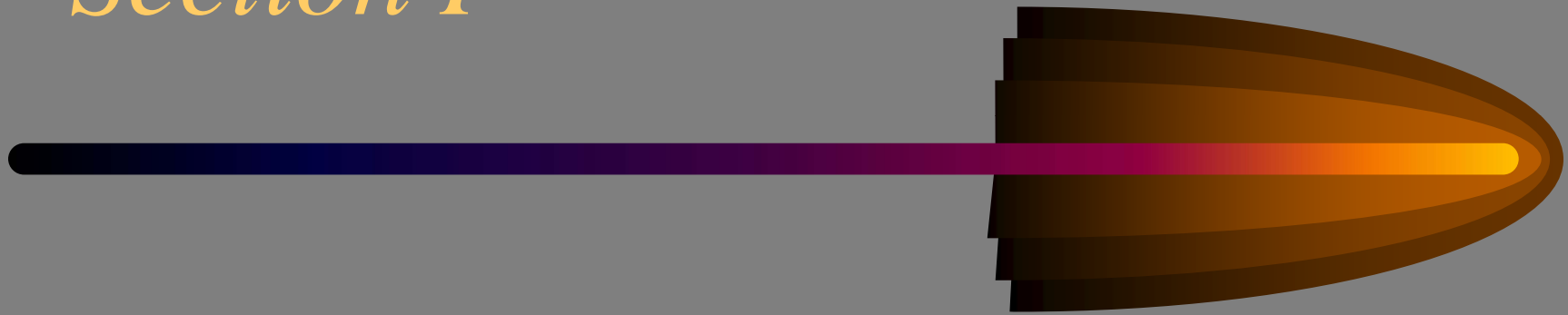


*OFFICE OF THE STATE FIRE
MARSHAL*



HAZARDOUS MATERIAL
OPERATIONS

Section I



Introduction to Laws, Regulations & Standards

CLASSIFICATIONS

- Hazardous materials (U.S. Dept. of Transportation)
 - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported for commerce, and which has been so designated

CLASSIFICATIONS



- Hazardous chemical (OSHA)
 - Any chemical which is a physical or health hazard to employees

CLASSIFICATIONS

- Hazardous substance (CERCLA)
 - Any substance designated via the Federal Water Pollution Control Act
 - Any substance listed in CERCLA
 - Any hazardous waste having the characteristics identified under the Solid Waste Disposal Act (SWDA)
 - Any hazardous air pollutant listed under the Clean Air Act

CLASSIFICATIONS

- Hazardous substance (CERCLA) cont.
 - Any imminently hazardous substance or mixture with respect to which the Administrator of the United States Environmental Protection Agency has taken action under the section 7 of the Toxic Substances Control Act

CLASSIFICATIONS

- Extremely hazardous substance (EPA)
 - An extremely hazardous substance is a chemical determined by the EPA to be extremely hazardous to a community during an emergency spill or release due to the chemical's toxicity and physical/chemical properties as listed in Section 302 of SARA

CLASSIFICATIONS



- Toxic chemical (EPA)
 - A known toxic chemical, suspected carcinogen or class of chemicals which has specific release reporting and community right to know restrictions in addition to those of CERCLA and the Extremely Hazardous Substance Emergency Planning & Notification requirements

CLASSIFICATIONS

- Hazardous waste (DOT & EPA)
 - A waste material which is ignitable, corrosive, reactive, or toxic and which poses a substantial or potential hazard to human health and safety and to the environment when improperly managed

CLASSIFICATIONS

- Dangerous goods (DOT, Transport Canada)
 - Any product, substance, or organism included by its nature or by the regulation of any of the 9 classes listed in the UN/NA classes of hazardous materials
- Special waste
 - Does not meet the specific criteria for hazardous waste, but still has components which require specific disposal procedures

LAWS, REGULATIONS, & STANDARDS

- SARA (Superfund Amendments & Reauthorization Act of 1986)
 - Amendment of CERCLA
 - 3 titles
 - Title 1 - Provisions relating primarily to response & liability, cleanup ops, hazardous waste ops and emergency response ops as well as standards for health/safety of workers
 - Title II - Miscellaneous Provisions for cleanup of underground petroleum storage tank leaks and DOD restoration programs
 - Title III - Emergency planning & community right-to-know

LAWS, REGULATIONS, & STANDARDS

- Illinois Emergency Management Agency is Illinois SERC
- Placed requirements on facility owners
 - Immediate report of release of certain quantities and types of releases to Community Emergency Coordinator for LEPC and SERC. Exempted are releases which do not leave the boundaries of a facility
 - Evaluation of facility for preventing, detecting and monitoring releases and recommend improvements and public alerting systems for accidental releases
 - Submission of MSDS to LEPC, SERC and FD having jurisdiction annually
 - Annual submission of hazmat chemical inventories annually to LEPC, SERC and FD by 3/1
 - Fire department on site inspection of inventoried facilities
- **Funding** - Provided funding for planning, preparedness and training programs at federal, state & local levels

LAWS, REGULATIONS, & STANDARDS

- 29 CFR 1910.120 “HAZWOPER”
 - Emergency response plan
 - Pre emergency planning and coordination with outside parties and agencies
 - Personnel roles, lines of authority, training, & communication
 - Emergency recognition & prevention
 - Safe distances & control
 - Site security & control

LAWS, REGULATIONS, & STANDARDS

- 29 CFR 1910.120 “HAZWOPER”
 - Emergency response plan cont.
 - Evacuation routes & procedures
 - Decontamination
 - Emergency medical treatment & first aid
 - Emergency alerting & response procedures
 - PPE & emergency equipment
 - Use an Incident Command System (ICS)

LAWS, REGULATIONS, & STANDARDS

- 29 CFR 1910.120 “HAZWOPER”
 - Personal Protective Equipment (PPE)
 - SCBA
 - Written PPE plan
 - Safety Officer
 - Back-up personnel, buddy systems, & first aid
 - Limit Access
 - Decontamination

LAWS, REGULATIONS, & STANDARDS

- 29 CFR 1910.120 “HAZWOPER”
 - Training
 - Roles
 - First Responder Awareness
 - First Responder Operations
 - Hazardous Materials Technician
 - On Scene Incident Commander

First Responder Awareness



- Persons likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release

First Responder Operations

- Individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release

Hazardous Materials Technician



- Individuals who respond to releases or potential releases for the purpose of stopping the release. They will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance

On Scene Incident Commander



- Persons who will assume control of the incident scene beyond the first responder awareness level.

