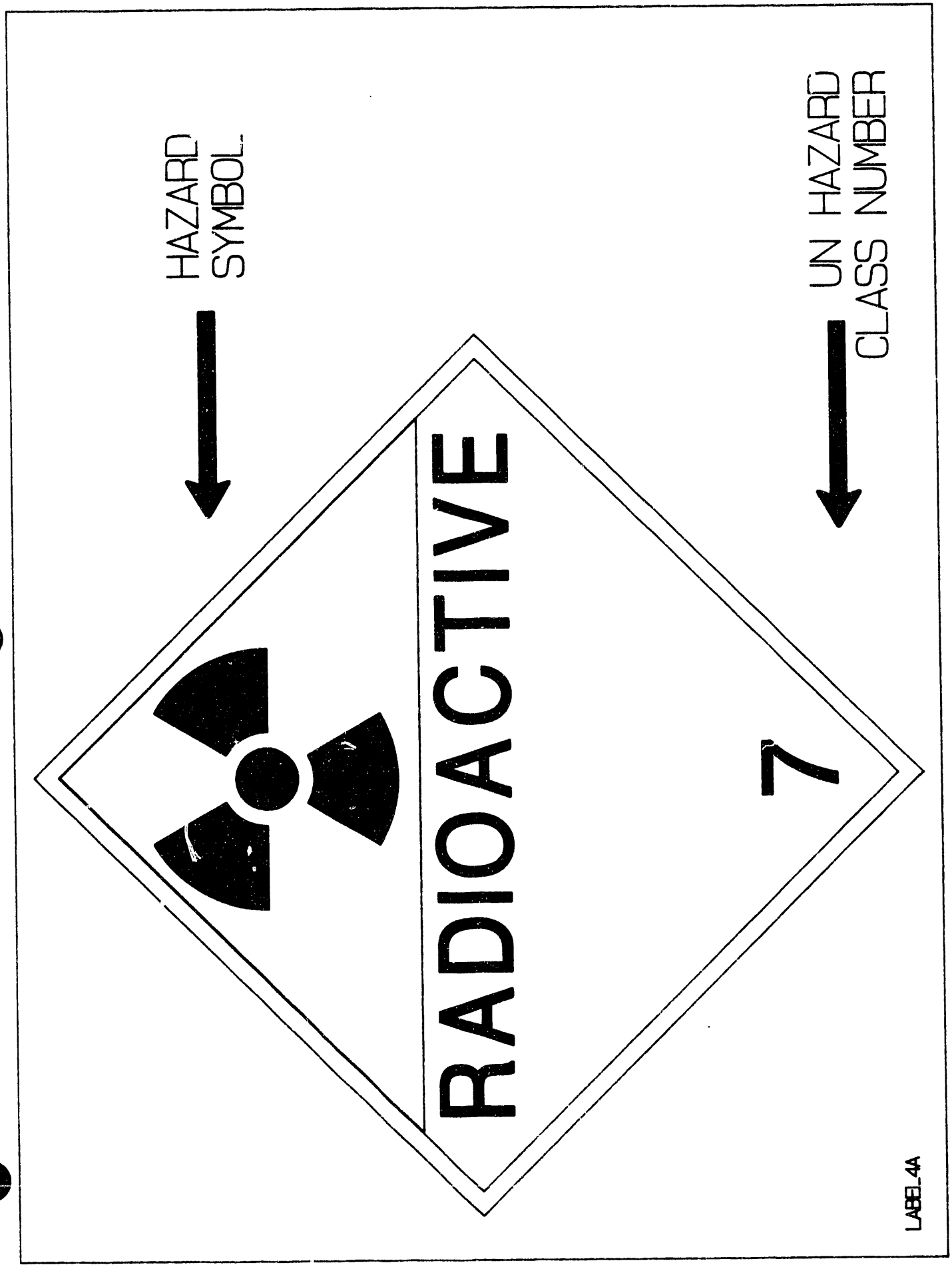
LABEL3A

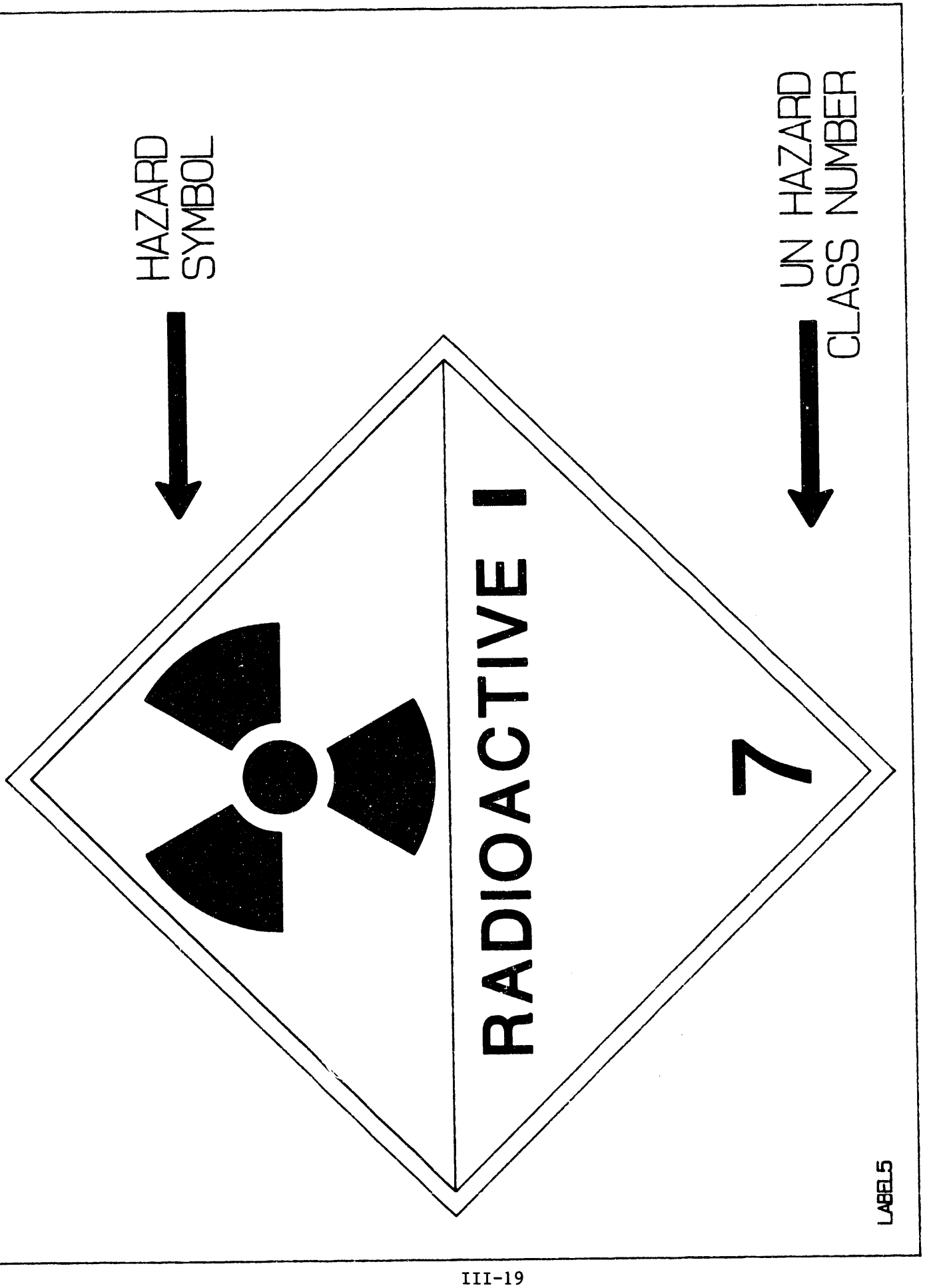
PLACARD AND ORANGE PANEL



1090

LABEL2A


HAZARD SYMBOL
RADIOACTIVE
7
UN HAZARD CLASS NUMBER
LABEL 4A


HAZARD SYMBOL
UN HAZARD CLASS NUMBER
RADIOACTIVE I
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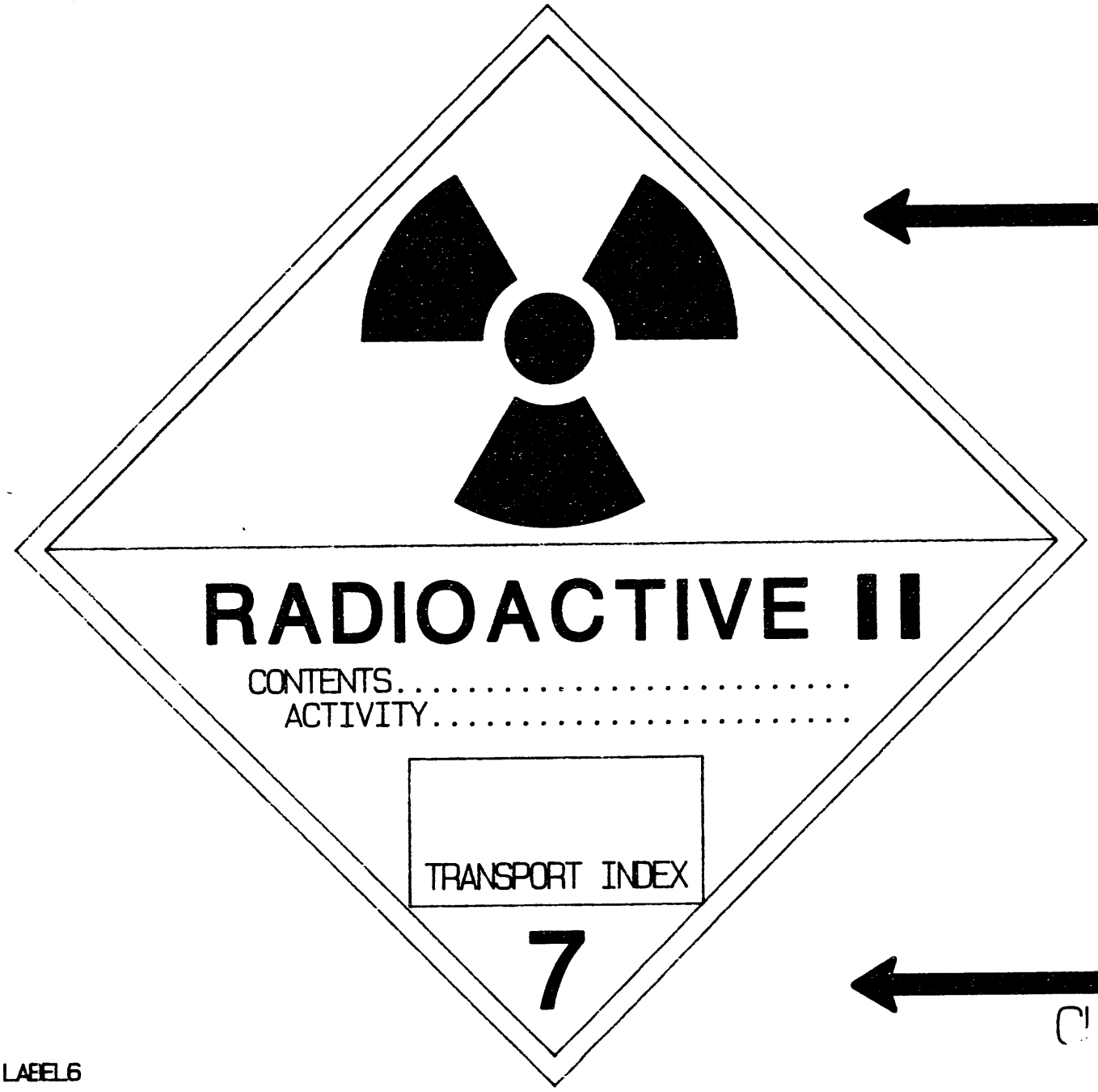
LABELS



HAZARD SYMBOL

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LABEL6

LABEL 11

TYPES OF HAZARDS

SCOPE

This ten-part module presents information about health hazards and physical hazards which may be encountered by hazardous waste site workers. Each portion of the module addresses a single type of hazard. These include hazardous chemicals, compressed gases, ionizing radiation, heat stress, cold stress, confined spaces, biological hazards, asbestos awareness, safety, and noise. Individual portions of this module need not be presented in sequence, but may be integrated into the course schedule in any appropriate position.
(Suggested time - 5 1/2 hours)

CHEMICAL HAZARDS

SCOPE

This portion of the Types of Hazards module presents information about the health hazards and physical hazards of chemicals in the workplace.

PARTICIPANT GOALS

1) Review the use of labels and MSDSs as a source of hazard information and the routes by which hazardous chemicals enter the body.

2) Gain an understanding of the types of hazardous chemicals (e.g., corrosives, irritants, sensitizers, toxic gases and vapors, carcinogens) which may be present at a hazadous waste site and their effects on the human body.

3) Gain an understanding of the ways engineering controls, respirators, and protective clothing are used to protect against hazardous chemicals.

4) Learn the physical hazards of common chemicals in the workplace.

5) Review the three parts of the fire triangle (i.e., heat, oxygen, and fuel) and learn how to use this information to prevent fires and explosions.

INSTRUCTOR PREPARATION

- Choose videotapes which present information about chemical hazards. (ORNL chose "Chemical Safety II, Health Hazards" and "Chemical Safety III, Fire and Explosions", Tel-A-Train, Incorporated, P. O. Box 4752, 309 N. Market Street, Chattanooga, TN 37405.)

- Prepare handout of chemical hazards information. The handout prepared and used by ORNL is included on pages IV-5 to IV-13.

- Choose source of employee booklet to use as handout, if desired. (ORNL chose "Working with Hazardous Materials," Business and Legal Reports, 64 Wall Street, Madison, CT 06443-1513.)

- Prepare participant worksheet or exam or use those which come with the videotapes.

INSTRUCTIONAL ACTIVITIES

- Show videotapes.
- Distribute handouts.
- Distribute and oversee completion of worksheet or exam.

CHEMICAL HAZARDS

The majority of health hazards arising from work in hazardous waste comes from inhaling chemical agents. Physical classification of these chemical agents is extremely important in toxicology. The physical characteristics and properties must first be established in order to ascertain the form of toxic agents in the air. The classification that follows is used to categorize contaminants on the basis of their physical properties.

Gases and Vapors

The terms gases and vapors are utilized to define contaminants in the molecular state. This physical state in general applies to liquids or gases existing at room temperature and pressure in their gaseous phase.

Gases are normally formless fluids that expand to occupy the space or enclosure in which they are confined and can be changed to the liquid state only by the combined effect of increased pressure and decreased temperatures. In common industrial hygiene usage the term "gas" is usually applied to a substance which is in the gaseous state at room temperature and pressure. Examples are welding gases, internal combustion exhaust gases and air.

Vapors are gaseous forms of substances which are normally in the solid or liquid state under ambient conditions. The vapor can be changed back to the solid or liquid state either by increasing the pressure or decreasing the temperature alone. Evaporation is the process by which a liquid is changed into the vapor state and mixed with the surrounding atmosphere. Examples of vapors include volatilization of organic solvents, mercury and some acids.

Particulates

Particulates or Aerosols is a classification referring to contaminants in the solid or liquid state of microscopic size dispersed in a gaseous medium. Although many classes of particulates have been defined, some typical categories are dusts, fumes, fog, smoke, mist, and smog.

Dusts are solid particles generated by crushing, handling, grinding, rapid impact, detonation and degradation of organic or inorganic materials, such as rock, ore, metal, coal, or wood. Dust is a term used in industry to describe airborne solid particles that range in size from 0.1 to 25 microns.

Fumes are solid particles generated by condensation from the gaseous state, generally after volatilization from molten materials. This physical change is often accompanied by a

chemical reaction, such as oxidation. A fume is formed when a volatilized solid, such as metal, condenses in cool air. The solid particles that make up a fume are extremely fine, usually less than 1.0 microns. In most cases, the hot material reacts with the air to form an oxide . Examples are lead oxide fume from smelting and iron oxide fume from arc-welding. A fume can also be formed when a material such as magnesium metal is burned or when welding or gas cutting is done on galvanized metal.

Fog is a loose term applied to visible aerosols in which the dispersed phase is liquid. Formation by condensation is implied.

Smoke refers to carbon or soot particles less than 0.1 microns in size which result from the incomplete combustion of carbonaceous materials such as coal or oil. Smoke generally contains droplets as well as dry particles.

Mist is also a loose term applied to dispersion of liquid particles, many of which are large enough to be individually visible without visual aid. Mist is formed when a finely divided liquid is suspended in the atmosphere. Examples are the oil mist produced during cutting and grinding operation, acid mists from electroplating, and paint spray mists from spraying operations.

Smog is a term derived from smoke and fog and applies to extensive atmospheric contamination by aerosols arising from a combination of natural and manmade sources.

These terms are typically used by toxicologists and health professionals to provide a physical classification of contaminants and should provide a working vocabulary with which to identify airborne hazards.

Corrosives

Corrosives are chemical substances that react with enough vigor to destroy the structure of other materials. Some of them can eat away metals, and others can cause severe injury to living tissue resulting in the killing of body cells. From an occupational safety and health point of view the definition of a corrosive results from its effects on living tissue rather than on metal plates. Specific tests have been prescribed to be performed on test animals (usually rabbits), and corrosives are compounds that cause, in the words of the OSHA standard, "visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact" during a four-hour test period. Corrosives are thus defined in terms of their chemical and physiological action, which does not have a particular relation to the chemical structural class. In other words, the name or structure alone is insufficient to identify a substance as a corrosive. Information on whether a compound is a corrosive or not must ultimately be based on experimentation and will be recorded on a safety label and a Material Safety Data

Sheet for the substance.

Acids and caustics are corrosive chemicals. They are dangerous to the human body because of their corrosive properties: they tend to eat away at or dissolve tissue. When acids or caustics come in contact with the skin, they cause chemical burns; when their mists or vapors are inhaled, they destroy lung tissue. The effects of acids and caustics are immediate.

Acids are extensively used in many different industries. Some uses of acids include water treatment, metal plating, chemical processing, and storage batteries. Many different kinds of acids are used. Sulfuric, hydrochloric, perchloric, chromic, and nitric acids are just a few of the types used in industry. The more highly concentrated the acid, the more corrosive it is and the more dangerous it is to handle. But again the chemical structural class is not enough sometimes to identify a substance as corrosive. For example, strong acids are known to be corrosives, but that is not to say that all acids are corrosives. Boric acid, for instance, is used as an eyewash.

Acids can also be dangerous in other ways. Some have delayed, or chronic effects. Chromic acid, widely used in metal plating, may cause chronic poisoning and even cancer in persons exposed to low concentrations of acid mists over a period of years.

Caustics, also called alkalis, are similar to acids in that they are both corrosive; however, caustics and acids are chemical opposites--mixed together, they neutralize each other. The property is used to advantage in waste water treatment--if the water is too alkaline, acids are added; if it is too acidic, alkalis are added.

In industry, caustics are used for a number of purposes, including water treatment and corrosion prevention. Some of the most common alkaline substances used are lime (calcium carbonate), lye (sodium hydroxide), phosphates, and chromates. All of these caustics are corrosive to the human body; their effects are similar to acids. They dry and crack the skin, and burn the eyes and lungs. The corrosive effect is intensified when the caustic contacts water.

Some caustics are also toxic in other ways. Chromates, for example, are extremely poisonous; their toxic effects may make themselves known before the corrosive properties of the substance cause damage. Chromates are often used in water treatment systems and paints as a corrosion inhibitor.

In general, the precautions and protective equipment needed for handling caustics and acids are the same. Rubber suits or aprons, rubber gloves, and eye protection keep spills off the worker's body and out of his eyes. Where large quantities of corrosive materials are being used, or anywhere that acid mists or vapors may be present, a respirator fitted with cartridge

designed for acid gases will prevent damage to the worker's lungs. If corrosives splash onto the skin or eyes, a person should immediately wash the affected areas with generous amounts of water.

Oxidizers

Oxidizing agents are sources of oxygen, one of the necessary components of a fire. Normal air with its 20% oxygen content is the primary source. However, many other materials are so constituted chemically that they can supply oxygen to a reaction, even in the absence of air. Some of these oxygen suppliers require heat before they will yield oxygen; others evolve significant amounts of it at room temperature. When containers of oxidizing materials are damaged, for example, by the forces unleased during a disaster, their contents can mix with the contents of other damaged containers and possibly start fires and explosions. This is a strong argument in favor of separate storage over mixed storage. Some classes of compounds noted for their ability to supply oxygen are: organic and inorganic peroxides, oxides, permanganates, chlorates, perchlorates, organic and inorganic nitrates, iodates, periodates, bromates, perbromates, chromates, dichromates, and ozone.

In general, it is unsafe to store oxidizers close to liquids of low flash point. In fact, even slightly flammable materials should be isolated from oxidizers. For instance, ordinary glycerol and potassium permanganate, when simply blended at room temperature, react violently to produce a hot fire.

As a general rule, it is wise to keep all flammables away from an area where oxidizing agents are stored. This storage area should be kept cool and ventilated, and should be fireproof. Normal fire fighting equipment is less useful here, since the blanketing or smothering effect of fire extinguishers is less effective because the oxidizers supply their own oxygen. With these materials it is best to keep fuel away.

Poisons

Poisons are substances that are liable to cause death or serious injury if they are swallowed, inhaled, or come in contact with the skin. The mechanism by which poisons act may vary widely, but the level of action is usually physiological. The poison interferes with the proper functioning of the body, for instance by affecting oxygen distribution in the bloodstream or by blocking nerve impulses.

OSHA defines two categories of toxic materials based on results of animal testing.

<u>Highly toxic materials.</u> A chemical falling within any of the following categories:

a. A chemical that has a median lethal dose of 50

milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

b. A chemical that has a median lethal dose of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less of death occurs with 24 hours) with the bare skin of Albino rabbits weighing between 2 and 3 kilograms each.

c. A chemical that has a median lethal concentration in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less of death occurs with one hour) to albino rats weighing between 200 and 300 grams each.

Toxic materials. A chemical falling within any of the following categories:

a. A chemical that has a median lethal dose of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

b. A chemical that has a median lethal dose of more than 200 milligrams per kilogram but not more the 1000 kilograms per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.

c. A chemical that has a median lethal concentration in air of more than 200 parts per million but not more than 2000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Other classes of substances that have a physiological action and are defined as health hazards by the OSHA standard are:

Irritants. Chemicals that are not corrosive but cause a reversible inflammatory effect on living tissue by chemical action at the site of contact. Conditions for a rabbit skin test are specified in federal regulations. Eye irritants are also defined in terms of animal tests in federal regulations.

Sensitizers. Chemicals that cause a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

Explosives

An explosive is a chemical substance which under certain conditions of temperature, shock, or chemical action can

decompose rapidly to evolve either large volumes of gas or so much heat that the surrounding air is forced to expand very rapidly; in either case, an explosion results. These materials are particularly dangerous when involved in shock or heat-producing disaster conditions. Beside the hazard of explosive substances, there is the hazard of explosive conditions in the workplace. Concentrations of vapor from a flammable substance may build up to form a combustible or explosive atmosphere.

Flammables and Combustibles

Fire is a chemical process involving four factors: fuel, oxygen, heat, and the chemical reaction between them. The combination of these is represented by the fire pyramid. Flammable and explosive substances are fuels. If sufficient amounts of heat and oxygen are added to a fuel, the chemical reaction starts and a fire takes place. If any one of the four factors is removed, the fire stops.

Each type of fuel has different burning characteristics and requires different combinations of heat and oxygen for ignition. One characteristic of a fuel is its flash point. A material's flash point refers to the lowest temperature at which the material gives off enough vapors to be ignited by a spark or flame. It is the vapors that actually burn; solid and liquid fuels will not ignite unless they have released sufficient vapors. The lower a material's flash point, the easier it is to ignite.

Materials with flash points below 100°F (38°C) are called flammable substances. Gasoline, benzene, and ethyl alcohol are flammable liquids. Burnable materials with flash points above 100°F (38°C) are called combustibles. Brake fluid, antifreeze, and No. 6 fuel oil are all combustibles.

Under certain conditions, almost any flammable or combustible material can also be explosive. The explosive potential of a fuel relates to its surface area. As surface area increases, more oxygen can come in direct contact with the fuel, and the substance ignites more readily. Concentrations of vapor from a flammable substance may build up in confined spaces to form a combustible or explosive atmosphere. When atomized fuels (fuels sprayed in fine droplets) or combustible dusts like coal dust are spread throughout the air in a confined space, an explosive mixture is created. Any spark or flame can cause the mixture to explode violently.

A prominent factor in rating the fire hazard of a flammable or combustible liquid is its flammable range, sometimes referred to as "explosive range." For each flammable or combustible liquid there is a minimum concentration of vapor in air below which propagation of flame will not occur on contact with a source of ignition because the mixture is too lean. There also is a maximum concentration of vapor in air above which propagation of

flame will not occur because the mixture is too rich. These boundary line mixtures of vapor with air that, if ignited, will just propagate flame are known as the lower and upper explosive limits, and are usually expressed in terms of percentage by volume of vapor in air.

Many flammable liquids have an additional characteristic that makes them dangerous above and beyond the hazards of fire and explosion: most are toxic. Vapors from fuels like gasoline and kerosene are poisonous; vapors from many common solvents can be deadly even in small amounts.

Everyone who works around flammable substances must take care that a stray spark does not start a fire. However, fires sometimes start even without an external heat source. Ignition without the addition of external heat is called spontaneous combustion. Spontaneous combustion typically occurs when a pile of used wiping rags is exposed to oxygen in the air. A slow chemical reaction gradually raises the temperature of the pile of rags until the ignition point is reached. Then the rags suddenly burst into flame, with no warning and no immediate apparent cause.

Solvents

No single chemical class can be defined as a solvent, but in looking at plant operations in the chemical industry it is natural to consider solvents as a group because of their common characteristics in handling, use, and storage.

Solvents are used to dissolve other materials. Some of them are thus used as cleaning fluids or for degreasing and others are used for extracting soluble materials from raw materials. Solvents are also used in chemical processing, because more uniform and controlled behavior can be obtained with chemicals uniformly present in solution. A wide variety of solvents is used because favorable reaction conditions have to be tailored to the kind of dissolved substances and reaction conditions required. Water is a very common solvent and dissolves a wide range of substances, particularly inorganic salts. However, many specialized organic liquids are used because they meet particular requirements better, and these are the solvents that may present health hazards.

Many solvents are flammable liquids, and they present more of a safety hazard than a health hazard. However, there can also be health effects of all kinds--solvents may be toxic, corrosive, or irritant.

Solvents vary widely in their toxicological properties. All organic solvents affect the central nervous system to some extent because they act as depressants and anesthetics. Depending upon the degree of exposure and the solvent involved, these effects may range from mild narcosis to death from

respiratory arrest. All solvents contacting and wetting the skin will cause dermatitis--inflammation of the skin. This may vary from simple irritation to systemic damage to the skin. Solvents dissolve the natural protective barrier of fats and oils and leave the skin susceptible to further irritation and harm.

Good ventilation systems, either local or general, are generally the most satisfactory means of controlling solvent vapors. Emergency or backup protection may be provided by the use of respirators. Air supplied respirators or air purifying respirators that are listed as approved by NIOSH for use against organic vapors should provide adequate protection for most solvents. Make sure, however, by working with industrial hygiene, that the level of solvent vapors in the air does not exceed the protective factor of the respirator.

Metals

Significant quantities of heavy metals, primarily lead, are known to have been placed in ORNL's Solid Waste Storage Areas. In addition, cadmium, chromium, copper, nickel, and zinc, among others, have been detected. Metals are quite toxic to biological systems. Most toxic metals are systemic poisons, accumulating in specific organs of the body and causing permanent damage to those organs. Persons may be exposed to toxic metals as dusts or vapors from pure metals or as part of a metallic compound.

There is very little in the way of generalizing principles about the effects of toxic metals. Those that have been studied the most have produced a wide array of biological effects involving multiple target organs and systems. To further complicate matters, metals bind with other constituents to form organic compounds that produce toxic effects that are quite different from those of inorganic forms.

Lead is perhaps the most common of all poisonous metals. Almost everyone is exposed to a certain amount of lead; however, medical problems set in when the amount of lead in the body exceeds the body's ability to dispose of it through the normal waste processes. When this toxic level is reached, symptoms of heavy metal poisoning begin to appear. If the toxic level has been reached during a single exposure to lead, the victim suffers from acute lead poisoning; the symptoms are anemia, severe stomach trouble, paralysis, and brain damage. Cases of chronic poisoning are far more common. When workers have been exposed to lead over a long period of time, it affects the central nervous system, the peripheral nerves, the kidney, and the blood forming systems. Signs of chronic lead poisoning include shaking, poor coordination, irritability, headaches, dullness, and loss of memory.

Carcinogens

Carcinogens are substances that cause cancer. Harmful health

effects of chemicals can range from gross destruction of tissue (as with corrosives) to interference with normal body functioning (as with toxic materials) to disruption of processes within body cells that affect their ability to divide. In cancer, modified body cells start reproduction and continue to do so out of control. This leads to tumor formation and is a severe assault on the body's normal functioning.

Cancer is not a single disease. Many types of body cells can show cancerous activity and result in different symptoms.

It has long been known that exposure to some substances is correlated with the development of cancer. With regard to dose levels and the duration of exposure, the range of effects seems to be broad. Some authorities hold that there is no safe exposure level, and this conservative approach is certainly the safest one to take. From an occupational safety and health point of view the definition of a carcinogen results from its effects in animal testing. There is an argument about the applicability of test data obtained with animals to humans.

According to the OSHA, a chemical is considered to be a carcinogen if it has been;

*Evaluated by the International Agency for Research on Cancer and found to be a carcinogen or potential carcinogen;

*Listed in the Annual Report on Carcinogens published by the National Toxicology Program as a carcinogen or potential carcinogen.

*Regulated by OSHA as a carcinogen.

COMPRESSED GASES

SCOPE

This portion of the Types of Hazards module presents information about the safe handling of compressed gases. It includes specific information about the hazards of the types of compressed gases most common at the facility.

PARTICIPANT GOALS

1) Learn safe handling procedures for transporting cylinders of compressed gas.

2) Learn safe handling procedures for storing cylinders of compressed gas.

3) Learn the general requirements for safe handling of compressed gas cylinders in general use.

4) Review the special precautions to be taken when dealing with specific compressed gases in use at the facility.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare viewgraphs for the discussion of facility-specific compressed gases, if needed.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives.
  (COMGAS 11, 12)

- Discuss the procedures for the safe transportation of compressed gas cylinders.
  (COMGAS 1)

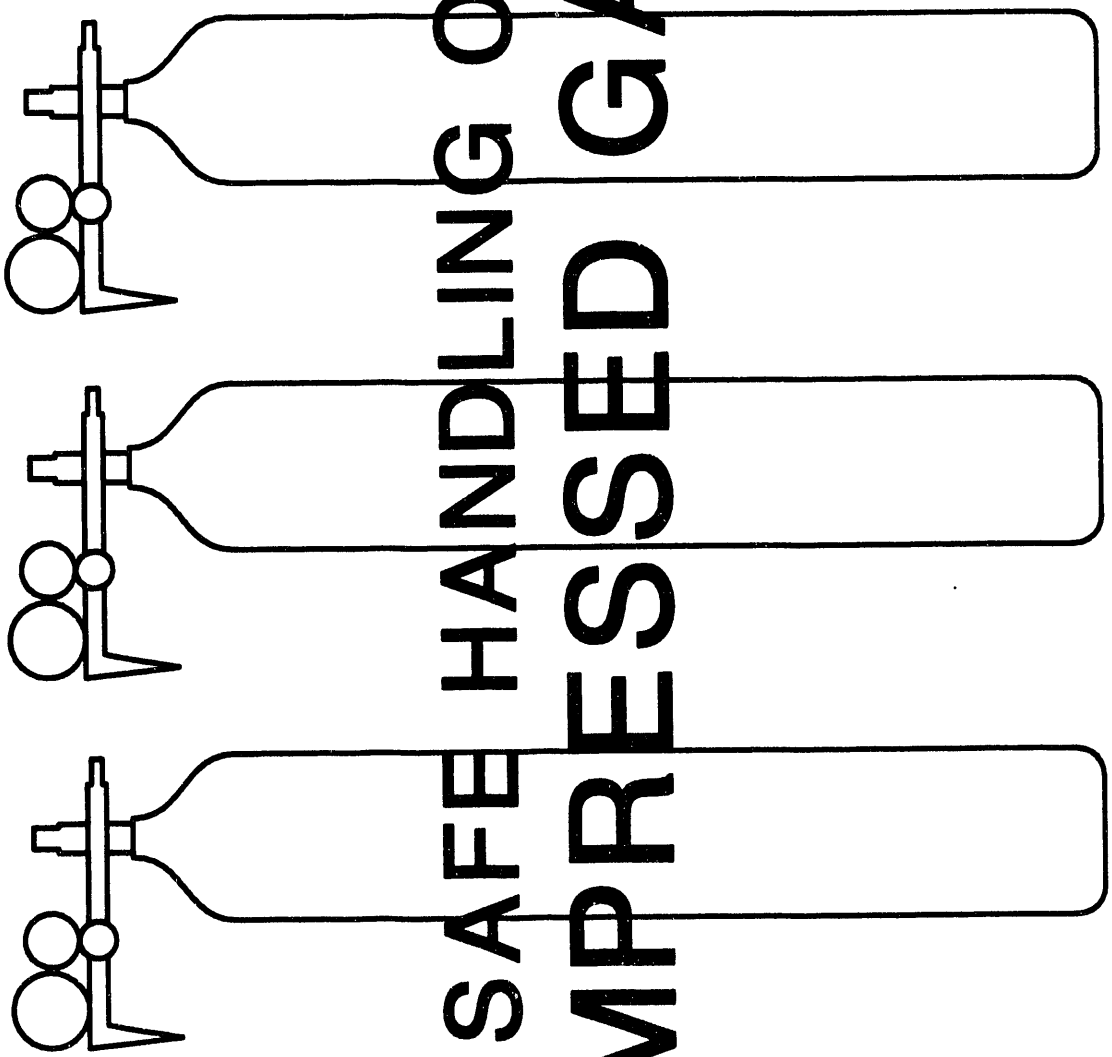
- Discuss the procedures for the safe storage of compressed gas cylinders.
  (COMGAS 2)

- Discuss the procedures for safe handling of compressed gases in general use.
  (COMGAS 3, 8, 7)

- Discuss safe handling procedures for specific compressed gases.
  (COMGAS 4, 5, 6, 9, 10)

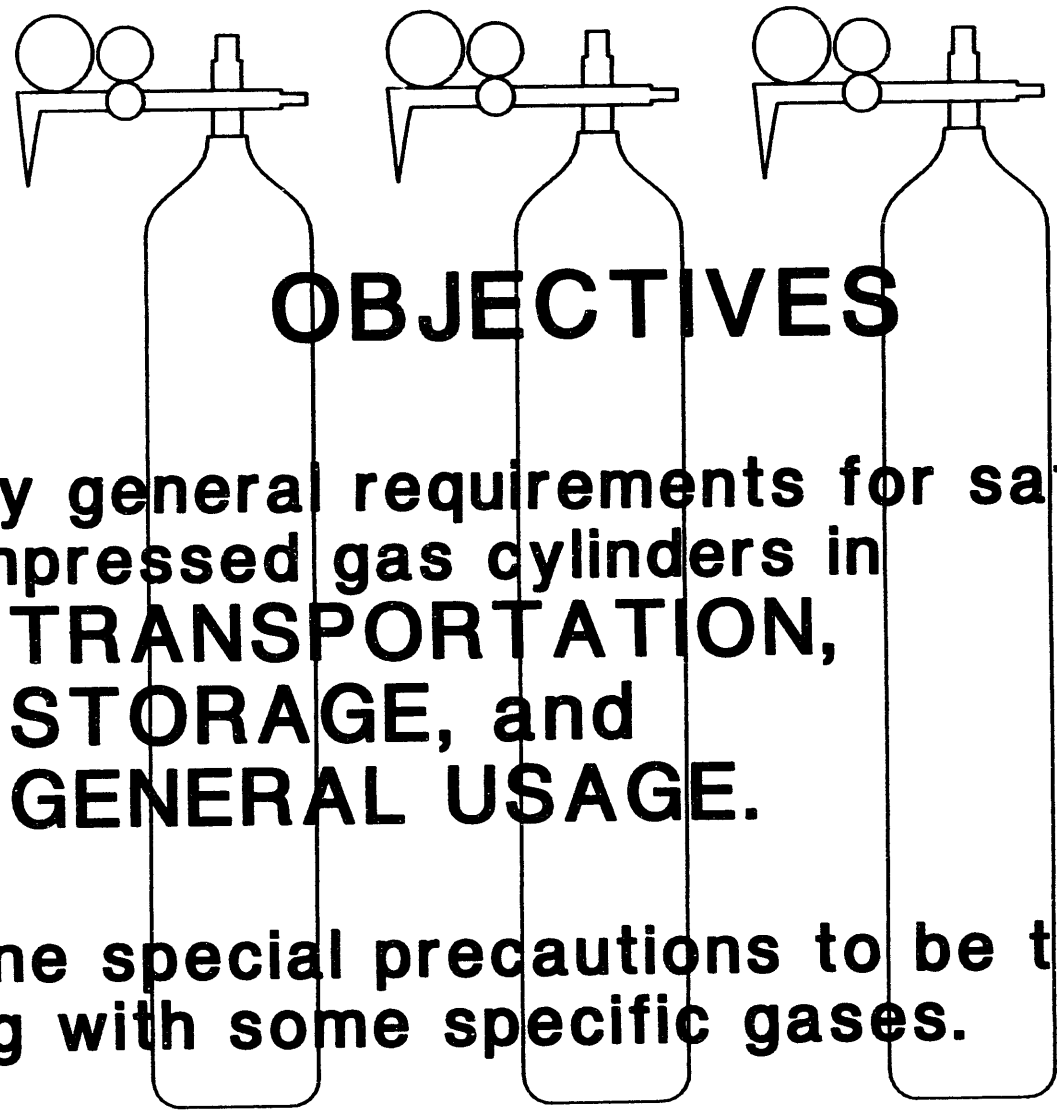
- Review the safety factors to remember when handling compressed gases.
  (COMGAS 13)

- Distribute and oversee completion of worksheet or exam.



SAFE HANDLING OF COMPRESSED GASES

COMGAS11



OBJECTIVES

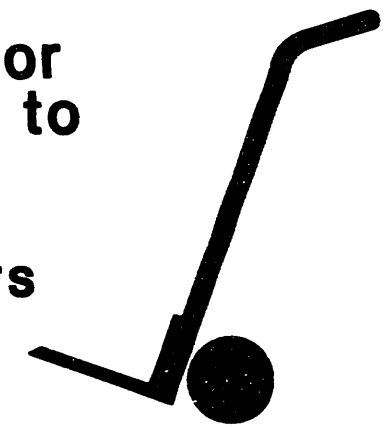
- Identify general requirements for safe handling of compressed gas cylinders in
  TRANSPORTATION,
  STORAGE, and
  GENERAL USAGE.

- Examine special precautions to be taken when dealing with some specific gases.

COMGAS12

COMPRESSED GAS CYLINDER TRANSPORATION

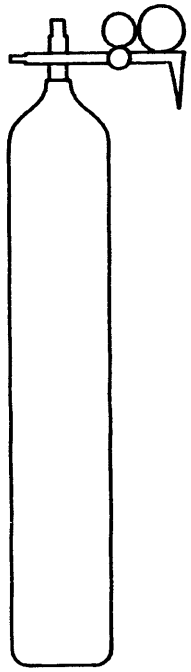
- Before moving, be certain all cylinder valves are closed, the regulator removed, and the protective cap installed.
- When possible, use a hand truck for moving single cylinders. Do not drag or slide containers.
- Take care not to drop cylinders or permit them to strike each other or other surfaces violently.
- Never use protective cap as a lifting point for moving a cylinder from one vertical position to another.
- When transporting by truck, make sure cylinders are well secured to prevent bumping. Do not transport in a closed vehicle.



COMGAS1

COMPRESSED GAS CYLINDER STORAGE

- Always store cylinders chained or strapped in an upright position in areas specially designated for that purpose.
- Protect cylinders against the possibility of being struck by a large passing or falling object.
- Store cylinders in dry, well-ventilated areas. If practicable, area should be resistant to fire.
- Keep storage area temperature below 125 F.
- Store cylinders away from heat sources and combustible materials.
- Protect cylinders stored in the open from the weather, dampness, and direct sunlight.



COMGAS2

USING COMPRESSED GAS CYLINDERS

- Do not use containers not bearing a legible label identifying the contents.
- Keep caps on cylinders at all times except when cylinders are connected to dispensing equipment.
- Keep container valves closed at all times except when the cylinder is in use.
- Do not place containers where they might become part of an electrical circuit.
- Use the proper regulator for a particular gas.
- If a leaking cylinder cannot be simply remedied, close the valve, tag, and remove to the outdoors or a well-ventilated location.
- Discontinue use of high-pressure cylinder when pressure approaches 30 psig, and clearly mark EMPTY.

COMGAS3

SAFE HANDLING RULES FOR COMPRESSED GASES

INSTALLING A REGULATOR

- Be certain to obtain the proper regulator for the specific gas cylinder being used.
- Visualy inspect the cylinder valve and regulator to make certain they are free of foreign material.
- Turn the delivery pressure adjusting "tee" counter-clockwise until it turns freely.
- Install the regulator on the cylinder valve. Open the cylinder valve slowly until cylinder pressure registers on the regulator.
- With the flow control valve at the outlet of the regulator closed, turn the delivery pressure adjusting "tee" clockwise until the desired pressure is reached.
- To remove the regulator, be certain that the cylinder valve is tightly closed.

COMGAS8

SAFE HANDLING RULES FOR COMPRESSED GASES

OPENING A GAS CYLINDER

- Open compressed gas cylinders slightly at first, then all the way.
- Stand to one side and look away from the regulator and guage face when opening the cylinder valve. Valve outlets should be pointed away from yourself and others.
- Use your hands to open the cylinder valve; never use a hammer or wrench. If the cylinder will not open with hand pressure, have it returned to the supplier.

COMGAS7

SAFE HANDLING RULES FOR COMPRESSED GASES

OXYGEN

- Oxygen containers, valves, regulators, hose and other oxygen apparatus should be kept free from oil or grease and should not be handled with oily hands, oily gloves, or with greasy equipment.

- Oxygen containers in storage should be separated from flammable-gas containers or combustible materials (especially oil or grease) by a minimum distance of 20 feet.

COMGAS4

SAFE HANDLING RULES FOR COMPRESSED GASES

ACETYLENE

- Keep acetylene away from any open flame or sources of heat as well as other combustible materials. Acetylene can explode with extreme violence if ignited.

- Acetylene should not be used under more than 15 psig, since it may spontaneously decompose with explosive force. Note the red warning area on acetylene regulators.

- Never use unalloyed copper pipe or fittings on acetylene systems. Fittings with more than 65% copper can react to form explosive, shock sensitive acetylides.

COMGAS5

SAFE HANDLING RULES FOR COMPRESSED GASES

CHLORINE

- Extreme care must be taken when moving, storing, or using chlorine gas cylinders. The gas is a strong irritant to eyes, nose, throat, and lungs.

- When hooking up chlorine gas cylinders, or working with any equipment which is attached to a chlorine gas cylinder, a full face respirator with appropriate cartridge filter is required.

- Chlorine cylinders have fusible plugs that melt between 140 and 160 F. For this reason, chlorine gas cylinders must be kept away from any source of heat, and the plug must not be tampered with.

COMGAS6

SAFE HANDLING RULES FOR COMPRESSED GASES

FLAMMABLE GASES

- Do not store cylinders near flammable solvents, combustible material, or near unprotected electrical connections, gas flames, heat, or other sources of ignition.
- Ground all manifolds for flammable gas cylinders.
- Never use a flame to detect flammable gas leaks. Use soapy water.
- Do not store reserve stocks of flammable gas cylinders with cylinders containing oxygen. Stored oxygen and fuel gas cylinders should be separated by a minimum of 20 feet.