LAWS, REGULATIONS, & STANDARDS

- 29 CFR 1910.120 “HAZWOPER”
 - Medical surveillance required by 1910.120
 - Any emergency response employee who exhibits signs of exposure to hazardous substances
 - Prior to assignment to a hazmat team
 - One every 12 months unless dr allows (24 month max)
 - At termination of employment or reassignment if last exam was more than 6 months ago
 - Consultations are financial responsibility of organization not responder
- 40 CFR 311
- Illinois Department of Labor
 - Adopted 29 CFR 1910.120 and the IDOL has enforcement jurisdiction for its provisions over state & local government employees

LAWS, REGULATIONS, & STANDARDS



- Illinois Department of Labor cont.
 - Others
 - Confined space operations
 - Respiratory protection/fit testing of respirators
 - Fire brigade training
 - Personal protective clothing

LAWS, REGULATIONS, & STANDARDS

- NFPA 471 - Recommended Practices for Responding to Hazardous Materials Incidents
 - Planning
 - Procedures
 - Policies
 - Application of Procedures for Incident Levels
 - Personal Protective Equipment
 - Decontamination
 - Safety
 - Communications

LAWS, REGULATIONS, & STANDARDS

- NFPA 472 - Standards for Professional Competence of Responders to Hazardous Materials Incidents
 - Specifically requires competencies
 - First Responder Awareness
 - First Responder Operations
 - Hazardous Materials Technician
 - Incident Commander
 - Off-Site Specialist Employees A, B, or C

LAWS, REGULATIONS, & STANDARDS



- NFPA 472 - cont.
 - Meets or exceeds 29 CFR 1910.120
 - Office of the State Fire Marshal
- NFPA 473 - Standard for Competencies for EMS Personnel Responding to Hazardous Materials Incidents
- Others

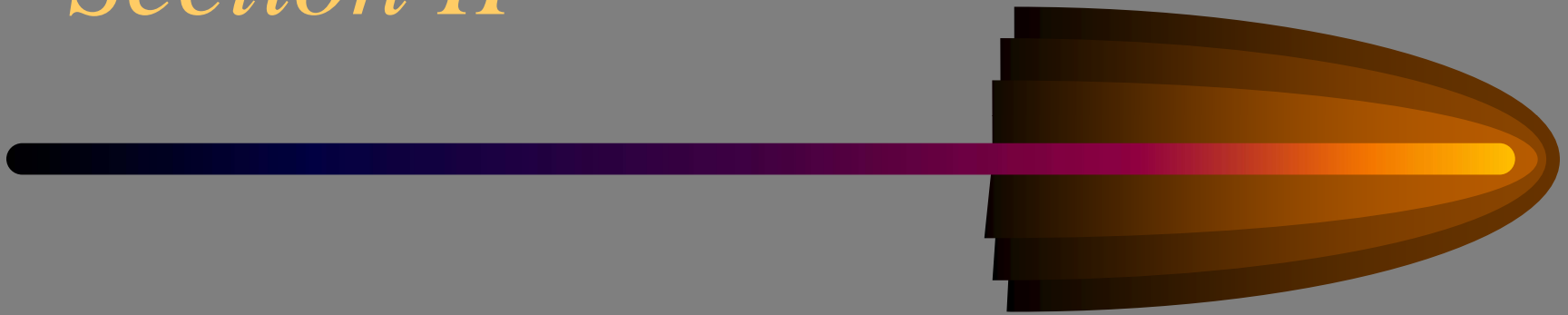
THE 4 ASPECTS Of RESPONSE ORGANIZATION

- Planning & preparedness
 - Any planning must start with an identification of hazards and likely potential emergency situations which may arise in the area.
- Prevention
 - Response organizations should actively participate in the community, educating potential spillers on potential hazards and about how the agencies can help each other avoid incidents involving hazardous materials.
- Response
 - Isolate, Identify, Notify, Mitigate and Terminate
- Remediation: cleanup & recovery
 - NOT THE REALM OF THE EMERGENCY RESPONDERS

Remediation: Cleanup and Recovery

- Responders should only stand by during certain remediation operations, not participate in such activities. To do so may bring about harsh financial consequences due to:
 - Assumption of scene cleanup costs and consequences of actions taken during such activity
 - Violations of laws and regulations controlling such practices (CERCLA and RCRA). In general, responders are not trained to meet the requirements of such laws and regulations
 - May be entering long term operations for which the emergency responders are not prepared

Section II



Response Components

PLANNING & PREPAREDNESS

- Hazard analysis (Any planning must start with an identification of hazards and likely potential emergency situations which may arise in the area)
- Plans
 - Local Emergency Response Plans - Produced by LEPC with input review and study by fire departments
 - Site Response Plans - Individual business emergency plan
 - Pre-plans - Fire departments plan for hazardous response
 - Coordination - Many agencies (LEPC, SERC, IEMA, IEPA, EPA, IDOL, public works, utility companies, water/sanitary districts/ police, fire, DOT)

PLANNING & PREPAREDNESS

- Training - We MUST have trained individuals to implement the plan or the planning efforts will be a paper chase done in vain
- Standard Operating Guidelines
 - Introduction - who, what, where, when and why
 - Pre-planning & coordination - predetermined methods for information exchange among agencies & resources
 - Chain of command and communications - lines of authority and working structure of the response
 - Training - expectations of responders should be spelled out
 - Alerting & response procedures - how response will be handled
 - Scene set-up considerations - scene set up considerations

PLANNING & PREPAREDNESS

- Standard Operating Guidelines cont.
 - Protective action procedures - primary/secondary evacuations as well as sheltering in place
 - Decontamination procedures - set up considerations
 - EMS - medical services for responders and civilians
 - Documentation - beginning to termination including a critique should be provided
 - Critique - lessons learned approach

PREVENTION



- Response organizations should actively participate in the community, educating potential spillers on potential hazards and about how the agencies can help each other avoid incidents involving hazardous materials

RESPONSE



- Response elements : A Methodology
 - Isolate - make size up, rescue endangered persons, deny access
 - Identify - id the product, monitor the scene, assess response is it an incident or emergency
 - Notify - gather/disseminate information to proper agencies
 - Mitigate - limit impact on persons, property and environment (non-intervention or defensive action only)
 - Terminate - turn scene over to responsible party

RESPONSE



- Response levels

- Level I

- An incident which can be controlled by the initial responding compliment of personnel and apparatus

- Level II

- An incident which involves a greater hazard than a Level I or which poses a potential threat to life or property. This incident may require a limited evacuation of surrounding areas

- Level III

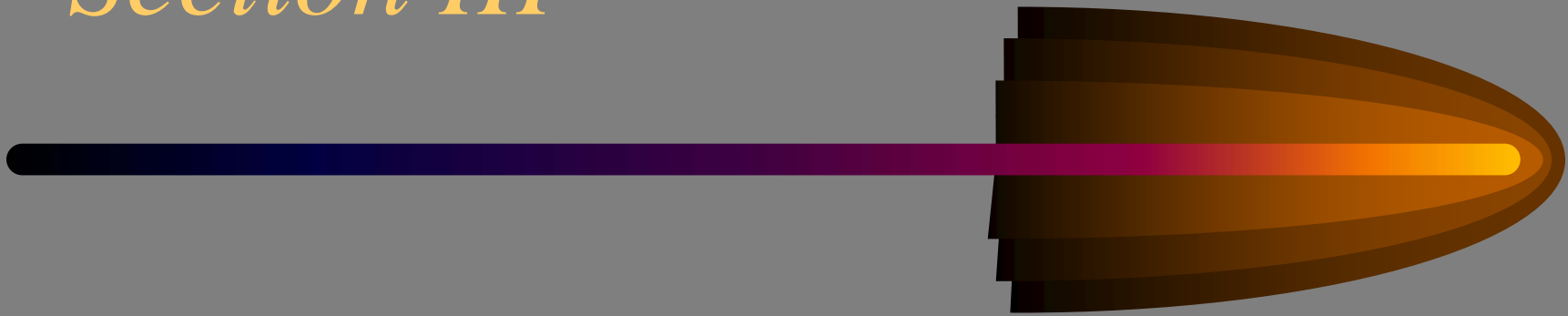
- An incident which involves severe hazard or large area. This incident poses an extreme risk to life and property and will most likely require large scale evacuations and/or multi-agency response

REMEDIATION: CLEANUP & RECOVERY



- Although responders may be required to stand by during certain remediation operations, it is not the responder's role to participate in such activities
- **NOT THE REALM OF THE EMERGENCY RESPONDERS!!!**

Section III



Health and Safety

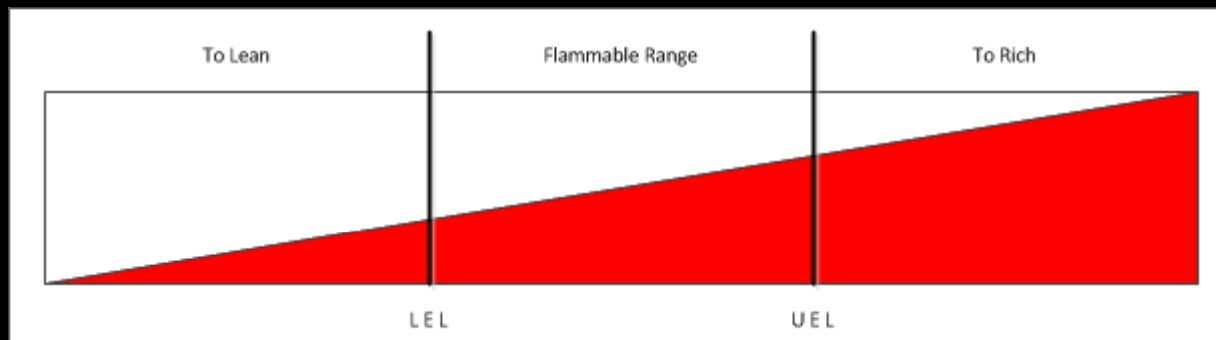
HAZARDOUS MATERIALS CHARACTERISTICS



- Flash point
 - The minimum temperature at which a liquid will produce sufficient vapors to form an ignitable mixture in air near the surface of the liquid
- Autoignition temperature
 - The temperature at which vapors will ignite without an outside ignition source

HAZARDOUS MATERIALS CHARACTERISTICS

- Lower explosive limit (LEL)
 - The minimum vapor concentration of a product, in air, which will burn
- Upper explosive limit (UEL)
 - The maximum concentration of a product, in air, which will burn
- Flammable range
 - The range between the UEL and LEL



HAZARDOUS MATERIALS CHARACTERISTICS



- Vapor pressure
 - The pressure exerted on the sides of a container by the vapor of a product within the container
- Boiling point
 - The temperature at which the vapor pressure of the material equals the atmospheric pressure (therefore, lower boiling point liquids have higher vapor pressures at a given temperature)

HAZARDOUS MATERIALS CHARACTERISTICS



- Melting or freezing point
 - The temperature at which the liquid form of a product turns solid or the solid form turns to a liquid
- Vapor density
 - The weight of a given volume of the vapors of a specific product compared to the same volume of dry air

HAZARDOUS MATERIALS CHARACTERISTICS



- Specific gravity
 - The weight of a given volume of solid or liquid compared to an equal volume of water
- Solubility
 - The degree to which a material will dissolve in solvent
- Toxicity
 - The ability of a material to harm, destroy, poison, kill, or otherwise damage body tissue
- Corrosivity
 - Ability of a material to damage skin tissue and or steel or aluminum metal

HAZARDOUS MATERIALS CHARACTERISTICS

- Radioactivity
 - High energy waves & particles emitted from radioactive materials
 - Non-ionizing radiation (no chemical change to irradiated objects but may cause heat damage
 - radar, heat and microwave radiation
 - Ionizing radiation (capable of chemically alter the object being irradiated)
 - Alpha radiation
 - Beta radiation
 - Gamma radiation
 - Neutron radiation

Alpha Radiation



- Large, low energy form of nuclear radiation. It has a low penetrating ability and may be stopped by something as thin as a sheet of paper. Little or no danger as an external source, but poses a great danger as an internal source due to its extreme activity on the cellular level.

Beta Radiation



- Small, moderate energy nuclear radiation. It has a fair penetrating power. High energy beta particles **WILL PENETRATE** bunker clothes. It is moderately dangerous as either an internal or an external source.

Gamma Radiation



- High energy form of nuclear radiation. It has high penetrating power and is the most dangerous common form of ionizing radiation. It is highly reactive, causing great cellular damage.

Neutron Radiation



- High energy form of nuclear radiation.
Most penetrating, but relatively inactive and rarely encountered.

HAZARDOUS MATERIALS CHARACTERISTICS



- Oxidizing ability
 - Ability of a material to act as an oxidizer in the Fire Triangle or Tetrahedron
- Instability
 - Term describing the ease in which a chemical may undergo a rapid, and sometimes violent, chemical change

HAZARDOUS MATERIALS CHARACTERISTICS



- **Reactivity**
 - Ability of a chemical to react with other chemicals
 - Exothermic reactions - release heat to surroundings
 - Endothermic reactions - absorb heat from surroundings
- **Compatibility**
 - Ability of two materials to remain in contact without reaction

HAZARDOUS MATERIALS CHARACTERISTICS



- Forms of matter
 - Solid, liquid, or gas (have various hazards according to state of matter)
- Toxic products of combustion
 - All products of combustion should be considered toxic, however products from fires involving hazardous materials should be treated as contaminated to a greater degree

HAZARDOUS MATERIALS EXPOSURES

- Terminology
 - Exposure
 - Actual contact with an agent in any physical form
 - Hazard
 - Degree of risk associated with an exposure
 - Contamination
 - When an agent is physically left on an object or person
 - Primary contamination - direct contact
 - Secondary contamination - contact with contaminated items

HAZARDOUS MATERIALS EXPOSURES



- Routes of exposure
 - Contact
 - Direct contact with hazardous materials may cause severe burns or other tissue damage
 - Absorption
 - Process by which materials pass through the body's outer defenses and into the inner structure of the body. Prime areas are arm pits and groin.