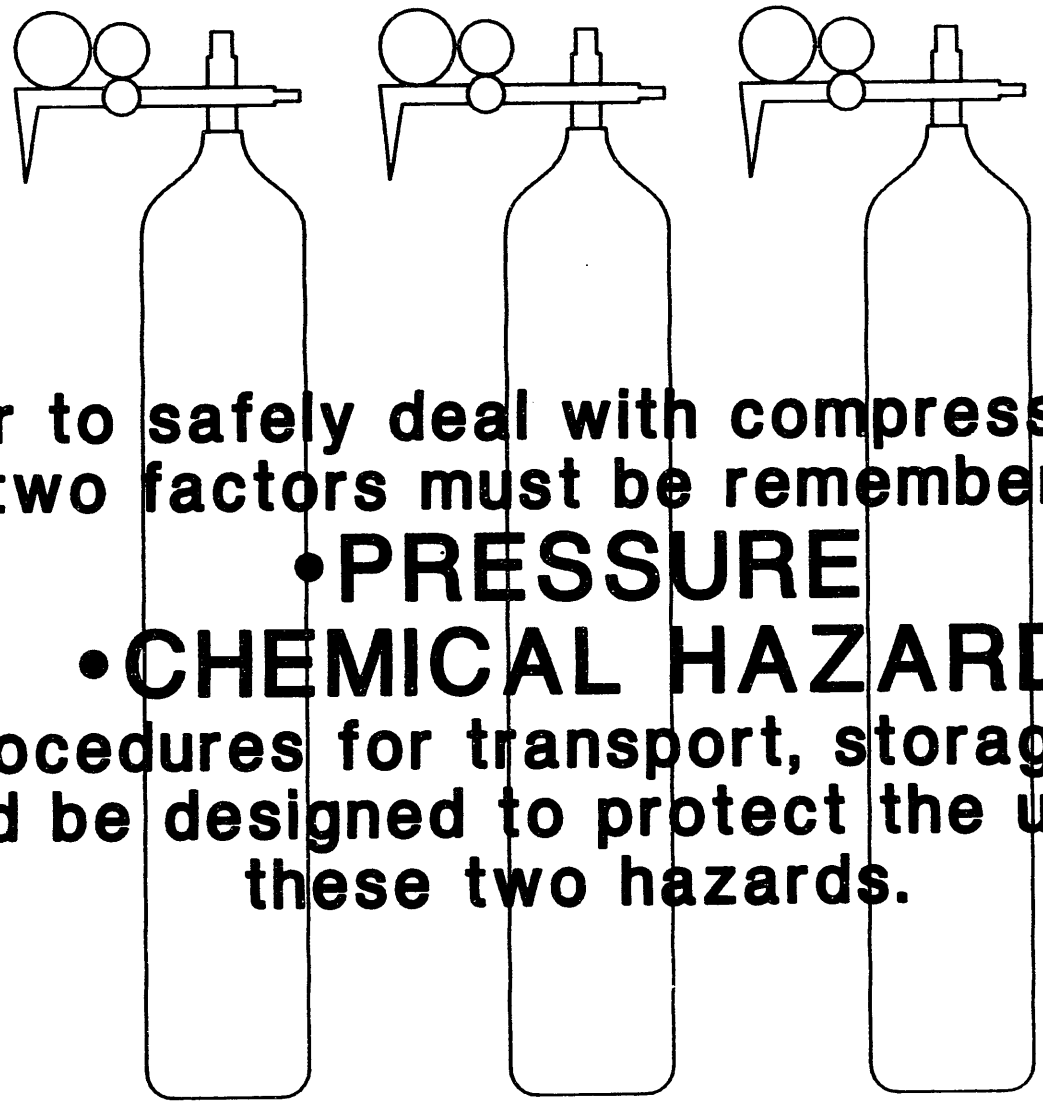
COMGAS9

SAFE HANDLING RULES FOR COMPRESSED GASES

TOXIC GASES

- Personnel handling and using toxic gases should have respiratory protection approved by Industrial Hygiene available for immediate use.
- Toxic gases should be used only in forced ventilation areas or, preferably, in hoods with forced ventilation to out-of-doors.
- Before using, read all label information and data sheets associated with the use of the particular toxic gas.

COMGAS10



In order to safely deal with compressed gases, two factors must be remembered:

- PRESSURE
- CHEMICAL HAZARD

All procedures for transport, storage or use should be designed to protect the user from these two hazards.

COMGAS13

IONIZING RADIATION

SCOPE

This portion of the Types of Hazards module presents a much shortened version of the radiation protection training for general employees and radiation workers. It includes basic information on sources, types, and properties of radiation; biological effects of radiation and exposure risks; and radiation protection measures.

PARTICIPANT GOALS

1) Learn to identify the three main sources of natural radiation.

2) Review the risks associated with radiation relative to other health risks.

3) Learn to identify the basic types and properties of radiation.

4) Gain an understanding of the biological effects of ionizing radiation.

5) Learn radiation protection fundamentals such as radiation protection zones, radiation work permits, radiation exposure standards and limits, and ALARA.

INSTRUCTOR PREPARATION

- Determine the information to be presented on a flip chart.

- Prepare viewgraph illustrating the penetrating power of the different types of radiation.

- Prepare viewgraphs for facility-specific radiation protection procedures, radiation work permits, monitoring instruments, occupational exposure limits, radiation exposure experiences, and ALARA.

- Assemble viewgraphs.

- Prepare lecture notes.

- Choose a short videotape about ionizing radiation, if desired. The technical content should either center on a concept or an account of a recent event.
  Suggested materials includes:

  The Story of Radiation - This series consists of ten 15-minute videotapes dealing with the fundamantal concepts of ionizing radiation. The films present scientific facts without making value judgments. They may be purchased from most training vendors.

  Videotapes may be available from organizations that respond to major events that have occured. Such an event might include the dismantling of a medical therapy source in Goiania, Brazil, in September 1988.

  Use may be made of locally produced videotapes that incorporate site-specific application of the concepts of ionizing radiation. This allows the participants an opportunity to closely identify with the material being presented.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the contents and objectives of this portion of the training.
  (RAD 1, 2)

- Discuss the sources of natural radiation including external terrestrial, internal terrestrial, and cosmic radiation.
  (C 3, 4, 64)
  Write the most common naturally occurring isotopes on flip chart.
  Use flip chart to explain the Chart of the Nuclides and how participants can use this chart for information.

- Discuss non-occupational, artificial sources of radiation.
  (C 65)

- Discuss the risks associated with ionizing radiation exposure relative to other health risks.
  (D 8, 9, 10, 14, 11, 12)

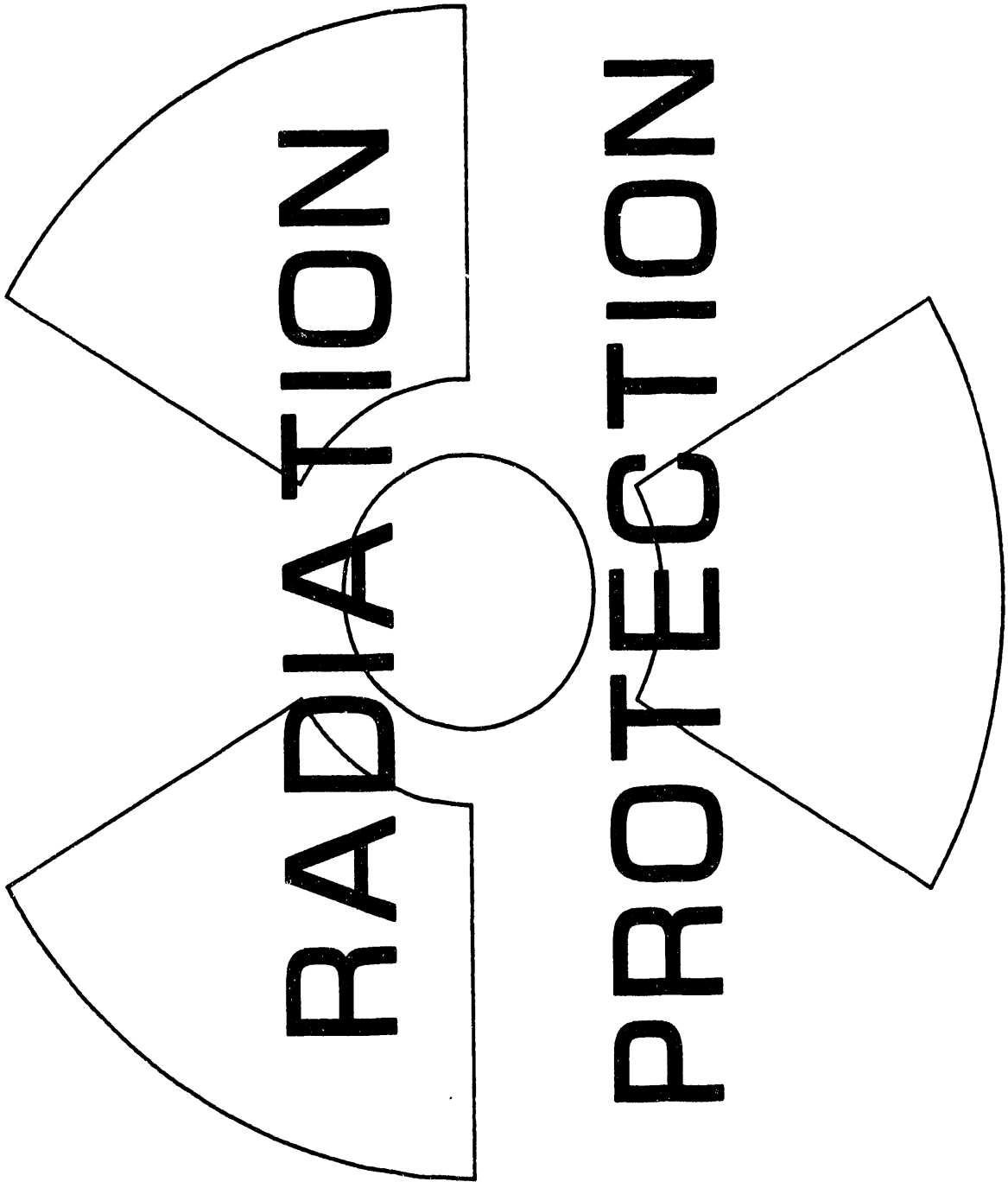
- Discuss the types and properties of ionizing radiation and radioactivity, including an explaination of radiation units.
  (C 5; D 13; RAD 3; C 19; RC 1)
  Use flip chart to correlate SI units with the more familiar units and to explain the radiation units used by the facility's radiation protection department.

- Discuss the biological effects of acute and chronic exposure to ionizing radiation.
  (C 7, 8; D 40; B 106; C 43, 20, 11, 44; HE 2, 1)

- Discuss radiation and contamination safety measures including training; time, distance, and shielding; protective clothing; zoning; monitoring; radiation protection standards; and ALARA.
  (C 13, 36, 45-52; D 16, 17, 41; C 73, 39, 17, 40, 41)
  facility-specific viewgraphs

- Show videotape, if desired.

- Distribute and oversee completion of worksheet or exam.



RAD1

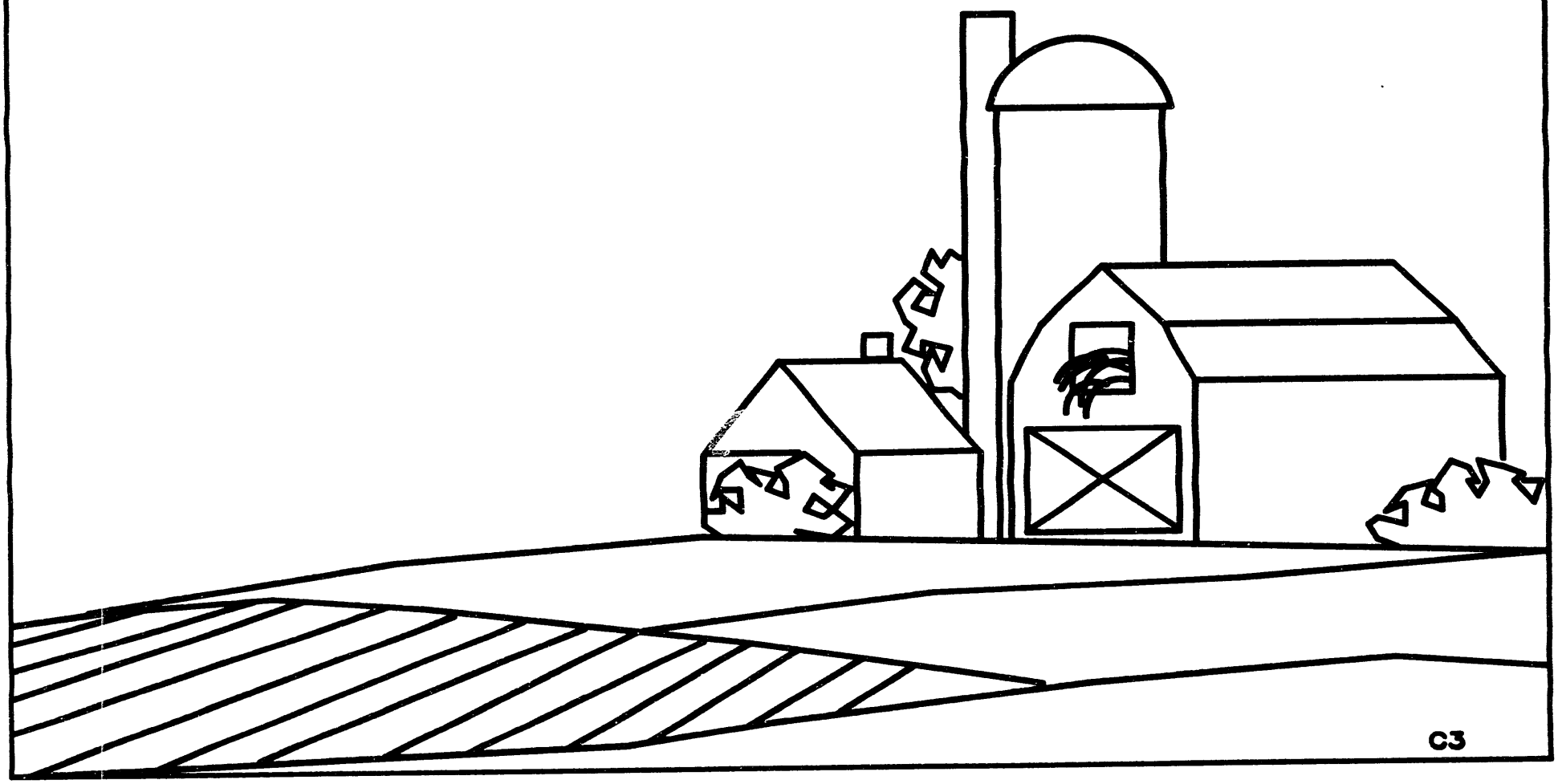
OBJECTIVES

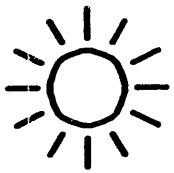
- Identify types and properties of radiation
- Discuss methods used to protect workers and environments

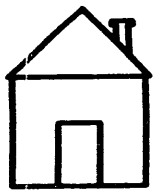
RAD2

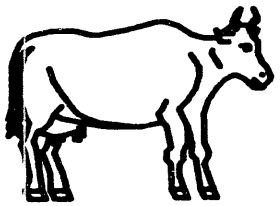
NATURAL

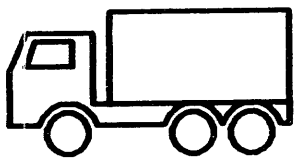
RADIOACTIVITY











NATURAL RADIATION . . .

- continually surrounds us
- also called background radiation
- natural levels serve as indicators of accepted levels
- natural standard for minimal levels
- starting point for working standards for radiation protection professionals

C4

HOW ARE WE EXPOSED TO RADIATION?

- Cosmic Radiation
  - Varies with Elevation
- Exposure
- Air
  - Radon
- Human Body
  - Potassium-40
- Water
  - Radium (Dissolved)
- Food

C64

CONSUMER PRODUCTS

- Radioactivity Essential Property
  - Smoke Detectors
  - Luminous Items
- Chemical Property of Radioactive Material
  - Lantern Mantles
  - Uranium Glass
- Radioactive Material Unwanted
  - Tobacco
- Product Does Not Contain Radioactive Material But May Produce Radiation
  - Television Sets
  - Medical Devices

C65

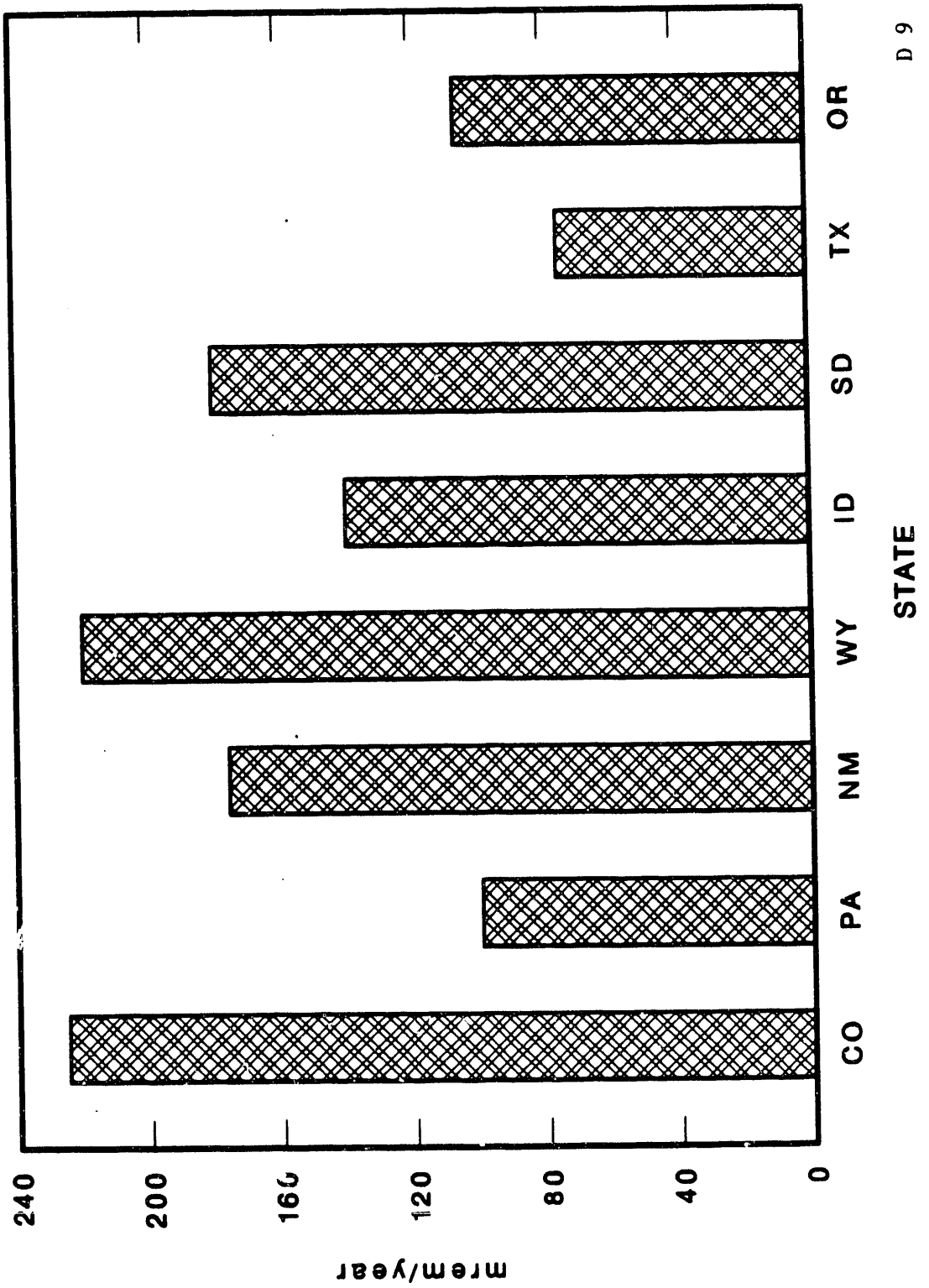
REM — Dose of Any Ionizing Radiation to Body Tissue in Terms of Its Estimated Biological Effect.

Millirem — 1/1000 of a REM.

D8

ORNL-DWG 88C-8455

NATURAL BACKGROUND RADIATION



D 9

PROBABILITY OF ACCIDENTAL DEATH BY TYPE OF OCCUPATION

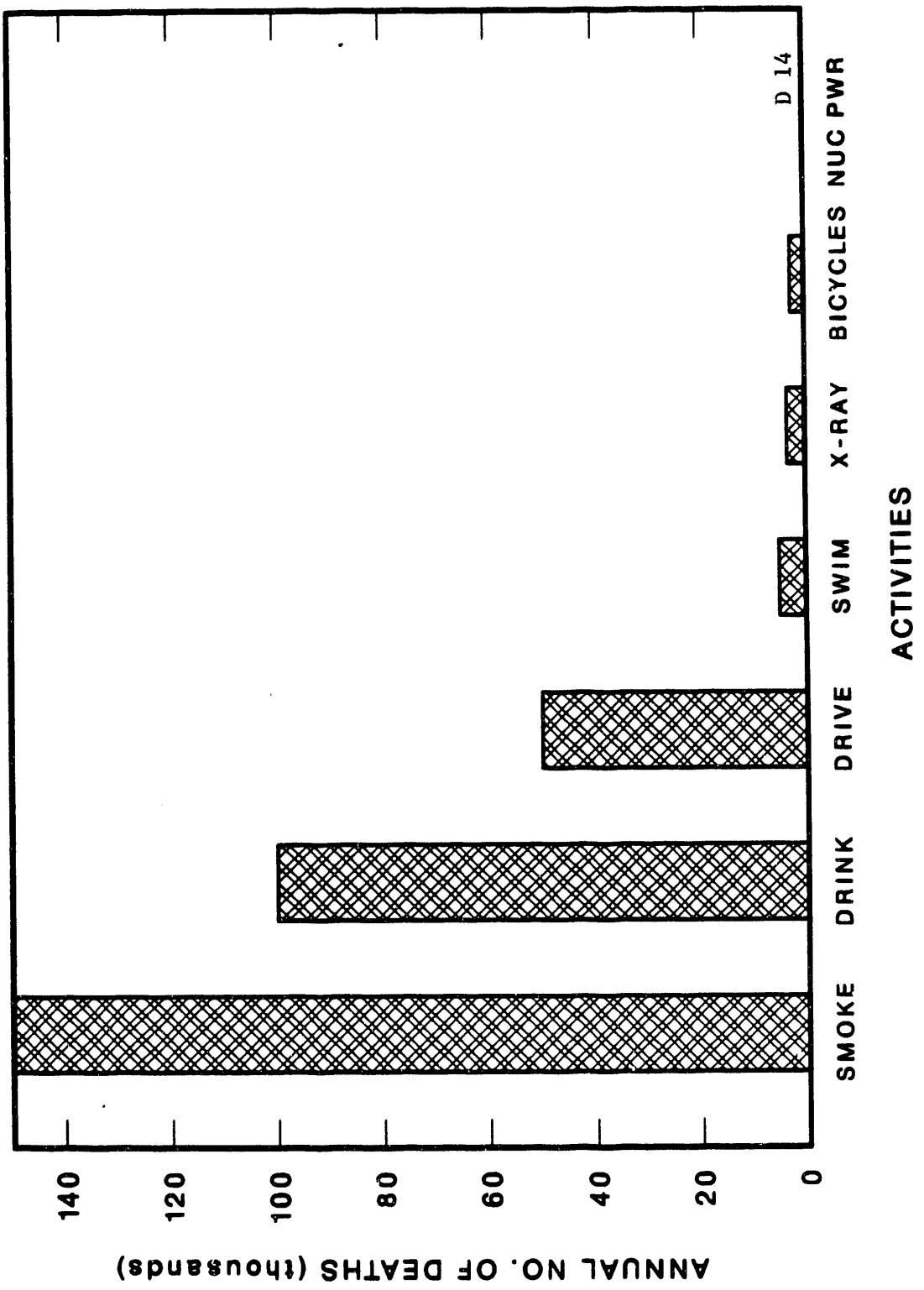
Occupation	No. of Accidental Deaths for 10,000 Workers for 40 Years
Mining	252
Construction	228
Agriculture	216
Transportation & Public Utilities	116
All Industries	56
Government	44
Nuclear Industry (Excluding Construction)	40
Manufacturing	36
Services	28
Wholesale and Trade	24

D 10

April 1988

ORNL-DWG 86C-8454

RELATIVE RISKS



ESTIMATED LOSS OF LIFE EXPECTANCY FROM HEALTH RISKS

Health Risk	Estimates of Days of Life Expectancy Lost (Average)
Smoking 20 cigarettes/day	2370 (6.5 yrs)
Overweight (by 20%)	985 (2.7 yrs)
All accidents combined	435 (1.2 yrs)
Auto accidents	200
Alcohol consumption (U.S. average)	130
Home accidents	95

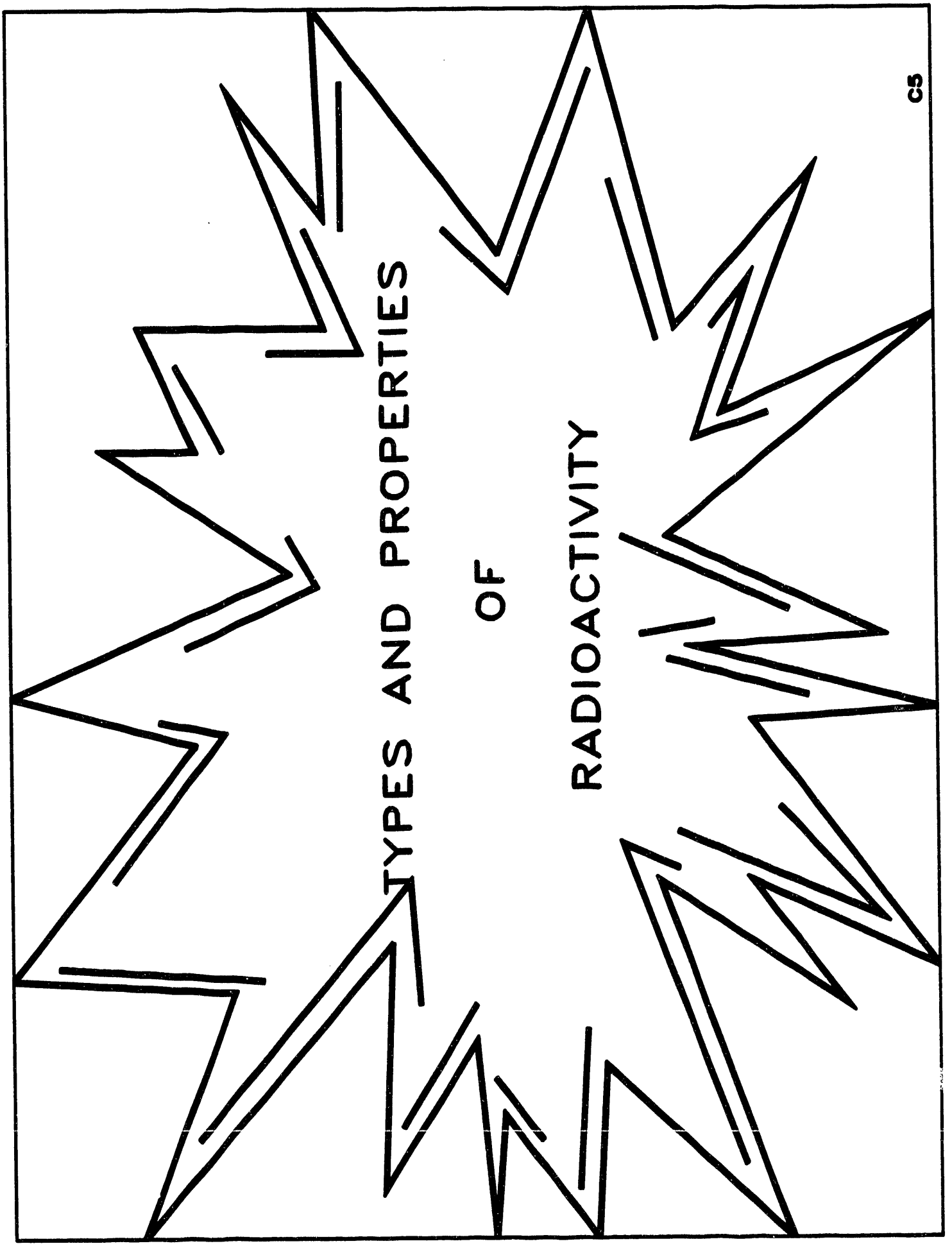
D11

ESTIMATED LOSS OF LIFE EXPECTANCY FROM HEALTH RISKS (continued)

Health Risk	Estimates of Days of Life Expectancy Lost (Average)
Drowning	41
Natural background radiation (calculated)	8
Medical diagnostic x-rays (US average, calculated)	6
All catastrophes (earthquake, etc.)	3.5
1 rem occupational radiation dose* (calculated)	1
1 rem/year for 30 yrs (calculated)	30

*Industry average for the higher-dose job categories is 0.65 rem/yr.

D12


TYPES AND PROPERTIES
OF
RADIOACTIVITY
C5

RADIOACTIVITY is the spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation.

D13

ORNL WS-44597

RADIOACTIVITY

Alpha:	A "big" charged particle consisting of two protons and two neutrons. Stopped by paper.
Beta:	A particulate radiation, smaller and more penetrating than alpha, negatively charged. 1/1840 mass of a proton or a neutron. Stopped by 0.250" Al.
Gamma:	Electromagnetic radiation. A bundle of energy-photon. Emitted from an unstable isotope.
X-ray:	Same as gamma except the source. X-ray and gamma rays require heavy shielding, i.e., lead.
Neutron:	The neutral portion of the nucleus of an atom.

RADIATION UNITS

The unit of activity is the CURIE, Ci

The unit of exposure is the ROENTGEN, R

The unit of absorbed dose is the RAD,

The unit of dose equivalent is the REM,

The unit of millirem equals 1/1000 rem.

C19

RADIATION UNITS COMPARISON TRADITIONAL/INTERNATIONAL

UNIT	TRADITIONAL	INTERNATIONAL
Activity	Curie, Ci	Becquerel, Bq
Absorbed Dose	RAD	Gray, Gy
Dose Equivalent	REM	Seviert, Sv
Exposure	Roentgen, R	

RC1

BIOLOGICAL EFFECTS OF RADIATION

C7

QUALITY FACTOR — A Measure of the Relative Biological Damage Caused by Different Types of Radiation.

CRITICAL ORGAN — The Body Organ Receiving a Radionuclide or Radiation Dose That Results in the Greatest Overall Damage to the Body.

CB

QUALITY FACTORS

Beta	1
Gamma	1
X-ray	1
Neutrons	
Thermal	3
Fast	10
Alpha	20

D40

AIIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910

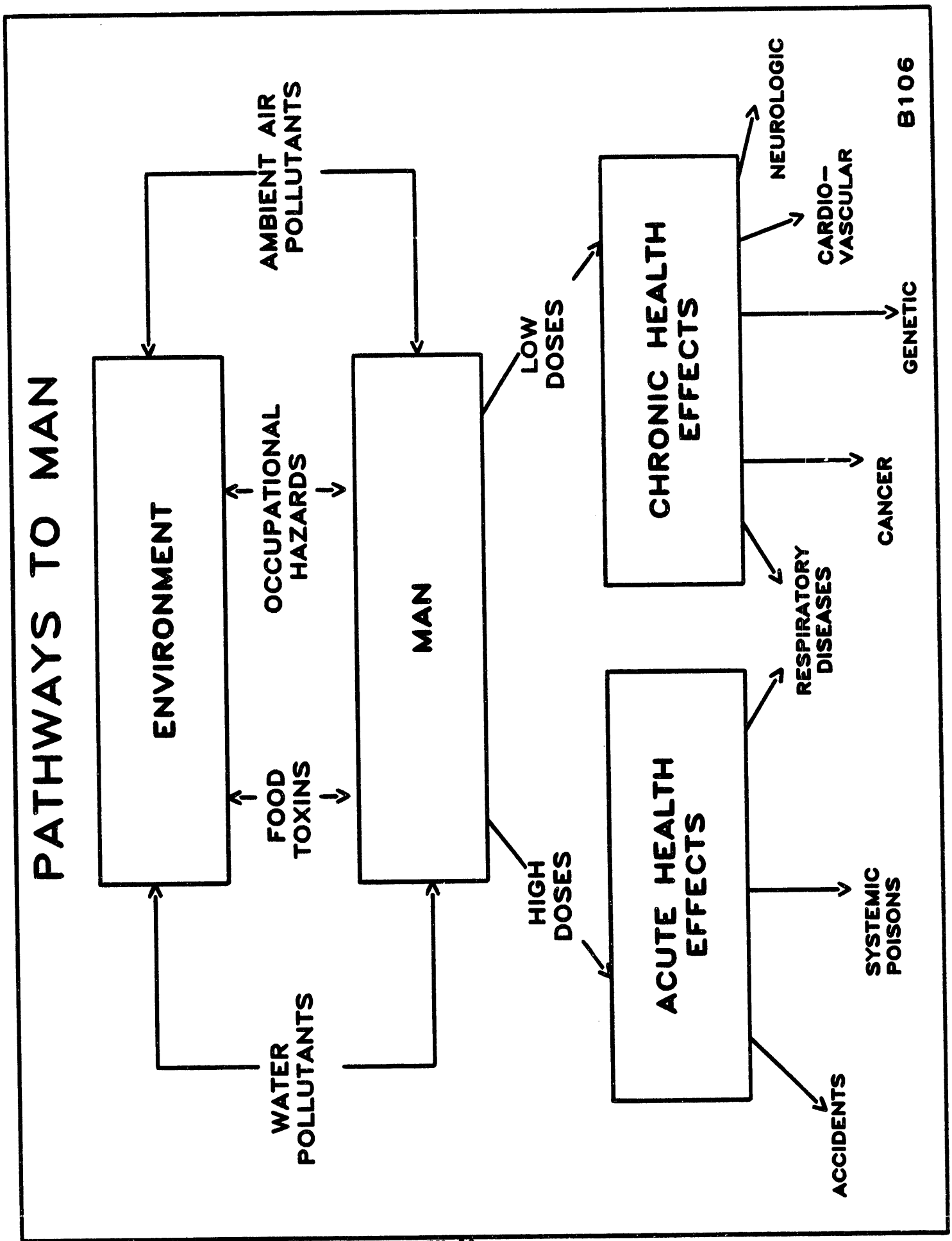
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

3 of 6


PATHWAYS TO MAN
ENVIRONMENT
AMBIENT AIR POLLUTANTS
OCCUPATIONAL HAZARDS
FOOD TOXINS
WATER POLLUTANTS
MAN
LOW DOSES
HIGH DOSES
CHRONIC HEALTH EFFECTS
ACUTE HEALTH EFFECTS
NEUROLOGIC
CARDIO-VASCULAR
GENETIC
CANCER
RESPIRATORY DISEASES
SYSTEMIC POISONS
ACCIDENTS
B106

ACUTE EXPOSURE — An Exposure Received in a Short Time, Usually Less than 24 Hours.

CHRONIC EXPOSURE — Continuing Exposure Over a Long Time.

C43

BIOLOGICAL EFFECTS OF ACUTE RADIATION EXPOSURES

0–25 rem (0–25,000 mrem)	Risk of Leukemia is 2 in 100,000. Elevated Number of Chromosome Aberrations; No Detectable Injury or Symptoms.
25–50 rem (25–50,000 mrem)	Detectable from Changes in Number of Blood Cells.
50–100 rem (50–100,000 mrem)	Mild Radiation Sickness – Nausea, Vomiting, Fatigue is Possible.
100–400 rem (100–400,000 mrem)	Radiation Sickness Worsens.
400 rem (400,000 mrem)	Mid–lethal LD–50/30. Likely to Result in Death for 50% of Exposed and Untreated Population within 30 days.

C20

LIFETIME RISK OF FATAL CANCER FROM IONIZING RADIATION

	Risk per Million Persons per Rem*
Leukemia	15–50
Thyroid	10
Breast	50
Lung	25–50
Stomach, Liver, Colon	10–15
Bone, Esophagus, Small Intestine, Urinary Bladder, Pancreas, Lymphatic Tissues	2–5
All Cancers	100–250

*At doses of 100 rem or more. Lower doses may carry lower risk.

C11

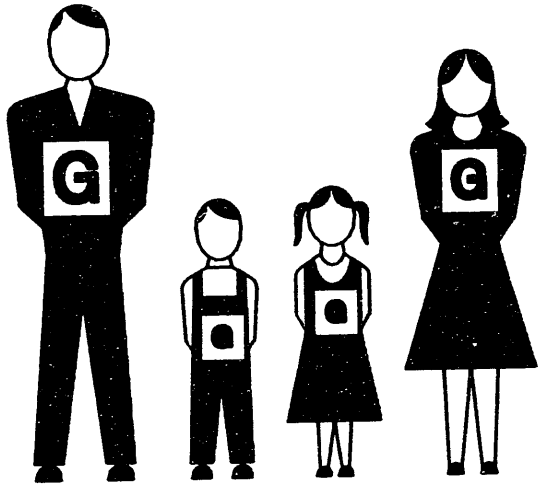
GENETIC EFFECT — Any Effect That May be Passed to a Future Generation.

SOMATIC EFFECT — An Effect Occurring Directly in Affected Individual and Not Passed to Future Generations.

C44

GENETIC EFFECT

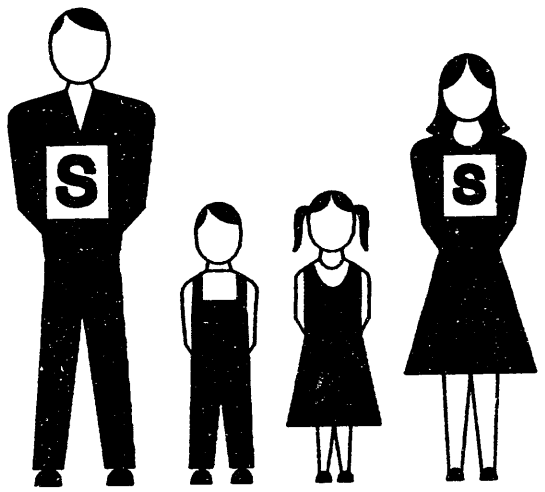
Any Effect That May Be PASSED To A Future Generation



HE2

SOMATIC EFFECT

An Effect Occurring Directly in Affected Individual and NOT PASSED To Future Generations



HE1

RADIATION/CONTAMINATION SAFETY MEASURES

- Training
- Time, Distance, Shielding
- Protective Clothing
- Zoning
- Monitoring
- Radiation Protection Standards

C13

TIME, DISTANCE, SHIELDING

Time: Amount of exposure directly proportional to time of exposure.

Distance:
- Alpha — Approximately 1/4 in. in air.
- Beta — Approximately 10 feet in air.
- Gamma — Decreases inversely proportionally with square of distance.

Shielding:
- Alpha — Paper.
- Beta — 1/2 in. Plexiglass, 1 in. aluminum.
- Gamma — Lead, Concrete.

C36

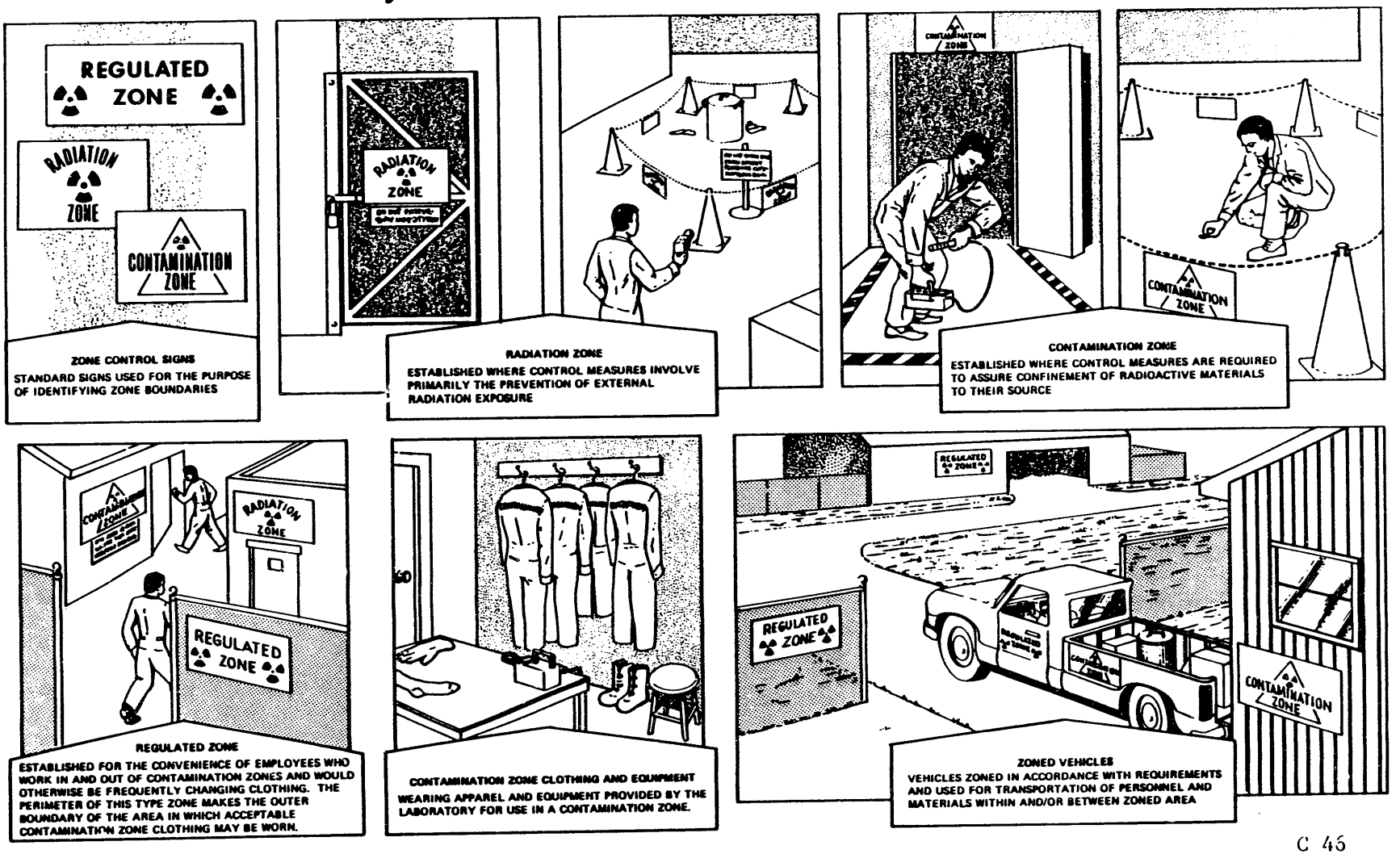
PROTECTION FROM RADIATION

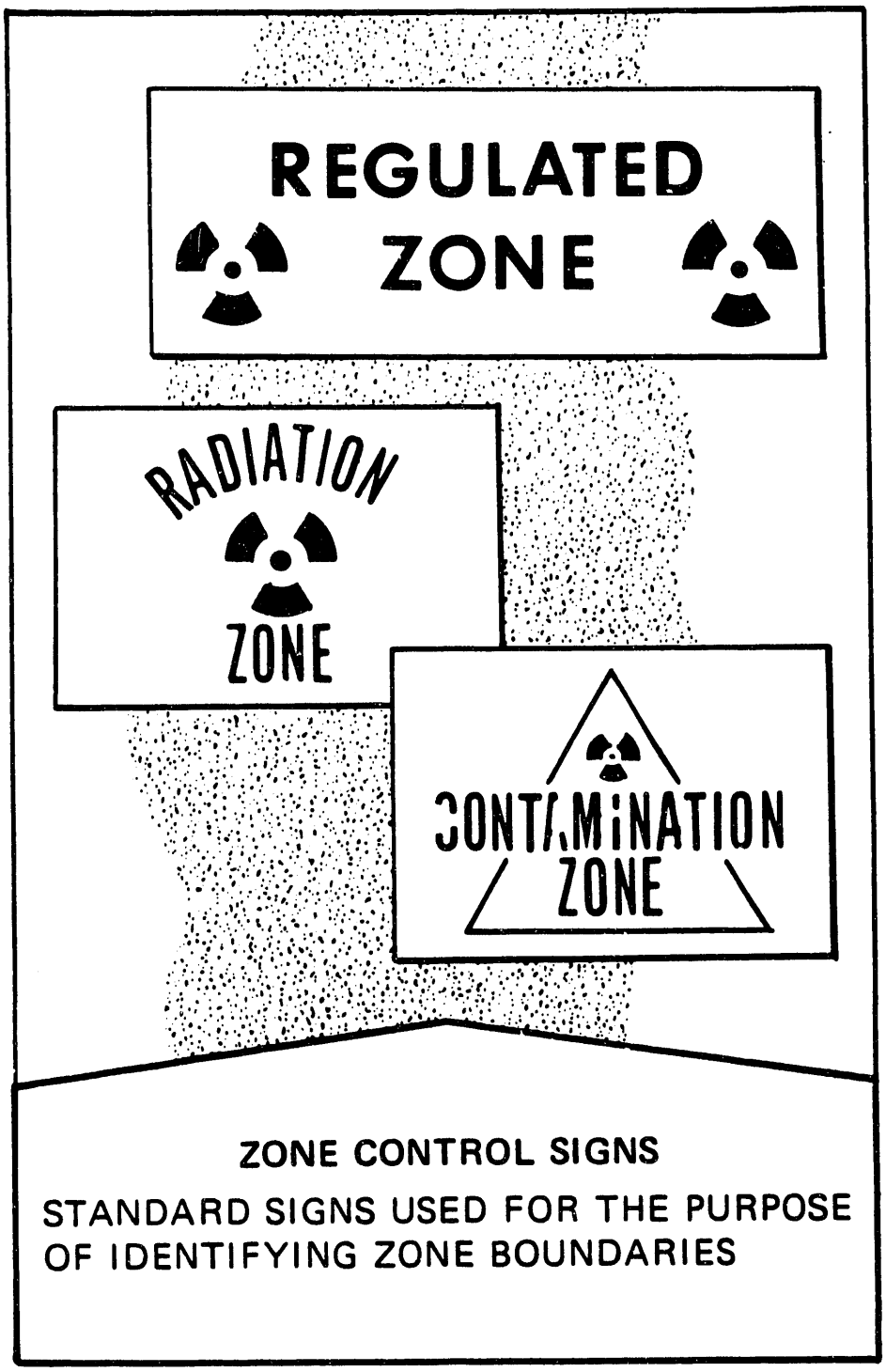
Radiation	Protection	Biological Hazard
Alpha	Face Masks, Coveralls, Gloves, Shoe Covers, Hoods, etc.	Inhalation, Absorption, Ingestion
Beta	Plexiglass, Aluminum, Face Mask, Glasses, Time, Distance	Inhalation, Ingestion, Penetration
Gamma	Heavy Materials (i.e., Lead, Concrete) Shielding, Time, Distance	Penetration

C45

ORNL-DWG 83 7626

ZONED AREA *for* RADIATION HAZARD *and* EXPOSURE CONTROL

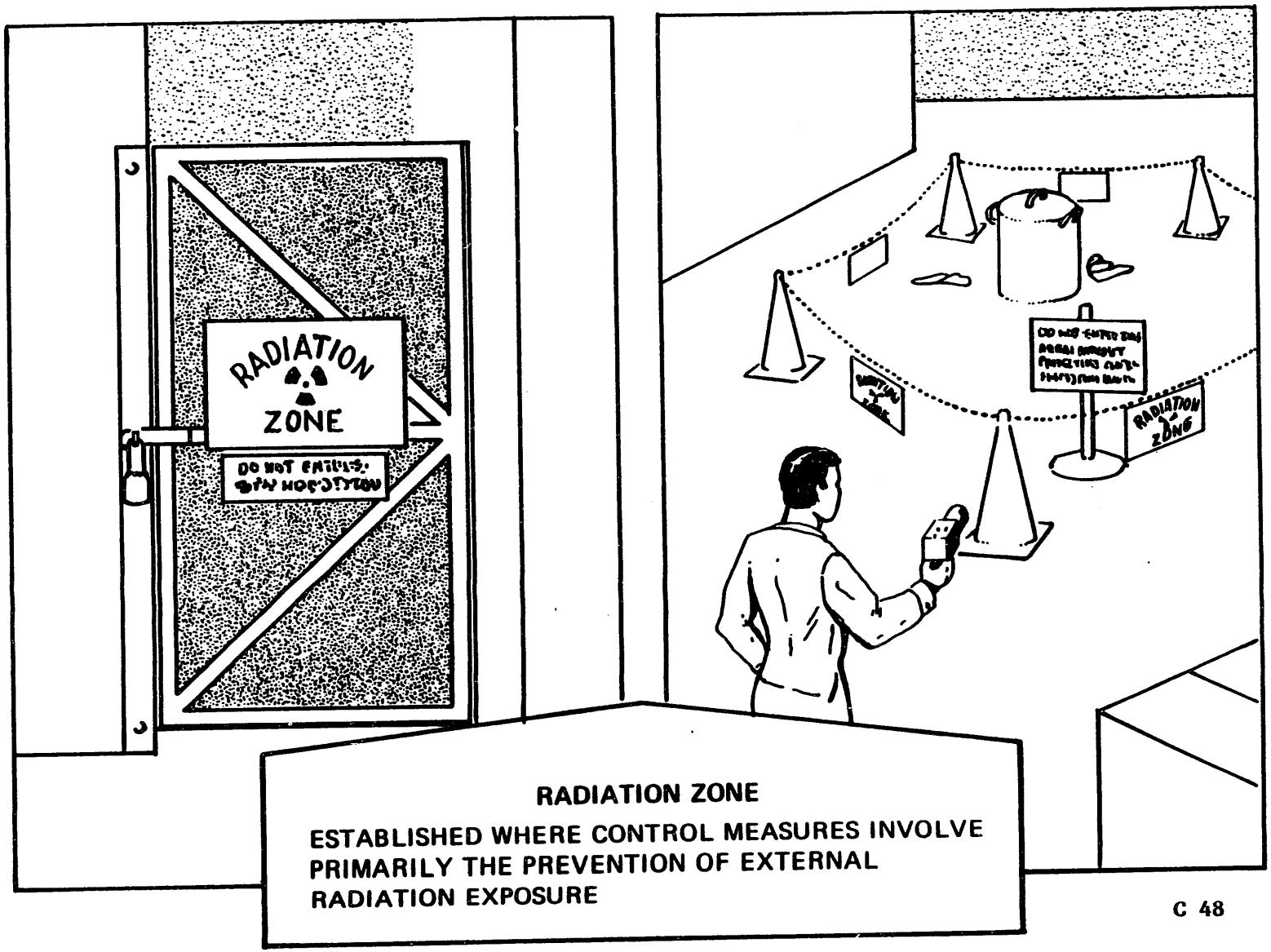




C 47

ZONE CONTROL SIGNS

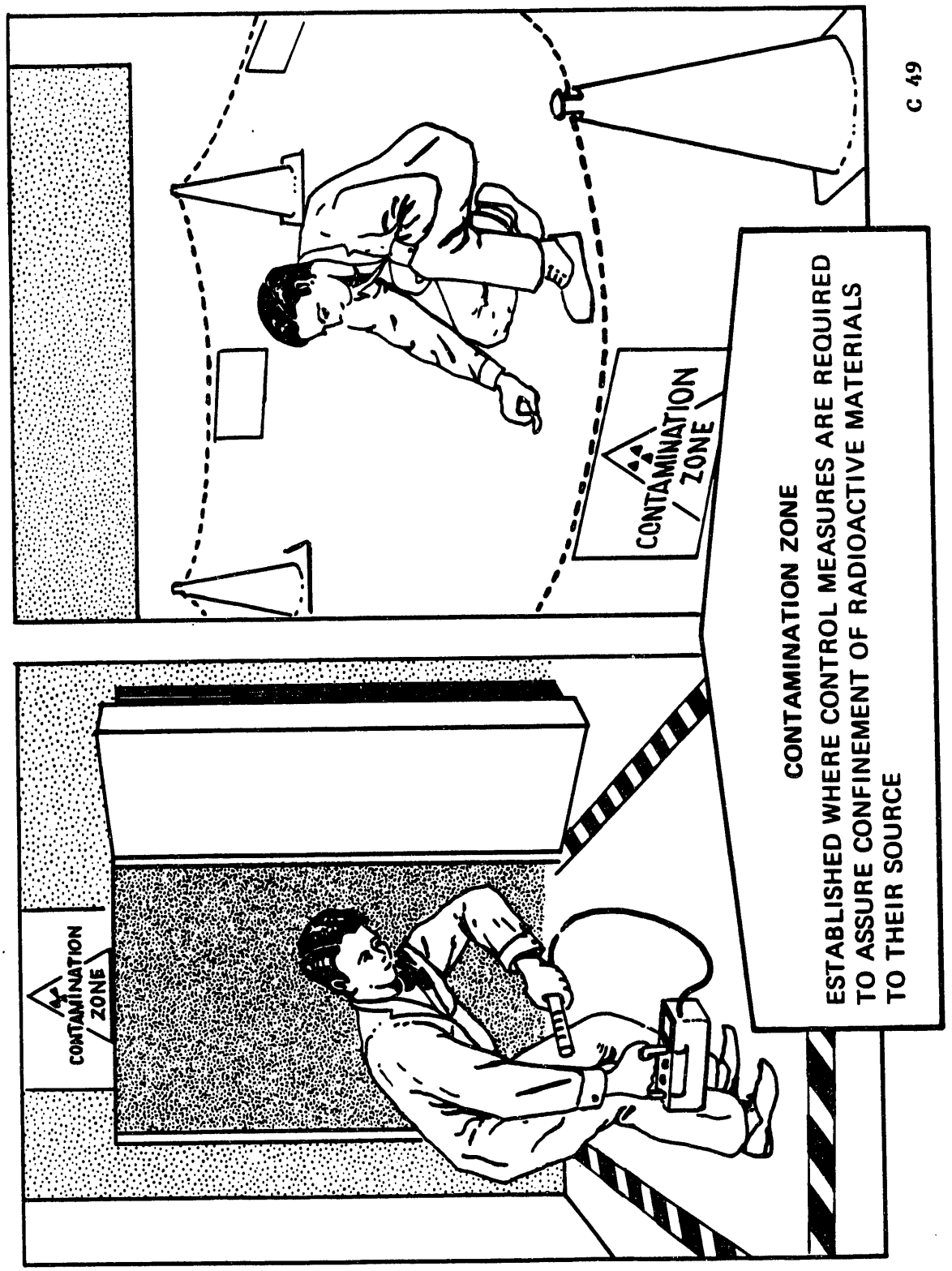
STANDARD SIGNS USED FOR THE PURPOSE OF IDENTIFYING ZONE BOUNDARIES



RADIATION ZONE

ESTABLISHED WHERE CONTROL MEASURES INVOLVE PRIMARILY THE PREVENTION OF EXTERNAL RADIATION EXPOSURE

C 48

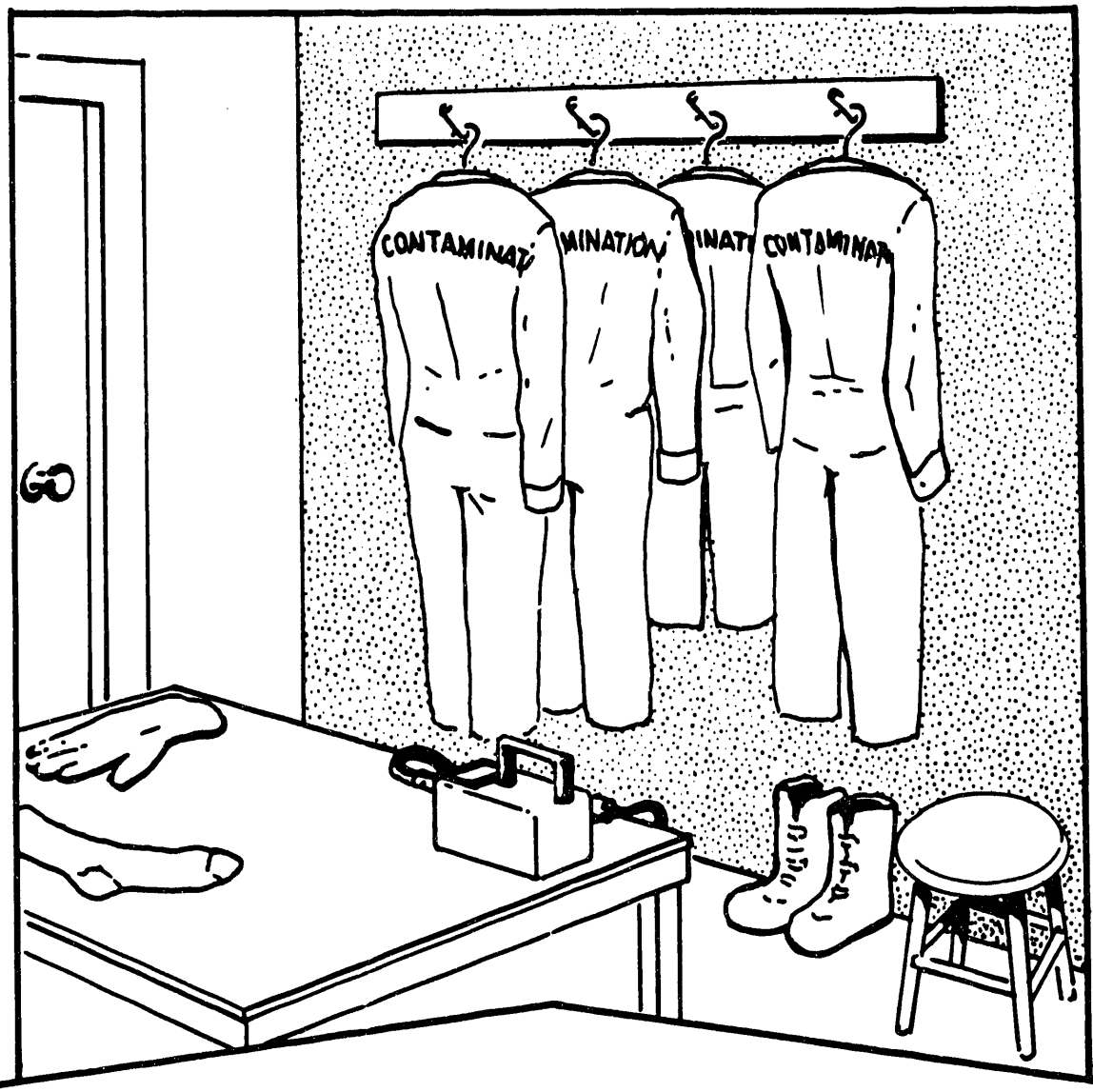

CONTAMINATION ZONE
CONTAMINATION ZONE
CONTAMINATION ZONE
ESTABLISHED WHERE CONTROL MEASURES ARE REQUIRED TO ASSURE CONFINEMENT OF RADIOACTIVE MATERIALS TO THEIR SOURCE

C 49

C 50

REGULATED ZONE

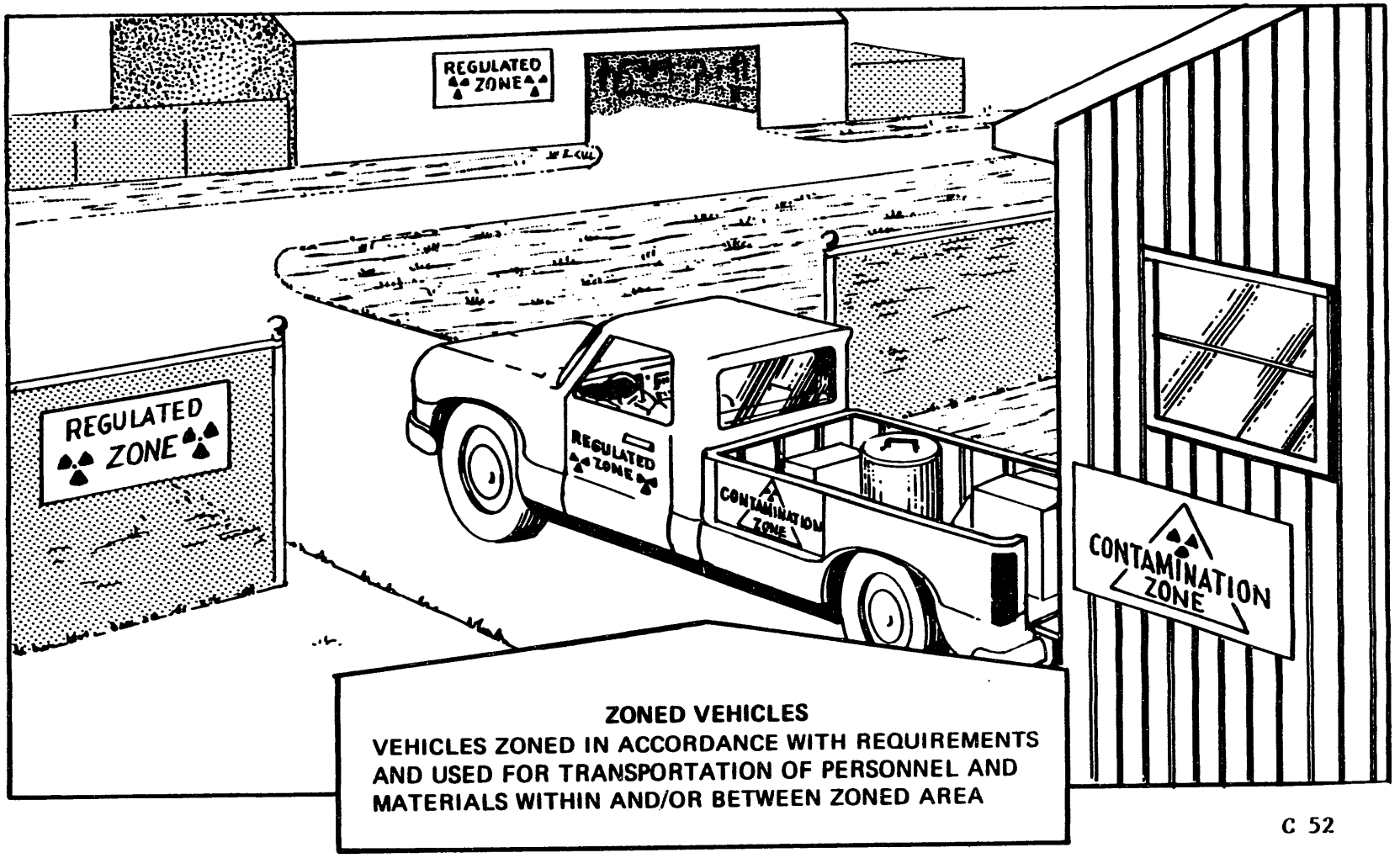
ESTABLISHED FOR THE CONVENIENCE OF EMPLOYEES WHO WORK IN AND OUT OF CONTAMINATION ZONES AND WOULD OTHERWISE BE FREQUENTLY CHANGING CLOTHING. THE PERIMETER OF THIS TYPE ZONE MAKES THE OUTER BOUNDARY OF THE AREA IN WHICH ACCEPTABLE CONTAMINATION ZONE CLOTHING MAY BE WORN.



C 51

CONTAMINATION ZONE CLOTHING AND EQUIPMENT

WEARING APPAREL AND EQUIPMENT PROVIDED BY THE LABORATORY FOR USE IN A CONTAMINATION ZONE.



ZONED VEHICLES

VEHICLES ZONED IN ACCORDANCE WITH REQUIREMENTS AND USED FOR TRANSPORTATION OF PERSONNEL AND MATERIALS WITHIN AND/OR BETWEEN ZONED AREA

C 52

GUIDE FOR ESTABLISHING RADIATION ZONES

Dose Rate Range (rem/hr)	Action Required
0.003–0.006	Post low–level tags. Define zone boundaries & establish access control if daily dose may be 20 mrem.
0.006–1	Post warning signs or tags, define zone boundaries, and establish positive access control.
1–5	Post warning signs or tags and erect barricade which provides absolute control of personnel access to area.
>5	Post warning signs or tags (Bull's Eye Radiation Hazard Sign if ≥10 rem/hr) and erect barricade to provide absolute exclusion of unauthorized personnel with entrances locked or blocked.

D16

GUIDE FOR ESTABLISHING CONTAMINATION ZONES

Type of Radiation	Airborne Contamination (μCi/cc air)	Direct Reading Surface Contamination	Transferable Surface Contamination (d/m/100 cm 2)
Alpha	>0.1 x $(CG)_a$	>300 d/m/100 cm^2	>30
Beta–Gamma	>0.1 x $(CG)_a$	>0.25 mrad/hr	>1000

D17

CRITERIA FOR ISSUING RADIATION WORK PERMITS

- Expected Dose is Greater than 20 mrem to Whole Body or 300 mrem to Extremities for Individual During a Single Work Shift, or

- Airborne Radioactivity is Greater than Maximum Permissible Concentration (MPC)a for 40-hour Week (Respirators Required), or

- Work Involves Exposure of Individual To Dose Rate Greater than 5 rem/hour to Total Body.

D41

RADIATION WORK PERMIT

- Location and Job Description
- Radiation Survey Data
- Monitoring Requirements
- Protective Equipment
- Monitoring Instruments
- Personnel and External Exposure Control
- Radiation Limits
- Approvals

C73

MONITORING INSTRUMENTS

• Geiger–Mueller (GM) Instruments – Side Window – End Window	Detects
• Ionization Chambers – Cutie Pie – Pocket Dosimeter	Measures
• Proportional Counters	Detects
• Scintillation Detectors	Detects
• Thermoluminescent Dosimeters (TLD)	Measures

C39

AS LOW AS REASONABLY

ACHIEVABLE

(ALARA)

C17

A L A R A

As Low As Reasonably Achievable

A Policy of Reducing Personnel and Environmental Radiation Exposures to the Lowest Levels Commensurate with Sound Economics, Available Technology, and Good Operating Procedures.

C40

HOW IS ALARA ACHIEVED?

Through Implementation of:

- Facility Considerations
  - Design
  - Operating Equipment
  - Monitoring and Protective Equipment
  - Procedures
- Radiation Safety Management
  - Worker Training
  - Supervisor Training
- Documentation
- Involvement of Health Physics Professionals at all Levels

C41

HEAT STRESS

SCOPE

This portion of the Types of Hazards module presents information about how the body handles heat, the health and safety problems associated with heat stress, and heat stress prevention.

PARTICIPANT GOALS

1) Gain an understanding of the ways the human body handles heat.

2) Learn to identify the health and safety problems associated with heat stress.

3) Learn how to prepare for working in a hot environment.

4) Learn ways to prevent heat stress.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives.
  (HTSRT 1A, 26)

- Discuss how the body handles heat and the effects of high temperatures and humidity on the body's heat removal mechanisms.
  (HTSTR 2, 3A, 4, 5A, 6)

- Discuss the potential hazards in hot environment.
  (HTSTR 23)

- Describe the factors which interact to cause heat stress.
  (HTSTR 7A)

- Describe the symptoms of and treatment for heat cramps and heat exhaustion.
  (HTSTR 8, 9, 12A, 27)

- Describe the symptoms of and treatment for heat stroke.
  (HTSTR 14A, 15, 17A)

- Describe the symptoms of and treatment for other, less serious, heat disorders.
  (HTSTR 16A, 18A, 19A, 20, 21)

- Discuss how to prevent heat stress.
  (HTSTR 24A)

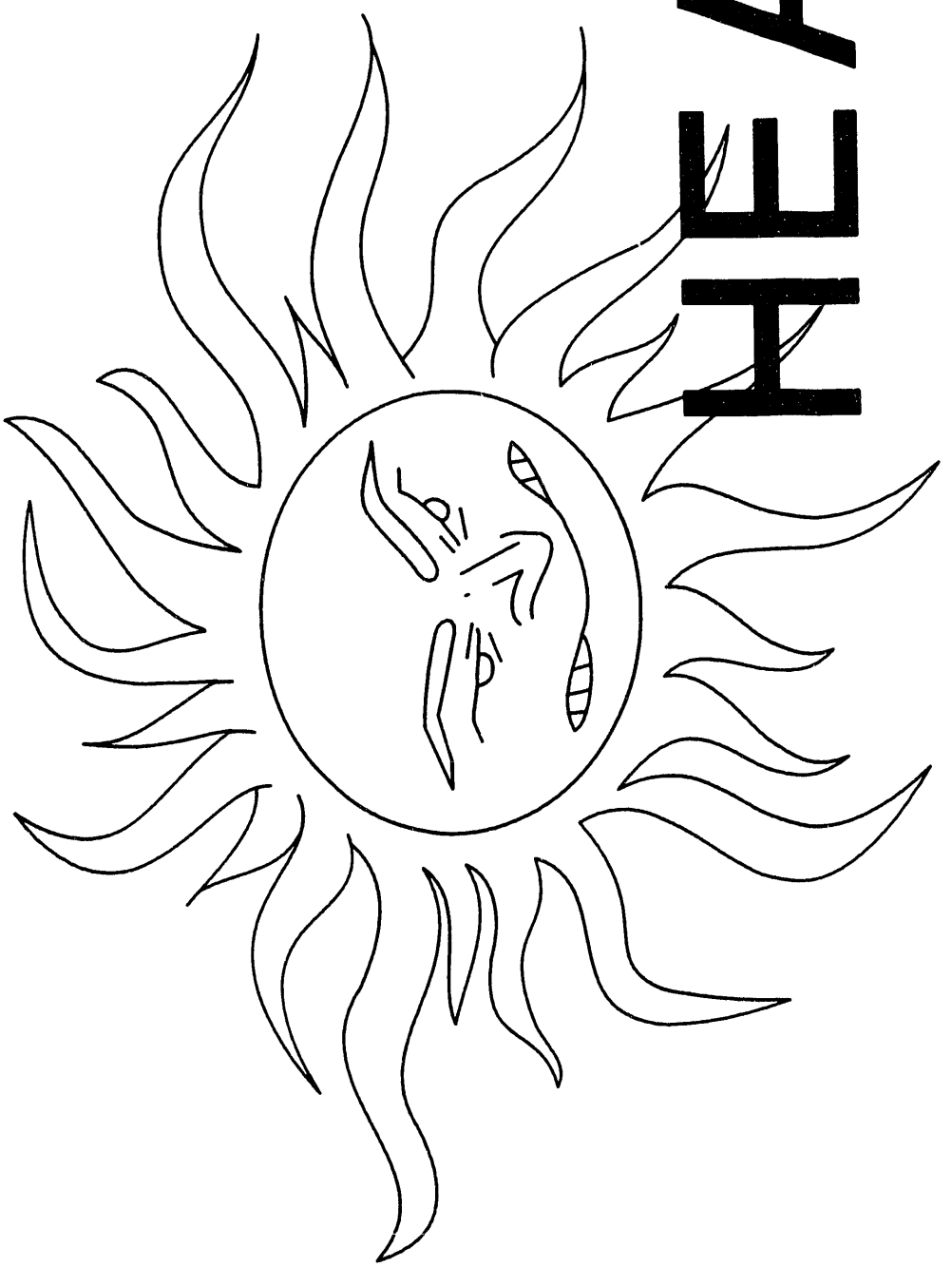
- Discuss ways to prepare for working in a hot environment.
  (HTSTR 22)

- Review the important points to remember about heat stress.
  (HTSTR 25)

- Distribute and oversee completion of worksheet or exam.

HEAT STRESS

HTSTR1A



OBJECTIVES

Discuss How the Body Handles Heat

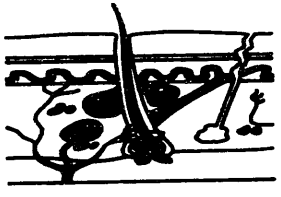
Identify Health and Safety Problems Associated With Heat Stress

Discuss Heat Stress Prevention and Preparation for Working in Hot Environments

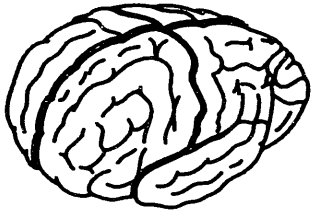
HTSTR26

HOW THE BODY HANDLES HEAT

- VARYING RATE AND AMOUNT OF BLOOD CIRCULATION TO SKIN



- PERSPIRATION MAJOR COOLING MECHANISM



- BRAIN AUTOMATICALLY CONTROLS THESE RESPONSES

HTSTR2

EVAPORATION OF SWEAT IS THE BODY'S MAJOR COOLING MECHANISM AND ELIMINATES LARGE QUANTITIES OF HEAT FROM THE BODY

AIR TEMPERATURE $\geq$

BODY TEMPERATURE:

BODY SURFACE CANNOT LOSE HEAT

HTSTR4

HIGH HUMIDITY,

DECREASED

SWEAT

EVAPORATION

HTSTR5A

EFFECTS OF HOT ENVIRONMENTS

- FATIGUE
- LOSS OF STRENGTH
- REDUCED ACCURACY, COMPREHENSION, & RETENTION
- REDUCED ALERTNESS & MENTAL CAPACITY

HTSTR6

POTENTIAL HAZARDS IN HOT ENVIRONMENTS

- FOGGING OF SAFETY GLASSES
- DIZZINESS
- SLIPPERY PALMS
- BURNS
- LOWERED MENTAL ALERTNESS & PHYSICAL PERFORMANCE
- PHYSICAL DISCOMFORT PROMOTES IRRITABILITY, ANGER & OTHER EMOTIONAL STATES

HTSTR23

FACTORS IN HEAT STRESS

- ENVIRONMENTAL CONDITIONS
- CLOTHING
- WORKLOAD
- INDIVIDUAL WORKER CHARACTERISTICS

HTSTR7A

HEAT STRESS CAUSES

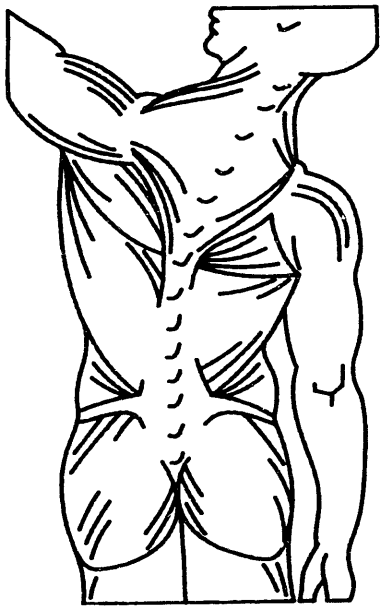
- HEAT CRAMPS
- HEAT EXHAUSTION
- HEAT STROKE

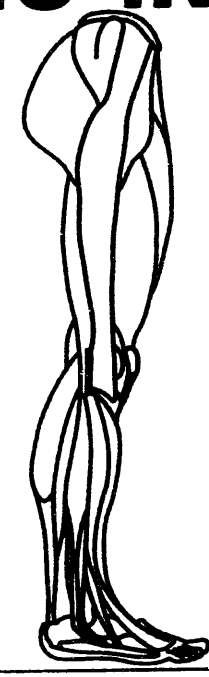
HTSTRB

HEAT CRAMPS

CAUSE: EXCESSIVE LOSS OF SALT DURING SWEATING

SIGNS: MUSCLE SPASMS IN EXTREMITIES, ABDOMEN, BACK





HTSTR9

HEAT EXHAUSTION

CAUSE ☞ FLUID & SALT LOSS

SIGNS ☞ PALE OR FLUSHED, COOL, MOIST SKIN

☞ HEADACHE, FATIGUE, WEAKNESS DIZZINESS

☞ NAUSEA

☞ NORMAL OR SLIGHTLY ELEVATED TEMPERATURE

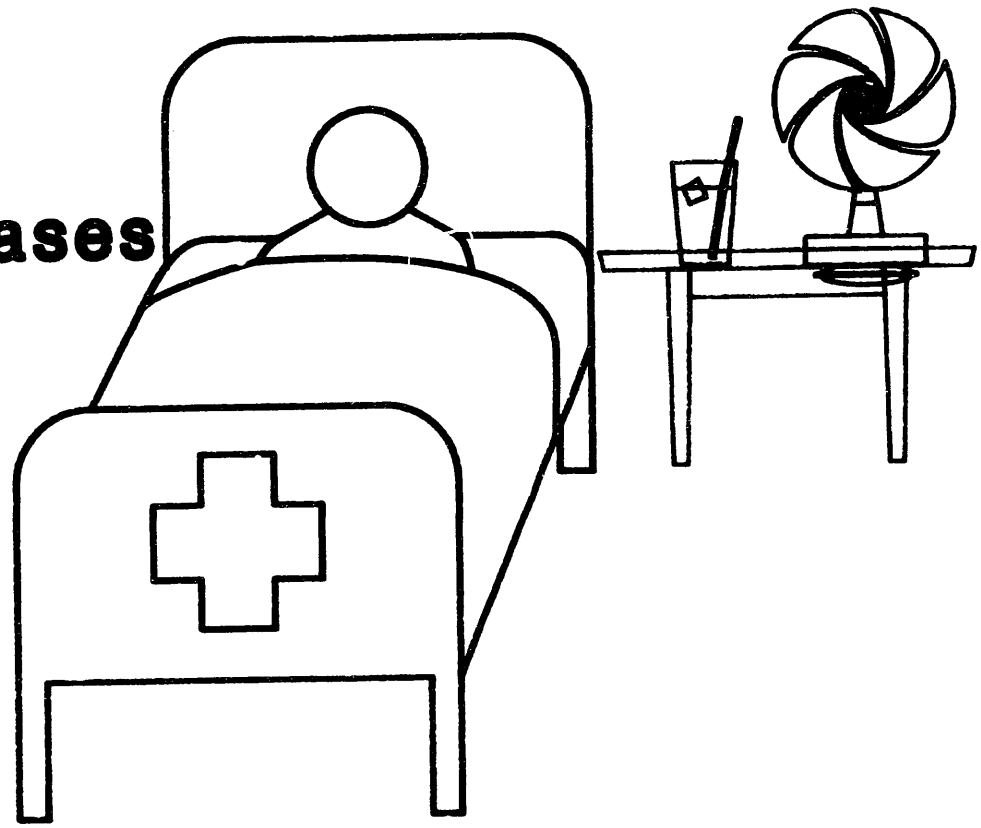
☞ PROFUSE SWEATING

HTSTR12A

TREATMENT FOR HEAT EXHAUSTION

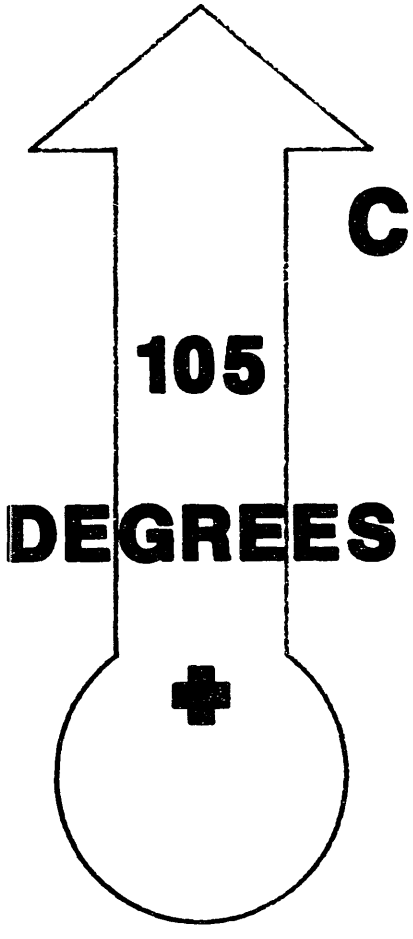
* Resting in a Cool Place
* Drinking Lots of Liquids

Victims with Mild Cases of Heat Exhaustion Usually Recover Spontaneously.



HTSTP27

HEAT STROKE



CAUSE: **FAILURE OF BODY'S TEMPERATURE REGULATION MECHANISM**

MOST SERIOUS HEAT DISORDER, BODY TEMPERATURE RISES TO CRITICAL LEVEL

HTSTR14A

SIGNS OF HEAT STROKE

- ★ Sweating absent or diminished
- ★ Body temperature elevated (Can be 105 degrees or more)
- ★ Skin is red, hot, and dry
- ★ Pulse is strong, rapid
- ★ Dizziness, nausea, confusion
- ★ Delirium, convulsions, coma (Possible death)

HTSTR15

TREATMENT OF HEAT STROKE

TAKE VICTIM TO COOL AREA

COOL BODY RAPIDLY BY IMMERSING IN WATER

HTSTR17A

LESS SERIOUS HEAT DISORDERS

FAINTING

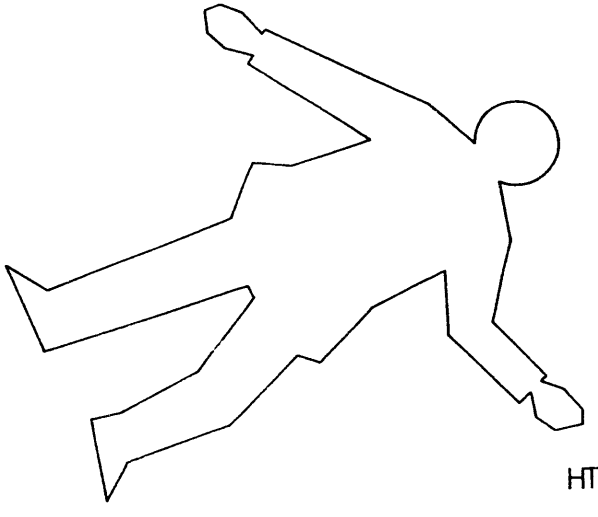
HEAT RASH (PRICKLY HEAT)

TRANSIENT HEAT FATIGUE

HTSTR16A

FAINTING

- WORKER NOT ACCUSTOMED TO HOT ENVIRONMENTS AND STANDING
- BLOOD VESSELS ENLARGE
- BLOOD POOLS



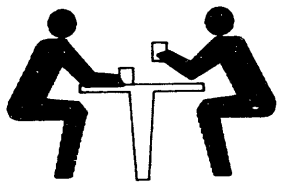
HTSTR18A

HEAT RASH
(PRICKLY HEAT)

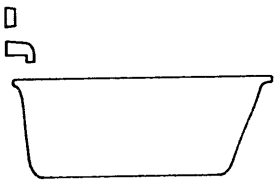
- HOT, HUMID ENVIRONMENT
- SWEAT UNABLE TO EVAPORATE SO SKIN REMAINS WET
- SWEAT DUCTS CLOG
- SKIN RASH APPEARS

HTSTR19A

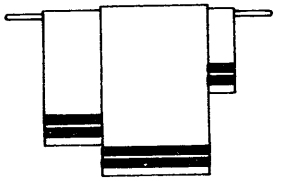
HEAT RASH PREVENTION



REST IN COOL PLACE
PART OF THE DAY



BATHE REGULARLY

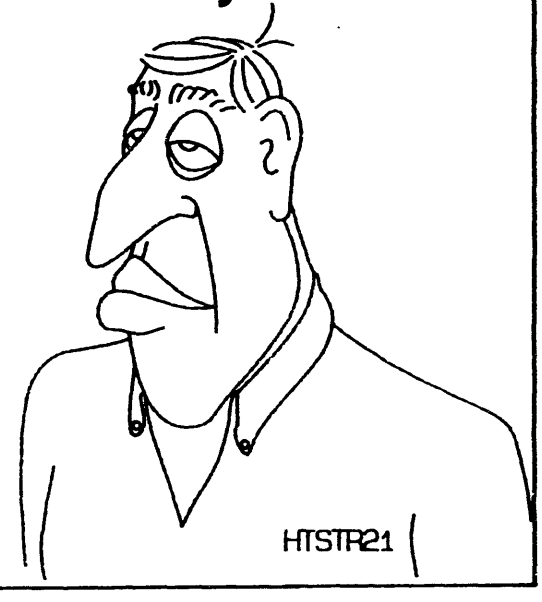


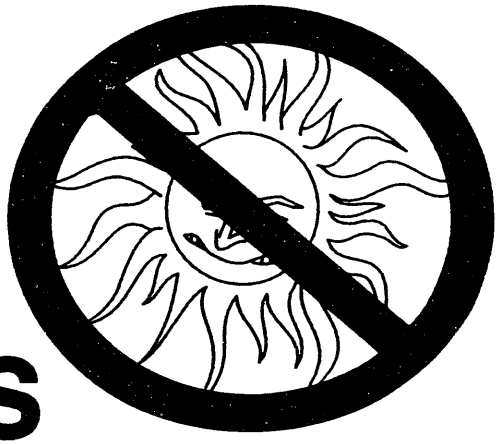
DRY SKIN THOROUGHLY

HTSTR20

TRANSIENT HEAT FATIGUE

- TEMPORARY DISCOMFORT
- MENTAL OR PSYCHOLOGIC STRAIN
- AFFECTS TASK PERFORMANCE, COORDINATION, ALERTNESS, AND VIGILANCE
- LESSENED BY PERIOD OF GRADUAL ADJUSTMENT TO HEAT





HEAT STRESS PREVENTION

Drink Lots of Liquids

Take Breaks in Cool Place, If Possible

Learn Signs and Symptoms of Heat Stress

HTSTR24A

PREPARING FOR HOT ENVIRONMENTS (ACCLIMATIZATION)

* After 5-7 days body undergoes a series of changes that makes continued exposure to heat more bearable.
* On first day of work in hot environment, body temperature, pulse rate, and general discomfort are higher.
* With each succeeding daily exposure, all of these responses gradually decrease, while sweat rate increases.
* When body becomes acclimated to heat, it is possible to perform work with less strain and distress.
* Gradual exposure to heat gives body time to become accustomed to higher environmental temperatures.
* Heat disorders are more likely to occur if you haven't had time to adjust to working in heat or if you've been away from hot environments and have become accustomed to lower temperatures.
* Readjustment period is necessary after returning to work after a leisurely vacation or extended illness.

HTSTR22

IMPORTANT POINTS

Environmental Conditions, Clothing, Workload, and Individual Worker Characteristics Determine Heat Stress

Heat Stroke, Heat Exhaustion, and Fainting are 3 Major Illnesses Caused by Heat Stress

To Prevent Heat Stress, Drink Lots of Liquids, Take Breaks in Cool Places, and Learn the Signs and Symptoms of Heat Stress

HTSTR 25

COLD STRESS

SCOPE

This portion of the Types of Hazards module presents information about how the body handles cold, the types and symptoms of cold stress, and cold stress prevention.

PARTICIPANT GOALS

1) Gain an understanding of the ways the human body handles cold.

2) Learn the types of cold stress and their symptoms.

3) Learn ways to prevent cold stress.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives.
  (CLDSTR 1, 13)

- Discuss how the body handles cold and the signs of cold stress.
  (CLDSTR 2, 3)

- Discuss the wind chill factor.
  (CLDSTR 4, 5a)

- Describe the two basic types of cold stress and the symptoms of and treatment for each.
  (CLDSTR 6-10)

- Discuss how to prevent cold stress.
  (CLDSTR 11)

- Review the important points to remember about cold stress.
  (CLDSTR 12, 14)

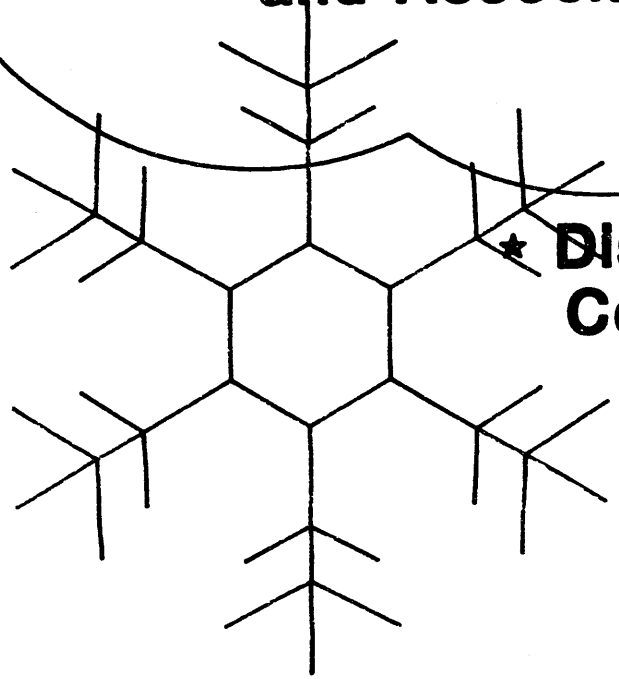
- Distribute and oversee completion of worksheet or exam.