HAZARDOUS MATERIALS EXPOSURES



- Routes of exposure cont.
 - Inhalation
 - Simply breathing in the hazardous material
 - Ingestion
 - Includes swallowing the material in food or drink or may occur by wiping the mouth with contaminated gloves and subsequently swallowing the saliva

MANNER IN WHICH HAZARDOUS MATERIALS HARM



- Thermal
 - May be in the form of excessive cold or heat; both can cause permanent tissue damage, induce shock, and/or cause death
- Mechanical
 - Caused by the direct contact with an object such as being struck by a falling or flying object

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Poisonous
 - Harm & kill by inhibiting the body's normal biological activities
 - Irritants
 - upper - very soluble in water dissolving in fluids of mouth, nose and larynx, causing damage there
 - lower - less soluble in water making it further down respiratory track before dissolving in trachea, bronchus and bronchioles, causing deep damage there
 - terminal - almost no solubility in body fluids traveling to the alveolus where blood-gas exchange occurs
 - Anesthetics - alter perception, organ poisons, act as narcotics
 - Narcotics - cause sleep, anesthetic effects, altered consciousness, death, coma
 - Sensitizer - allergic reaction in normal tissue after repeated exposure
 - Target organ poisons - attacks tissues and organs, disrupt/alter the nervous system, damage the nerves which transmit information to and from brain, liver damage, kidney damage, reproductive system disruption, skin layer damage, affect vision, block the ability of hemoglobin to function in the blood stream or irritate or damage lung tissues

Manner in Which Hazardous Materials Harm continued

- Toxics
 - Toxic
 - A material which meets any of the following criteria:
 - $50 \text{ mg/kg} < \text{LD}_{50} < 500 \text{ mg/kg}$ (orally to rats)
 - $200 \text{ mg/kg} < \text{LD}_{50} < 1,000 \text{ mg/kg}$ (24 hr contact in rabbits)
 - $200 \text{ ppm} < \text{LC}_{50} < 3,000 \text{ ppm}$ (1 hr inhalation in rats)
 - Highly Toxic
 - $\text{LD}_{50} < 50 \text{ mg/kg}$ (orally to rats)
 - $\text{LD}_{50} < 200 \text{ mg/kg}$ (24 hr contact in rabbits)
 - $\text{LC}_{50} < 200 \text{ ppm}$ (1 hr inhalation in rats)

Manner in Which Hazardous Materials Harm continued

- Carcinogens - substances which may cause cancer. Carcinogens are encountered at all fire situations as byproducts of the combustion process.
- Teratogens - Substances which may affect the unborn fetus when the mother is exposed to the chemical (will cross placental barrier)
- Mutagens - Substances which may induce genetic changes

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Corrosive - Cause chemical degradation of tissues and metals
 - Acids - destroy tissue and generate heat, causing chemical and thermal burns, irritation, or itching
 - Bases, alkalis, or caustics - turns tissue into soap while reacting with fatty tissues (saponification). Typically, intensive damage is done prior to the victim noticing the burns since they are not initially painful. Caustic burns tend to be deeper burns.
 - pH scale - the pH of a corrosive will provide the responder with a relative measure of its corrosive ability.

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- **Asphyxiants**
 - Substance which interferes with the uptake of oxygen by the body's respiratory process
 - Simple asphyxiates - replaces oxygen
 - Chemical asphyxiates - blocks uptake of oxygen
- **Radiation**
 - Radiation injury (2 types)
 - Irradiation injuries - ionizing radiation not a danger to responders
 - Contamination injuries - contamination with radioactive particles internally or externally do pose a risk to responders
 - Radiation Exposure Effects - loss of hair, bleeding from gums, nausea, vomiting, immune deficiency, bruising

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Radiation cont.
 - Radiation exposure effects
 - Radiation sickness - takes days for all symptoms to appear and up to 8 weeks to recover
 - Radiation injury - confined to areas most directly exposed
 - Radiation poisoning - internalization of radiation sources
 - Protection from radiation
 - Time - Limit exposure time
 - Distance - Stay back as far as possible
 - Shielding - Keep dense items and thick items between you and the source
 - SCBA - Minimizes likelihood of ingestion or inhalation of radioactive particles

MANNER IN WHICH HAZARDOUS MATERIALS HARM



- Etiological
 - Exposure to microorganisms or their toxins
- Psychological harm
 - The stress of dealing with severe trauma, destruction, death, or even with the slow pace of hazardous materials incidents may place large amounts of stress on individuals and the responders as a whole

MANNER IN WHICH HAZARDOUS MATERIALS HARM



- Multiple harms
 - It is important to realize that chemicals are capable of producing more than a single type of harm at once

MANNER IN WHICH HAZARDOUS MATERIALS HARM



- Measures of toxicity
 - TLV-TWA - Threshold limit value-time weighted average
 - Average concentration for a normal 8 hr. work day and a 40 hr. work week, to which nearly all workers can be repeatedly exposed, day after day, without adverse effect

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Measures of toxicity cont.
 - TLV-STEL - Threshold Limit Value-Short Term Exposure Limit
 - The concentration to which workers can be exposed for short periods of time without irritation, chronic, or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of injury, impair self rescue, or reduce work efficiency. The value is usually for a 15 minute exposure.

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Measures of toxicity cont.
 - TLV-C - Threshold Limit Value Ceiling
 - The concentration which should never be exceeded during work
 - PEL - Permissible Exposure Limits
 - Used by OSHA in its health standards covering exposures
 - Similar in application to TLV-TWA

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Measures of toxicity cont.
 - REL - Recommended Exposure Limits
 - Recommended concentration limits for exposure issued by NIOSH, and are for up to 10 hr. workdays and 40 hr. workweeks
 - IDLH - Immediately Dangerous to Life & Health
 - Concentration limit at which over a 30 min. exposure, the commodity is likely to cause death, delayed permanent damage, or prevent a worker from escaping a given contaminated environment

MANNER IN WHICH HAZARDOUS MATERIALS HARM

- Measures of toxicity cont.
 - LD₅₀ - Lethal Dose 50
 - Dose of material absorbed, ingested, or injected which causes 50% of a test population of laboratory animals to die
 - LC₅₀ - Lethal Concentration 50
 - Concentration of inhaled material which causes 50% of a test population of laboratory animals to die

HAZARDS & HEALTH EFFECTS



- Health hazards
 - **Immediate health hazards**
 - Those hazards which have immediate health consequences such as those of a mechanical harm
 - **Delayed health hazards**
 - Those hazards which produce harm which is delayed for a period of time prior to manifestation
 - **Chronic health hazards**
 - Those hazards, such as carcinogens, mutagens, or teratogens, which have long-term health effects