COLD STRESS

CLDSTR1

OBJECTIVES

* Describe How the Body Handles Cold
* Identify Types of Cold Stress and Associated Symptoms
* Discuss Measures to Prevent Cold Stress



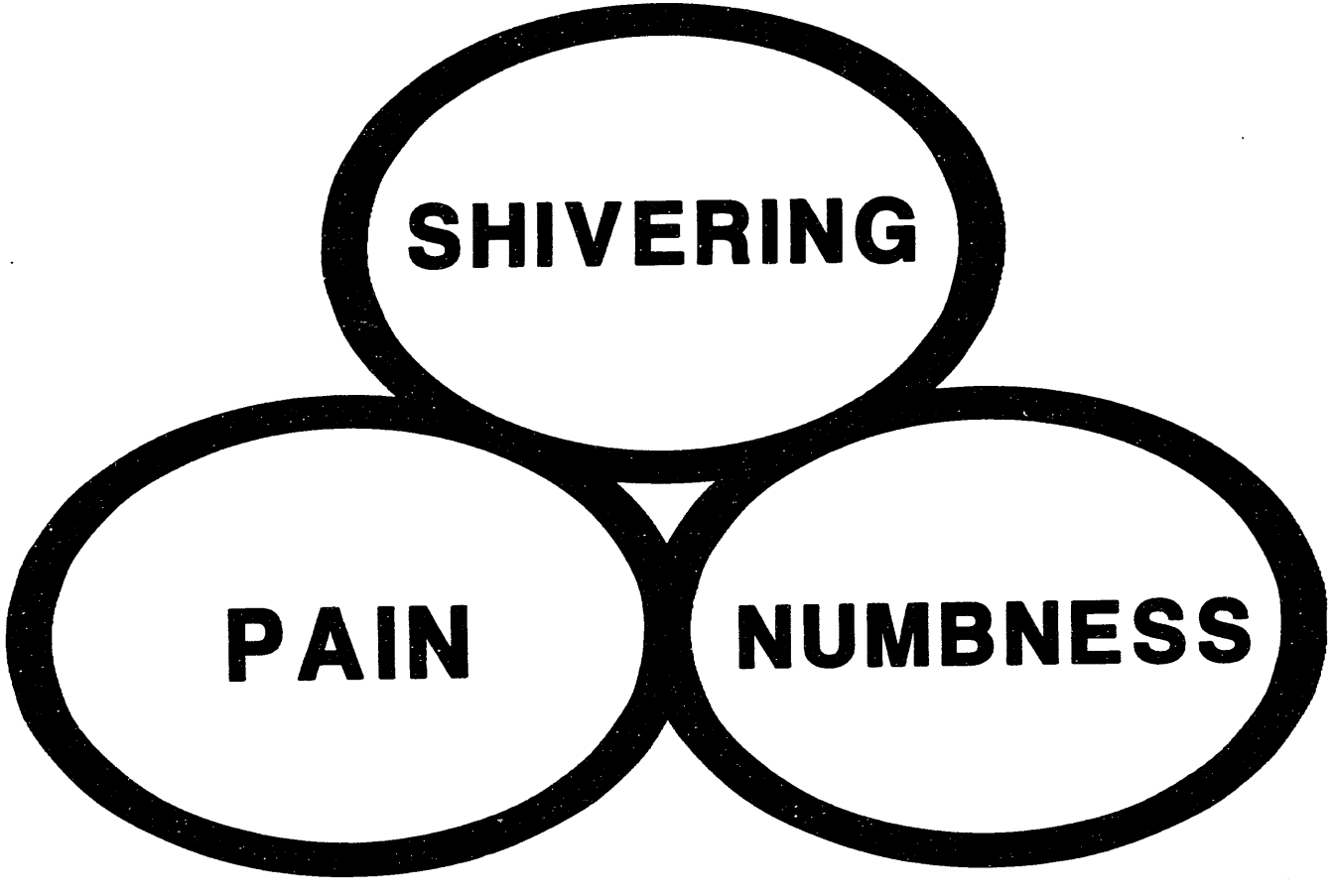
COLDSTR13

HOW THE BODY HANDLES COLD

1. Shivering
2. Vasoconstriction
3. Increased metabolic rate

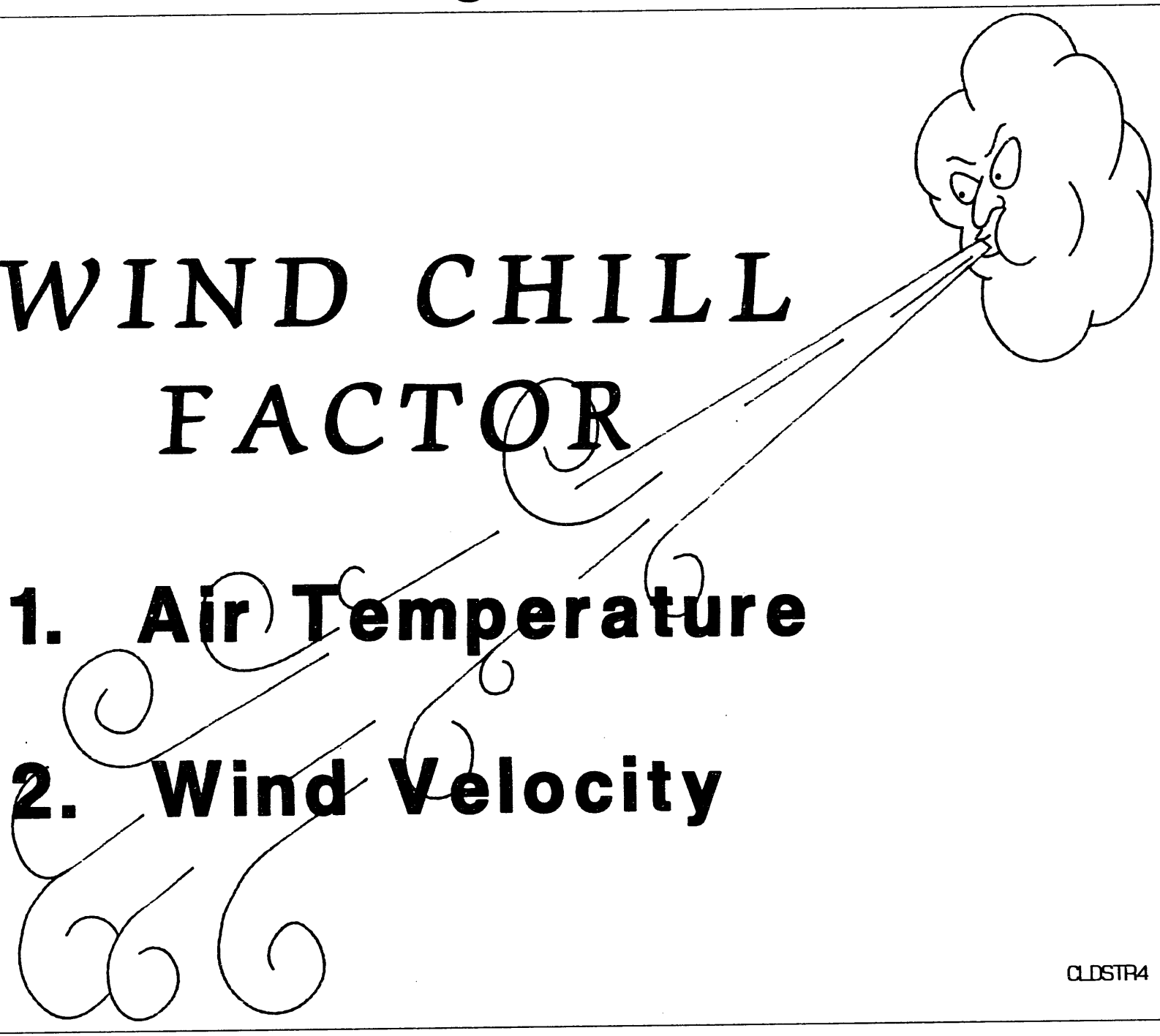
CLDSTR2

SIGNS OF COLD STRESS



CLDSTR3

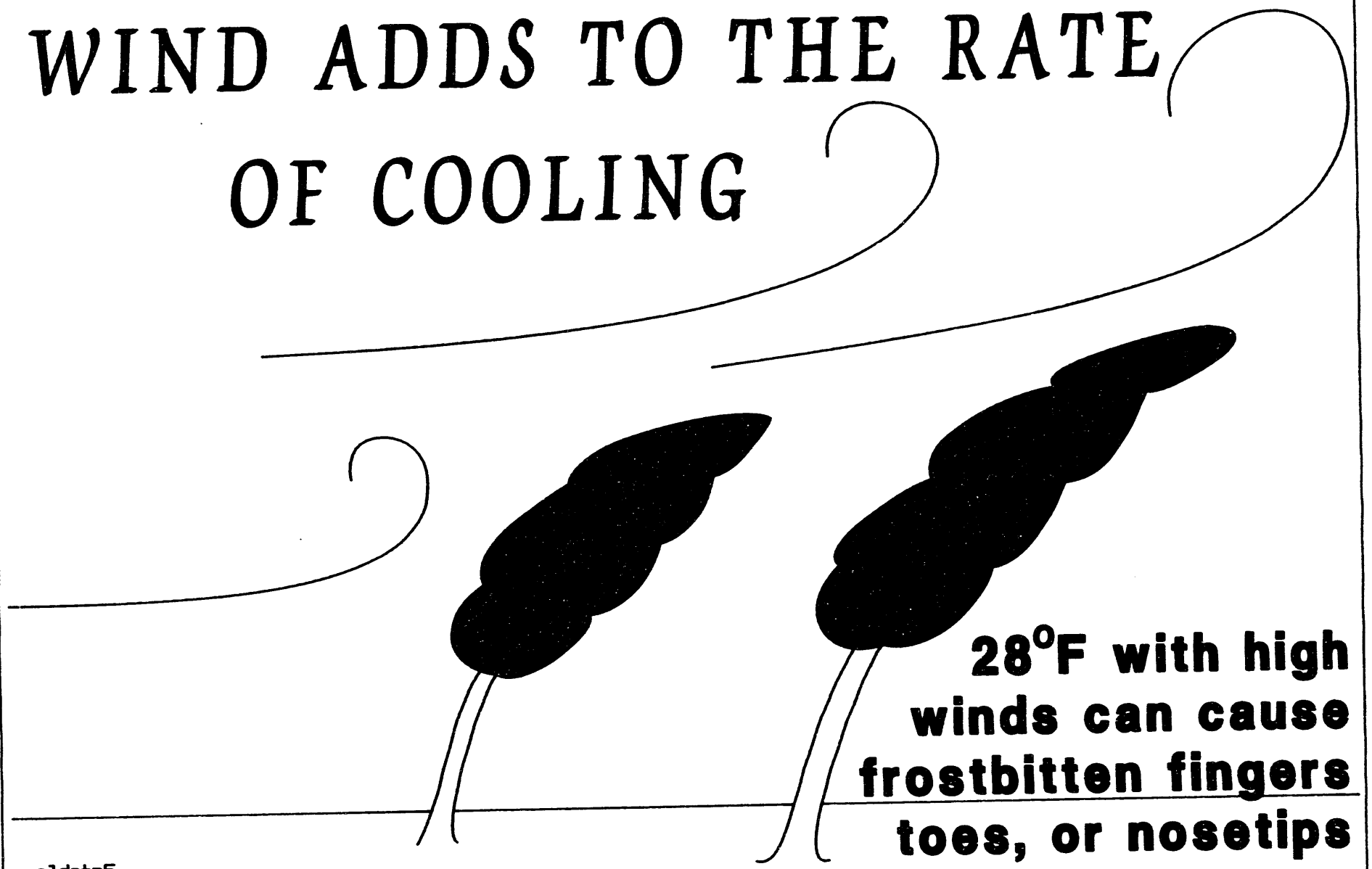
WIND CHILL FACTOR



1. Air Temperature
2. Wind Velocity

CLDSTR4

WIND ADDS TO THE RATE OF COOLING



28°F with high winds can cause frostbitten fingers toes, or nosetips

cldstr5

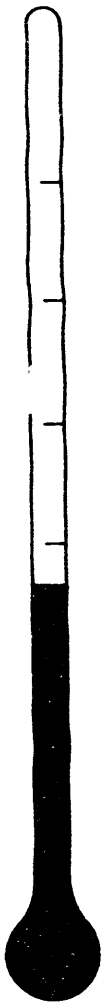
TYPES OF COLD STRESS

- Hypothermia
- Frostbite
  - Superficial
  - Deep

COLDSTR6

HYPOTHERMIA

- ★ Subnormal Body Temperature
- ★ Treatment: Keep Warm and Drink Warm Beverages
- ★ Caution: Alcohol Consumption Increases Risk



cldstr7

SUPERFICIAL FROSTBITE

- Freezing Resulting in Skin Damage Only
- Treatment:
  - Cover Exposed Area with Hands Until Pain Returns
  - Place Uncovered Fingers Under Opposite Arm Pits
  - Place Bare Frostbitten Feet Under Clothes or Against the Skin of a Companion
- Do Not Warm Frostbitten Parts By the Following:
  - Massaging
  - Warming by Open Fire
  - Soaking in Cold Water
  - Rubbing with Snow

CLDSTRB

DEEP FROSTBITE

- Freezing Resulting in Damage Beneath the Skin.

- Treatment:
  - Get Victim to Hospital Quickly
  - Keep Victim Warm
  - Protect Frozen Part(s) from Cold

- Protect frozen Parts from Additional Injury, But Don't Attempt to Thaw Them in the Field.

cldstr9

SIGNS OF ADVANCED COLD EXPOSURE

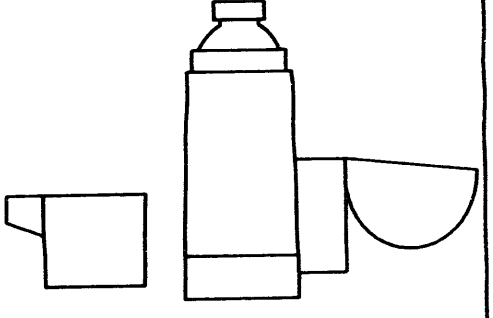
- Forgetfulness
- Loss of Manual Dexterity
- Difficulty with Speech
- Collapse
- Death

CLDSTR10

TO PREVENT COLD STRESS:

- Wear Loose, Layered Clothing
- Wear Masks, Woolen Scarves and Hats in Extreme Cold
- Keep Clothes Dry
- Wear Water & Wind Resistant Clothing & Footwear When Necessary

- Eat Well-Balanced Meals
- Maintain Adequate Intake of Liquids
- Avoid Alcoholic Beverages



- Have Warm Shelter Available
- Implement Work-Rest Schedules
- Monitor Yourself for Changes in Physical & Mental Condition

cldstr11

CAUTION

★ Remove Face Protector Periodically to Check For Frostbite

★ Never Touch Cold Metal With Bare Hands

cldstr12

REMEMBER

- Shivering, Pain and Numbness Are Signs of Cold Stress
- Wind Adds to the Rate of Cooling
- Hypothermia and Frostbite Are Types of Cold Stress
- Proper Diet, Clothing, Shelter, Work-Rest Schedules & Monitoring Physical & Mental Conditions Help Prevent Cold Stress

CLDSTR14

CONFINED SPACE

SCOPE

This portion of the Types of Hazards module presents information about the hazards of working in confined spaces.

PARTICIPANT GOALS

1) Learn to recognize all of the different types of confined spaces.

2) Gain an understanding of the hazards which confined spaces may present.

3) Learn the proper safety measures to use when working in confined spaces.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce subject and objectives.
  (CONSP 26, 2)

- Define a confined space and give examples.
  (CONSP 6A, 4, 27)

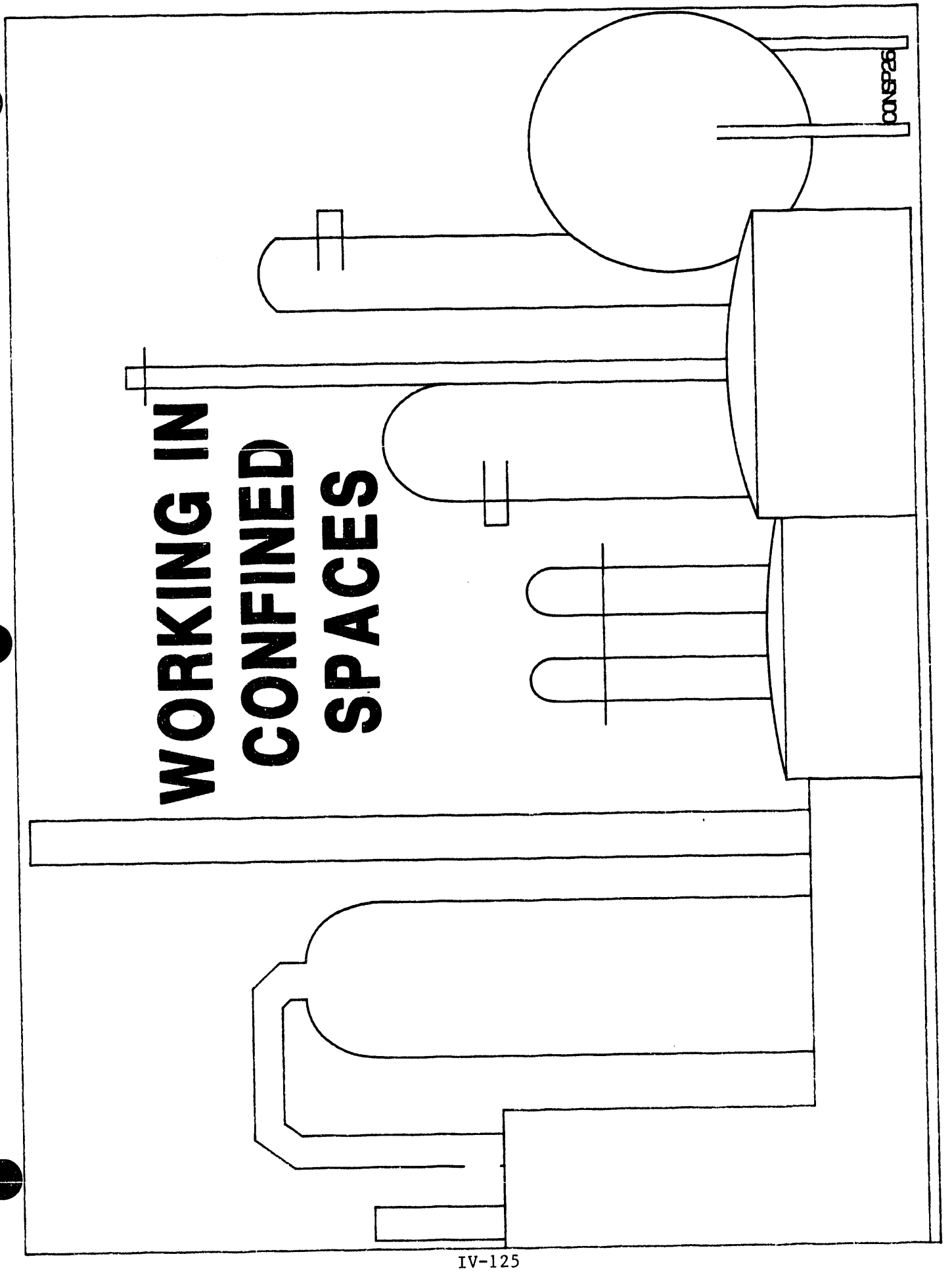
- Discuss the hazards of confined spaces and how to minimize them.
  (CONSP 3, 5, 7, 9, 25)

- Discuss personal protection equipment and procedures used when working in confined spaces.
  (CONSP 24, 13, 14, 15, 16, 12, 30)

- Describe the general safety hazards of confined spaces.
  (CONSP 29, 31, 33, 32)

- Review the important points to remember about working safely in confined spaces.
  (CONSP 21, 22)

- Distribute and oversee completion of worksheet or exam.


WORKING IN
CONFINED
SPACES
CONSP26

OBJECTIVES

1. DESCRIBE CONFINED SPACES AND GIVE EXAMPLES
2. IDENTIFY HAZARDS
3. DISCUSS SAFETY MEASURES

CONSP2

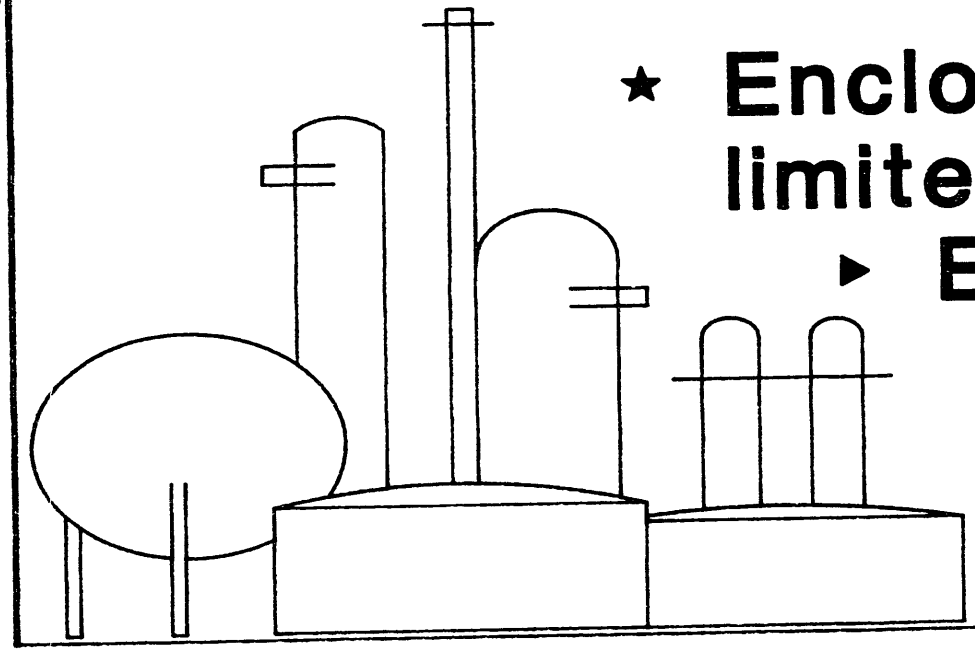
WHAT IS A CONFINED SPACE?

- HAS FEW ENTRANCES OR EXITS
- MAY NOT BE EASY TO ENTER OR EXIT
- NOT CONSTRUCTED TO BE REGULARLY OCCUPIED BY WORKERS
- MAY DEVELOP HAZARDOUS ATMOSPHERE OR PRESENT OTHER SAFETY OR HEALTH HAZARD

CONSP6A

CONFINED SPACES CATEGORIES

- ★ Open topped spaces, depth restricts natural air flow
  - ▸ Examples: Pits, Trenches



- ★ Enclosed spaces with limited entry area
  - ▸ Examples: Sewers Silos, Tanks

CONSP4

CONFINED SPACE CLASSES

Class A: Hazards create IDLH situation

Class B: Potenial for causing injury or illness, not IDLH

Class C: No special modification of work procedure required

consp27

CONFINED SPACE HAZARDS

- ★ ATMOSPHERIC
- ★ ENGULFMENT OR ENTRAPMENT
- ★ MECHANICAL EQUIPMENT
- ★ GENERAL SAFETY & HEALTH HAZARDS

CONSP3

ATMOSPHERIC HAZARDS

- OXYGEN DEFICIENCY OR EXCESS
- GASES OR VAPORS THAT ARE:
  - CORROSIVE OR IRRITANT
  - TOXIC
  - FLAMMABLE

CONSP5

INITIAL TESTING FOR ATMOSPHERIC HAZARDS

* DETERMINES HAZARDS PRESENT
* VERIFIES REMOVAL OF HAZARDS
* TESTS FOR POSSIBLE HAZARDS DEVELOPING DURING PRE-ENTRY PHASE

CONFSP7

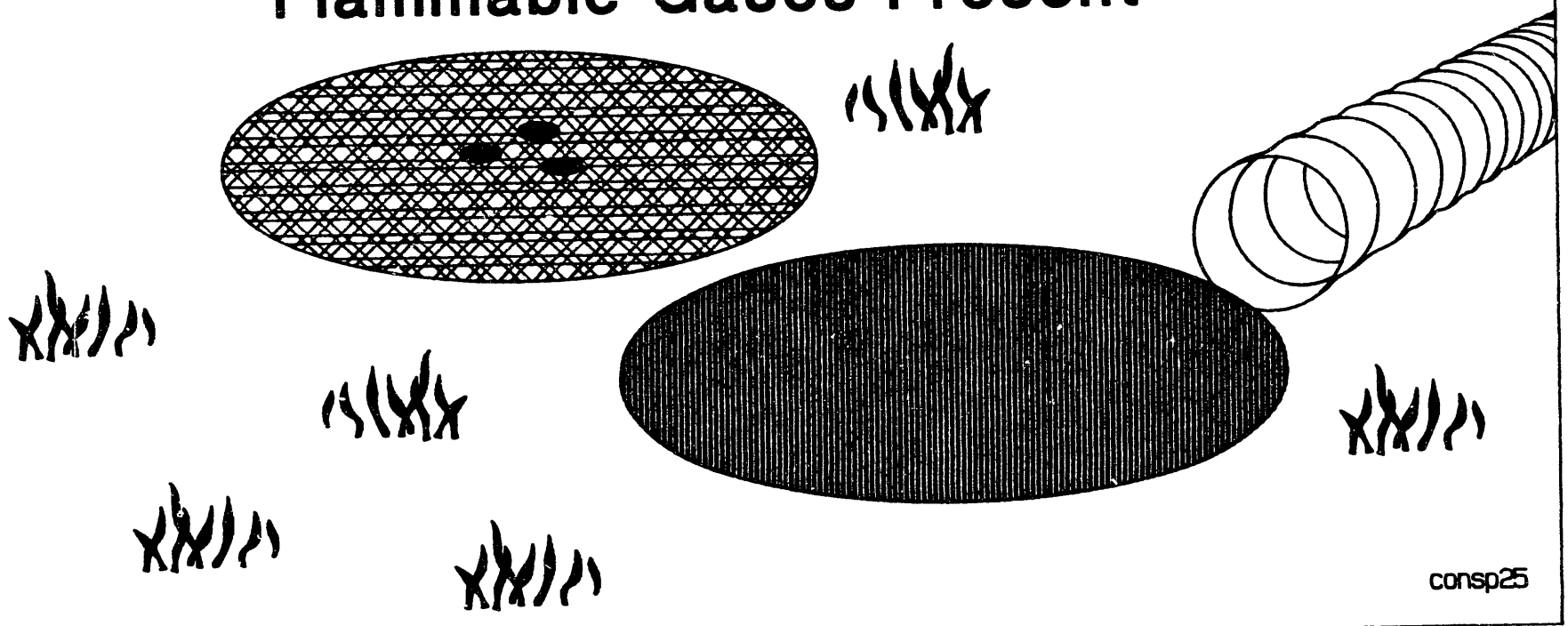
ATMOSPHERIC HAZARD CONTROL

- VENTILATION
- PERSONAL PROTECTIVE EQUIPMENT
  - Respirators
  - Proper Protective Clothing
  - Chest or Full Body Harness
  - Lifeline or Retrieval System

CONSP9

VENTILATION

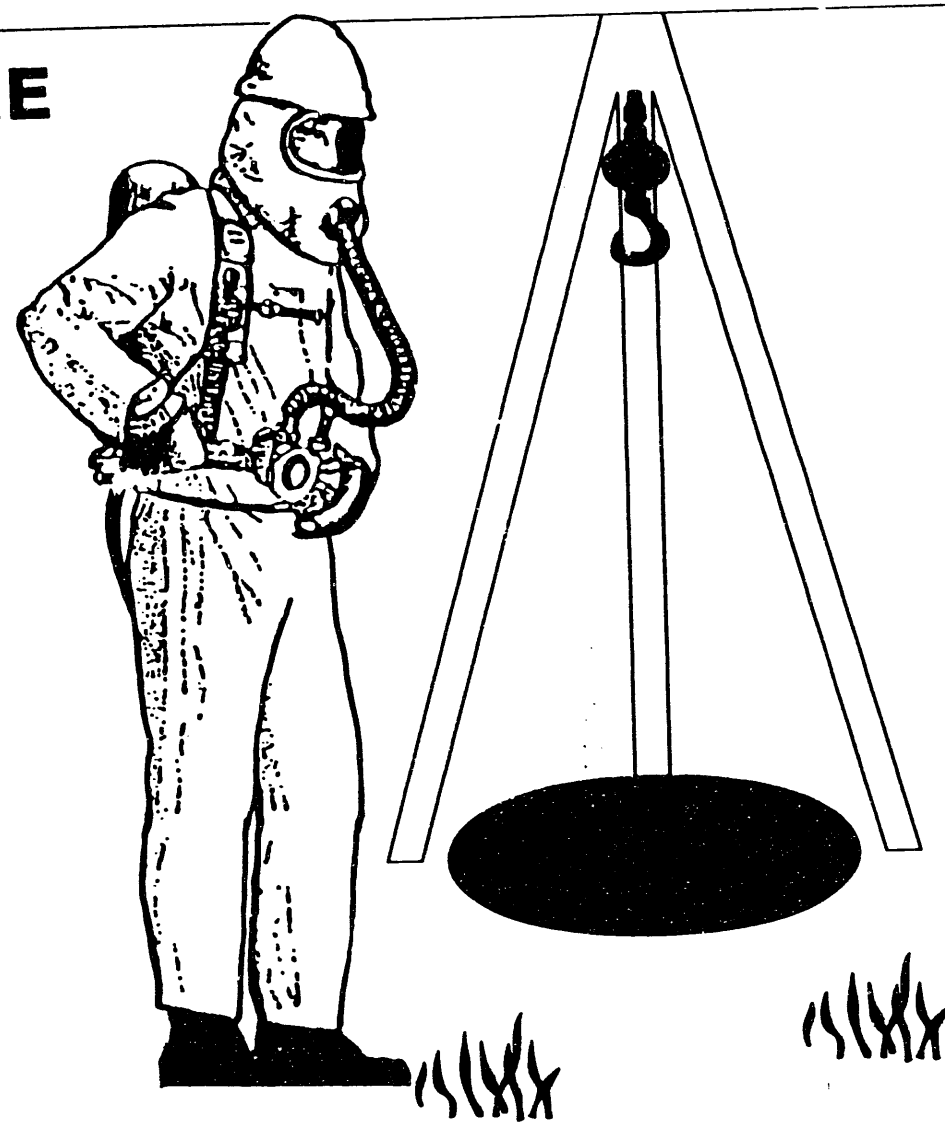
- Circulates Fresh Air in Space
- Removes Fumes & Vapors
- Must Be Explosion-Proof If Flammable Gases Present



consp25

IDLH ATMOSPHERE PROTECTIVE EQUIPMENT

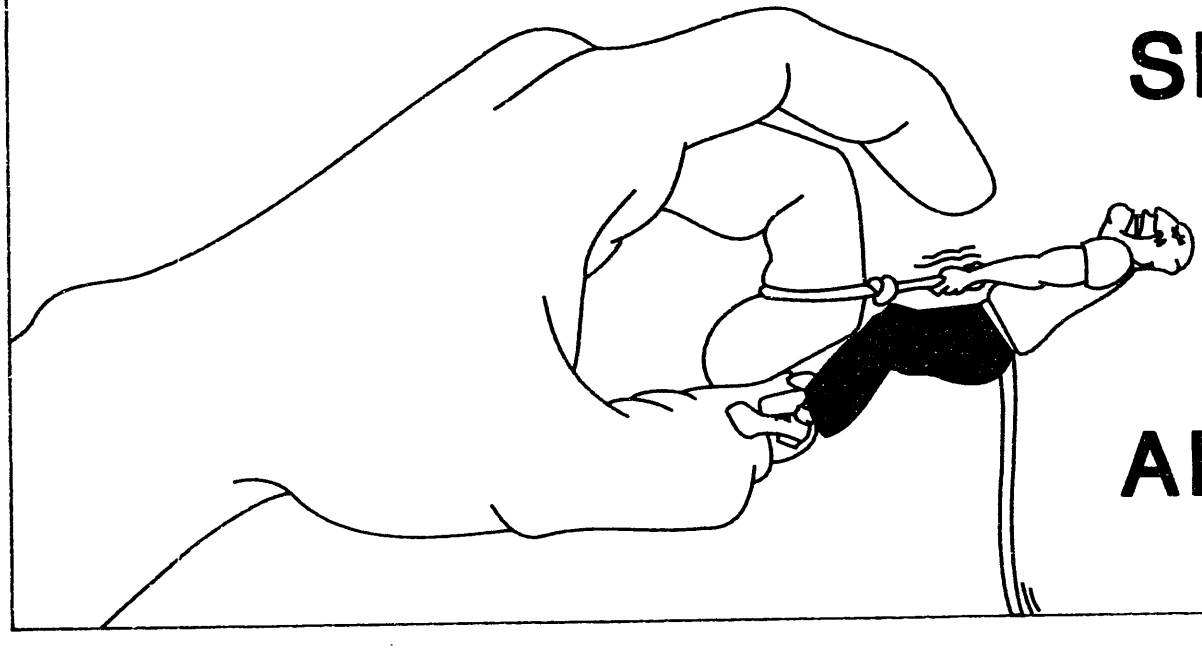
* Supplied-Air Respirator
* Proper Protective Clothing
* Full Body or Chest Harness
* Lifeline or Retrieval System



consp24

ENGULFMENT

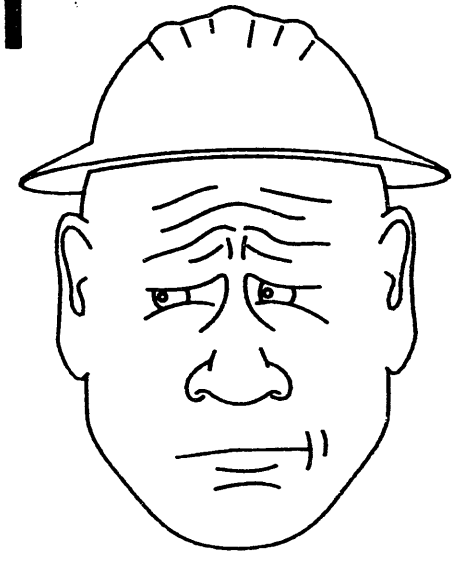
TO MAKE CERTAIN THAT YOU CAN BE PULLED FROM A CONFINED SPACE, WEAR A LIFELINE AND HARNESS



CONSP13

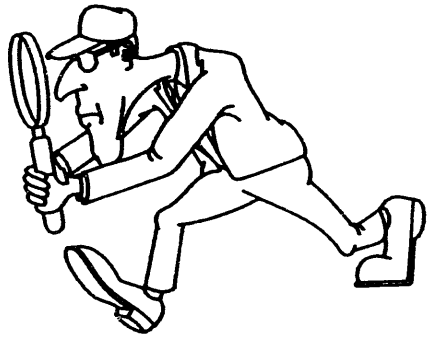
ENTRAPMENT

ALWAYS HAVE A STANDBY PERSON WATCHING OUT FOR YOU WHEN YOU ENTER A CONFINED SPACE



CONSP14

A STANDBY PERSON OBSERVES AND:



- Knows who is working in the space and maintains communication
- Maintains clear access to and from the space
- Makes certain only authorized persons are allowed in the area
- Watches for changes in the mental and physical condition of workers in the space
- Watches for possible hazards both inside and outside the space

CONSP15

RESCUE

THE STANDBY PERSON-

* Calls for backup attendant and/or rescue team
* Never enters space until backup attendant arrives
* Rescues victim from outside the space if possible
* Helps rescuers and victims

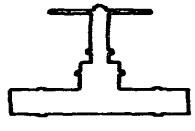
CONSP16

CAUTION
NEVER GO INTO
A CONFINED SPACE
TO ATTEMPT A
RESCUE BY
YOURSELF

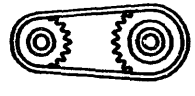
CONSP12

MECHANICAL HAZARD PREVENTION

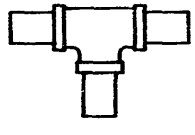
Follow standard isolation procedures to prevent injury by mechanical equipment:



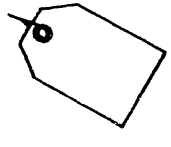
Close valves



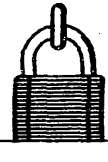
Disconnect drives and belts



Disconnect pipes or bolt isolation blanks in place, check for leakage



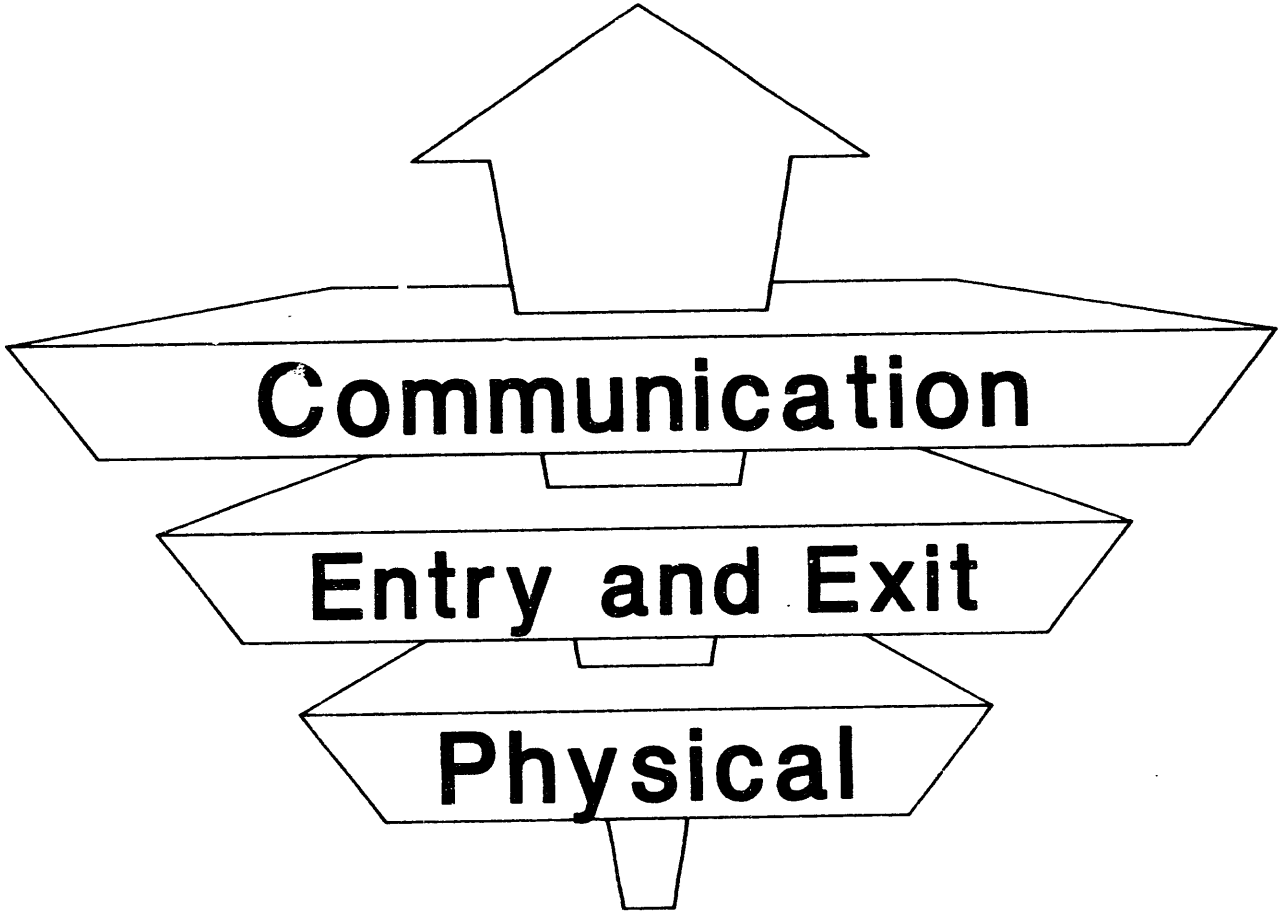
Lock and/or tag out valves



Lock and/or tag out electrical circuits

consp30

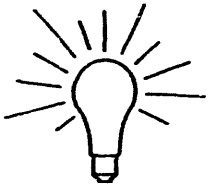
GENERAL SAFETY HAZARDS



consp29

PREVENT COMMUNICATION PROBLEMS

- ★ Visually monitor workers



  Approved, suitable illumination is required

- ★ Provide voice or alarm-activated explosion proof communication system

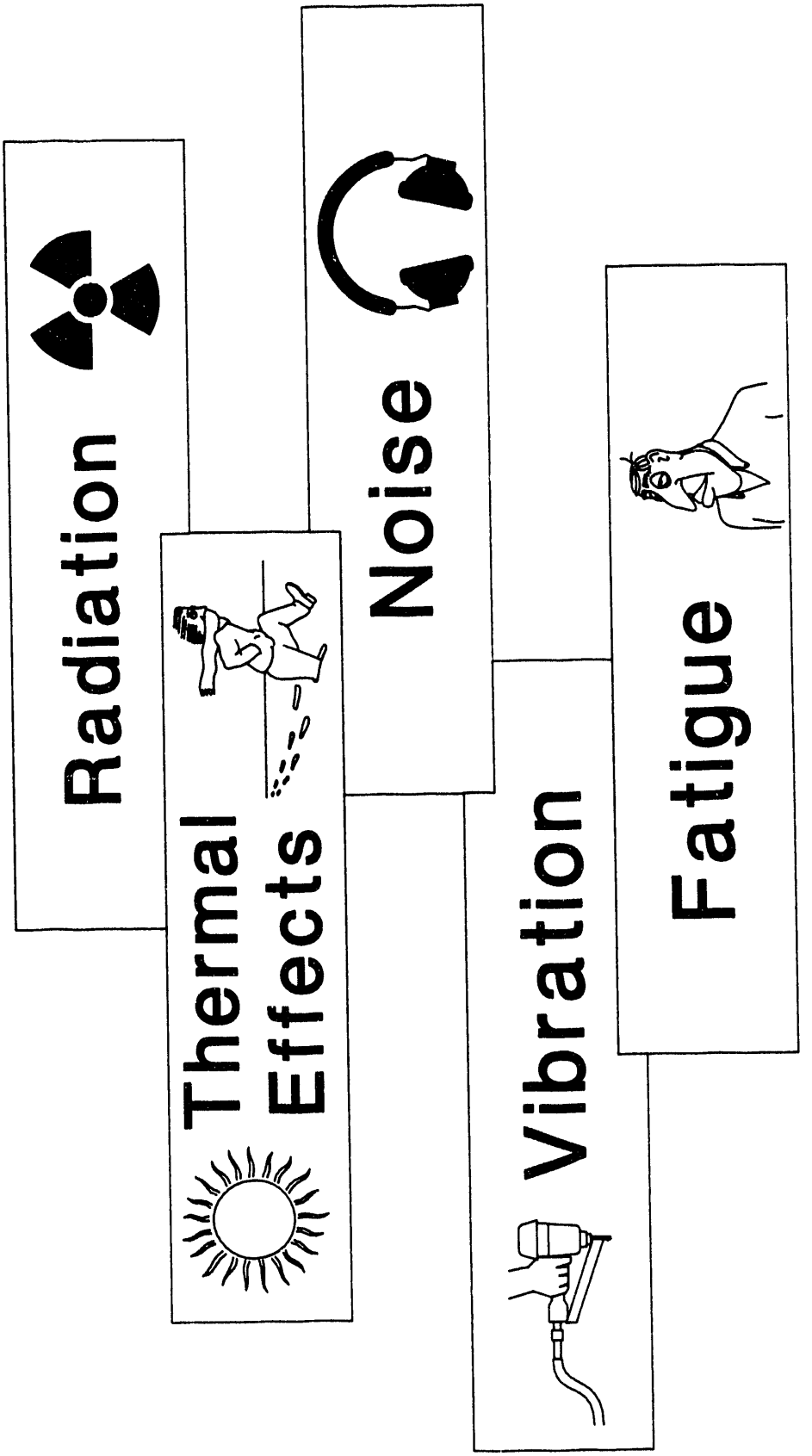
consp31

ENTRY AND EXIT HAZARDS

- Physical limitations of confined space
- Always consider:
  - Type of confined space
  - Access to entrance
  - Number and size of openings
  - Barriers within space
  - Occupancy load
  - Escape time in case of fire or vapor incursion
  - Rescue time for injured workers

consp33

PHYSICAL HAZARDS

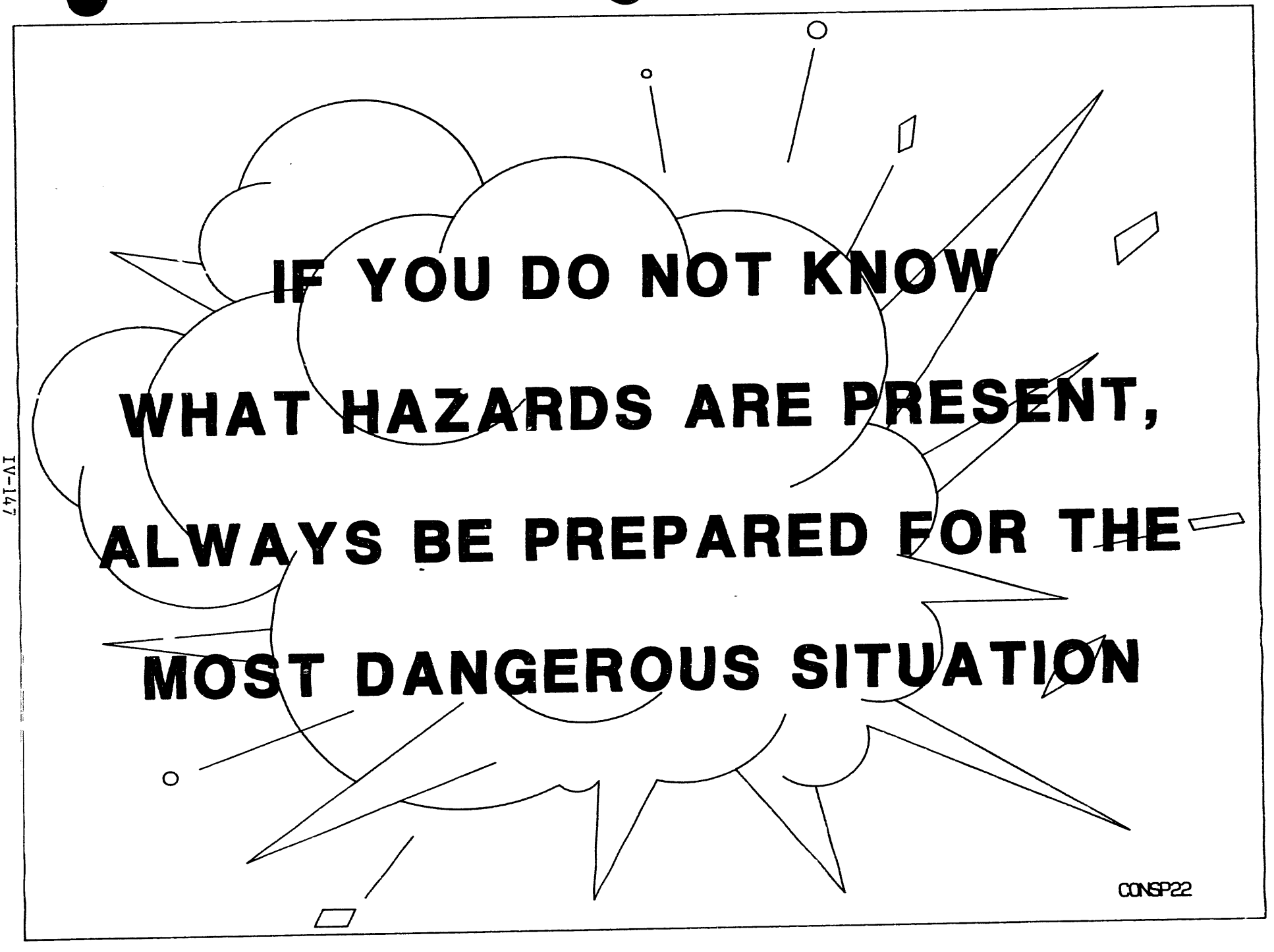


CONSP32

REMEMBER

- **Always make sure your rescue system is in place before entering a confined space**
- **Never go into a confined space to attempt a rescue by yourself**
- **Always follow proper procedures for safe confined space entry**

consp21


IF YOU DO NOT KNOW
WHAT HAZARDS ARE PRESENT,
ALWAYS BE PREPARED FOR THE
MOST DANGEROUS SITUATION
CONSP22

Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

4 of 6

BIOLOGICAL HAZARDS

SCOPE

This portion of the Types of Hazards module presents information about the types of biological hazards which may be present at a hazardous waste site.

PARTICIPANT GOALS

1) Learn the types of biological hazards which may be present at a hazardous waste site.

INSTRUCTOR PREPARATION

- Assemble viewgraphs which illustrate all potential biological hazards present at the facility's hazardous waste site(s).

- Prepare lecture notes.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Discuss the types of disease-causing organisms which may be present at a hazardous waste site.
  (BIOHAZ 1)

- Discuss the poisonous animals and plants which may be present at a hazardous waste site.
  (BIOHAZ 02)

- Distribute and oversee completion of worksheet or exam.

Bacteria
Viruses
Rickettsiae
Fungi
Parasites

BIOHAZ1

Other biological hazards that may be present at a hazardous waste site include:

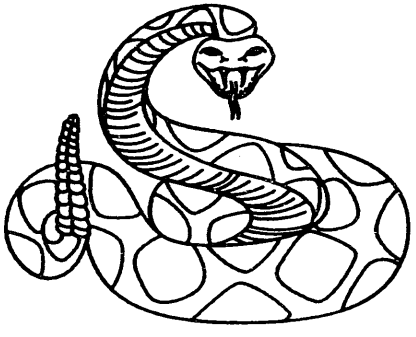
Spiders

Bees, Wasps, Hornets, and Ants

Mosquitoes, Flies, Fleas, Lice

Ticks

Mites



Poisonous Snakes

Poisonous Plants

BIOHAZ02

ASBESTOS AWARENESS

SCOPE

This portion of the Types of Hazards module presents information about the types of asbestos, the ways each type was most often used, and the locations within the facility where asbestos hazards may exist.

PARTICIPANT GOALS

1) Learn the definition and different types of asbestos.

2) Learn the health hazards of asbestos.

3) Become aware of regulations and facility policy pertinent to asbestos.

4) Become aware of the locations where asbestos is found and the protection methods used at the facility.

INSTRUCTOR PREPARATION

- Determine the location of asbestos at the facility. Take photographs to be used as viewgraphs.

- Prepare facility-specific viewgraphs for the asbestos policy, locations of asbestos, handling procedures, and hazard prevention procedures.

- Assemble viewgraphs.

- Prepare lecture notes.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce subject and objectives.
  ($ASBO_1$, A3)

- Define asbestos and describe the three main types of asbestos.
  (A 4-8)

- Discuss the uses of asbestos.
  (A 10)

- Discuss the locations in which workers should expect to find asbestos.
  (Facility-specific viewgraphs and photographs)

- Discuss the health hazards of asbestos.
  (A 12)

- Discuss asbestos regulations and operating procedures.

- Describe asbestos protection measures and hazard prevention.
  (A 13, 15)

- Distribute and oversee completion of worksheet or exam.

ASBESTOS AWARENESS

ABSO 1

OBJECTIVES

- State Definition and Types of Asbestos
- List Various Regulations and Procedures Pertinent to Asbestos
- Discuss General Locations of Asbestos Material
- Discuss the Health Hazards of Asbestos
- Review Personnel Protection Measures Used

A3

DEFINITION OF ASBESTOS

Asbestos is the common name given to a number of naturally occurring inorganic silicates that possess a chrystalline structure and are incombustible in air and separable into filaments.

A4

THREE MAIN TYPES OF ASBESTOS

- CHRYSOTILE
- AMOSITE
- CROCIDOLITE

A5

CHRYSOTILE

- MOST ABUNDANT AND MOST USED
- COMMONLY CALLED WHITE ASBESTOS
- HAS LONGEST AND STRONGEST FIBERS
- USED TO REINFORCE CEMENT AND OTHER MATERIALS

A6

AMOSITE

- Amosite : Commerical Name For Asbestos Mines Of South Africa
- Commonly Called Brown Asbestos
- Chemically Stable and Resistant to Acids
- Used in Fire-Resistant Insulating Boards

A7

CROCIDOLITE

- BLUE AND LESS SILKY THAN CHRYSOTILE
- COMMONLY CALLED BLUE ASBESTOS
- MORE BRITTLE AND SHORTER FIBERS THAN CHRYSOTILE
- CROCIDOLITE WAS SOMETIMES LESS EXPENSIVE THAN CHRYSOTILE IN SPRAYING APPLICATIONS

A8

USES OF ASBESTOS

- Asbestos has some 3000 uses recorded
- Asbestos is relatively inexpensive
- Asbestos is chemical resistant and fire resistant with excellent mechanical strength
- Asbestos has been used in the following products:
  (1) Flooring and Roofing
  (2) Electrical and Thermal Insulation
  (3) Friction and Wear Resistant Products

A10

HEALTH HAZARDS OF ASBESTOS

HARMFUL FORMS

- Friable
- Non- Friable

HARMFUL ENTRY PATHS

INTERNAL

- Ingestion
- Inhalation

HARMFUL EFFECTS

- Mesothelioma
- Cancer

A12

ASBESTOS PROTECTION MEASURES

- Monitoring Of Employees With Potential For Exposure
- Respiratory Protection For Exposed Employees
- Coveralls, Foot Covering, Goggles, Gloves
- Regulated Zoning
- Communication Of Asbestos Hazard
  - Material Safety Data Sheet
  - Warning Labels
- Isolation (Glove Bag, Water Soluble Bag)

A13

HAZARD PREVENTION

- Notify Supervisor Before:
  - o Removing Pipe Insulation
  - o Penetrating Wall Material
  - o Removing Ductwork
  - o Disturbing Questionable Materials (Friable)
- Safety Work Permit
- Excavation/Penetration Permit
- Follow Procedures

A15

SAFETY HAZARDS

SCOPE

This portion of the Types of Hazards module presents information about the types of safety hazards which may occur at hazardous waste sites and ways to avoid or prevent accidents.

PARTICIPANT GOALS

1) Review general on-the-job safety hazards and accident prevention.

2) Learn about additional safety hazards which might be encountered at a hazardous waste site.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce subject.
  (SAFE 11)

- Describe the safety hazards which may be found at a hazardous waste site, including the hazards inherent in the use of heavy equipment and protective clothing.
  (SAFE 01, 02)

- Discuss general industrial hazards and accident prevention.
  (SAFE 03, 12, 13, 14)

- Review standard facility safety procedures.
  (SAFE 04, 05, 06)

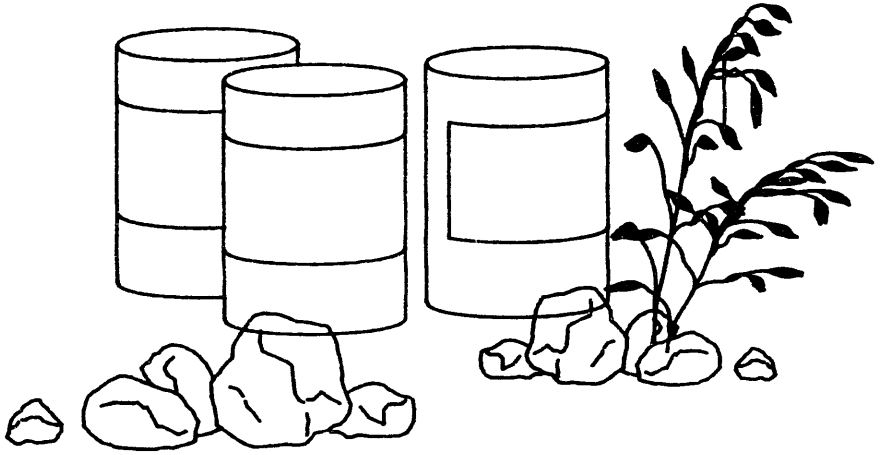
- Discuss things to remain aware of at the hazardous waste work site.
  (SAFE 07, 08, 09)

- Distribute and oversee completion of worksheet or exam.

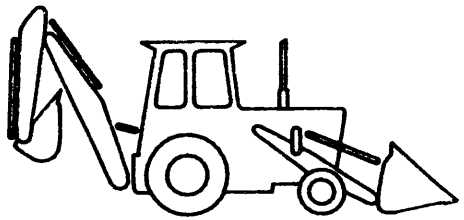
SAFE11

Hazardous waste sites may contain numerous safety hazards such as:

- Holes or ditches
- Dangerously positioned objects
- Sharp objects
- Slippery surfaces
- Steep grades
- Uneven terrain
- Unstable surfaces



SAFE01



When working around heavy equipment:

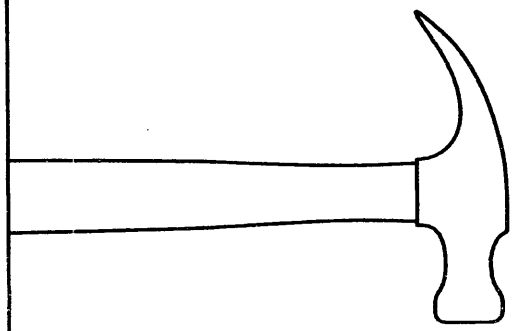
- Never walk under suspended loads.
- Never walk in front or back of moving heavy equipment.
- Always be aware of heavy equipment location.
- Always wear a hard hat and proper foot and eye protection.
- Do not operate any heavy equipment unless fully qualified and authorized to do so.
- Be aware that equipment can be a source of ignition for flammable or explosive materials.

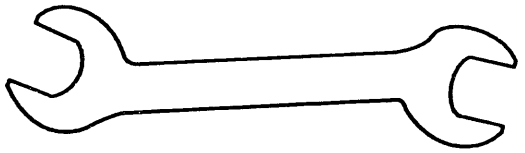
SAFE02

Some points to remember
when using smaller equipment such as pumps, compressors, generators, trucks, and hand tools.

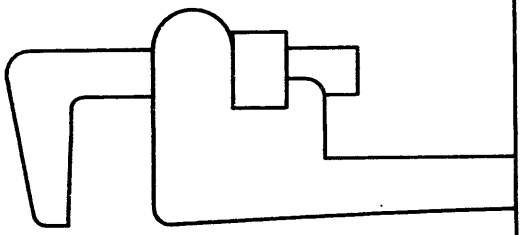
- Be sure all machine guards are in place.
- Use equipment at their recommended speeds and only for the jobs they were designed to do.
- Always keep loose clothing away from moving parts.
- Use only nonsparking tools and be sure to ground equipment and containers when working in a flammable atmosphere or transferring flammable liquids.
- Never pump flammable material with gasoline or electric pumps.
- Be aware of the types of fittings on pumps and hoses.
- Never add fuel to equipment while it is running.

SAFE03

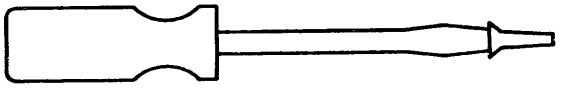




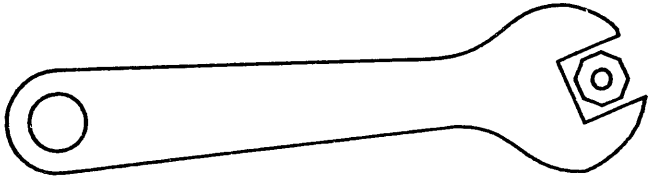
Hand Tools



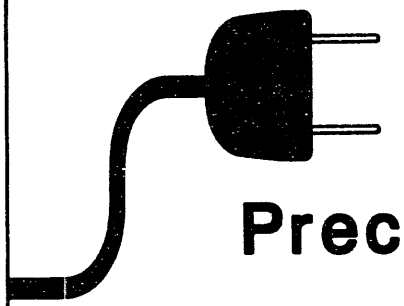
- Use the right tool for the right job.
- Make sure the tool is in good condition.
- Use the tool correctly.



- Keep tools in a safe place.



SAFE12

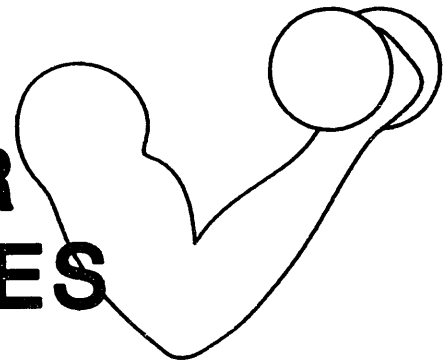


Precautions Against Electrical Hazards

- Switchyard areas of the plant should be avoided unless required to enter.
- Unauthorized entry into major power centers or substations is forbidden.
- Avoid exposed wiring or unfamiliar conductors.
- Be alert for defects in electrical machines or power tools.
- Do not place extension cords where they may be damaged.
- Report all electrical shocks.

SAFE13

PROPER LIFTING TECHNIQUES



a. Consider size, shape, and weight of object.

b. Set feet solidly to give good balance.

c. Get close to load.

d. Bend legs about 90 degrees at knee.

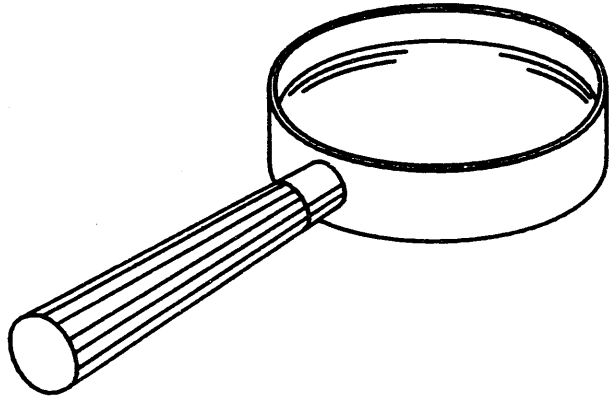
e. Keep back as straight as possible.

f. Grip object firmly.

g. Straighten legs and bring back to vertical position to lift.

h. DO NOT TWIST YOUR BACK.

SAFE14



Workers should constantly
LOOK OUT FOR POTENTIAL SAFETY HAZARDS,
and should immediately
INFORM THEIR SUPERVISORS
of any new hazards so that
corrective action can be taken.

SAFE04

Follow
Standard Operating Procedures
and
your supervisor's instructions.

SAFE05

REMEMBER!

Commom sense is based upon experience and training.

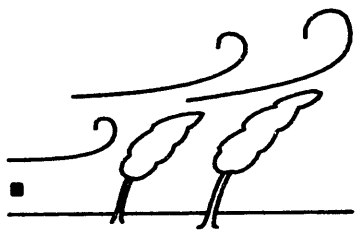
If you don't understand and haven't been trained,

ASK FOR INSTRUCTION.

SAFE06

Some things to remain aware of at the work site:

- Any weather changes.



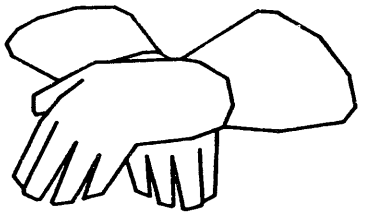
- Wind direction.

- Unusual odors.

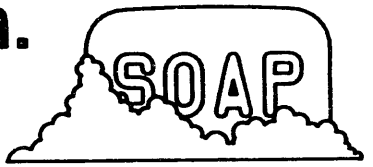
SAFE07

Some things to remain aware of at the work site:

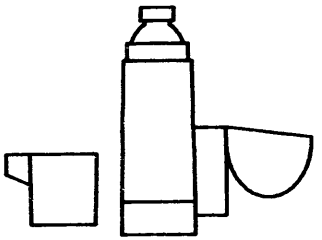
- Decontamination procedures



- Washing your hands BEFORE eating, drinking, smoking, or using the restroom.



- Showering and changing into clean clothes.



- Keeping food, drinks, smoking materials, and personal care items in clean areas.

SAFE08

Some things to remain aware of at the work site:

- Heavy equipment operating near you.
- The proper handling of drums and other equipment so as to prevent personal injury.
- The need for proper personal protective equipment and its limitations.
- The location of someone who can help if an emergency arises.
- Emergency procedures and evacuation signals.
- Where and how to exit from every area.

SAFE09

NOISE

SCOPE

This portion of the Types of Hazards module presents information about the effects of noise on the human ear and the types of hearing protection used at the facility.

PARTICIPANT GOALS

1) Review the structure and function of the human ear.

2) Gain an understanding of the effects of noise exposure.

3) Learn about the personal protective devices that prevent hearing loss.

INSTRUCTOR PREPARATION

- Collect examples of the types of hearing protection devices in use at the facility.
- Choose a booklet on noise and hearing protection to use as a handout, if desired.
- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce subject and objectives.
  (Noise 3A, Noise 7)

- Describe the structure and function of the human ear.
  (Noise 10)

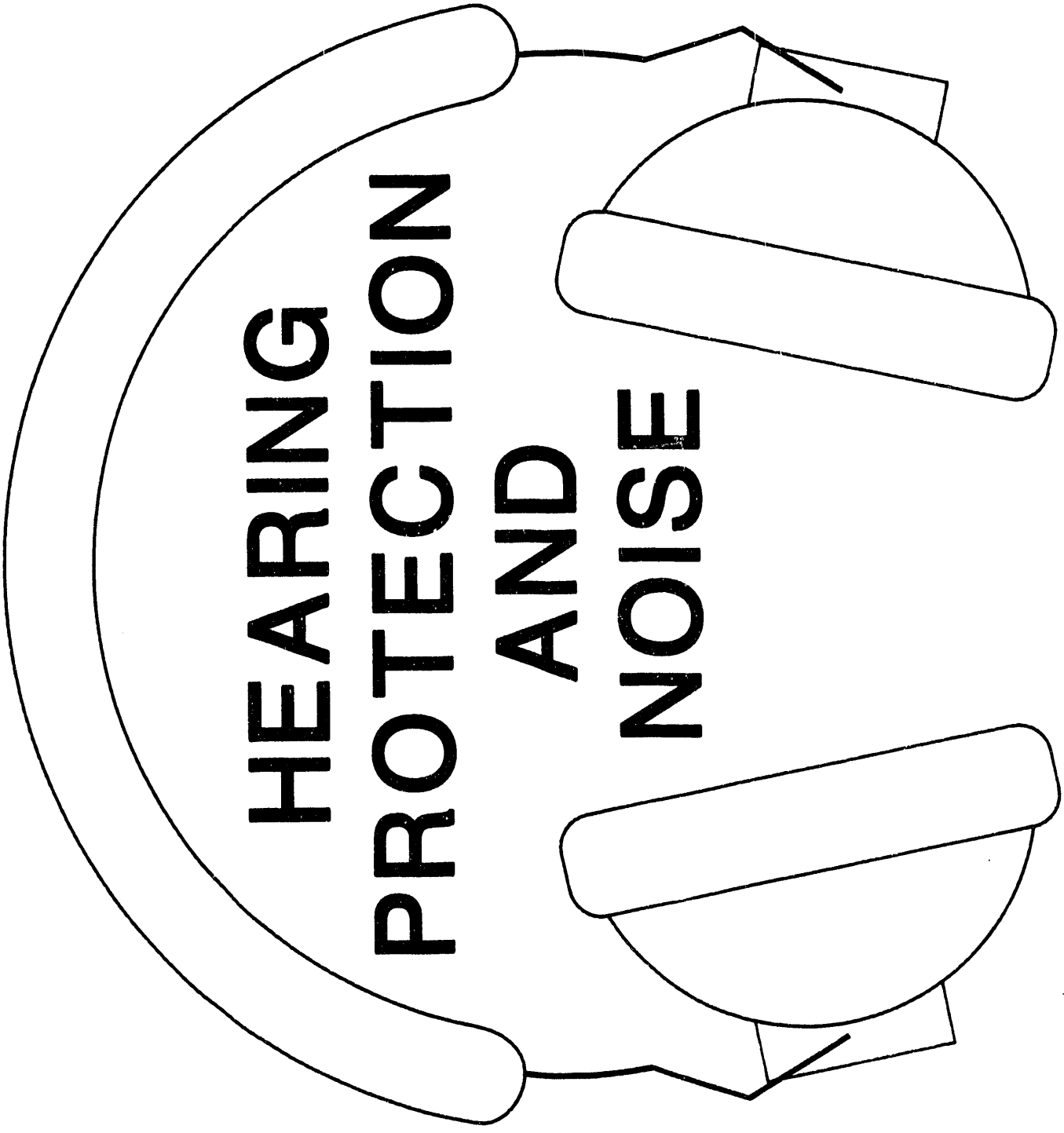
- Discuss the sources of noise and the adverse effects of noise exposure.
  (Noise 5, 2a, 6)

- Discuss the types of hearing loss caused by noise exposure.
  (Noise 4)

- Demonstrate the different types of hearing protection devices in use at the facility and the circumstances under which each is used.
  (Noise 9, 8a)

- Distribute employee booklet, if desired.

- Distribute and oversee completion of worksheet or exam.



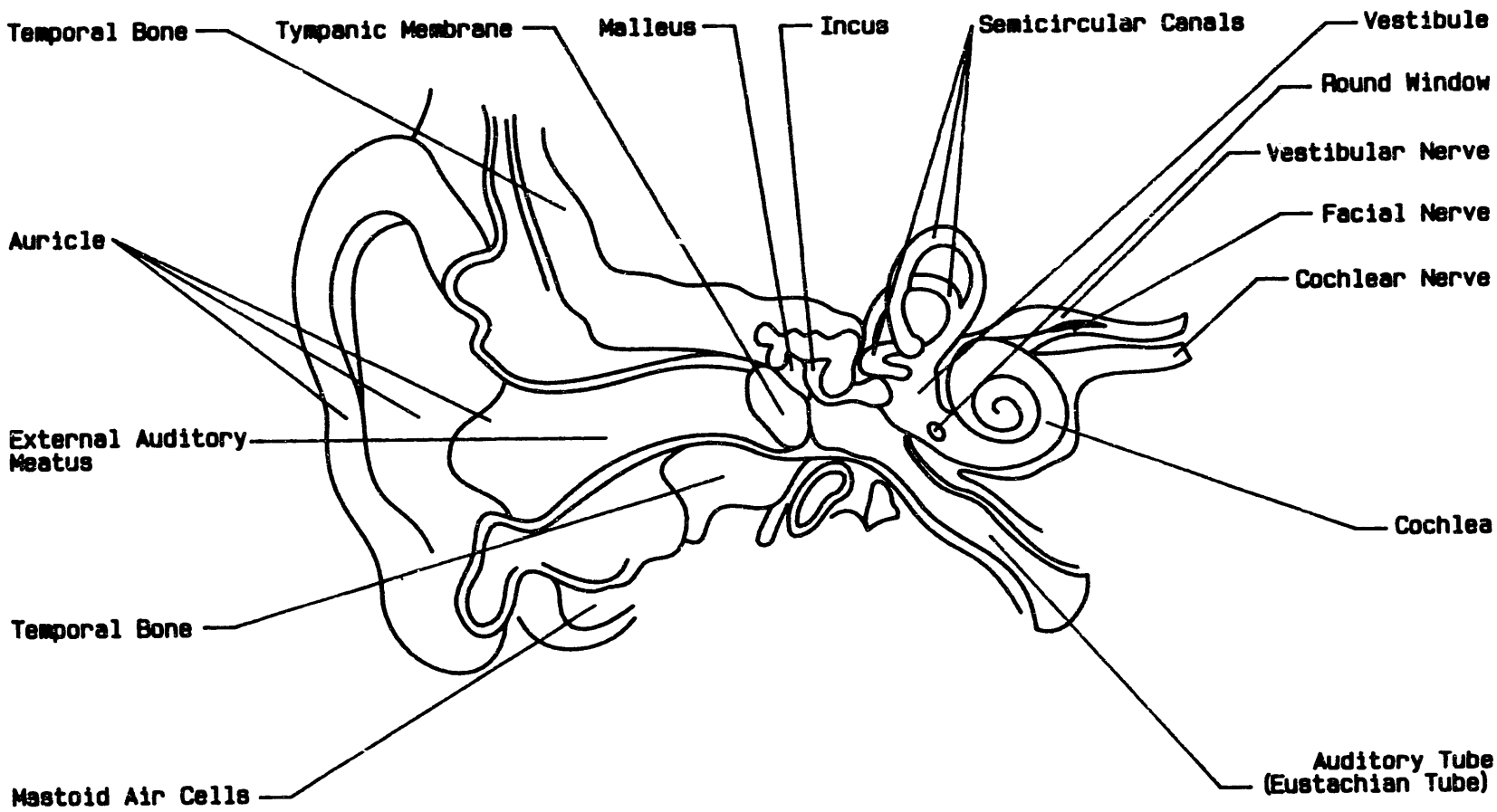
NOISE3A

OBJECTIVES

* Explain How The Ear Works
* Discuss Effects of Noise Exposure
* Describe Personal Protective Devices That Prevent Hearing Loss

noise7

NERVOUS SYSTEM
Auditory System



EXTERNAL EAR, MIDDLE EAR, INTERNAL EAR

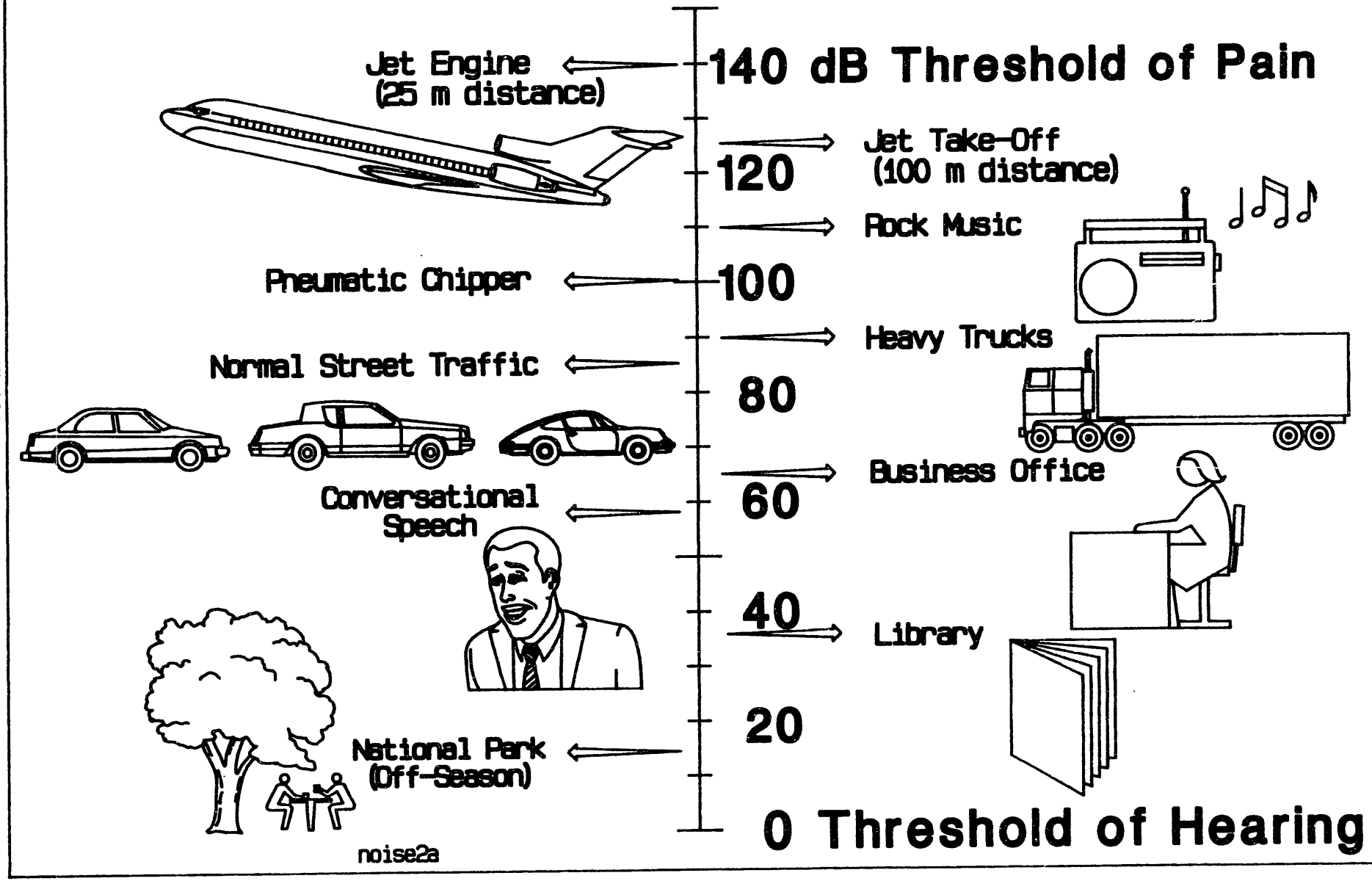
noise10

NOISE EXPOSURE FACTORS

- Intensity or loudness of sound
- Type of noise
- Length of daily exposure
- Total work duration
- Individual worker susceptibility

noise5

COMMON NOISE EXPOSURES



EFFECTS OF NOISE EXPOSURE

Physical

- ★ Hearing Damage
  - ▸Acoustic Trauma
  - ▸Sensorineural
- ★ Increased Pulse Rate and Blood Pressure
- ★ Abnormal Hormone Secretion
- ★ Muscle Tension

Psychological

- ★ Annoying, Startling
- ★ Disrupts Concentration, Sleep, Relaxation

Interference with Communication

- ★ Creates Safety Hazards
- ★ Affects Job Performance

noise6

HEARING LOSS

Acoustic Trauma

- ★ Sudden loud noise or blow to head or ear
- ★ Usually temporary

Sensorineural Hearing Loss

- ★ Continuous exposure to a loud noise over prolonged period
- ★ Permanent hearing loss

noise4

PERSONAL PROTECTIVE DEVICES

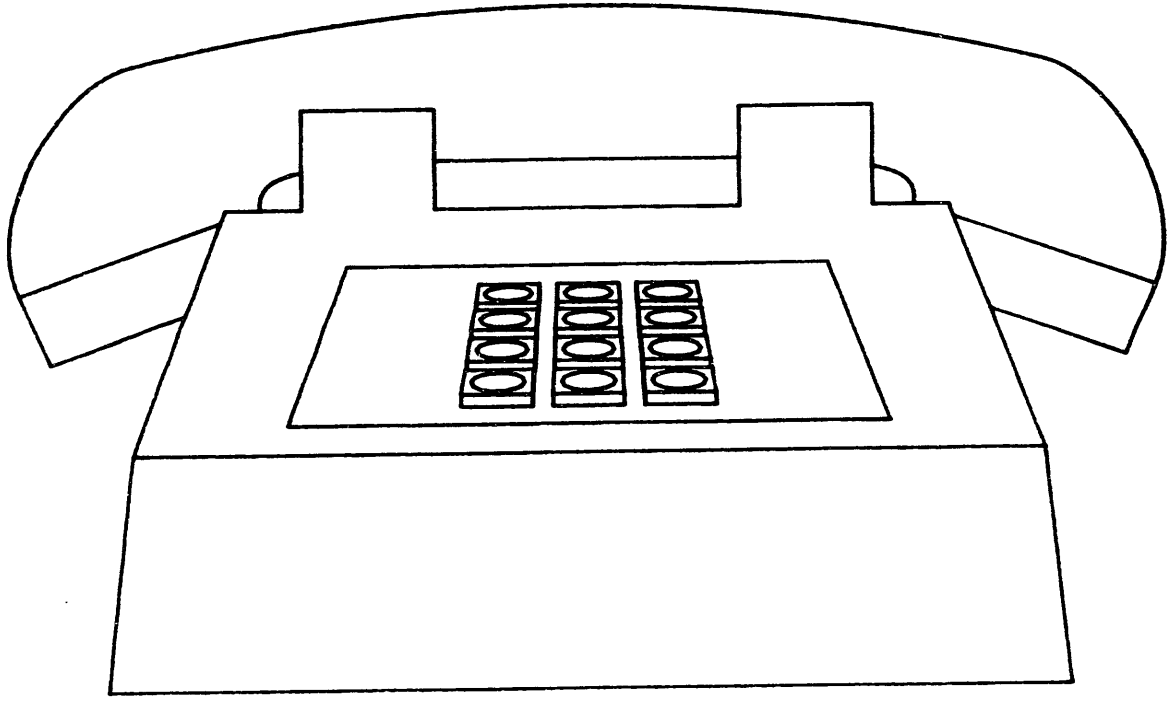
Earplugs

- ★ Custom Molded
- ★ Preformed
- ★ Disposable Foam

Earmuffs

noise9

Industrial Hygiene
Hearing Conservation Program



noise8A

PERSONAL PROTECTIVE EQUIPMENT

Scope

This two-part module presents information about the personal protective equipment which hazardous waste site workers will use. These include cartridge respirators, self-contained breathing apparatus (SCBA), and radiation and chemical protective clothing.
(Suggested time 3 1/4 hours)

RESPIRATORY PROTECTION

SCOPE

This portion of the Personal Protective Equipment module presents information about inhalation hazards and the types of respirators to be used under different conditions.

PARTICIPANT GOALS

1) Learn the types of respiratory hazards.

2) Gain an understanding of the effects and conditions associated with exposure to respiratory hazards.

3) See demonstration of different types of respirators, chemical canisters, and SCBA in use at the facility.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.

- Prepare lecture notes.

- Arrange for a live demonstration which includes information about when to use the following types of respiratory protection: dust masks, half- and full-face respirators, chemical-specific canisters, and SCBA used at the facility.

- Select a videotape describing facility-specific procedures for correct respirator use, if desired.

- Select a videotape about the use of SCBA, if desired. (ORNL chose to use "Breathing Apparatus--Why?", Fire Fighter Films, Inc., RD 1, Box 335B, Columbia, NJ 07832)

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

NOTE: Collect and copy participants' respirator certification cards (or use another procedure) to ensure that all participants who may be required to use respirators because of their work at hazardous wastes sites are qualified for respirator use.

- Introduce the contents and objectives of this portion of the module.
  (RESPRO 1, resprob)

- Introduce the basic steps for the selection of proper respiratory protective equipment.
  (RESPRO 22)

- Describe the three types of respiratory hazards.
  (RESPRO 2)

- Discuss gaseous contaminants.
  (RESPRO 3, 4, 5)

- Discuss the effects of gaseous irritants.
  (RESPRO 6, 7, 8)

- Discuss the effects of asyphyxiants and anesthetic gases.
  (RESPRO 9, 10)

- Discuss the effects of gaseous systemic poisons and their target organ effects.
  (RESPRO 11)

- Discuss particulates that are respiratory hazards.
  (RESPRO 12, 13)

- Discuss oxygen deficient atmospheres.
  (RESPRO 18, 15)

- Review and emphasize that the type of respiratory protection required depends upon the type of contaminant present.
  (RESPRO 16A)

- Give demonstration of respirators and chemical cartridges.
  (RESPRO 19, 20, 21)

- Show videotape of correct respirator use, if desired.

- Describe the uses and limitations of SCBA.
  (SCBA 1, ORNL-DWG 88-6913, SCBA 2-4, 6)

- Give demonstration of how to don, operate, and doff the SCBA in use at the facility.

- Discuss the correct procedures for maintenance and storage of SCBA.

- Show videotape illustrating use of SCBA, if desired.

- Distribute and oversee completion of worksheet or exam.

RESPR01

OBJECTIVES

Identify respiratory hazards and give examples

Discuss effects and conditions associated with exposure to respiratory hazards

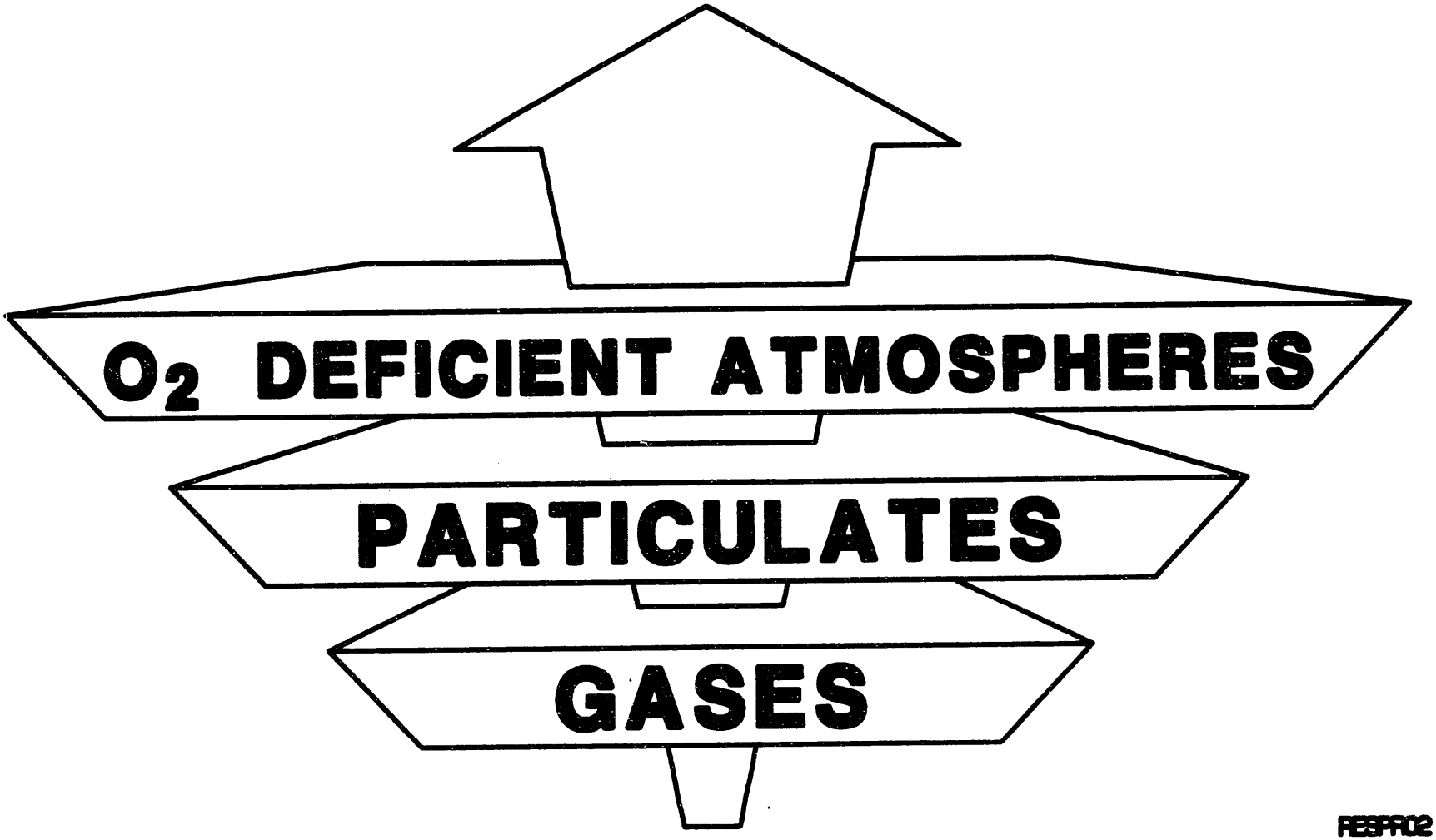
respob

BASIC STEPS IN CHOOSING RESPIRATORY PROTECTIVE EQUIPMENT

- ★ Identification of hazard
- ★ Evaluation of hazard
- ★ Selection of proper respiratory protective equipment

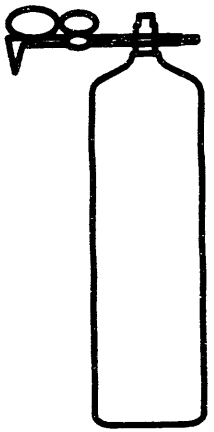
RESPR022

RESPIRATORY HAZARDS



RESPR02

GASEOUS CONTAMINANTS



GASES

EX.- CARBON DIOXIDE

VAPORS

EX.- TRICHLOROETHYLENE
ACETONE

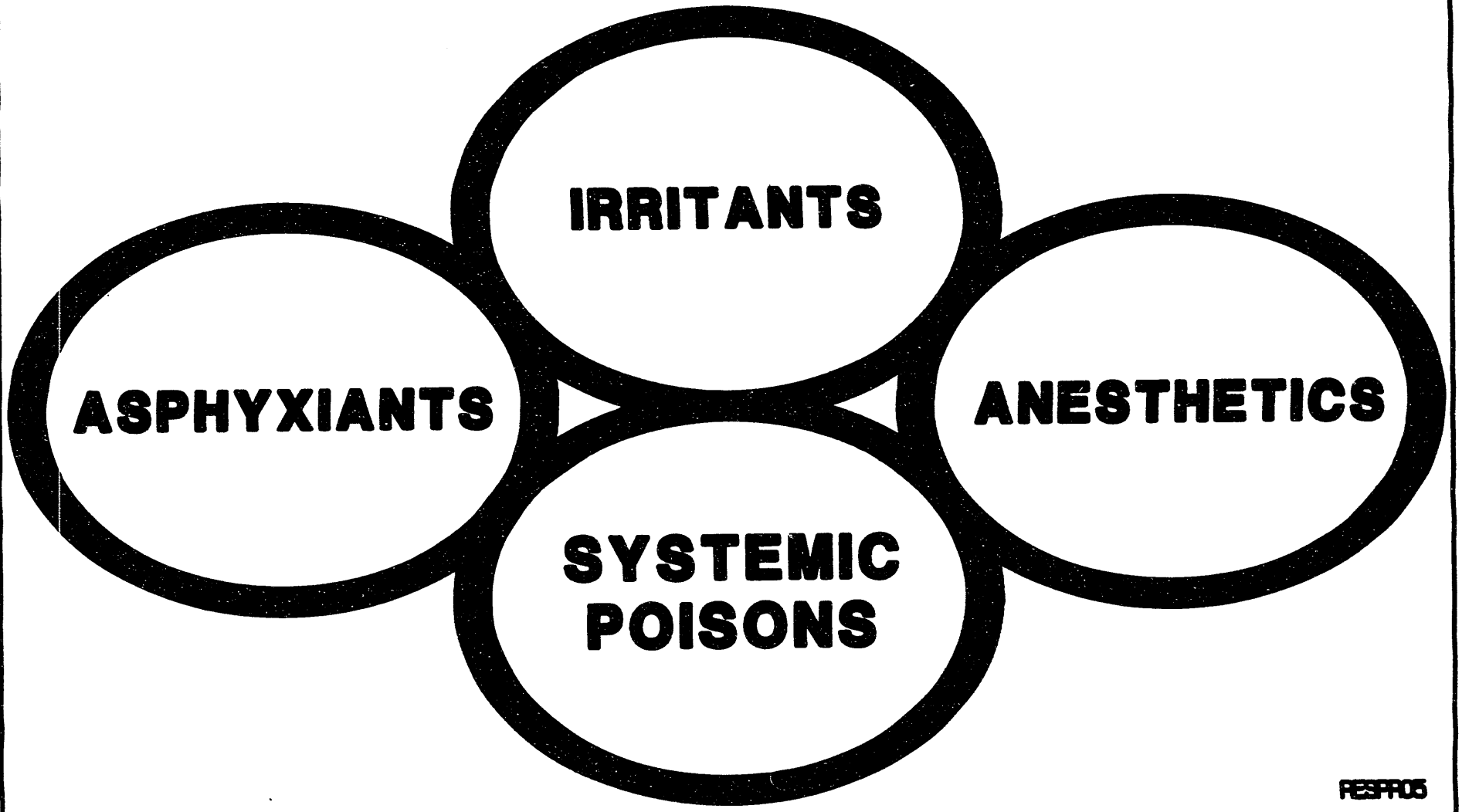
RESPRO3

DEGREE OF HAZARD

- IMMEDIATELY DANGEROUS TO LIFE AND HEALTH
- NOT IMMEDIATELY DANGEROUS TO LIFE AND HEALTH

RESPR04

CLASSIFICATION OF GASEOUS CONTAMINANTS



RESPRO5

IRRITANTS

EFFECTS: CORROSIVE ACTION ON THROAT AND LUNGS

SIGNS & SYMPTOMS:

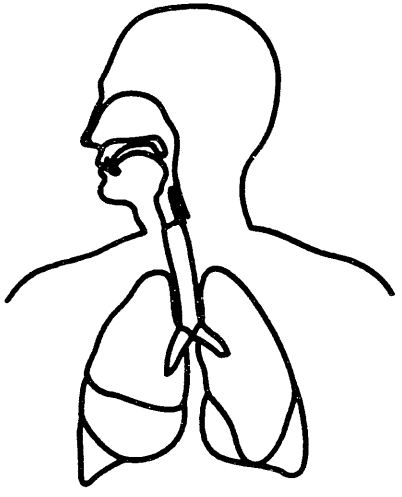
MILD EXPOSURE

- SNEEZING
- SWELLING OF NASAL MEMBRANE
- SORE THROAT
- EYE IRRITATION
- TEARING

RESPROS

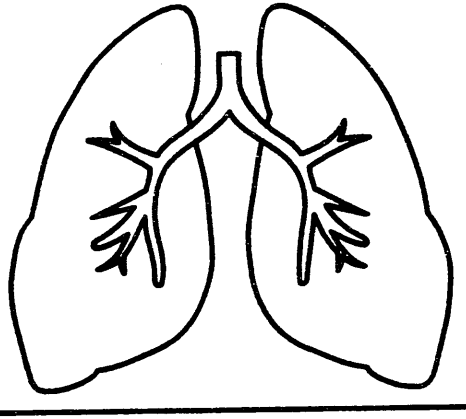
IRRITANTS CON'T:

MORE INTENSE EXPOSURES:



COUGH, SPUTUM, PAIN, CHEST CONSTRICTION, SHORTNESS OF BREATH, WHEEZING

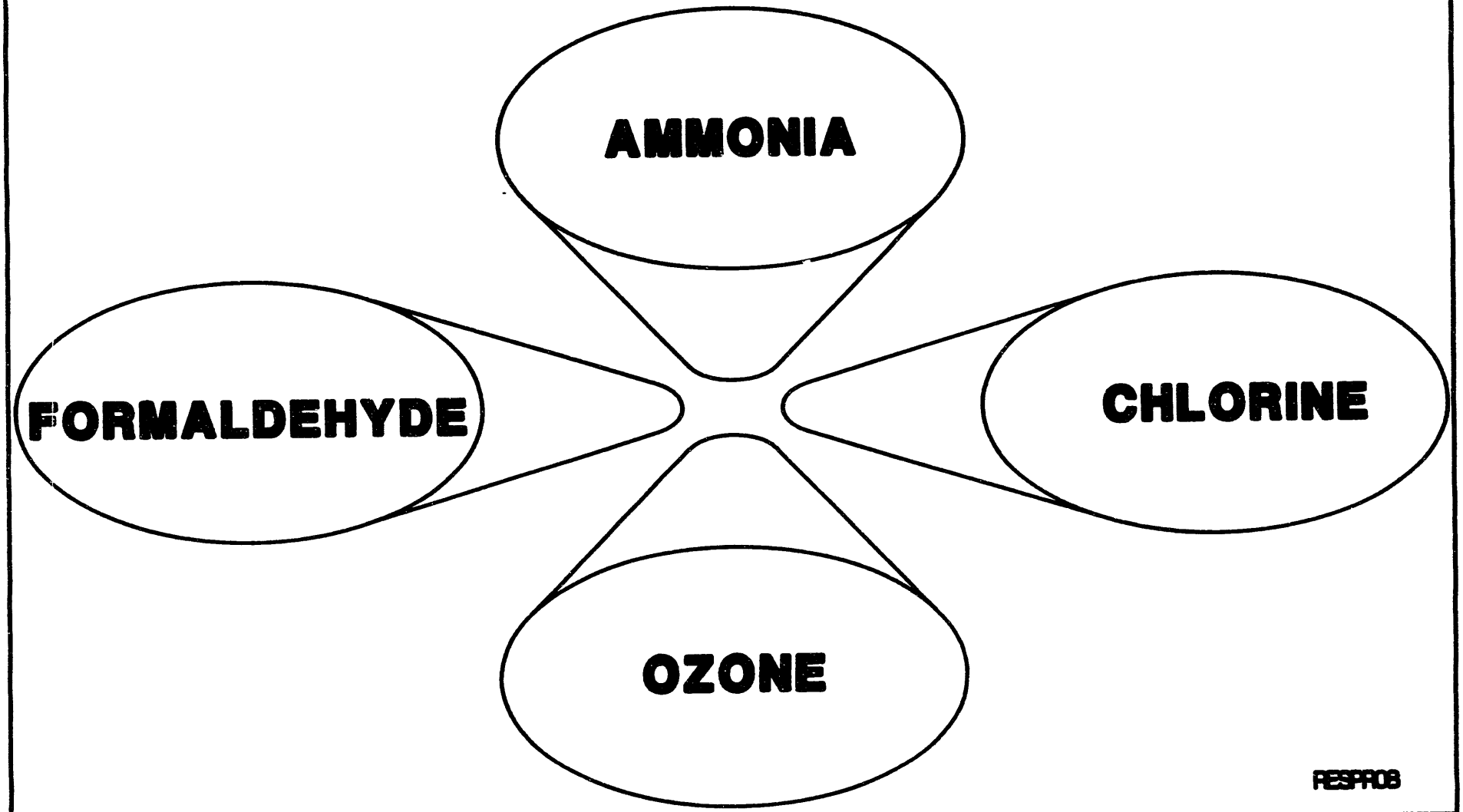
MOST INTENSE EXPOSURES:



PULMONARY EDEMA

RESPR07

COMMON GASES THAT ARE CHEMICAL IRRITANTS



RESPROB

ASPHYXIANTS

SIMPLE

CHEMICAL

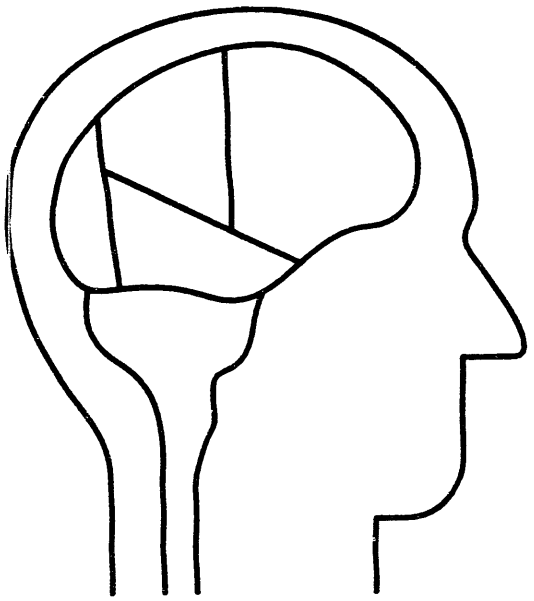
EFFECTS: POSSIBLE BRAIN DAMAGE OR DEATH

EXAMPLES: CARBON MONOXIDE
HYDROGEN CYANIDE

RESPA09

ANESTHETIC GASES

EFFECTS: DIZZINESS, SLEEPINESS, LOSS OF COORDINATION, UNCONSCIOUSNESS, RESPIRATORY PARALYSIS, POSSIBLE DEATH,



AFFECTS CENTRAL NERVOUS SYSTEM

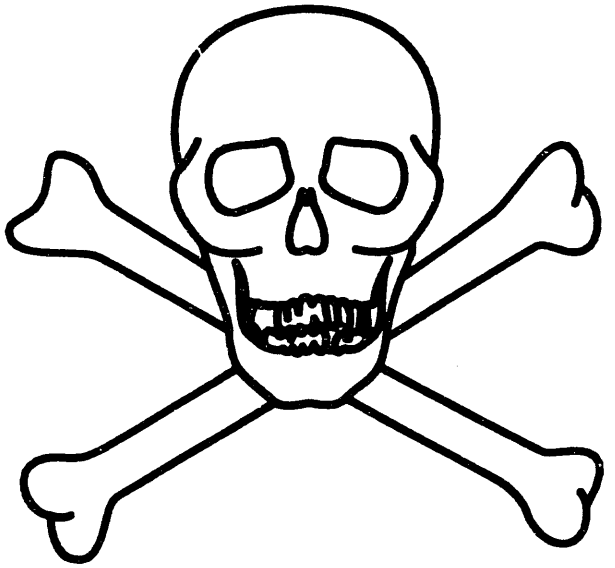
EXAMPLES: ALCOHOLS
ETHERS
CHLOROFORM

RESPRO10

SYSTEMIC POISONS

EFFECTS:

- Cancer
- Paralysis
- Irreversible Organic Damage



EXAMPLES:

- **Mercury-** Nervous System, Kidneys, Glands
- **Carbon Tetrachloride-** Liver, Kidneys
- **Benzene-** Bone Marrow

RESPR011

PARTICULATES (AEROSOLS)

Tiny Particles or Droplets of Material Including:

- Dusts
- Mists
- Fumes

RESPR012

HEALTH EFFECTS OF PARTICULATES

IRRITATION

SYSTEMIC POISONING

RESPIRATORY PROBLEMS

ALLERGIC REACTIONS

RESPR013

OXYGEN DEFICIENT ATMOSPHERE

Atmosphere Does Not Contain

Enough Oxygen to Support

Human Life Indefinitely

O_2

RESPR018

OXYGEN DEFICIENT ATMOSPHERES

EFFECTS:

Dizziness
Euphoria
Brain Damage

EXAMPLES:

Tunnels
Shafts
Enclosed Vessels

CONTROLS:

Ventilation
Supplied-Air Respirators

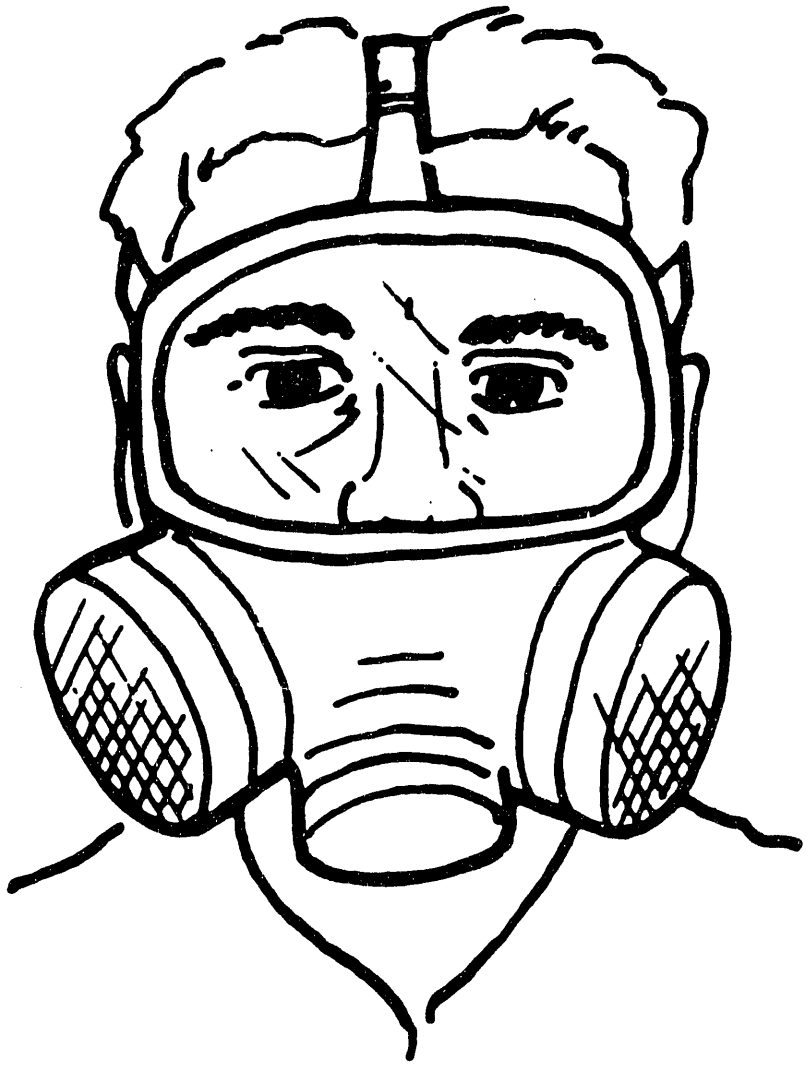
RESPR015

THE TYPE OF RESPIRATORY PROTECTION REQUIRED DEPENDS ON THE TYPE OF CONTAMINANT(S) ENCOUNTERED

RESPR16A

HALF-MASK, FACEPIECE-MOUNTED CARTRIDGE

RESPR019



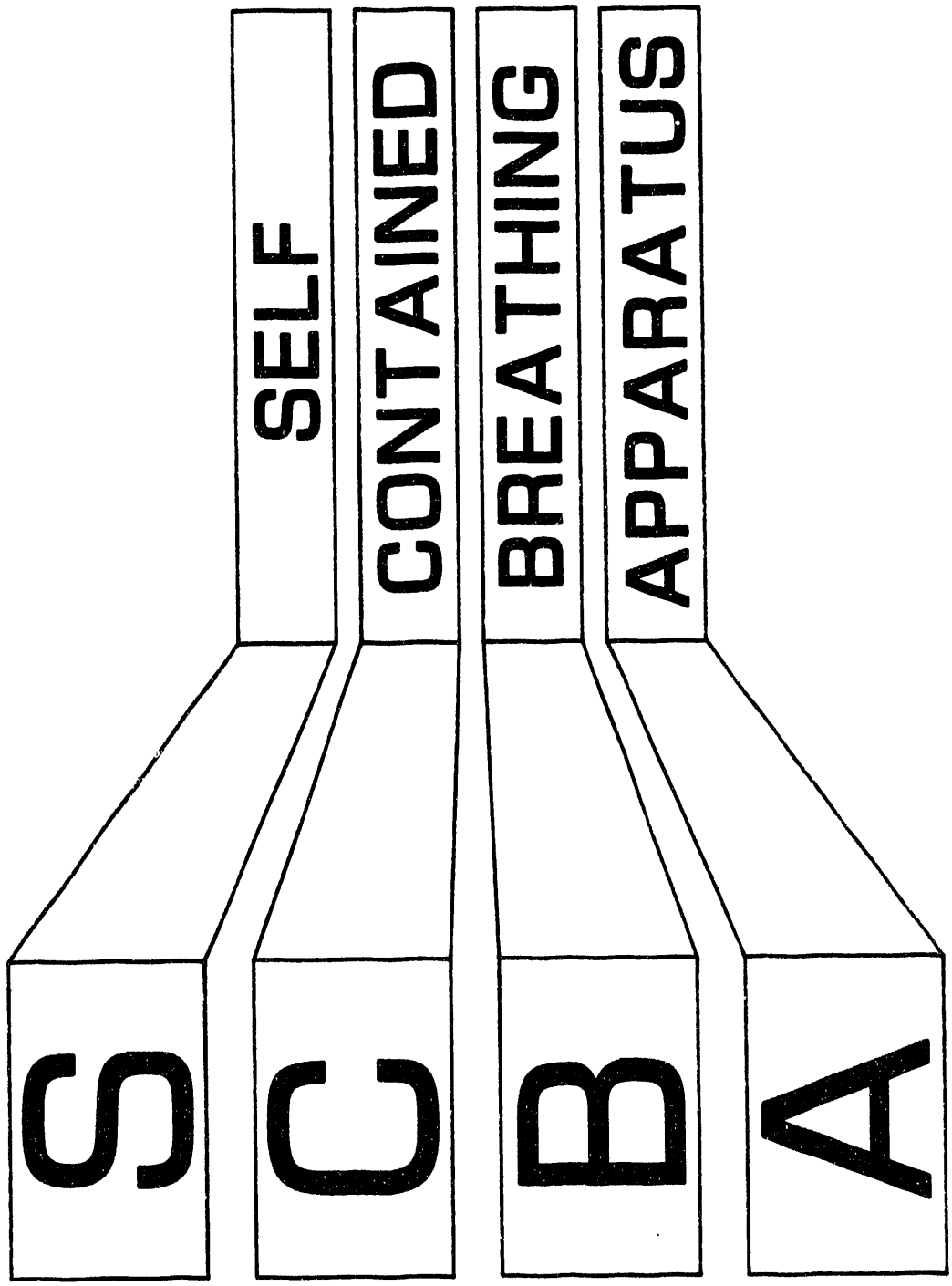
FULL-FACEPIECE, DUAL CARTRIDGE

RESPR020

FULL-FACEPIECE, CHIN-MOUNTED CANISTER

RESPR021

SCBA1



ORNL-DWG 88-6913

RECOMMENDED METHOD FOR DONNING THE... SCOTT® AIR-PAK® IIa

Improper use of this Apparatus in a Hazardous Atmosphere may result in injury or death. Personnel should receive Adequate Training prior to use.

BACK-STYLE

Remove Air-Pak from case. Grasp at backplate and cylinder band.

Swing unit up and over head, making sure that elbows extend through loops formed by shoulder straps.

Lean forward, resting unit on back. Buckle chest strap.

Pull down side straps. Return to upright position, snugging unit on back.

Connect and adjust waist belt.

Don Scottoramic® face-piece*, open cylinder valve and connect breathing hose to regulator.

SCOTT* where safety starts

Printed in USA

SCOTT AVIATION, Lancaster, N.Y. 14086 • TEL: 716 683-5100 • TELEX: 91-394

89104 01 2/78

IMPROPER USE OF THIS APPARATUS IN A HAZARDOUS ATMOSPHERE MAY RESULT IN INJURY OR

DEATH

SCBA2

WHEN WE WOULD USE A SCBA

1. WHEN ENTERING AN ATMOSPHERE IMMEDIATELY HOSTILE TO RESPIRATORY SYSTEM AND LIFE.

2. WHEN ENTERING ATMOSPHERES WITH UNKNOWN PROBLEMS (E.G. FIRE, CHEMICAL LEAK OR SPILL, LEAKING GAS CYLINDER, ETC.).

3. WHEN PROTECTIVE EQUIPMENT RECOMMENDATIONS ARE AT LEVEL A OR B.

SCBA3

SCOTT PRESUR-PAK IIA LIMITATIONS

- Respiratory protection only!
- Air supply- Working at moderate exertion, Approximately 30 minutes
- When low-air supply alarm comes in, you have approximately 5 minutes or 500 psi left in tank

SCBA4

SCBA AIR SUPPLY DURATION

DEPENDS ON:

- Degree of Physical Activity of User
- Physical Condition of User
- Degree of Training or Experience User Has Had With This Or Similar Equipment
- Degree User's Breathing Is Affected By Excitement, Fear or Other Emotional Factors
- Whether Or Not Cylinder Is Fully Charged At Beginning Of Work Period
- Condition of Apparatus

SCBA6

RADIATION AND CHEMICAL PROTECTIVE CLOTHING

SCOPE

This portion of the Personal Protective Equipment module presents information about the clothing used at the facility to protect workers from the harmful effects of radiation and chemical exposure. It includes demonstrations of types of protective clothing; the proper ways to don, use, and doff the clothing; and the levels of protection provided by specific types of equipment.

PARTICIPANT GOALS

1) Review the function of protective clothing.

2) See demonstrations of the proper way to don and doff protective clothing.

3) Learn the five common sense rules for contamination zones.

4) Gain an understanding of the levels of protective equipment, the protection provided by each level, and proper uses and limitations of the equipment.

INSTRUCTOR PREPARATION

- Arrange for live demonstrations of all the types of radiation and chemical protective clothing in use at the facility.
- Prepare outline of the information to be included during the demonstration.
- Assemble viewgraphs of level A, B, C, and D protective equipment.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Demonstrate the proper way to don, use, and doff radiation protective clothing.

- Discuss the function of the protective clothing, the important things to remember as clothing is donned and doffed, and ALARA.

- Discuss the importance of being aware of special hazards, such as fire, explosions, and low oxygen levels, in addition to radiation hazards in contamination zones.

- Describe the limitations that protective clothing impose on the wearer including noise, difficulties in hearing and communicating, heat stress, and limited vision.

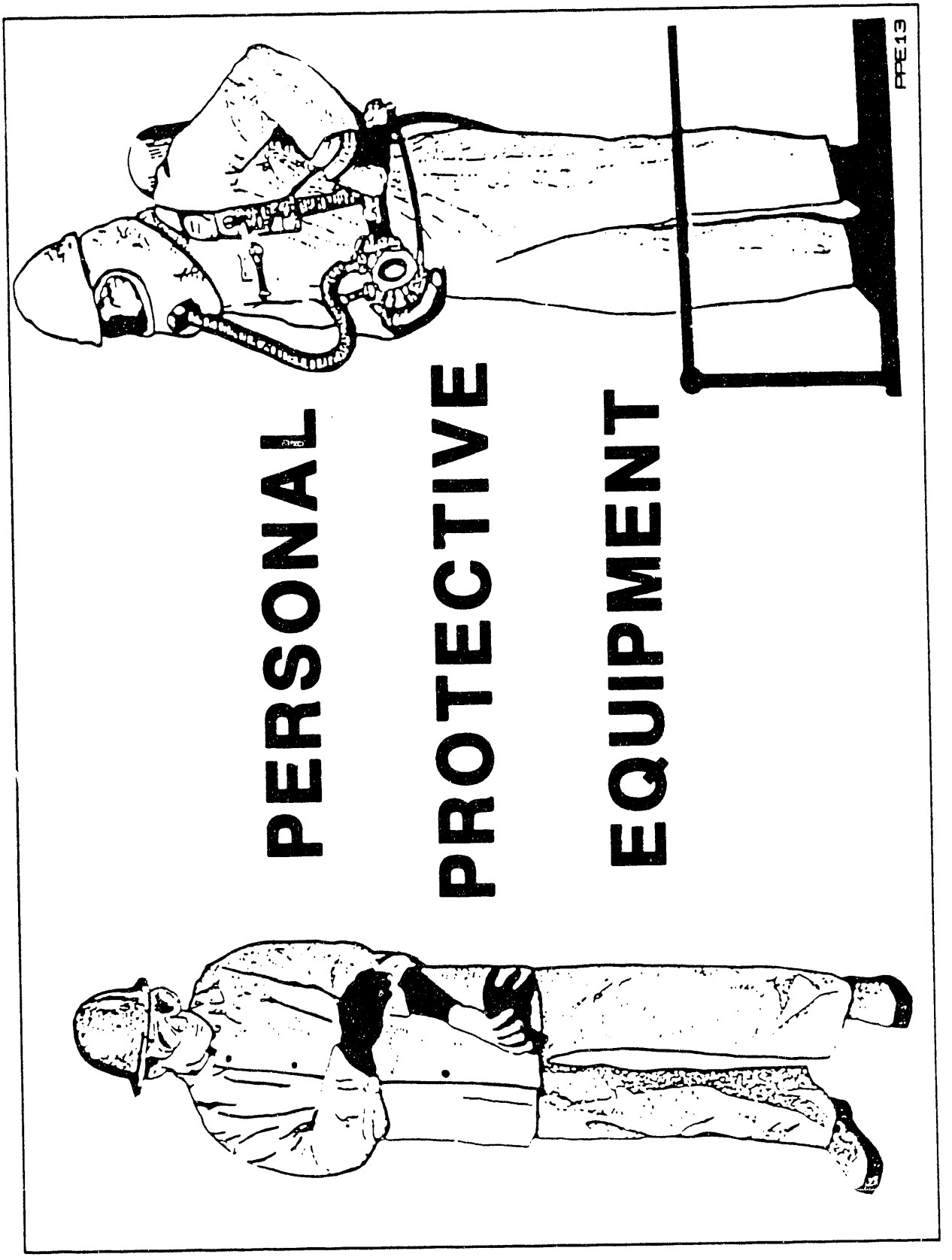
- Discuss the five common sense rules for contamination zones:
  1. no smoking, eating, drinking;
  2. use respiratory protection;
  3. don and doff protective clothing properly;
  4. always monitor when leaving the area;
  5. remember you must protect yourself.

- Demonstrate the proper way to don, use, and doff chemical protective clothing.

- Describe the protection provided by each level of equipment, the proper uses and limitations of each level of equipment, and identify the specific equipment needed for each level of protection.
  (PPE 13, 14, 1-3, 6, 4, 5, 7, 9, 10, 8, 11, 12)

- Distribute and oversee completion of worksheet or exam.

ORNL-DWG 88-6925



OBJECTIVES

DESCRIBE PROTECTION PROVIDED BY EACH LEVEL OF EQUIPMENT

DISCUSS PROPER USES AND LIMITATIONS OF VARIOUS LEVELS OF EQUIPMENT

IDENTIFY SPECIFIC EQUIPMENT NEEDED FOR EACH LEVEL OF PROTECTION

PPE14

ORNL-DWG 88-6924

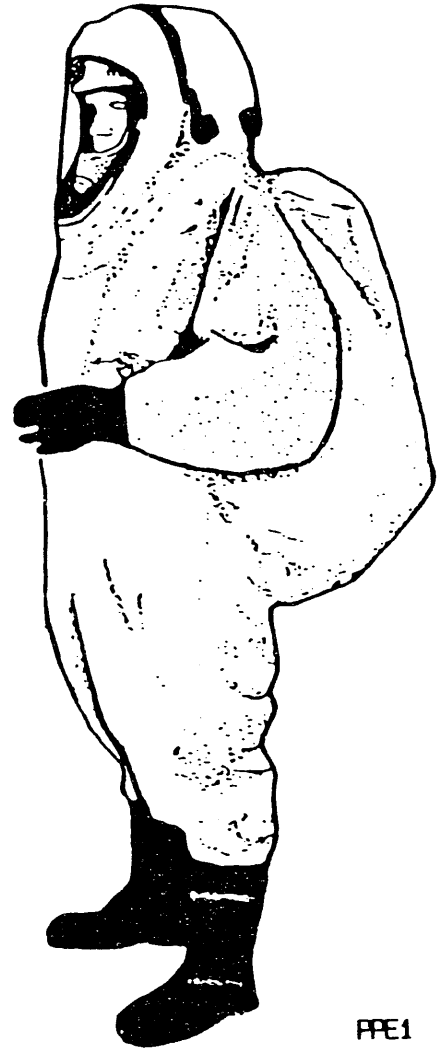
LEVEL A EQUIPMENT

RECOMMENDED:

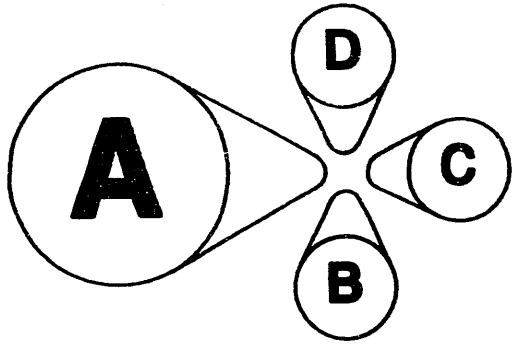
- Positive Pressure SCBA
- Totally Encapsulating Chemical-Resistant Suit
- Inner and Outer Gloves
- Chemical-Resistant Boots/Shoes

OPTIONAL:

- Cooling Unit, Coveralls, Long Cotton Underwear, Hard Hat, Disposable Gloves and Boot Covers



LEVEL A

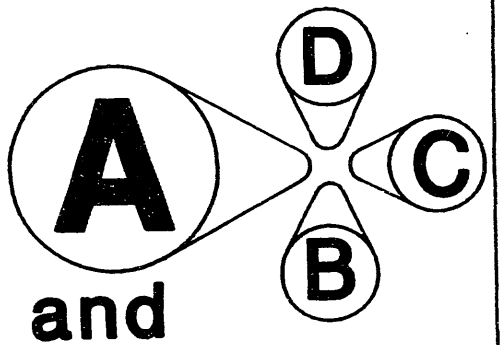


PROTECTION PROVIDED

Highest Level Provided for:

Respiratory Tract
Skin
Eyes

PPE2



SHOULD BE USED WHEN:

Chemical Substance Identified and Requires the Highest Degree of Protection for Respiratory Tract, Skin, and Eyes

Possibility of Contact with Substances Which Present a High Degree of Hazard to Skin

LIMITATIONS:

Fully-encapsulated Suit Does Not Offer Protection from All Chemicals

PPE3

ORNL-DWG 88-6923

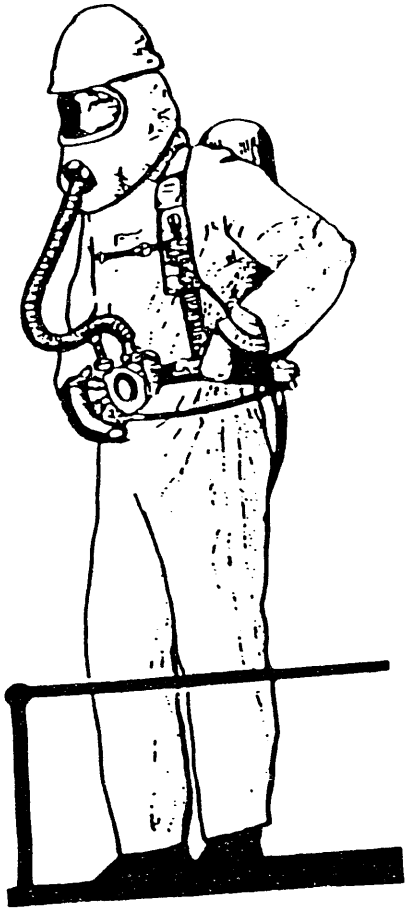
LEVEL B EQUIPMENT

RECOMMENDED:

- Full-Facepiece SCBA or Supplied-Air Respirator with Escape SCBA
- Chemical-Resistant Clothing
- Chemical-Resistant Inner & Outer Gloves
- Chemical-Resistant Safety Boots/Shoes
- Hard Hat

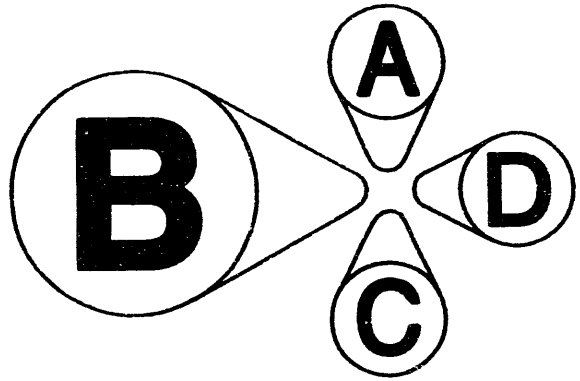
OPTIONAL:

- Coveralls, Faceshield, Disposable Boot Covers, Long Cotton Underwear



PPE6

LEVEL B



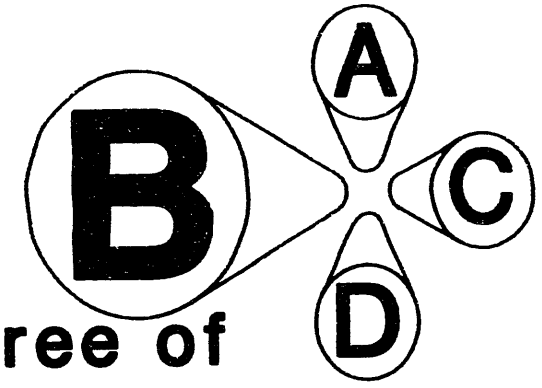
PROTECTION PROVIDED:

Maximum Respiratory Protection

Lesser Degree of Skin Protection

Minimal Level Recommended For Initial Site Entry Until Hazards Are Identified

PPE4



SHOULD BE USED WHEN:

Contaminants Identified, High Degree of Respiratory Protection Required, but Less Skin Protection Needed

Atmosphere Contains Less Than 19.5% Oxygen

Incompletely Identified Vapors or Gases Are Not Suspected to Contain High Levels of Chemicals That Are Harmful to Skin

LIMITATIONS:

Cannot Be Used When Chemicals Present Are Harmful to Skin

PPE5

ORNL-DWG 88-6922

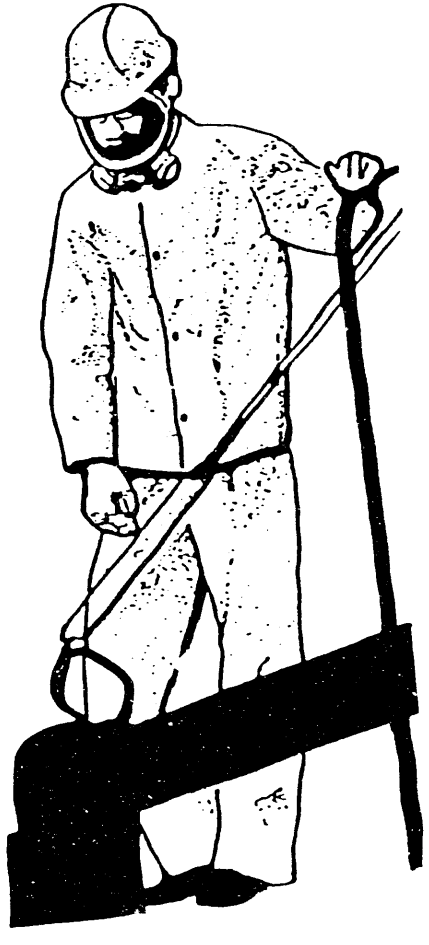
LEVEL C EQUIPMENT

RECOMMENDED:

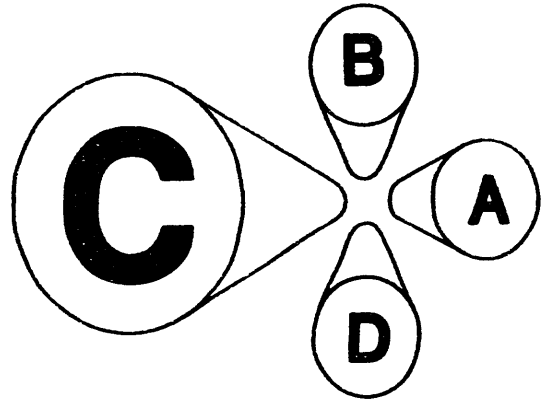
- Full-facepiece Canister Respirator
- Chemical-Resistant Clothing
- Chemical-Resistant Inner & Outer Gloves
- Chemical-Resistant Safety Boots/Shoes
- Hard Hat

OPTIONAL:

- Coveralls, Face Shield, Disposable Boot Covers, Long Cotton Underwear, Escape Mask



LEVEL C

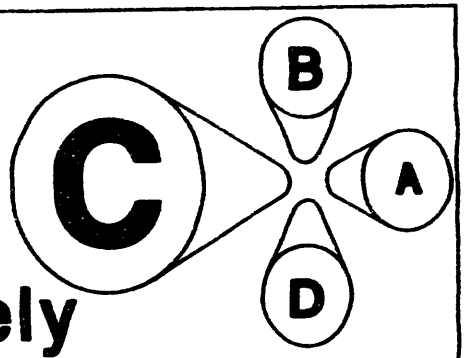


PROTECTION PROVIDED:

Same Skin Protection As Level B

Less Respiratory Protection than Level B

PPE9



SHOULD BE USED WHEN:

Contaminants Will Not Adversely Affect Any Exposed Skin

Air Contaminants Identified, Concentration Known, and Proper Respirator Canister Is Available

LIMITATIONS:

Atmospheric Concentration of Chemicals Must Not Exceed IDLH Levels

Atmosphere Must Contain At Least 19.5% Oxygen

PPE10

ORNL-DWG 88-6921

LEVEL D EQUIPMENT

RECOMMENDED:

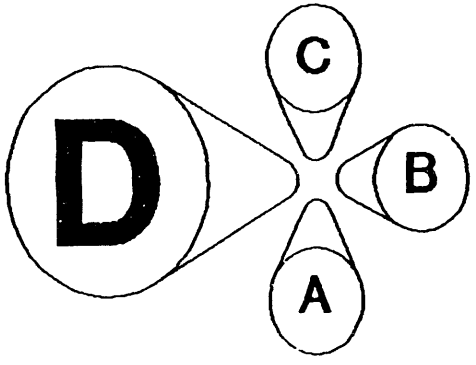
- Coveralls
- Safety Boots/Shoes
- Safety Glasses or
  - Chemical Splash Goggles
- Hard Hat

OPTIONAL:

- Gloves
- Escape Mask
- Face Shield

PPEB

LEVEL D

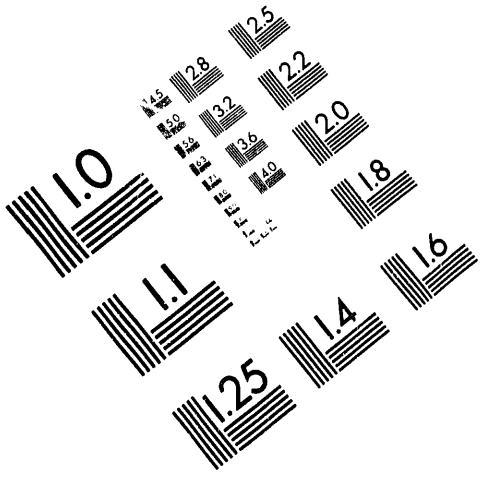


PROTECTION PROVIDED:

No Respiratory Protection

Minimal Skin Protection

PPE11



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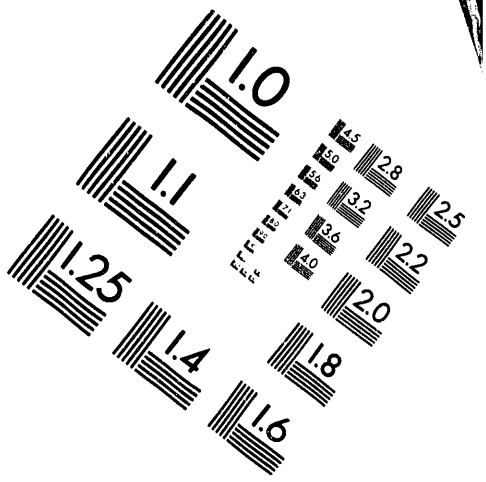

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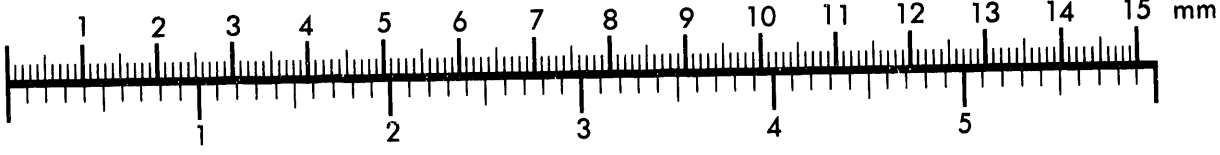
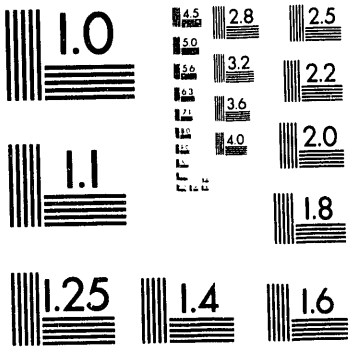
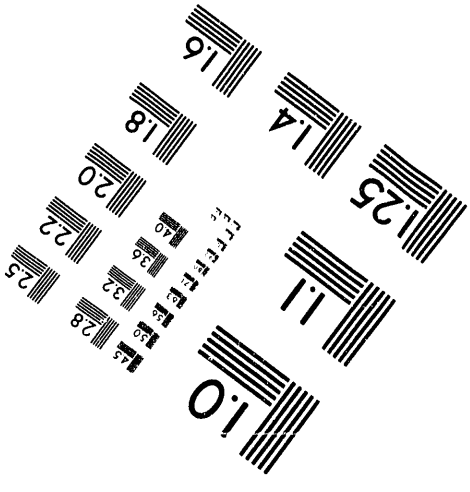
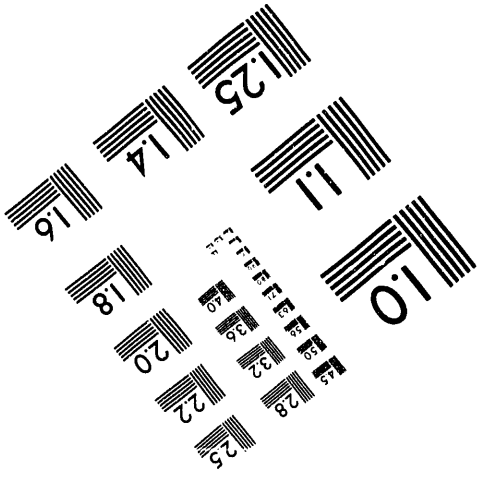


Inches







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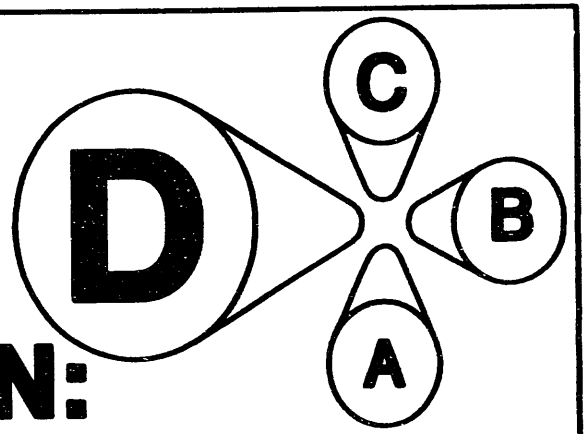


SHOULD BE USED WHEN:

Atmosphere Contains No Known Hazards

There Is No Possibility of Unexpected Inhalation or Contact With Hazardous Levels of Any Chemical

LIMITATIONS:

Should Not Be Worn In Contamination Zone

Atmosphere Must Contain At Least 19.5% Oxygen

PPE12

OVERVIEW OF FACILITIES

SCOPE

This module presents an overview of the hazardous waste sites which exist at this DOE Contractor facility. All waste sites will be described with the emphasis being on those sites on which the individuals participating in this training course will be expected to work. (Suggested time - 1 3/4 hours)

PARTICIPANT GOALS

1) Receive an historical perspective of closed and operating hazardous waste sites at the facility.

2) Gain an understanding of the waste generation, storage, treatment and disposal activities, both historical and ongoing, at the facility.

3) Learn that there are ongoing remedial action activities at the facility.

4) Recognize the existing liquid, solid, and gaseous waste systems at the facility.

INSTRUCTOR PREPARATION

NOTE: This suggested approach is the one used at ORNL

- Research the historical waste management documents (reports and their references) of the facility for information, flow sheets, and historical photographs with file numbers.

- Prepare a set of viewgraphs which describe the name (if applicable), geographical location, date of opening and closing, type of waste (including results of monitoring for radioactivity and chemicals), and current problems requiring remedial action for each hazardous waste site at the facility.

- Find historical photographs and take current photographs of each generation, treatment, and disposable site. These photographs should be shown at the same time as, and correlated with, all waste stream flowsheets.

- Diagram the process waste system which was used for all closed hazardous waste sites to be used as a viewgraph or handout.

- Review the facility's RCRA Facility Assessment Documentation which identifies and characterizes what is at each RCRA 3004(u) site.

- Prepare viewgraphs which illustrate below-grade tank installations, if applicable.

- Prepare maps giving the location of waste disposal sites relative to the major components of the watershed both on and adjacent to the facility to be used as viewgraphs or handouts.

- Create a flow sheet for liquid waste streams.

- Create a flow sheet of the solid, liquid, and gaseous radioactive waste disposal system(s).

- Create a flow sheet for liquid chemical wastes.

- Create a flowsheet for solid wastes.

- Create flow sheets for mixed wastes and miscellaneous hazardous wastes.

- Create topographic maps of each waste site indicating movement of ground water, direction of prevailing wind, location of trenchs and seeps, identity of streams and rivers, location of access roads.

- Create flow sheets identifying the source and type of potentially hazardous emissions into the air and illustrating emission controls, monitoring procedures, and the agency or DOE Order under which the emissions are permitted or controlled.

- Prepare viewgraphs of all flow sheets and maps.

- Prepare viewgraphs of maps which show the location of air monitoring stations on-site, at the perimeter, and in locations remote from the waste site.

- Prepare viewgraphs of maps showing the location of groundwater monitoring wells around waste ponds, near pits and underground tanks, and near solid waste disposal areas.

- Prepare worksheet or exam which covers current TSD sites on which the participants may work.

INSTRUCTIONAL ACTIVITIES

- Show and discuss the viewgraphs and photographs describing waste generation, storage, treatment, and disposal activities, both historical and ongoing, at the facility.

- Discuss all of the hazardous waste sites on which the participants may be expected to work and identify the sites requiring remedial action.

- Distribute and oversee completion of worksheet or exam.

SITE CONTROL AND CHARACTERIZATION

SCOPE

This module contains information about site control, site characterization, and site monitoring. The site control portion will present the components of the facility program to minimize contamination of waste site workers and members of the public. The site characterization portion is a discussion of the way specific waste site information is used to tailor worker protective measures to the existing hazards. The site monitoring portion presents information about the capabilities and limitations of industrial hygiene instrumentation and sampling methods. (Suggested time - 1 3/4 hour)

SITE CONTROL AND CHARACTERIZATION

SCOPE

This portion of the module contains information about both site control and site characterization. The site control section will present the components of the facility program to minimize decontamination of waste site workers and members of the public. The site characterization section is a discussion of the way specific waste site information is used to tailor worker protective measures to the existing hazards.

PARTICIPANT GOALS

1) Learn the purpose of site control.

2) Gain an understanding of the elements of site control including site preparation techniques and work zones, use of the buddy system, site security, communication systems, and safe work practices.

3) Learn the purpose and phases of the off-site characterization which is used to prepare the Site Safety Plan.

4) Gain an understanding of the procedures for on-site hazard assessment.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Assemble photographs illustrating site control.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Discuss the purpose and elements of site control.
  (CONTROL, CONTROL 1, 2)

- Discuss site preparation and work zones.
  (CONTROL 3, 4)

- Discuss site security.
  (CONTROL 5)

- Discuss comunication systems.
  (CONTROL 6)

- Discuss the elements of a Site Safety Plan and project planning for hazardous waste sites.
  (CONTROL 7-9)

- Describe the purpose and three phases of site characterization.
  (SITE 4D, 1, 2)

- Discuss the off-site characterization procedure.
  (SITE 3, 4A, 6)

- Discuss the way that site characterization information is used to protect site workers.
  (SITE 7)

- Discuss on-site characterization procedures, the elements of hazard identification, hazard assessment, and sample collection points.
  (SITE 8-11)

- Discuss ongoing site monitoring and instrumentation.
  (SITE 13)

- Distribute and oversee completion of worksheet or exam.