HAZARDS & HEALTH EFFECTS

- Factors effecting harm (toxicity)
 - **Concentration**
 - The concentration of the toxin to which one is exposed will effect the harm
 - **Exposure duration**
 - Term or time of exposure will also effect the ability of a toxin to harm
 - Acute - Single exposure of short duration
 - Subacute - Several discrete exposures with intervals of time in between
 - Chronic - Long term repetitive exposures

HAZARDS & HEALTH EFFECTS

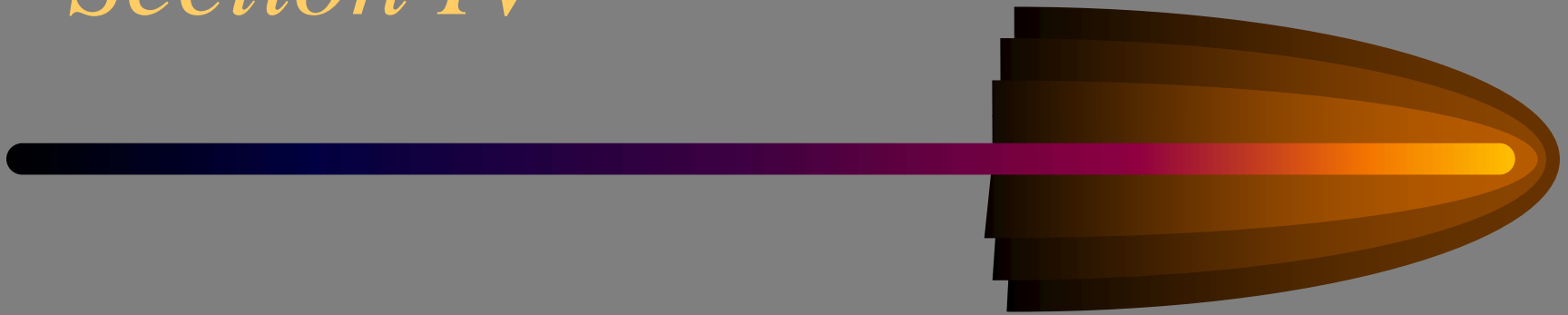
- Factors effecting harm (toxicity) cont.
 - **Route of exposure**
 - The route of exposure will affect the harm which an exposure will have
 - **Dose response**
 - Dose-response characteristics of a particular chemical will have an effect on the harm produced
 - **Personal variables**
 - Individual characteristics of the exposed individual such as family history, fitness, sex, age, etc. can also play a role on the amount of harm done by an exposure

OCCUPANCY & LOCATION



- Fixed facilities
 - Service stations
 - Hardware stores
 - School laboratories
 - Doctor's offices
 - Agricultural stores
 - Farms
 - Residences
 - Plastic and high tech factories
 - Metal plating facilities
 - Mercantile businesses

Section IV



Recognition and Identification

OCCUPANCY & LOCATION



- Transportation
 - Roadway - prone to accidents in the following areas
 - Truck routes
 - Blind intersections
 - Sharp turns
 - Steep grades

OCCUPANCY & LOCATION



- Transportation cont.
 - Railway - prone to accidents in the following areas
 - Depots
 - Switch yards
 - Steep grades
 - Shunts & sidings
 - Uncontrolled crossings
 - Poorly maintained track

OCCUPANCY & LOCATION



- Transportation cont.
 - Waterway - prone to accidents in the following areas
 - Bridges
 - Piers, docks
 - Locks
 - Shallows
 - Narrow or difficult passages

OCCUPANCY & LOCATION

- Transportation cont.
 - Air - prone to accidents in the following areas
 - Fueling ramps
 - Repair & maintenance areas
 - Freight terminals
 - Pipeline - prone to accidents in the following areas
 - Exposed crossings
 - Pumping stations
 - Construction/demolition sites
 - Storage facilities

CONTAINER SHAPES



- Fixed facility
 - Cone roof tanks
 - Cylindrical tanks with a skyward pointed conical roof, which may or may not be insulated, with an inverted cone roof, operating at atmospheric pressure
 - Products - flammable & combustible liquids

CONTAINER SHAPES



- Fixed facility cont.
 - Open floating roof tanks
 - Cylindrical tank with open top. Roof floats up and down with the product level. This feature suppresses vapors and avoids the dangerous vapor space above products. Ladder-to-roof angle will indicate relative level of product
 - Products - flammable & combustible liquids

CONTAINER SHAPES



- Fixed facility cont.
 - Geodesic dome open floating roof tanks
 - Open floating roof tank which is covered to protect the floating roof from the element
 - Products - flammable liquids
 - Covered floating roof tanks
 - Looks like a cone roof tank, but with large vent holes around the top of the tank just below the roof line
 - Products - flammable & combustible liquids

CONTAINER SHAPES



- Fixed facility cont.
 - Horizontal tanks
 - Horizontal cylindrical tanks sitting on structural supports. Integrity of the support is critical
 - Products - flammable liquids, combustible liquids, poison liquids, corrosive liquids, etc.
 - Dome roof tanks
 - Vertical cylindrical tanks supporting a dome roof
 - Products - flammable liquids, combustible liquids, fertilizers, solvents, etc.

CONTAINER SHAPES



- Fixed facility cont.
 - Underground tanks
 - Horizontal steel, fiberglass, or fiberglass-coated steel tanks
 - Products - primarily petroleum products
 - Vertical cryogenic tanks
 - Large holding tanks that look similar to the dome roofed tank
 - Products - cryogenic liquids

CONTAINER SHAPES

- Fixed facility cont.
 - Horizontal pressure tanks
 - Cylindrical horizontal tanks, typically looking like large hot dogs
 - Products - typically liquefied gaseous petroleum products or commodities such as mercaptans
 - Spherical high pressure tanks
 - Large supported ball-shaped tanks
 - Products - light weight or low molecular weight petroleum gases

CONTAINER SHAPES



- Small containers
 - Radioactive material containers
 - May include fiberboard boxes, steel drums, or heavy duty steel containers with paraffin and lead linings
 - Products - radioactive materials
 - Compressed gas cylinders
 - Vertical or horizontal cylinders of heavy construction, should be transported with threaded valve cover in place
 - Products - compressed gases of any type, including flammable, corrosives, poisons, and non-flammable

CONTAINER SHAPES

- Small containers cont.
 - Cryogenic containers - DEWARs & cylinders
 - DEWARs - non pressurized, vacuum jacketed containers, often made of glass and coated with implosion protection
 - Cylinders - Typically large metal, shelled, insulated, vacuum jacketed containers
 - Products - cryogenic liquids

CONTAINER SHAPES



- Small containers cont.
 - Non-bulk containers/cans
 - Various bottles, cans, and tubs containing small quantities of commodities
 - Products - various, including non-hazardous materials, may contain flammable solids, oxidizers, corrosives, flammable liquids, pyrophorics, poisons, etc.