SITE CONTROL

CONTROL

SITE CONTROL

PURPOSE

MINIMIZE THE POTENTIAL CONTAMINATION OF WORKERS, PROTECT THE PUBLIC FROM THE SITE'S HAZARDS, AND PREVENT VANDALISM. SITE CONTROL IS IMPORTANT IN EMERGENCY SITUATIONS FOR ORDERLY EVACUATION

CONTROL1

ELEMENTS OF SITE CONTROL

- SITE PREPARATION
- SITE WORK ZONES
- BUDDY SYSTEM
- SITE SECURITY
- COMMUNICATION SYSTEMS
- SAFE WORK PRACTICES

CONTROL2

SITE PREPARATION

- ACCESS ROADWAYS
- ELIMINATE PHYSICAL HAZARDS
- PREPARE LOADING DOCKS
- ILLUMINATION
- PROVIDE ADEQUATE ELECTRICAL REQUIREMENTS
- SANITARY SYSTEMS

CONTROL3

SITE WORK ZONES

- HAZARDOUS WASTE SITE SHOULD BE DIVIDED INTO AS MANY ZONES NEED TO MEET SAFETY OBJECTIVES
- EXCLUSION ZONE (CONTAMINATED ZONE)
- CONTAMINATION REDUCTION ZONE (RADIATION ZONE)
- SUPPORT ZONE (REGULATED ZONE)

CONTROL4

SITE SECURITY

- PROVIDE FENCE AND WORKER IDENTIFICATION SYSTEM
- POST SIGNS ALONG PERIMETER
- USE VIDEO SURVEILLANCE DURING OFF-HOURS
- SECURE ALL EQUIPMENT AND MATERIALS

CONTROLS

COMMUNICATION SYSTEMS

- HAVE SIGNAL SYSTEM FOR HIGH NOISE AREAS OR PPE AREAS
- ESTABLISH EMERGENCY RESPONSE TEAMS
- USE RADIOS
- ESTABLISH USE OF SIGN FOR HIGH NOISE, OR AREAS NOT PERMITTING SMOKING, FOOD, etc.

CONTROL6

SITE SAFETY PLAN

- KEY PERSONNEL
- RISKS
- TRAINING
- PROTECTIVE EQUIPMENT
- MEDICAL SURVEILLANCE
- MONITORING (PERSONNEL, ENVIRONMENT)
- HAZARD MINIMIZATION
- SITE CONTROL MEASURES
- DECONTAMINATION
- DOCUMENT STANDARD OPERATING PROCEDURES
- EMERGENCY RESPONSE PLAN

CONTROL7

PROJECT PLANNING

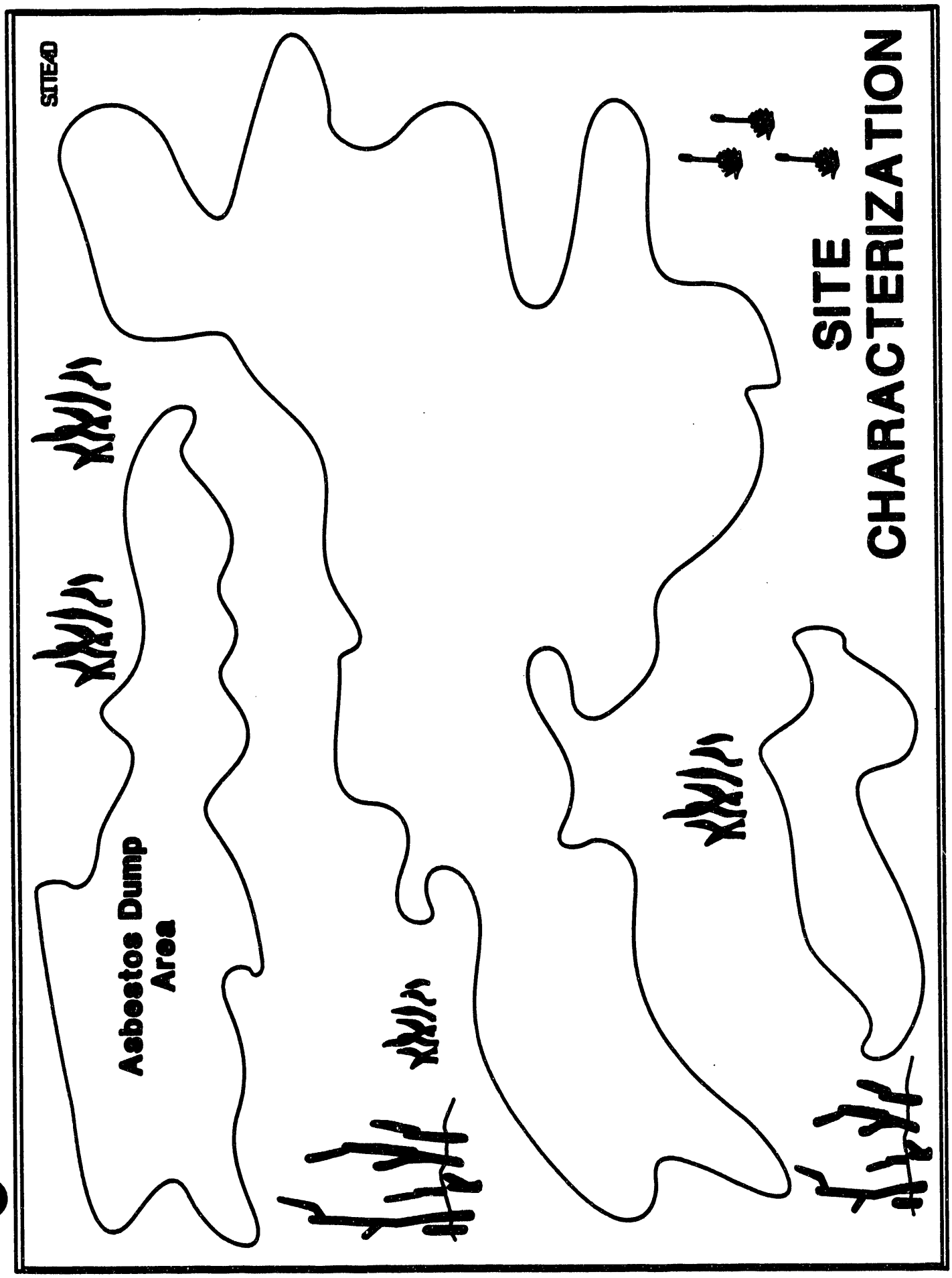
- Quality Assurance
  - Quality Assurance Assessment Plan
  - Site Specific Plan
- Environmental Assessments
  - Action Description Memorandum (ADM)
  - Activities Description Memorandum (AcDM)
  - Environmental ALARA Review Letter (EARL)
- Safety Assessments
  - Worker Protection
  - Criticality

CONTROLS

PROJECT PLANNING (continued)

- Radiation Work Permit
- Excavation Permit
  - Specific Area Utility Drawings
  - Atlas Review
- Construction Safety Work Permit
- Project Waste Management Plan

CONTROL9

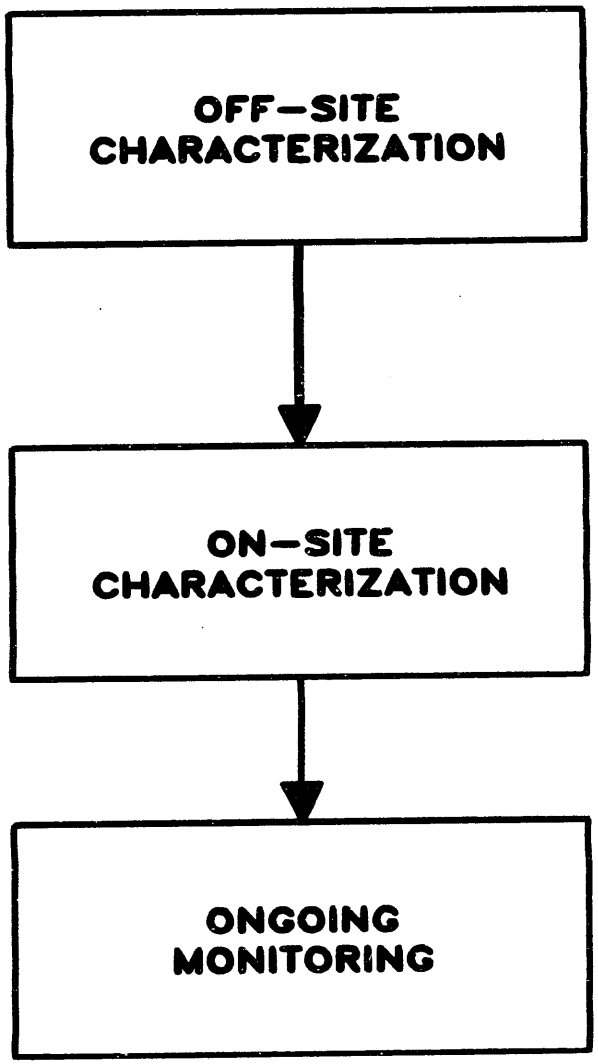

SITE 40
Asbestos Dump Area
SITE CHARACTERIZATION

PURPOSE OF SITE CHARACTERIZATION

SITE CHARACTERIZATION PROVIDES THE INFORMATION NEEDED TO IDENTIFY SITE HAZARDS AND TO SELECT WORKER PROTECTION METHODS

SITE 1

THREE PHASES OF CHARACTERIZATION



SITE2

OFF-SITE CHARACTERIZATION

PURPOSE

Obtain information before site entry so that hazards are evaluated and controls can be instituted to protect initial entry workers

FOCUS

Initial information should focus on potential and suspected conditions that may pose inhalation hazards that are immediately dangerous to life and health and other conditions

SITE3

OFF-SITE CHARACTERIZATION

TWO METHODS

- INTERVIEWS/RECORDS SEARCH
- PERIMETER RECONAISSANCE

FACILITY SOURCES (INTERVIEWS,RECORDS)

- WASTE OPERATIONS, PLANT AND EQUIPMENT, AND ENVIRONMENTAL WORKERS
- PLANT ATLAS DRAWINGS, INTRAPLANT CORRESPONDANCE, ENVIRONMENTAL MONITORING DATA
- RCRA ASSESSMENT PLANS (RAPs)
- TECHNICAL REPORTS

SITE4A

PERIMETER RECONNAISSANCE

- DEVELOP SITE MAPS, LOCATE BLDGS, PONDS, TANKS, etc.

- REVIEW AERIAL PHOTOGRAPHS
  - o DISAPPEARANCE OF NATURAL DEPRESSION
  - o VARIATION IN REFORESTATION OF DISTURBED AREAS
  - o MODIFICATIONS IN GRADE, PAVED AREAS
  - o CHANGES IN VEGETATION
  - o NOTE ANY LABELS, MARKINGS, AND PLACARDS
  - o NOTE DETERIORATION OR DAMAGE OF CONTAINERS
  - o NOTE BIOLOGICAL INDICATORS (DEAD ANIMALS OR PLANTS)
  - o NOTE DISCOLORED LIQUIDS, DIRT, OR VAPORS

SITE6

PROTECTION OF SITE ENTRY PERSONNEL

- THE INFORMATION FROM INTERVIEWS/RECORDS RESEARCH AND PERIMETER RECONNAISSANCE IS USED AS A BASIS FOR SELECTING THE PROTECTIVE EQUIPMENT FOR THE INITIAL SITE SURVEY.
- OBJECTIVES OF SITE ENTRY MAY VARY PROTECTIVE EQUIPMENT REQUIREMENTS. IF SURVEY JUST INVOLVES BECOMING FAMILIAR WITH ONSITE CONDITIONS AND DOESN'T INVOLVE OPENING CONTAINERS OR SAMPLING THEN PROTECTIVE EQUIPMENT CAN BE LESS STRINGENT

SITE7

ON-SITE CHARACTERIZATION

PURPOSE

VERIFY AND SUPPLEMENT INFORMATION FROM THE OFFSITE CHARACTERIZATION. PRIOR TO GOING ON-SITE, THE OFF-SITE CHARACTERIZATION SHOULD BE USED TO DEVELOP THE SITE SAFETY PLAN FOR SITE ENTRY.

FOCUS

MONITOR AIR FOR IDLH AND OTHER HAZARDOUS CONDITIONS.
MONITOR FOR IONIZING RADIATION AT ALL TIMES.
SAMPLING CAN BE DONE IF CONDITIONS ARE SAFE

SITE8

ON-SITE HAZARD IDENTIFICATION

- CONTAINERS AND STORAGE SYSTEMS
  - PAPER AND WOOD PACKAGES
  - METAL/PLASTIC BARRELS
  - UNDERGROUND TANKS
  - ABOVEGROUND TANKS
  - GAS CYLINDERS
  - LAGOONS, PONDS etc.
- CONDITIONS OF CONTAINERS
- PHYSICAL CONDITION OF MATERIALS
- DISPERSION PATHWAYS
- SAFETY HAZARDS
- BIOLOGICAL HAZARDS

SITE9

SAMPLING COLLECTION POINTS

- AIR MONITORING
- DRAINAGE DITCHES
- SOIL (SURFACE AND SUBSURFACE)
- STANDING POOLS OF LIQUIDS
- STORAGE CONTAINERS
- STREAMS AND PONDS
- GROUNDWATER

SITE10

HAZARD ASSESSMENT

PURPOSE

ONCE THE PRESENCE AND CONCENTRATIONS OF SPECIFIC CHEMICALS OR CLASSES OF CHEMICALS HAVE BEEN DETERMINED, THE HAZARD ASSOCIATED WITH THESE CHEMICALS MUST BE DETERMINED

- THRESHOLD LIMIT VALUE (TLV)
- PERMISSIBLE EXPOSURE LIMIT (PEL)
- RECOMMENDED EXPOSURE LIMIT
- IDLH CONCENTRATION LIMITS

SITE11

ONGOING MONITORING

SITE MONITORING

- MONITORING FOR IDLH AND OTHER DANGEROUS CONDITIONS
- GENERAL ONSITE MONITORING
- PERIMETER MONITORING
- PERIODIC MONITORING

PERSONAL MONITORING

INSTRUMENTS

- H-NU METER (ORGANICS)
- GEIGER-MUELLER (IONIZING RADIATION)
- COMBUSTIBLE GAS METER (OXYGEN, HYDROGEN)
- DIRECT-READING COLORIMETRIC INDICATOR

SITE13

SITE MONITORING

SCOPE

This portion of the Site Characterization and Control module presents information about the capabilities and limitations of industrial hygiene instrumentation and sampling methods.

PARTICIPANT GOALS

1) Receive information about the principles and instruments used for air monitoring, air sampling, and personal monitoring.

2) Gain an understanding of both the capabilities and limitations of industrial hygiene instrumentation and sampling methods.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare lecture notes.
- Assemble examples of the sampling and monitoring instruments used by industrial hygiene at the facility and small quantities of selected chemicals to use to demonstrate these instruments.
- Create an Odor Threshold Chart which includes chemicals in use at the facility. A suggested format for this type of chart is provided on page VII-30.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives.
  (Monitor 1)

- Describe instantaneous or grab sampling instruments, procedures, and usefulness.
  (Monitor 2, 3, 3B)

- Describe the procedure used to identify asbestos fibers in a sample.
  (Monitor 4)

- Describe integrated sampling instruments, procedures, and usefulness.
  (Monitor 5-7)

- Discuss sampling with direct reading instruments and the capabilities and limitations of each.
  (Monitor 8-14)

- Demonstrate the reactivity, cross-reactivity, and sensitivity of as many instruments as possible.

- Discuss the Odor Threshold viewgraph and the capabilities and limitations of the human nose as an instrument to detect harmful chemicals.

- Distribute and oversee completion of worksheet or exam.

ODOR THRESHOLD CHART

Chemical name	OT	TLV	Odor

OT < TLV

List several chemicals for which the odor threshold concentration is lower than the TLV. List the actual odor threshold concentration, the TLV, and a description of the odor.

OT = TLV

List several chemicals for which the odor threshold concentration and the TLV are the same. List the actual odor threshold concentration, the TLV, and a description of the odor.

OT > TLV

List several chemicals for which the odor threshold concentration exceeds the TLV. List the actual odor threshold concentration, the TLV, and a description of the odor.

Exceptions

List several chemicals which do not fall into any of these catagories such as chemicals with no odor and those which are depressants of the sense of smell. List the actual odor threshold concentration, the TLV, and a description of the odor or lack of odor.

PURPOSE

- GAIN A BETTER UNDERSTANDING OF BOTH CAPABILITIES AND LIMITATIONS OF INDUSTRIAL HYGIENE INSTRUMENTATION & SAMPLING METHODS

Monitor1

INSTANTANEOUS OR GRAB SAMPLES

- A SAMPLE COLLECTED OVER A VERY SHORT PERIOD OF TIME, RANGING FROM A FEW SECONDS TO A FEW MINUTES

Monitor2

INSTANTANEOUS OR GRAB SAMPLING

- 1. EVACUATED FLASKS/PLASTIC BAGS

  - Useful for determining the composition of air at a given moment (i.e. peak concentrations)
  - Useful for sampling events of short duration
  - May or may not be representative
  - May require long turnaround time for analysis

- 2. LIQUID SAMPLES

  - Useful if concerned about skin contact or ingestion
  - Useful as a basis for determining potential airborne contaminants
  - Useful for determining microbiological contamination

Monitor3

INSTANTANEOUS OR GRAB SAMPLING

- **3. BULK MATERIAL SAMPLES**
  - ▶ Useful for identifying asbestos in materials
  - ▶ Useful as a basis for determining potential airborne contaminants

Monitor3B

BULK ASBESTOS IDENTIFICATION

- 1. STEREOSCOPIC MICROSCOPE, LOW POWER
  - ▸ Used to locate and isolate fibers
  - ▸ Requires HEPA filtration to protect operating technician
- 2. POLARIZED LIGHT MICROSCOPE (PLM)
  - ▸ Reliable for materials containing greater than or equal to 1% asbestos
  - ▸ Two techniques used
    - ▪ Fiber extinction analysis
    - ▪ Refractive index analysis

Monitor4

INTEGRATED SAMPLING

- Definitions
  - ▸ A sample collected over an extended period of time, ranging from several minutes to several hours
  - ▸ Integrated samples involve the passage of a known volume of air through a collection medium to remove contaminants from the air
  - ▸ Most often, integrated samples are taken to an analytical laboratory for determination of contents
  - ▸ Integrated samples offer a much more reliable picture of the true composition and levels of contaminants than do grab samples

Monitor5

INTEGRATED SAMPLING

- Used when composition of the air is not uniform
- Used when analytical sensitivity necessitates collection of a minimal sample volume
- Used for compliance purposes

Monitor8

INTEGRATED SAMPLING COLLECTION METHODS

- 1. ACTIVE COLLECTION
  - ▸Components
    - a. Sampling Pump
    - b. Calibrated Air Flow
    - c. Collecting Media
    - d. Collection Time
  - ▸Methods
    - a. Charcoal Tubes
    - b. Silica Gel
    - c. XAD Resin
    - d. Filters
    - e. Bubblers
- 2. PASSIVE COLLECTION
  - ▸Advantages
    - a. Small and unobstrusive
    - b. Easy to use
  - ▸Methods
    - a. Liquid sorbant badge
    - b. Solid sorbant badge
    - c. Crystal growth badge
    - d. Passive colorimetry

Monitor7

SAMPLING WITH DIRECT READING INSTRUMENTS

- Direct Reading Instruments (DRI) offer the advantage of instant feedback, thus they are useful for screening and pinpointing sources of emissions
- DRIs may be used to quantitatively determine effectiveness of controls
- DRIs may be used as continuous monitoring devices in conjunction with alarms, data loggers and strip chart recorders

Monitor8

COLORIMETRIC INDICATORS

- **DETECTS**

  ▸Specific Gases and vapors

- **PRINCIPLE**

  ▸Chemical Reaction

- **LIMITATIONS**

  ▸Subject to cross-interferences
  ▸Semiquantitative
  ▸Limited Shelf-Life
  ▸Should be Refrigerated
  ▸Reading are subjective
  ▸Affected by high humidity
  ▸Sensitivity may not be adequate for some uses
  ▸One-time use for each tube

Monitor9

INFRARED SPECTROPHOTOMETER

- DETECTS
  - ▸Many Gases and Vapors
- PRINCIPLE
  - ▸Infrared absorption
- LIMITATIONS
  - ▸Must know specific chemical suspected
  - ▸Subject to cross interferences, i.e., false-positive reading
  - ▸High concentrations and dusts can damage analyzer optics
  - ▸Not to be used in potentially flammable or explosive atmospheres
  - ▸Easily mis-aligned in field situations
  - ▸Limited number of compounds in programmed library
  - ▸Time consuming due to program cycle and the ability to analyze for only one compound at a time

Monitor10

PHOTOIONIZATION DETECTORS

- **DETECTS**

  ▸Many organic and some inorganic gases and vapors

- **PRINCIPLE**

  ▸Molecular Ionization by UV radiation

- **LIMITATIONS**

  ▸Does not detect methane
  ▸Non-specific; measures total pollutant burden
  ▸Measures only those compounds having an ionization potential of less than 10.6 eV
  ▸Variable response
  ▸Affected by high humidity

- **COMMENTS:**

  ▸Primarily used as a screening device

Monitor11

COMBUSTIBLE GAS INDICATOR

- **DETECTS**

  ▸Combustible gases and vapors

- **PRINCIPLE**

  ▸Heat of Combustion

- **LIMITATIONS**

  ▸Non-specific
  ▸Sensitivity is dependent on differences between the calibration gas and the gas being sampled
  ▸Silicones, Halides, and Tetraethyl Leads may damage filament
  ▸Inaccurate readings under oxygen-deficient atmospheres
  ▸Cannot measure percentage of vapors in steam or inert atmospheres
  ▸Cannot detect explosive or combustible mists, spray or explosive dusts

Monitor12

OXYGEN METER

- **DETECTS**
  - ▸Percent of Oxygen in the air
- **PRINCIPLE**
  - ▸Electrochemical Sensor
- **LIMITATIONS**
  - ▸Affected by high humidity
  - ▸Carbon Dioxide can damage the sensor
  - ▸Oxidants can affect readings

Monitor 13

FIBROUS AEROSOL MONITOR

- **DETECTS**
  - ▸Airborne Fibers
- **PRINCIPLE**
  - ▸Laser-Electric Field
- **LIMITATIONS**
  - ▸Does not distinguish between fiber types
  - ▸Does not detect fibers less then 0.5 microns in diameter
  - ▸Cannot be field-calibrated

Monitor14

DECONTAMINATION

SCOPE

This module will present information about the types of contamination that hazardous waste site workers may encounter, measures used to prevent and control contamination, and the established facility decontamination procedures.
(Suggested time - 1 hour)

PARTICIPANT GOALS

1) Recognize types and sources of potential contamination.

2) Gain an understanding of contamination prevention measures.

3) Learn about the established facility and hazardous waste site decontamination procedures.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.
- Prepare viewgraph outlining the facility's standard decontamination procedures.
- Prepare lecture notes.
- Plan simulated decontamination scenario for inclusion in the Emergency Drill which is described in Module XII.
- Prepare participant handouts consisting of the Personnel Contamination Monitoring Data forms, Dose Rate forms, and Health Division Information forms which are in use at the facility.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce subject and objectives.
  (DECON 20, 14)

- Define decontamination.
  (DECON 1)

- Discuss the facility decontamination plan and the way it is used in hazardous waste site work zones. NOTE: It may be helpful to correlate this with the more familiar zones used for radiation.
  (DECON 2, 2A, facility-specific viewgraph)

- Discuss the standard operating procedures used to prevent contamination.
  (DECON 3)

- Discuss the types of contamination that hazardous waste site workers may encounter and the factors which affect permeation of these contaminants into the various levels of protective clothing.
  (DECON 4-7)

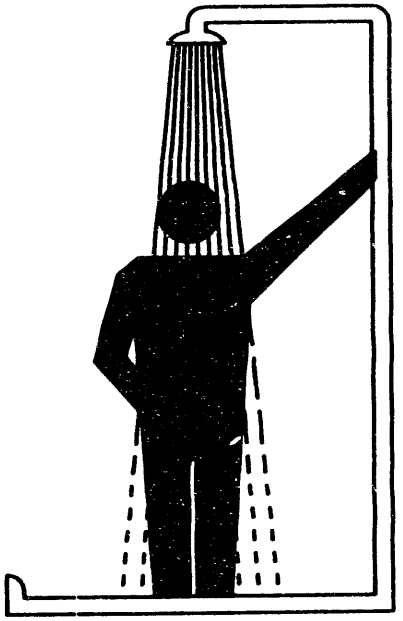
- Discuss physical and chemical decontamination methods and the potential health and safety hazards of incorrectly performing these procedures.
  (DECON 8-10, 10A)

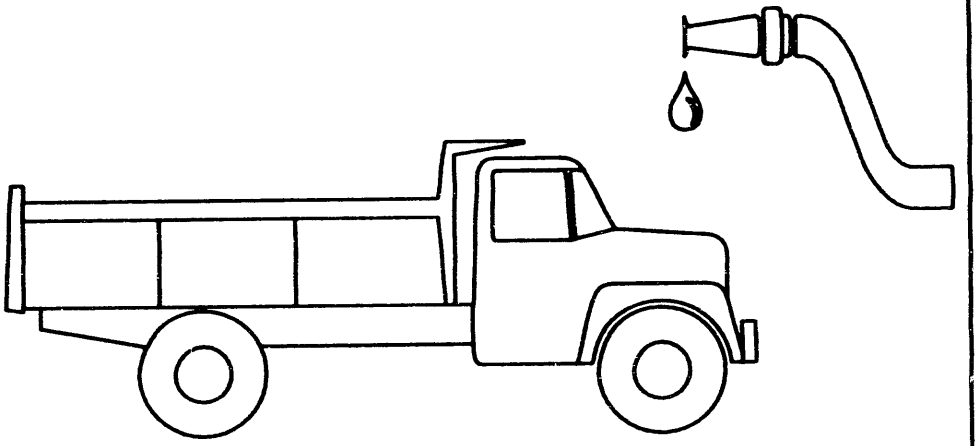
- Discuss the procedures used to test the effectiveness of decontamination procedures.
  (DECON 11-12)

- Distribute standard facility contamination monitoring forms and discuss how they are completed and used.

- Distribute and oversee completion of worksheet or exam.

DECONTAMINATION





DECON20

OBJECTIVES

- DEFINE DECONTAMINATION
- DISCUSS THE CONTENT OF DECONTAMINATION PLAN
- REVIEW CONTAMINATION PREVENTION MEASURES
- DISCUSS THE TYPES OF CONTAMINATION
- DECONTAMINATION METHODS
- EVALUATING DECONTAMINATION EFFECTIVENESS
- IDENTIFY ORNL DECONTAMINATION PROCEDURES

DECON14

DECONTAMINATION

DEFINITION

PROCESS OF REMOVING OR NEUTRALIZING CONTAMINANTS THAT HAVE ACCUMULATED ON PERSONNEL AND EQUIPMENT

PURPOSE

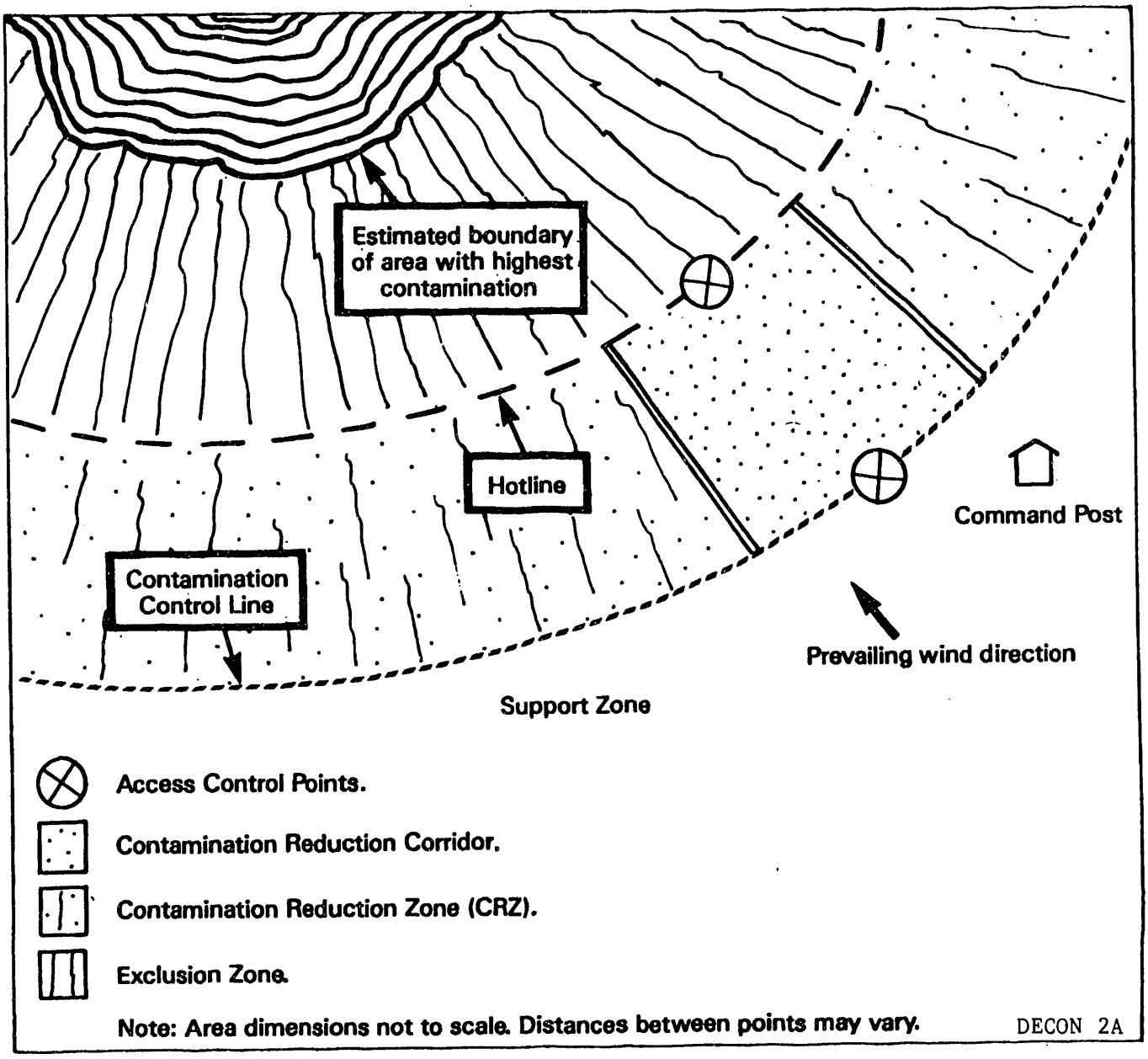
DECONTAMINATION PROTECTS WORKERS FROM HAZARDOUS SUBSTANCES THAT MAY CONTAMINATE OR EVENTUALLY PERMEATE THE PROTECTIVE CLOTHING, RESPIRATORY EQUIPMENT, TOOL, VEHICLES, AND OTHER EQUIPMENT

DECON1

DECONTAMINATION PLAN

- NUMBER AND LAYOUT OF DECONTAMINATION STATIONS
- DECONTAMINATION EQUIPMENT NEED/USED
- DECONTAMINATION METHODS
- CONTAMINATION CONTROL (Proper Removal of PPE/CLOTHING)
- DISPOSAL OF CONTAMINATED MATERIAL/CLOTHING

DECON2



Site Work Zones. (Note that decontamination facilities are located in the Contamination Reduction Zone.)

CONTAMINATION PREVENTION

- STRESS WORK PRACTICES THAT MINIMIZE CONTACT
- USE REMOTE SAMPLING, HANDLING, AND CONTAINER OPENING TECHNIQUES (DRUM GRAPPLERS, IMPACT WENCHES
- BAG MONITORING AND SAMPLING EQUIPMENT. MAKE OPENING IN BAGS FOR SAMPLE PORTS AND SENSORS THAT REQUIRE CONTACT
- WEAR DISPOSABLE OUTER GARMENTS AND USE DISPOSABLE EQUIPMENT WHERE POSSIBLE
- COVER EQUIPMENT AND TOOLS WITH STRIPPABLE COATING
- PLACE CONTAMINATED SOIL/MATERIALS ON PLASTIC

DECON3

TYPES OF CONTAMINATION

SURFACE

- SURFACE CONTAMINANTS MAY BE EASY TO DETECT AND REMOVE

PERMEATED

- CONTAMINANTS THAT HAVE PERMEATED A MATERIAL ARE DIFFICULT OR IMPOSSIBLE TO DETECT AND REMOVE.
- IF CONTAMINANTS THAT HAVE PERMEATED A MATERIAL ARE NOT REMOVED BY DECONTAMINATION, THEY MAY CONTINUE TO PERMEATE TO EITHER SURFACE OF THE MATERIAL WHERE THEY CAN CAUSE AN UNEXPECTED EXPOSURE

DECON4

PERMEATION

FIVE MAJOR FACTORS AFFECT PERMEATION :

(1) CONTACT TIME

(2) CONCENTRATION

(3) TEMPERATURE

(4) SIZE OF MOLECULE AND PORE SPACE

(5) PHYSICAL STATE OF WASTE

DECON5

PERMEATION (cont'd)

CONTACT TIME

THE LONGER THE CONTAMINANT IS IN CONTACT WITH AN OBJECT, THE GREATER THE PROBABILITY AND EXTENT OF PERMEATION. !!! THUS MINIMIZE CONTACT !!!

CONCENTRATION

MOLECULES FLOW FROM AREAS OF HIGH CONCENTRATION TO AREAS OF LOW CONCENTRATION. AS CONCENTRATION OF A WASTE INCREASES SO DOES POTENTIAL FOR PERMEATION

TEMPERATURE

AN INCREASE IN TEMPERATURE GENERALLY INCREASES THE PERMEATION RATE OF CONTAMINANTS

SIZE

PERMEATION INCREASES AS THE CONTAMINANT MOLECULE BECOMES SMALLER, AND AS THE PORE SPACE OF THE MATERIAL TO BE PERMEATED INCREASES

DECON6

PERMEATION (cont'd)

PHYSICAL STATE

AS A RULE, GASES, VAPORS, AND LOW-VISCOSITY LIQUIDS TEND TO PERMEATE MORE READILY THAN HIGH VISCOSITY LIQUIDS OR SOLIDS

DECON7

DECONTAMINATION METHODS

THREE MAJOR METHODS

- REMOVAL
- INACTIVATION
- COMBINATION

DECON8

PHYSICAL REMOVAL

LOOSE CONTAMINANTS

DUSTS AND VAPORS THAT CLING TO EQUIPMENT AND WORKERS OR BECOME TRAPPED IN SMALL OPENING CAN BE REMOVED WITH WATER OR LIQUID RINSE

ADHERING CONTAMINANTS

SOME CONTAMINANTS THAT ARE ADHESIVES REQUIRE PHYSICAL REMOVAL BY SCRAPING, BRUSHING, OR WIPING. REMOVAL OF ADHESIVES CAN BE ENHANCED BY SOLIDIFYING, FREEZING (dry ice), ABSORPTION (clay), OR MELTING

VOLATILE LIQUIDS

VOLATILE LIQUID CONTAMINANTS CAN BE REMOVED FROM PROTECTIVE CLOTHING OR EQUIPMENT BY EVAPORATION FOLLOWED BY A WATER RINSE. EVAPORATION CAN BE ENHANCE BY USING STREAM JETS.

DECON9

CHEMICAL REMOVAL

DISSOLVING CONTAMINANTS

CHEMICAL REMOVAL OF SURFACE CONTAMINANTS CAN BE ACCOMPLISHED BY DISSOLVING THEM IN A SOLVENT. THE SOLVENT MUST BE COMPATIBLE WITH THE PPE. ORGANIC SOLVENTS INCLUDE ALCOHOLS AND PETROLEUM PRODUCTS.

SURFACTANTS

SURFACTANTS AUGMENT PHYSICAL CLEANING METHODS BY REDUCING ADHESION FORCES BETWEEN THE CONTAMINANTS AND THE SURFACE TO BE CLEANED. SURFACTANTS INCLUDE HOUSEHOLD DETERGENTS.

SOLIDIFICATION

SOLIDIFYING LIQUID OR GEL CONTAMINANTS CAN ENHANCE THEIR PHYSICAL REMOVAL. MECHANISMS FOR SOLIDIFICATION INCLUDE MOISTURE REMOVAL (clay), AND FREEZING.

DECON10

General Guide to Solubility of Contaminants in Four Solvent Types

SOLVENT	SOLUBLE CONTAMINANTS
Water	Low-chain hydrocarbons. Inorganic compounds. Salts. Some organic acids and other polar compounds.
Dilute Acids	Basic (caustic) compounds. Amines. Hydrazines.
Dilute Bases For example: —detergent —soap	Acidic compounds. Phenols. Thiols. Some nitro and sulfonic compounds.
Organic Solvents[a] For example: —alcohols —ethers —ketones —aromatics —straight-chain alkanes (e.g., hexane) —common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds).

[a]WARNING: Some organic solvents can permeate and/or degrade the protective clothing.

DECONTAMINATION EFFECTIVENESS

VISUAL OBSERVATION ESTIMATE

THERE IS NO RELIABLE TEST TO IMMEDIATELY DETERMINE HOW EFFECTIVE DECONTAMINATION IS. VISUAL OBSERVATION CAN BE USED UNDER NATURAL LIGHT OR WITH ULTRAVIOLET LIGHT. SOME CONTAMINANTS WILL FLUORESCE (PAH) UNDER UV.

WIPE SAMPLING

WIPE TESTING PROVIDES AFTER-THE-FACT INFORMATION ON THE EFFECTIVENESS OF DECONTAMINATION. BOTH INNER AND OUTER SURFACES OF PPE AND EVEN SKIN SHOULD BE TESTED.

CLEANING SOLUTION ANALYSIS

EFFECTIVENESS CAN BE MEASURED BY ANALYZING THE CLEANING SOLUTION AFTER USE. CONTAMINANTS IN THE FINAL RINSE MAY INDICATE ADDITIONAL CLEANING IS NEEDED

DECON11

DECONTAMINATION EFFECTIVENESS

TESTING FOR PERMEATION

TESTING FOR THE PRESENCE OF PERMEATED CHEMICAL CONTAMINANTS REQUIRES THAT PIECES OF THE PROTECTIVE GARMENTS BE SENT TO A LABORATORY FOR ANALYSIS

DECON12

MEDICAL SURVEILLANCE

SCOPE

This module is an explanation of the purpose and components of the medical surveillance program required by OSHA 29 CFR 1910.120 for hazardous waste site workers. It includes specific information about the health care program at the facility.
(Suggested time - 1 hour)

PARTICIPANT GOALS

1) Learn the purpose and components of the medical surveillance program.

2) Recognize the different types of medical examinations and the reason each is necessary.

INSTRUCTOR PREPARATION

- Assemble viewgraphs.

- Prepare viewgraphs which give the following information for the medical department at the facility:

  - the health care professionals (by title) who staff the medical department;
  - which professional are at work and available for emergency treatment during each portion of a 24-hour day;
  - ambulance service(s) and local hospital(s) used by the medical department;
  - location of on-site decontamination facility(s);
  - availability of non-emergency treatment.

- Prepare lecture notes.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and explain the purpose of the medical surveillance program.
  (MDSUR 1, 22, 2, 14)

- Discuss the capabilities of the medical department.
  (MDSUR 4, 6, and viewgraphs covering staffing)

- Discuss the medical surveillance procedure including pre-employment, periodic, follow-up, and termination examinations.
  (MDSUR 15, 13, 16, 5A, 17, 7, 18, 8, 9, 10, 11A)

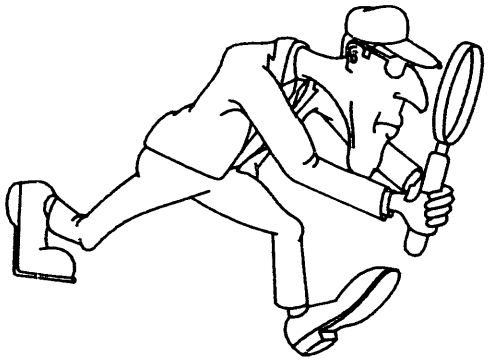
- Discuss emergency and non-emergency treatment.
  (MDSUR 12A and viewgraphs covering 24-hour day staffing, ambulance service, hospitals, and decontamination facilities)

- Explain the medical recordkeeping procedure.
  (MDSUR 19)

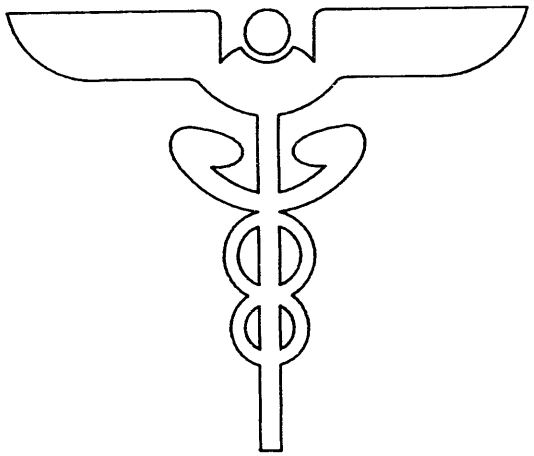
- Explain how the medical surveillance program is reviewed.
  (MDSUR 20)

- Conclude by explaining how the medical, industrial hygiene, and safety departments work together to ensure worker health.
  (MDSUR 21)

- Distribute and oversee completion of worksheet or exam.



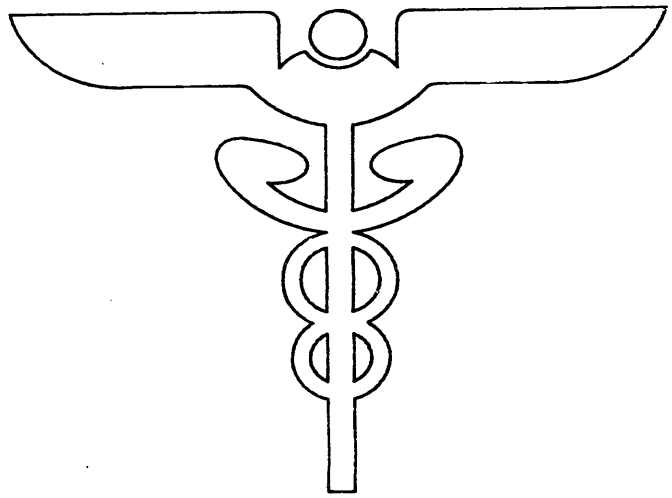
MEDICAL SURVEILLANCE



MDSUR1

A Medical Program is Essential:

* to assess and monitor workers' health and fitness
* to provide emergency and other treatment
* to keep accurate records



MDSUR22

MEDICAL SURVEILLANCE

A system set up to periodically provide:

1. **Physical examinations**
2. **Biological monitoring**
3. **Procedures**

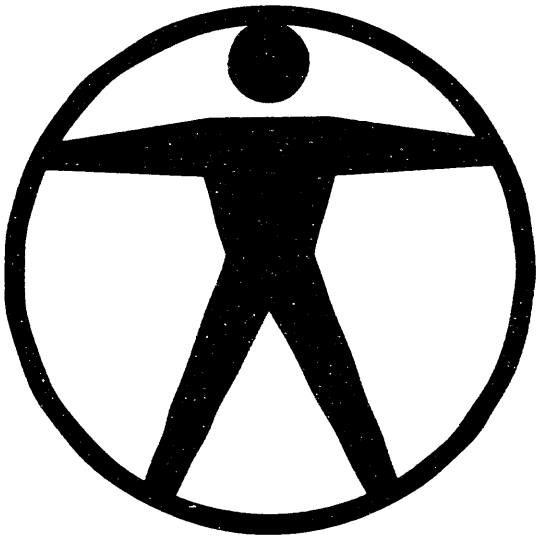
MDSUR2

PURPOSE OF MEDICAL SURVEILLANCE

* Observation of general health status
* Early detection of health disorders
* To assess the effects of potential hazardous exposure to the body

MDSUR14

MEDICAL SCREENING



1. Questionnaire
2. Physical Examination
3. Tests\Procedures

MDSUR 4

Medical Surveillance Program

4 Basic Parts

MDSURG

SURVEILLANCE

- Pre-employment
- Periodic
- Follow-up
- Termination

MDSUR15

PRE-EMPLOYMENT

- Establish baseline values
- Questionnaire
- Comprehensive physical examination

MDSUR13

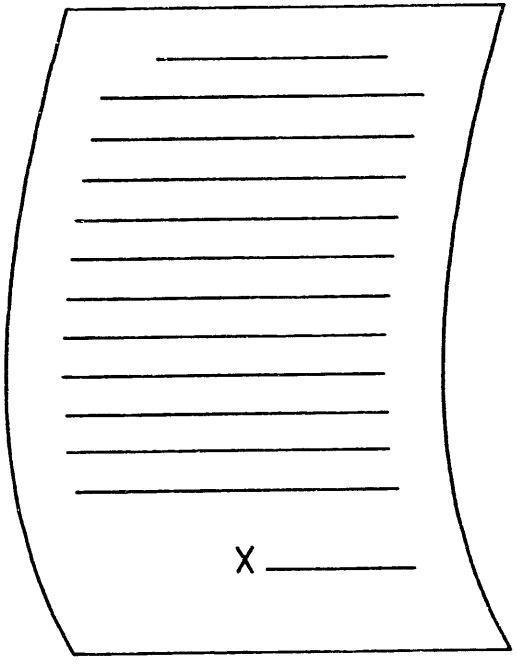
BASELINE VALUES

- Identify pre-existing conditions
- Identify employees who have increased susceptibility
- Provide medical data for future comparisons

MDSLR16

QUESTIONNAIRE

1. Past medical history
2. Occupational history
3. Family medical history
4. Lifestyles



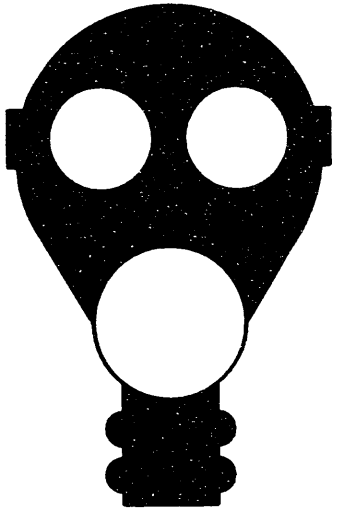
MDSURSA

COMPREHENSIVE PRE-EMPLOYMENT PHYSICAL EXAMINATION

Head, Nose, Throat	Growths, Pulses
Eyes	Intraocular Pressure
Ears	Canal, Eardrum
Chest (Heart, Lungs)	Beats, Sounds
Peripheral Vascular	Pulses
Abdomen, Rectum	Palpate, Listen, Hemocult
Genitourinary	Hernias, Pelvic Exam
Skin	Turgor, General Condition
Central Nervous System	Motor Movements
Tests, Procedures	Blood & Urine Lab Tests, EKG, X-Rays, Hearing & Vision Screening, Height, Weight, Vital Signs

MDSUR17

RESPIRATOR REQUIREMENTS



1. Pulmonary function test (PFT)
2. Chest xray
3. Physician's assessment of heart and lung sounds
4. Written medical clearance to Industrial Hygiene
5. Mandatory physical exam every 18 months

MDSUR7

TESTS AND PROCEDURES

Electrocardiogram (EKG)	Heart Function
Pulmonary Function Test (PFT)	Lungs
Chest X-Ray	Lungs
Vision Screening	Sight Depth, Distance
Audiometric Testing	Hearing Ability
Laboratory Tests	Urinalysis, Complete Blood Count, Chemistry Profile

(Chemistry profile includes glucose test to check sugar level in blood and sodium, potassium and chloride tests to check for minerals important to function of nerves, muscles and heart.)