CONTAINER SHAPES



- Small containers cont.
 - Drums
 - Generally vary in size from 35 gal to 95 gal. Constructed of steel, lined or coated steel, or plastic depending on intended use.
 - Products - Various liquids and solids of a hazardous and non-hazardous nature including flammable solids, oxidizers, corrosives, flammable liquids, pyrophorics, poisons, etc.

CONTAINER SHAPES



- Small containers cont.
 - Totes
 - Typically large poly/plastic containers contained within a protective and supportive metal cage
 - Products - non-hazardous and hazardous commodities including corrosives, poisons, etc.

CONTAINER SHAPES

- Transportation containers
 - Highway carriers
 - Box trucks/trailers
 - Standard van or box type trailer or truck
 - Products - various, including both non-hazardous & hazardous commodities
 - Flat beds
 - Flat trailer or truck with containers strapped or chained into the bed
 - Products - varies, can include compressed gas cylinders, totes, 1 ton cylinders of poisonous gas, flammable when wet metal in large containers, etc.

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - Dump trucks
 - Standard dump trucks
 - Products - such as corrosives, oxidizers
 - Garbage trucks
 - Standard garbage compactor trucks and flat bed type trucks with containers
 - Products - waste

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - MC 306/DOT 406: Atmospheric pressure
 - Oval shaped trailer, typically of aluminum. Bottom unloading piping and controls. Longitudinal rollover protection, internal & external shut-off valves, breakaway flanges/piping. Vapor recovery and manway at the top of each compartment likely source of leaks during rollover
 - Products - gasoline, flammable liquids, combustible liquids

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - MC 307/DOT 407: Low pressure
 - Typically the horseshoe shaped trailer, however, view is of the shell of the carrier. Tank will have round ends and may have exposed stiffeners
 - Products - Asphalt, heavy fuel oils, crude, mild corrosive, class B poisons

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - MC 312/DOT 412: Corrosive
 - Relatively smaller, round, cigar shaped tank with large number of external stiffening rings. Typically rear or mid top loading and unloading with a splash guard around the area, which also acts as rollover protection.
 - Products - strong corrosives, nitric acid, sulfuric acid, hydrochloric acid, sodium hydroxide solutions

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - MC 331: Liquefied compressed gas carrier
 - Large hot dog shaped trailer with hemispherical ends. Typically uninsulated, single shell vessels painted white. Have a bolted manway for service at the rear, and loading/unloading controls are at the bottom and enclosed for protection. This trailer will have pressure relief devices.
 - Products - liquefied compressed gas, anhydrous ammonia, liquefied petroleum, propane, etc.

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - MC 338 Cryogenic carrier
 - Tube like trailer with a rear or center bottom loading/unloading box. Shape may vary due to the fact that responders are viewing the outer shell. Ends of the trailer are typically flat. Double shell construction used to keep the cryogenics cold during transport.
 - Products - Cryogenic liquids such as liquid oxygen, liquid nitrogen, liquid helium

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - Tube trailer - high pressure compressed specialty gas carrier
 - Trailer has several large compressed air cylinders strapped on a flat bed trailer. A manifold system is contained at the rear of the trailer in a control box.
 - Products - compressed but not liquefied gases, such as methane or methyl bromide

CONTAINER SHAPES



- Transportation containers
 - Highway carriers cont.
 - Dry bulk trailer: Bulk material carriers
 - Typically large trailers with V-shaped bottoms and external loading pipes and bottom unloading pipes. These trailers have top manways and typically are unloaded using power take off engines on the tractor or auxiliary engines on the trailer
 - Products - Dry bulks such as corrosive solids, fertilizers, grain, etc.

CONTAINER SHAPES



- Transportation containers
 - Railway carriers
 - Box cars: General service
 - General box car constructed of wood or metal. May contain oxygen deficient environments or possibly tanks of hazardous materials
 - Products - various, may include hazardous and non-hazardous materials

CONTAINER SHAPES



- Transportation containers
 - Railway carriers
 - Non-pressure car: General service car
 - Rail tank car, possibly containing more than one compartment, may or may not be thermally protected, may have bottom connections or washouts. Telltale signs of a non-pressure car are the exposed fittings, piping, and relief devices. Corrosive cars will have no bottom fittings.
 - Products - various, may include hazardous and non-hazardous materials

CONTAINER SHAPES



- Transportation containers
 - Railway carriers
 - Pressure car
 - Rail tank car, top loading/unloading with all fittings and valving contained within an armored housing. Bottom washouts and connections very unlikely, may or may not be thermally protected
 - Products - most often poisonous gas, flammable and non-flammable gases, but may carry corrosives, etc.

CONTAINER SHAPES



- Transportation containers
 - Railway carriers
 - Cryogenic car
 - Rail tank car heavily insulated for cryogenic products. Box containing valving located on the lower mid section of the car with vents on the ends of the car.
 - Products - carbon dioxide, argon, etc.

CONTAINER SHAPES



- Transportation containers
 - Railway carriers
 - Dry bulk car/pneumatically operated covered hopper
 - Large cars, designed to haul dry bulk materials. Typically V-shaped bottoms with exit shoots or valves on the bottom.
 - Products - various, may contain oxidizers, poison solids, etc., ammonium nitrate; fertilizer is often shipped in this type of container

CONTAINER SHAPES



- Transportation containers
 - Intermodals
 - TOFC - Trailer on flat car
 - Highway box trailers placed on rail cars or wheel assemblies and shipped via rail. Often called “piggy back”.
 - Products - anything one would expect to find in a box trailer

CONTAINER SHAPES



- Transportation containers
 - Intermodals
 - COFC - Container on flat car
 - Boxes, often called sea boxes or sea containers, which are designed to be shipped in sea vessels, by truck on a trailer frame, or by rail on a flat car
 - Products - anything one would expect to find in a box trailer

CONTAINER SHAPES

- Transportation containers
 - Intermodals
 - Intermodal tanks
 - Tanks of up to 6,300 gals contained within a frame of metal bars. Designed to be placed in ships, on trailers and truck beds.
 - Products - may contain corrosives, poison liquids, liquefied compressed gas, cryogenics, etc., depending on the type of tank

CONTAINER SHAPES

- Transportation containers
 - Waterway carriers
 - Barges
 - A typical river barge round in Illinois would be approximately 35' x 195' x 12' and double hulled steel construction. Barges range in size from 10,000 to 30,000 barrels. Usually have 3-6 compartments.
 - Products - various products, corrosives, flammable liquids, crude oil, sludge, shredded metals, 55 gal drums of about anything, possibly even anhydrous ammonia in specially constructed barges, etc.