MDSUR18

PERIODIC PHYSICIALS

PURPOSE:

To maintain surveillance of health status and detect any possible adverse effects or changes

METHODS:

45 years or younger
- voluntary
- 1st phase exams every 18 months (labs)
- 2nd phase exams every 3 years (physician visit)

45 years or older
- Voluntary
- 2nd phase every 18 months

MDSUR8

MANDATORY PHYSICIALS

Security inspectors	Annual
Reactor workers	Every 18 months
Lead burners	Special blood work every 6 months
Asbestos workers	Every 18 months
Respirator wearers	Every 18 months

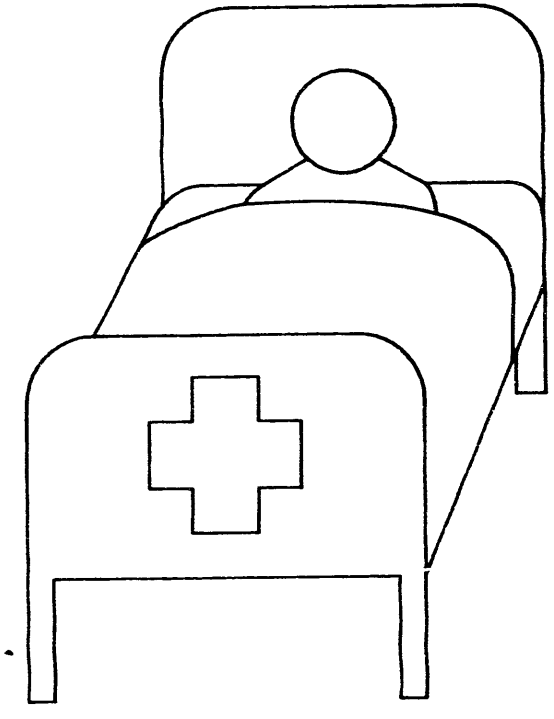
MDSUR9

FOLLOW-UP EXAMS

Determines progress

of a condition based

on previous exam



mdsur10

TERMINATION EXAM

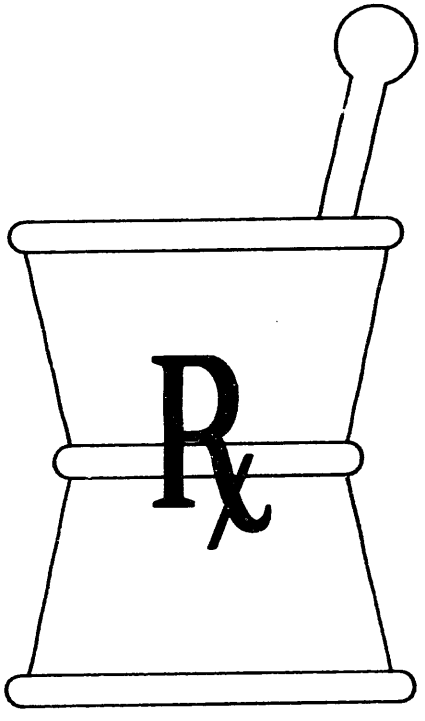
PURPOSE:

To document general health status and determine the presence or absence of toxic conditions.

Mandatory if employed full-time for more than six months

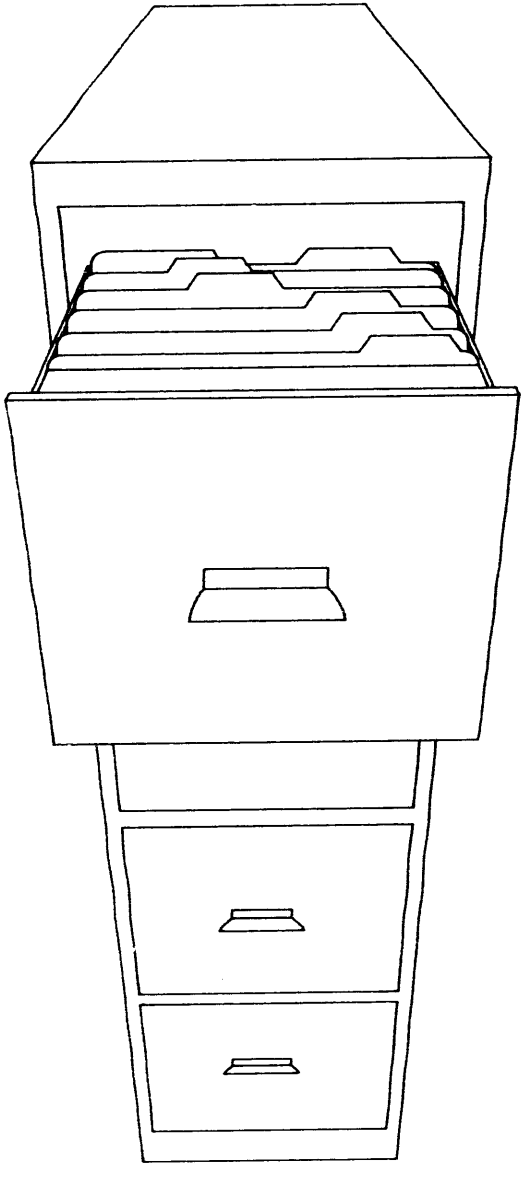
MOSUR11A

TREATMENT



* Emergency
* Non-emergency

MDSUR12A



RECORD KEEPING

- ★ Records must be kept indefinitely
- ★ Signed medical release form
- ★ All medical accident reports sent to Industrial Hygiene/Safety

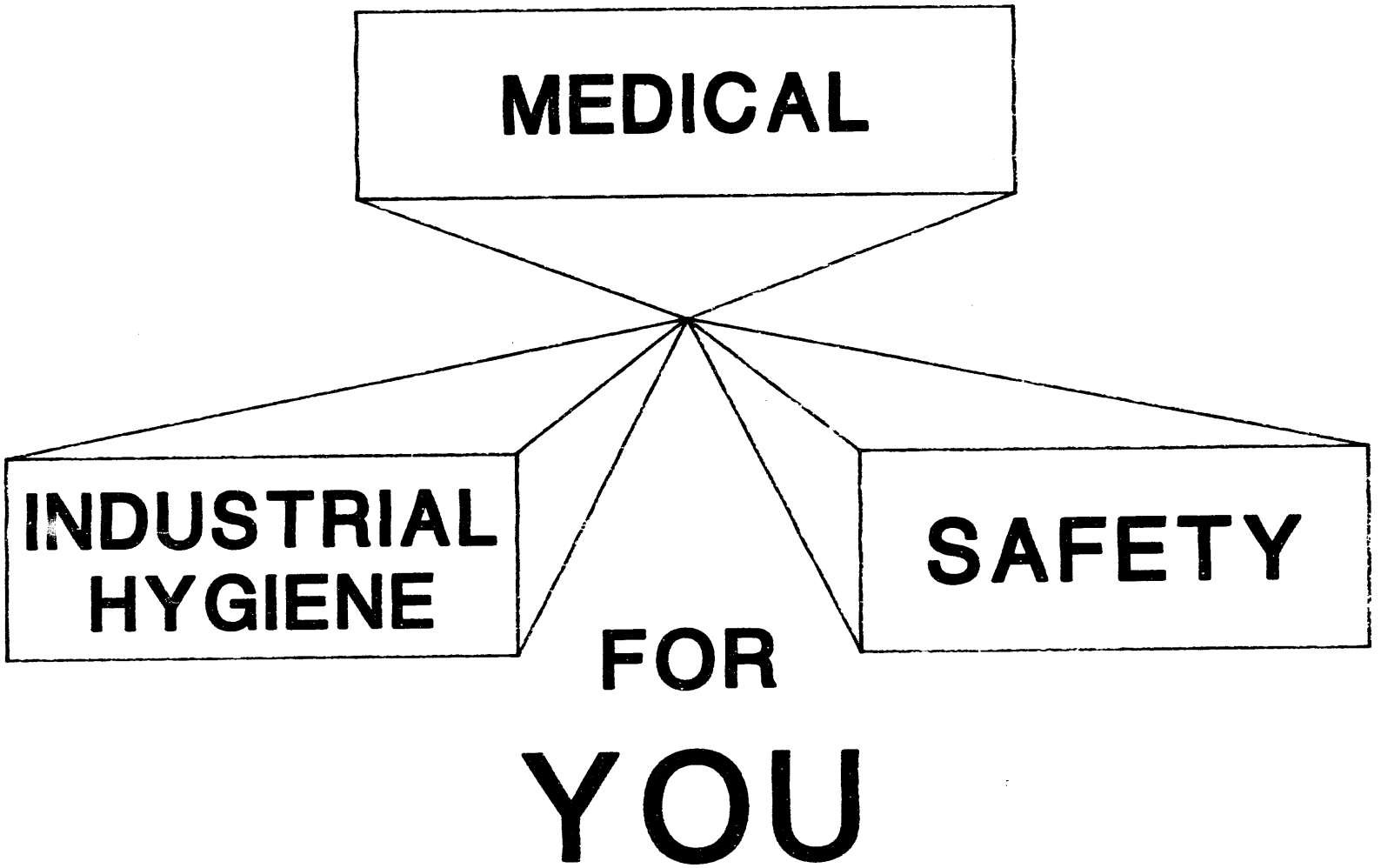
MDSUR19

PROGRAM REVIEW

- Investigation
- Evaluation
- Updating
- Review

MDSUR20

WORKING TOGETHER



MDSLR21

EMERGENCY PREPAREDNESS

SCOPE

This two-part module presents information about the facility's emergency preparedness and response programs and the uses of fire extinguishers.
(Suggested time - 1 3/4 hours)

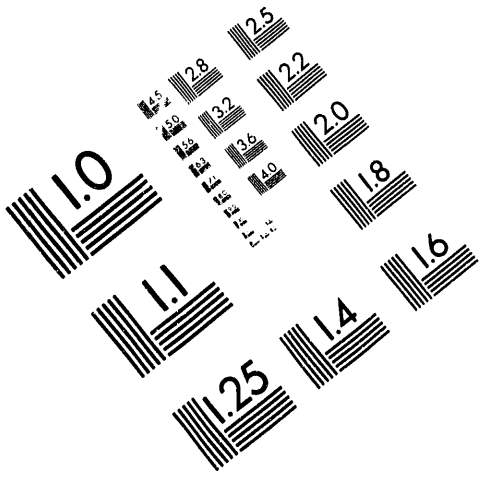
EMERGENCY RESPONSE

SCOPE

This module presents an overview of the emergency preparedness philosophy and programs which exist at a DOE Contractor facility. All types of emergency response actions are reviewed, with an emphasis upon emergencies dealing with hazardous materials releases. A tour of the facility emergency response center is incorporated as part of the instruction.

PARTICIPANT GOALS

1. Review the facility's emergency philosophy.
2. Learn the emergency event response levels and reporting time requirements.
3. Review appropriate emergency procedures.
4. Gain an understanding of the roles and responsibilities of facility personnel.
5. Learn about the ways in which hazardous material/chemical emergencies are managed.
6. Review the emergency communications system.
7. Review the Judgment Factor Checklist.



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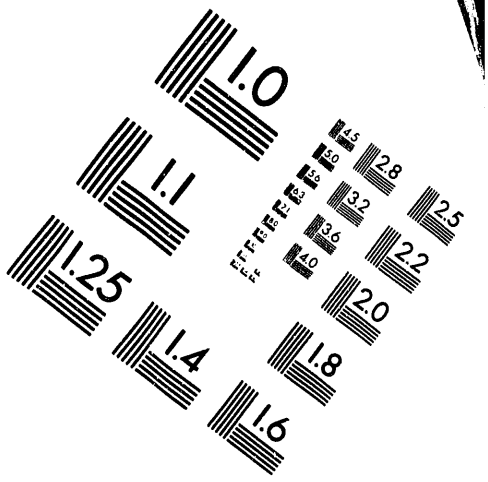

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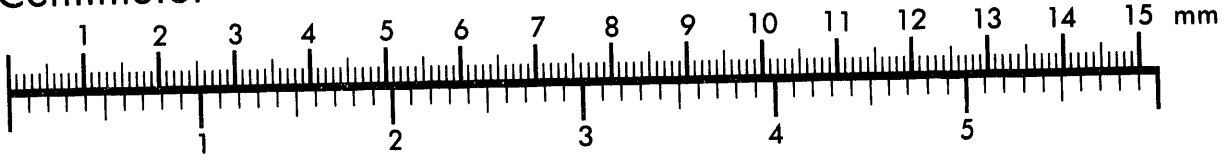

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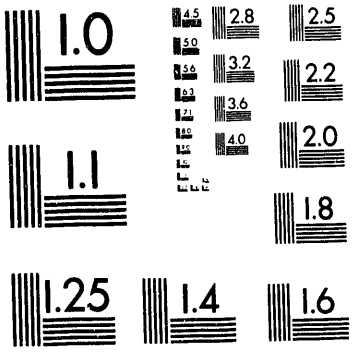

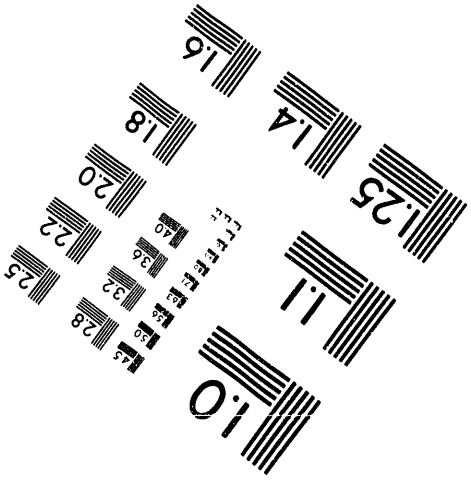

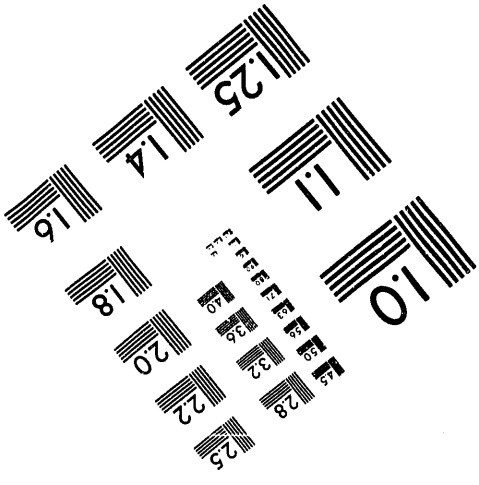

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6 of 6

INSTRUCTOR PREPARATION

- Review the facility's Emergency Manual and other procedures for appropriate material to meet the participant goals.

- Prepare handouts on the DOE Emergency Event Response Levels, Reporting Time Requirements, and a list of those individuals who are responsible for reporting during emergencies.

- Prepare a handout which emphasizes the resources available for handling emergencies dealing with hazardous materials/chemicals.

- Prepare a handout on the appropriate use of communications systems during emergencies.

- Arrange a visit to the emergency control center, if possible, to underscore the importance of emergency preparedness.

- Assemble viewgraphs.

- Prepare lecture notes.

- Choose a videotape of emergency response teams in action or of an emergency response drill.
  (ORNL chose "Just in Case III", a videotape designed to acquaint the viewer with SARA Title III - Community Awareness and Emergency Response. This videotape is available from Westinghouse Materials Company of Ohio, Emergency Preparedness Department, P. O. Box 398704, Cincinnati, OH 45239. FTS 774-6870; Commercial (513)738-6870)

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and objectives.
  (EP 1, 10)

- Explain the philosophy of emergency preparedness and response.
  (EP 8)

- Discuss the DOE Emergency Event Response Levels - general emergency, site emergency, alert, and unusual event; nonroutine events (reportable and loggable); and the reporting time requirements.
  (EP 2A, 3A, 4)

- Discuss the facility emergency procedures, what they cover, where they are located, and how they are practiced in drills.

- Explain the roles of different facility personnel in emergency situations and individual responsibilities for emergency preparedness, response, and reporting. Visit the control center and review how emergency management is maintained.
  (EP 7)

- Discuss in more detail how hazardous materials/chemical emergencies are managed. Review the roles that will be practiced in the emergency drill described in Module XII, with emphasis on who to call and not trying to handle an emergency alone unless absolutely necessary.

- Discuss the facility communications systems available for use during emergency situations.
  (EP 9)

- Review emergency preparedness drill activities and how they are documented by report of building emergency or evacuation drill.

- Explain the Judgment Factor Checklist on who's involved, what's the emergency, what got damaged, and how badly, location and circumstances, etc.
  (EP 5, 6)

- Show emergency response or emergency response drill videotape.

- Distribute and oversee completion of worksheet or exam.

EMERGENCY PREPAREDNESS AND RESPONSE

EP1

OBJECTIVES

Review:

- Emergency Philosophy
- Emergency Event Response Levels/Reporting
- Appropriate Emergency Procedures
- Personnel Roles and Responsibilites
- Hazardous Materials Emergencies
- Emergency Communications Systems
- Judgment Factor Checklist

EP10

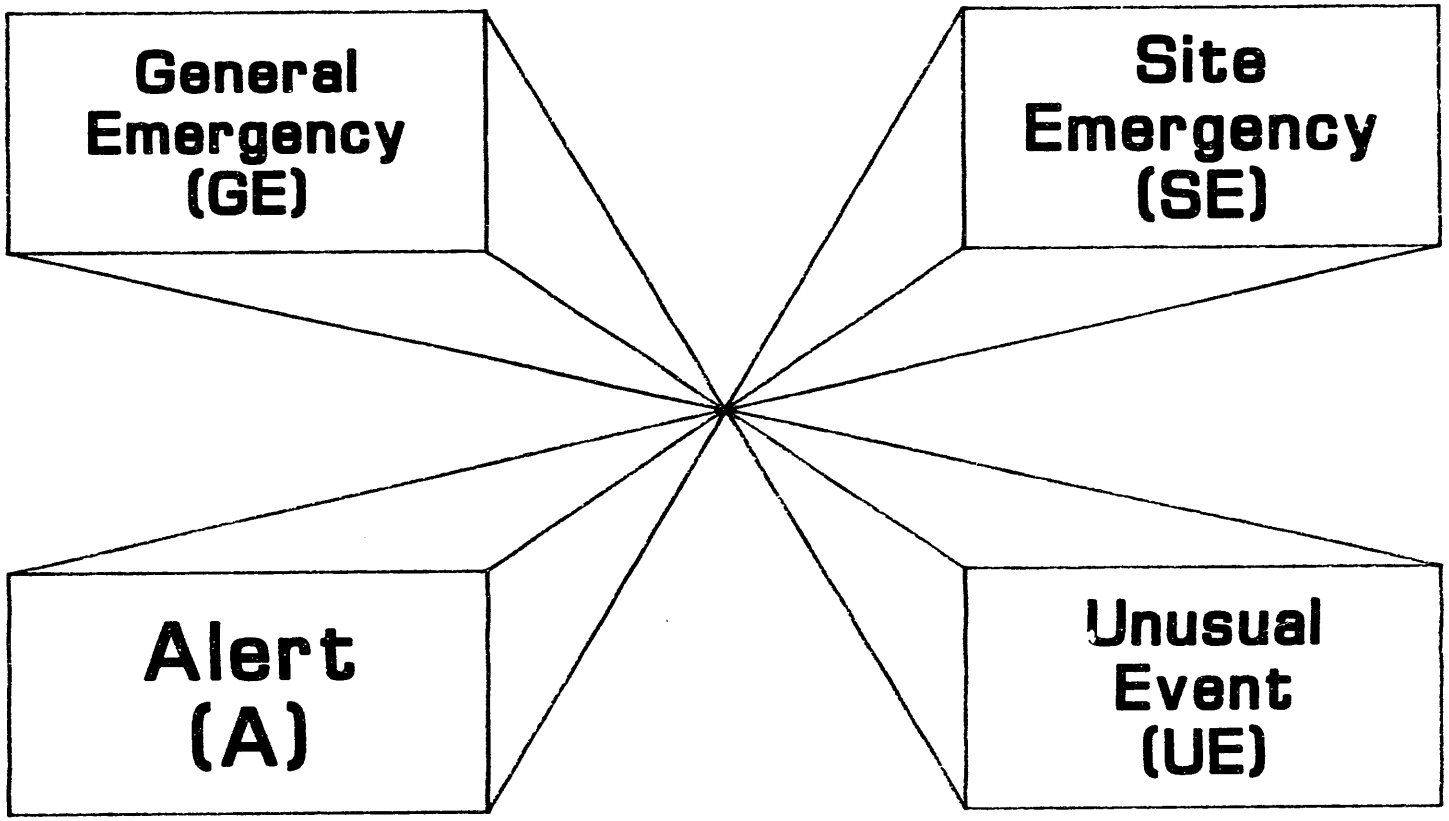
EMERGENCY PHILOSOPHY

- EVERYONE Has A Role in Emergency Planning And Response

- BASIS For Emergency Planning Is Explained and Documented in Emergency Response Manuals

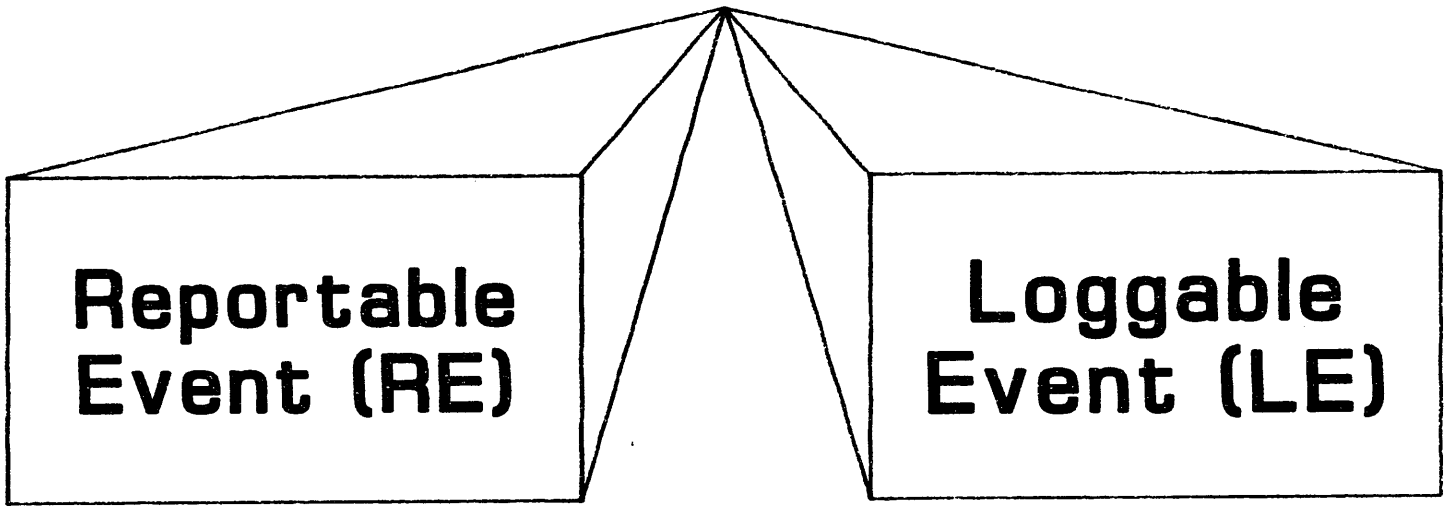
EP8

EMERGENCY EVENTS

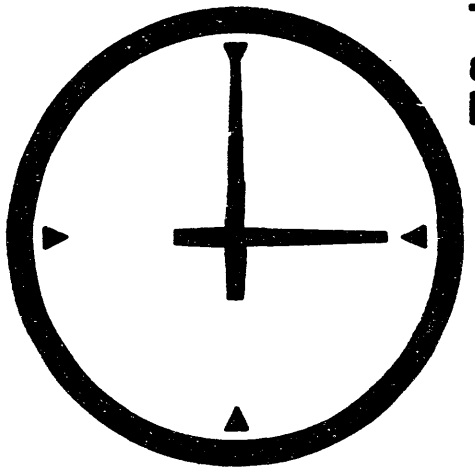


EP2A

NONROUTINE EVENTS



EP3A



The time clock starts at the time the event is classified.

REPORTING TIME REQUIREMENTS

General Emergency	15 Min
Site Emergency	15 Min
Alert	15 Min
Unusual Event	1 Hr
Reportable Event	ASAP Within 8 Hr

EP4

CATEGORY IDENTIFIERS

- Environmental (E)
- Safeguards and Security (SS)
- Health, Safety, and Fire (HSF)
- Radiological (R)

EP7

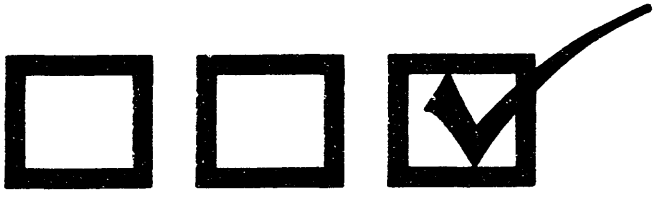
COMMUNICATION SYSTEMS

- Installation Communications Center
- Installation Emergency Response Center
- Radio Networks
- Emergency Public Address Systems
- Telephone Systems
- Computer Systems

EP9

JUDGMENT FACTOR CHECKLIST

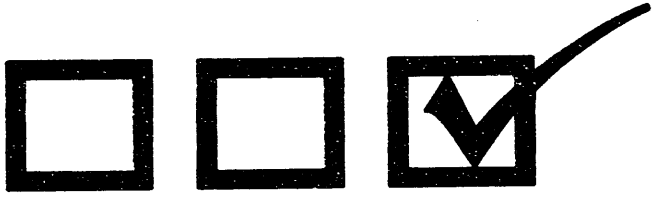
- Who's Involved?
  - ▸Sensitivity
  - ▸Number
  - ▸Severity of Injury or Exposure
- What's The Material?
- How Much?



EP5

JUDGMENT FACTOR CHECKLIST

- What Got Damaged?
  - ▸How Badly?
- Where Did It Happen?
  - ▸Location
  - ▸Circumstances
- What Do Regulations and Agreements Say?



EP6

FIRE EXTINGUISHERS

SCOPE

This portion of the Emergency Preparedness module is a discussion of proper response to a fire. It includes information about when and how to use portable fire extinguishers.

PARTICIPANT GOALS

1) Learn the correct procedure to report a fire at the facility.

2) Learn the types of portable fire extinguishers at the facility.

3) Learn when and how to use portable fire extinguishers.

INSTRUCTOR PREPARATION

- Decide what booklet to use as a handout and order copies.
  (ORNL chose to hand out copies of "Understanding Portable Fire Extinguishers", National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

- Choose and acquire a videotape describing fire extinguisher uses, if desired;
  (ORNL chose "Fighting Fires with Portable Fire Extinguishers", National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)
  or arrange a live demonstration and discussion of fire extinguisher uses and limitations.

- Outline introductory, facility-specific information about fire response and the use of fire extinguishers.

- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject and distribute handout booklet.
- Discuss how to use the types of portable fire extinguishers which are at the facility.
- Show videotape describing the uses of fire extinguishers, if desired, or demonstrate and discuss this subject.
- Inform participants of a mnemonic for fire extinguisher use: **PASS** - meaning Pull, Aim, Squeeze, Swish, back and forth.
- Describe the fire emergency reporting system at the facility.
- Distribute and oversee completion of worksheet or exam.

SPILL RESPONSE

SCOPE

This module defines a spill, presents information about when spills are to be reported, and outlines the correct procedure for reporting and cleaning up a spill.
(Suggested time - 1 hour)

PARTICIPANT GOALS

1) Learn how to respond to spills.

2) Learn the steps for fighting a spill.

INSTRUCTOR PREPARATION

- Collect photographs of spills at the facility to be used as viewgraphs.
- Prepare viewgraph listing the responsibilities of the person discovering an emergency.
  (SPLRSP 09 is included as an example)
- Assemble viewgraphs.
- Prepare lecture notes.
- Prepare participant worksheet or exam.

INSTRUCTIONAL ACTIVITIES

- Introduce the subject.
  (SPLRSP 10)

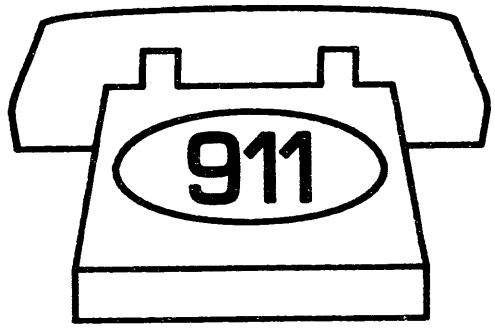
- Define a spill and discuss when spills are to be reported.
  (SPLRSP 11A, 12, and viewgraph of responsibilities)

- Discuss the facility's established steps for fighting a spill.
  (SPLRSP 01, 02, 03, 08, facility-specific viewgraph)

- Describe ways to safely identify spilled material.
  (SPLRSP 05, 04)

- Discuss spill clean-up and decontamination procedures.
  (SPLRSP 06, 07, photographs)

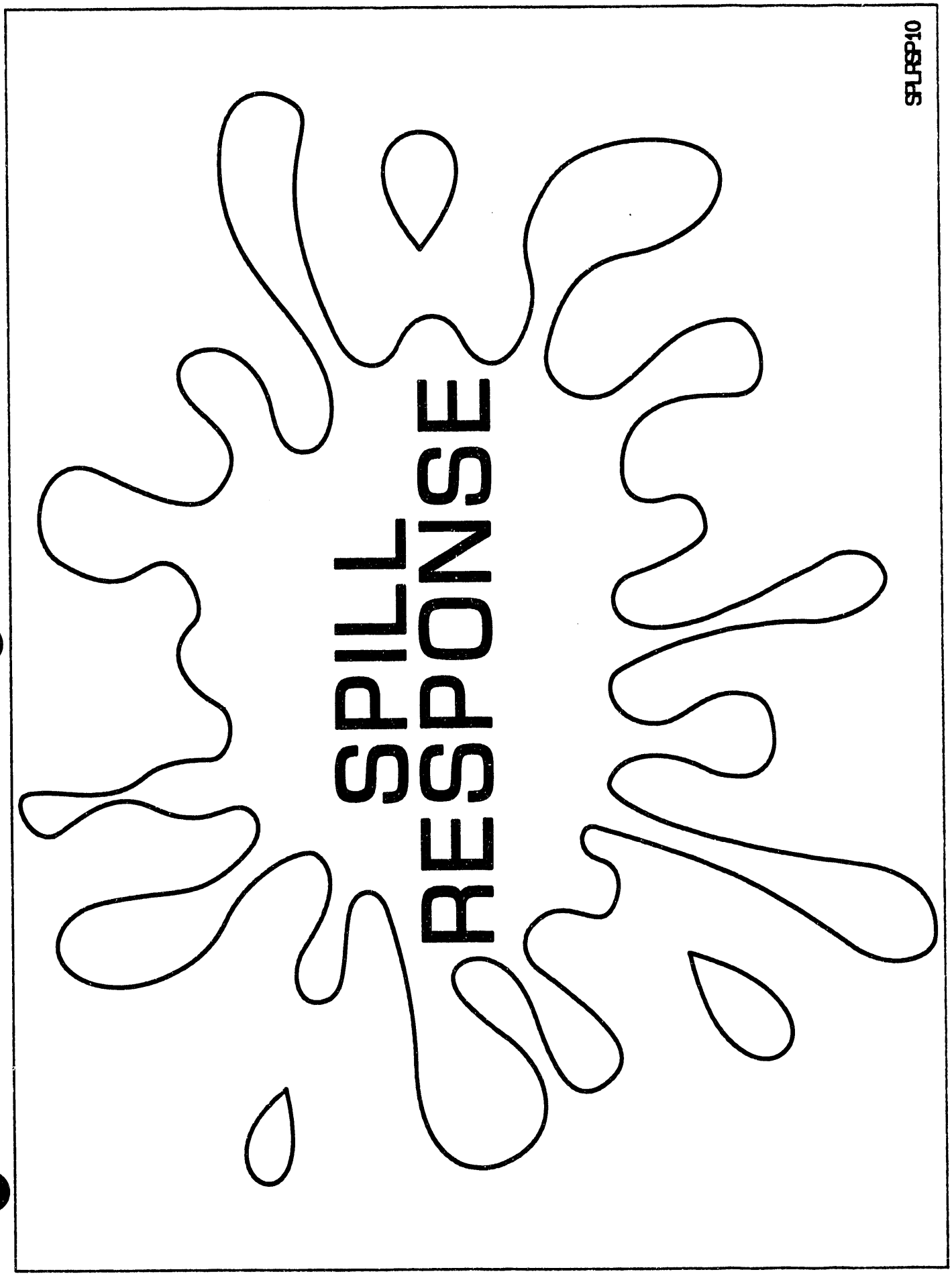
- Distribute and oversee completion of worksheet or exam.



RESPONSIBILITIES OF PERSON DISCOVERING AN EMERGENCY

Summon help immediately.
Telephone 911 (Laboratory Communications Center) for help.
Pull the nearest fire alarm box.
Call the local emergency supervisor or warden.
Sound the building evacuation alarm if necessary.
Meet and orient the emergency service unit or units.

SPLRSP09


SPILL
RESPONSE
SPLRSP10

A chemical spill (solid, liquid, or gas) is

A CHEMICAL OUT OF CONTROL!

Regardless of size all uncontrolled releases are potentially dangerous.

Employees should be encouraged to report such releases whenever human health or safety are threatened.

SPLRS11A

These spills should be reported regardless of the quantity involved.

EXTREME FLAMMABLES

EXTREME CORROSIVES

EXTREME TOXICS

ALL UNCONTROLLED COMPRESSED GAS RELEASES

ALL LEAKING CONTAINERS

SPLRSP12

STEPS FOR FIGHTING A SPILL

- CLEAR the affected area
- CONTACT Laboratory Shift Supervisor
- CHECK for Personnel Involvement
- IDENTIFY the material, quanitity, location, and personnel involved
- DETERMINE the chemical hazards

SPLRSP01

STEPS FOR FIGHTING A SPILL
cont'd

- DEVELOP a plan of action
- DON appropriate personal protective equipment
- SELECT proper containment materials
- CONTROL the spill source
- DIKE the spill, ABSORB all free liquid

SPLRSP02

STEPS FOR FIGHTING A SPILL
cont'd

- CLEAN UP and CONTAINERIZE bulk spill residue
- DECONTAMINATE area
- SALVAGE any equipment, etc., as apppropriate
- MANAGE all spill residue and refuse as hazardous waste
- DECONTAMINATE, CLEAN, and REPAIR all personal protective equipment and emergency equipment
- PREPARE necessary reports

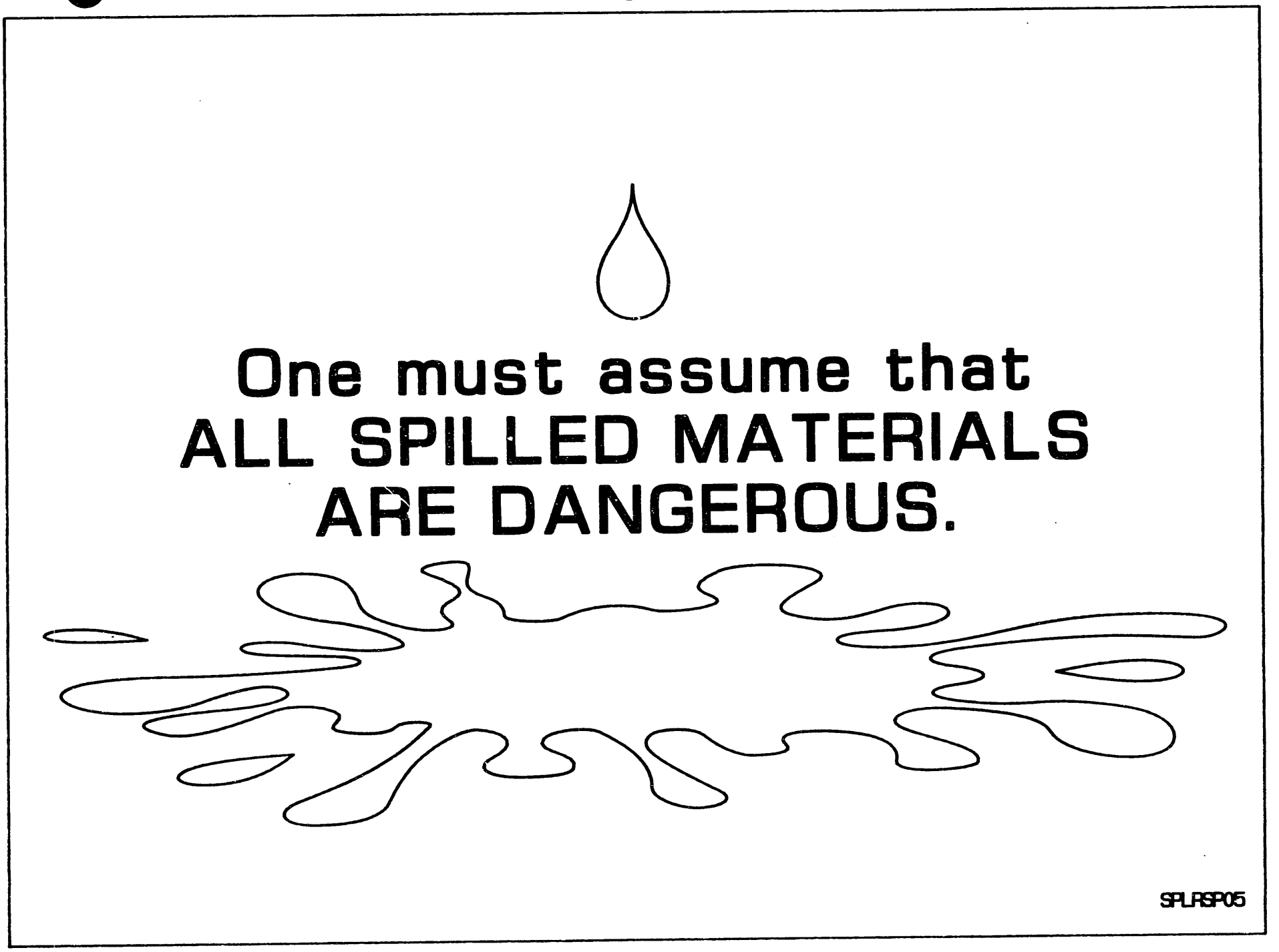
SPLRSP03

CLEAR THE AFFECTED AREA

ALL FIRES
and
ALL UNCONTROLLED
COMPRESSED GAS RELEASES
(including atmospheric gases if fire or
toxicity hazard is created.)
ALWAYS REQUIRE EVACUATION.

Chemical spills often,
but not always require evacuation.
The immediately affected area
MUST be cleared, however.

SPLRSP08


One must assume that
ALL SPILLED MATERIALS
ARE DANGEROUS.
SPLRSP05

IDENTIFYING THE SPILLED MATERIAL

1. Talk with those involved in the spill.
2. Look for any labels or other markings.
3. Obtain a sample and analyze.

SPLRSP04

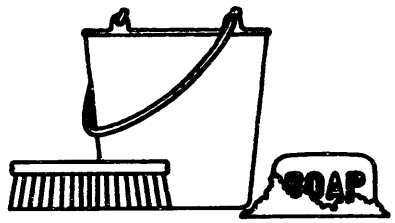
The two general approaches to fighting a spill are

CHEMICAL INACTIVATION

and

ABSORPTION

SPLRSP06



DECONTAMINATION

Complete decontamination of workers, tools, and the spill site must be performed before the spill response is completed.

Protective clothing and tools can be washed with detergent and rinsed with water, if necessary.

Rinsates from these type decontamination procedures may require treatment as hazardous wastes.

SPLRSP07

EMERGENCY DRILL

SCOPE

This module takes the form of an emergency drill dealing with a hazardous chemical leak. It is planned as a "hands on" activity for all class participants, allowing them to practice many of the principles and personal protective techniques learned during the course. Role playing includes dressing out, controlling the emergency, and clearing the site. The drill is then reviewed with a critique of the videotape of drill activities.
(Suggested time: 2 3/4 hours)

PARTICIPANT GOALS

1) Practice identification of hazardous material.

2) Practice personal protective techniques.

3) Practice emergency control techniques.

4) Practice site control techniques.

INSTRUCTOR PREPARATION

- Develop a drill scenario that emphasizes many of the principles taught in the course, such as identification of chemicals and degree of hazard; personal protective clothing and equipment; and emergency control and site control techniques.

- Set up the drill site, gather the necessary equipment, and arrange for experienced emergency personnel to be present to assist with the drill. Prepare different roles for the class participants to play.

- Arrange to have the drill activities videotaped.

INSTRUCTIONAL ACTIVITIES

- Carry out the drill scenario.
- Facilitate the role-playing by the class participants when necessary.
- Using the videotape of the drill, facilitate the critique of drill activities, emphasizing the principles observed and the errors committed.

EXAMPLE OF A DRILL SCENARIO

SITUATION

The facility Emergency Response Center receives a report of a drum leaking in an old abandoned building. The only information reported is that the substance has a heavy, sweet odor and the area appears to be clear of personnel.

ROLES INVOLVED

Facility Emergency Director.
Supervisor of Waste Operations Group.
Waste Operations Spill Team (2 members).

Optional roles:

Representatives from Fire Department, Industrial Hygiene, Environmental Compliance, Health Physics, and Engineering.

OBJECTIVES

1) Practice the management of and response to hazardous chemical spills.

2) Practice the use of personal protective clothing and equipment.

3) Practice identifying a spilled chemical and determining the degree of hazard.

4) Practice site control.

ACTIONS EXPECTED IN SPILL RESPONSE DRILL

(Members of the facility waste operations spill team offer guidance throughout the drill but do not participate.)

Throughout the drill, support groups who need to be notified of problems or potential problems created by the spill are identified. Individuals from the training group may be asked to perform these roles and make appropriate decisions.

Notify the facility Emergency Director who will take responsibility for the overall direction of the spill response.

Notify the Hazardous Waste Operations Group who will function as the spill response team.

At this point it is understood that to enter the building and assess the situation, Level "B" personal protective equipment is the minimum protection required. The drill participants, however, proceed to enter the area of the spill to learn how to make this initial assessment of the spill and its related hazards.

A leaking 55 gallon drum is found. The spilled liquid is flowing into a drain in the floor.

Using the United Nations (UN) Identification Number found to be written on the side of the drum, the spilled substance is identified as benzene.

Determine the degree of the hazard posed by the benzene spill as well as an appropriate initial response to the spill. This is done by the drill participants using a current copy of the DOT Emergency Response Guidebook.

The Hazardous Waste Operations Supervisor begins to formulate a plan of action.

The level of personal protection needed to contain the spill is determined based upon the potential health hazards. The spill response team dresses in appropriate personal protective equipment, including a self-contained breathing apparatus.

The spill response team enters the area and works to control the source of the spill. (Drum may be turned over, tipped on edge, plugged, etc.)

Check for sources of ignition because of the flammability hazard.

Dike the area around the floor drain to prevent entrance of additional spilled material.

Absorb the spilled liquid with an appropriate spill control media such as granular clay.

Establish an area for decontamination of the spill team and remove protective equipment as the workers exit the area.

Containment of the spill residue and decontamination of the area may be discussed at this point.

CRITIQUE OF DRILL

Review the videotape of the drill, noting the principles that were applied in the spill response and discussing any errors made in managing the situation.

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