MARKINGS AND COLORS

- **Rail car markings**
 - **Reporting marks & numbers**
 - Essentially the rail car's license plate, unique to the car
 - Found on left side of the car as you face it.
 - Will have a series of letters followed by a number unique to that car
 - **Specification markings**
 - Equivalent to the MC numbers in highway carriers
 - Found on right side of the car as you face it
 - Specifies the standard to which the rail car was built
 - **Volume markings on tank cars**
 - Given in gallons and/or liters - capacity of the car - found on ends of rail cars
 - **Dedicated car stencil**
 - Cars that are dedicated to service of a specific product may have to be stenciled
 - directly onto the car

MARKINGS AND COLORS



- NFPA 704 marking system
 - Construction
 - Red diamond - fire hazard
 - Blue diamond - health hazard
 - Yellow diamond - self-reactivity hazard
 - White diamond - special hazard

MARKINGS AND COLORS

- NFPA 704 marking system
 - Category locations
 - Red diamond - Top diamond at 12 o'clock
 - Fire Hazard
 - Blue diamond - Left diamond at 9 o'clock
 - Health Hazard
 - Yellow diamond - Right diamond at 3 o'clock
 - Self-Reactivity Hazard
 - White diamond - Bottom diamond at 6 o'clock
 - Special Hazard

MARKINGS AND COLORS

- NFPA 704 marking system
 - Fire hazard degrees
 - 0
 - Blue - materials that on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material
 - Red - materials that will not burn
 - Yellow - materials that are normally stable and therefore do not present any reactivity hazard to firefighters

MARKINGS AND COLORS

- NFPA 704 marking system
 - Fire hazard degrees
 - 1
 - Blue - materials that are only slightly hazardous to health
 - Red - materials that must be preheated before ignition can occur. Water may cause frothing if it gets below the surface of the liquid and turns to steam. If this is the case, water fog gently applied to the surface will cause a frothing that will extinguish the fire
 - Yellow - materials that are normally stable but may become unstable in combination with other materials or at elevated temperatures or pressures. Use normal precautions on approach

MARKINGS AND COLORS

- NFPA 704 marking system
 - Fire hazard degrees
 - 2
 - Blue - materials that are hazardous to health, but fire areas may be entered freely with SCBA
 - Red - materials that must be moderately heated before ignition will occur. Water spray must be used to extinguish the fire because the material can be cooled below its flash point
 - Yellow - materials that will undergo a violent chemical change at elevated temperature & pressure but do not detonate. Use straight streams from a distance to cool tanks and the materials in them. Use caution

MARKINGS AND COLORS

- NFPA 704 marking system
 - Fire hazard degrees
 - 3
 - Blue - materials that are extremely hazardous to health, but fire areas may be entered with extreme care. No skin surface should be exposed
 - Red - materials that can be ignited under almost all normal temperature conditions. Water may be ineffective because of low flash point of materials.
 - Yellow - materials that when heated and under fire confinement are capable of detonation or explosive decomposition and that may react violently with water. Firefighting should be from behind explosion resistant locations.

MARKINGS AND COLORS

- NFPA 704 marking system
 - Fire hazard degrees
 - 4
 - Blue - materials that are too dangerous to health for firefighters to be exposed. Full protective clothing and SCBA will not provide adequate protection against inhalation or skin contact with these materials.
 - Red - very flammable gases or very volatile flammable liquids. If possible, shut on/off flow and keep cooling water streams on exposed tanks or containers. Withdrawal may be necessary.
 - Yellow - materials that are readily capable of detonation or explosive decomposition at normal temperatures and pressures. If they are involved in a massive fire, vacate the area

MARKINGS AND COLORS

- NFPA 704 marking system
 - Symbols - bottom white diamond
 - W - indicates that a material may have hazardous reaction with water
 - OX - indicates an oxidizer
 - Others are used, such as the radioactive trefoil to indicate radioactive materials, COR to indicate corrosives, etc. They are by local code or agreement.

MARKINGS AND COLORS

- Hazardous materials information system, HMIS
 - Information provided
 - Provides information on substance name, hazards, safe handling, and use under normal working conditions
 - Protective equipment requirements
 - May provide information on personal protective gear requirements

MARKINGS AND COLORS



- Hazardous materials information system, HMIS
 - Color scheme
 - Color schemes may resemble that of the NFPA 704, with the white box indicating protective equipment requirements
 - The color scheme is not universal and may be different depending on the producer

MARKINGS AND COLORS



- Military marking system
 - Detonation and fire hazard
 - Class I - Mass Detonation Hazard
 - Indicated by an orange stop sign with the number “1” in the center
 - Class II - Explosion with Fragmentation Hazard
 - Indicated by an orange “x” with the number “2” in the center

MARKINGS AND COLORS



- Military marking system
 - Detonation and fire hazard
 - Class III - Mass Fire Hazard
 - Indicated by an orange inverted triangle with the number “3” in the center
 - Class IV - Moderate Fire Hazard
 - Indicated by an orange diamond with the number “4” in the center

MARKINGS AND COLORS



- Military marking system
 - Special hazard
 - Chemical hazard
 - Indicated by a person dressed in a chemically protective suit
 - Apply no water
 - Indicated by a water bucket with a slash through it
 - Wear breathing apparatus
 - Indicated by face wearing a respirator face piece

MARKINGS AND COLORS



- Pipeline markers
 - Marker location
 - Crosses under a rail line
 - Crosses a public road
 - Is spaced along the pipeline
 - Crosses a waterway
 - Marker contents
 - The word warning
 - Product information
 - Name of carrier
 - Emergency contact phone number

PLACARDS AND LABELS



- Label use
 - Used on small packages
 - Affixed on two sides, near shipping name
 - Indicate primary hazards
 - Similar to placards in most cases

PLACARDS AND LABELS

- Placard use requirements
 - Located on bulk packaging and vehicles
 - Indicates primary hazard of the material
 - Commodities that are classed as Explosives 1.1, 1.2, 1.3, Poison gas, Dangerous when wet, Poison 6.1 packing group I inhalation hazard, or Radioactive III must be placarded in any amount
 - Table 2 materials are placarded at 1,001 lbs. or greater
 - The dangerous placard is used for Explosives C under the old system, and mixed loads of Table 2 materials

PLACARDS AND LABELS



- Types of placards
 - Worded
 - Placards with a word in the center which will identify the primary hazard of the material
 - Wordless
 - Allowed when a UN/NA number is not required to be displayed and except on the Class 7 radioactive placard and the Class 2 oxygen placard

PLACARDS AND LABELS



- Types of placards
 - UN/NA number
 - When required by the regulations, the 4 digit UN/NA number will be displayed in the center of the appropriate placard. The UN/NA number may also be displayed in orange rectangular panel on the bulk container or trailer. The number may correspond to more than one specific product.

PLACARDS AND LABELS

- Four sources of information
 - Color of the placard
 - Symbol at the top of the placard
 - Word or UN/NA number in the center of the placard
 - UN hazard class or division at the base of the placard

PLACARDS AND LABELS



- Placard descriptions
 - Explosives 1.1, 1.2, 1.3
 - Color: Orange
 - Symbol: Exploding bomb
 - Word: Explosives
 - UN Class: 1

PLACARDS AND LABELS



- Placard descriptions
 - Explosives 1.4 and 1.6
 - Color: Orange
 - Symbol: UN division number placed here
 - Word: Explosives
 - UN Class: 1

PLACARDS AND LABELS



- Placard descriptions
 - Explosives 1.5
 - Color: Orange
 - Symbol: UN division number here, 1.5
 - Word: Blasting agents
 - UN Class: 1

PLACARDS AND LABELS



- Placard descriptions
 - Compressed gas 2.1 flammable gas
 - Color: Red
 - Symbol: White flame
 - Word: Flammable gas
 - UN Class: 2

PLACARDS AND LABELS

- Placard descriptions
 - Compressed gas 2.2 non-flammable gas
 - Color: Green
 - Symbol: Compressed gas cylinder
 - Word: Non-flammable gas
 - UN Class: 2

PLACARDS AND LABELS



- Placard descriptions
 - Compressed gas 2.2 oxygen, liquefied
 - Color: Yellow
 - Symbol: Flaming ball
 - Word: Oxygen
 - UN Class: 2

PLACARDS AND LABELS

- Placard descriptions
 - Compressed gas 2.3 poison gas
 - Color: White
 - Symbol: Skull and cross bones
 - Word: Poison gas
 - UN Class: 2

PLACARDS AND LABELS



- Placard descriptions
 - Chlorine 2.3
 - Color: White
 - Symbol: Skull and cross bones
 - Word: Chlorine
 - UN Class: 2

PLACARDS AND LABELS



- Placard descriptions
 - Flammable liquid
 - Color: Red
 - Symbol: White flame
 - Word: Flammable
 - UN Class: 3

PLACARDS AND LABELS

- Placard descriptions
 - Combustible liquid
 - Color: Red
 - Symbol: White flame
 - Word: Combustible
 - UN Class: 3

PLACARDS AND LABELS



- Placard descriptions
 - Flammable solid 4.1
 - Color: Red and white vertical stripes
 - Symbol: Black flame
 - Word: Flammable solid
 - UN Class: 4

PLACARDS AND LABELS

- Placard descriptions
 - Spontaneously combustible 4.2
 - Color: White top 1/2, red bottom 1/2
 - Symbol: Black flame
 - Word: Spontaneously combustible
 - UN Class: 4

PLACARDS AND LABELS



- Placard descriptions
 - Dangerous when wet 4.3
 - Color: Blue
 - Symbol: White flame
 - Word: Dangerous when wet
 - UN Class: 4

PLACARDS AND LABELS



- Placard descriptions
 - Oxidizer 5.1
 - Color: Yellow
 - Symbol: Flaming ball
 - Word: Oxidizer
 - UN Class: 5.1 (division displayed here)

PLACARDS AND LABELS



- Placard descriptions
 - Organic peroxide 5.2
 - Color: Yellow
 - Symbol: Flaming ball
 - Word: Organic peroxide
 - UN Class: 5.2 (division displayed here)

PLACARDS AND LABELS



- Placard descriptions
 - Poison 6.1, packing groups I & II
 - Color: White
 - Symbol: Skull and cross bones
 - Word: Poison
 - UN Class: 6

PLACARDS AND LABELS



- Placard descriptions
 - Poison 6.1 harmful stow away from food stuffs
 - Color: White
 - Symbol: Skull and cross bones
 - Word: Harmful stow away from food stuffs
 - UN Class: 6

PLACARDS AND LABELS



- Placard descriptions
 - Radioactive, for radioactive III materials only
 - Color: Yellow top 1/2, white bottom 1/2
 - Symbol: Trefoil or propeller
 - Word: Radioactive
 - UN Class: 7

PLACARDS AND LABELS



- Placard descriptions
 - Corrosive
 - Color: Black with symbol in white background
 - Symbol: Test tube dripping liquid onto steel bar and hand
 - Word: Corrosive
 - UN Class: 8

PLACARDS AND LABELS



- Placard descriptions
 - Miscellaneous
 - Color: Black and white vertical strips on top 1/2, white on bottom 1/2
 - UN Class: 9

PLACARDS AND LABELS



- Placard descriptions
 - Dangerous
 - Color: Red with white band across center
 - Symbol: None
 - Word: Dangerous
 - UN Class: Not class specific

PLACARDS AND LABELS



- Placard descriptions
 - Residue placards
 - Residue placards will be displayed on railroad cars and are indicated by the word “residue” in a black triangle at the bottom of the placard. This indicates up to 3% of the car volume remaining the car.

PLACARDS AND LABELS



- Placard descriptions
 - Subsidiary risk placards and labels
 - The primary and subsidiary (secondary) hazards of material may be on placards and labels. The primary hazard always has the hazard class number on the bottom of the placard or label. 49 CFR 172.402.

PLACARDS AND LABELS

- Agrochemical, pesticide labels
 - Signal word
 - High hazard - DANGER/POISON
 - Moderate hazard - WARNING
 - Low hazard - CAUTION
 - EPA registration number
 - Three group number such as 12345-6789-11. The first group indicates manufacturer, the second group indicates the specific product, the third group indicates locations where the product may be used

PLACARDS AND LABELS

- Agrochemical, pesticide labels
 - EPA establishment number
 - Indicates the actual production site of the commodity
 - Product name
 - The brand name or trade name is indicated on the label
 - Statement of treatment
 - Initial first aid or instructions for EMS or physicians

PLACARDS AND LABELS

- Agrochemical, pesticide labels
 - **Statement of hazard**
 - Describes hazards associated with the product
 - **Ingredient statement**
 - Breakdown of percentages of active ingredients
 - **Environmental statement**
 - Storage and disposal information and warnings
- **PCBs**
 - PCBs will have a label identifying the product as having PCBs present in the mixture as prescribed by the EPA

WRITTEN RESOURCES



- Shipping papers
 - By mode of transportation
 - Highway
 - Location of papers (truck cab arms reach of driver)
 - Bill of lading
 - Driver
 - Air
 - Location of papers (arms reach of pilot)
 - Airbill
 - Pilot

WRITTEN RESOURCES

- Shipping papers
 - By mode of transportation
 - Waterway
 - Location of papers (bridge/pilot/wheel house in a tube mailbox)
 - Dangerous cargo manifest
 - Captain or master
 - Train
 - Location of papers (engine/caboose arms reach of conductor)
 - Waybill & consist
 - Engineer/crew member

WRITTEN RESOURCES



- Shipping papers
 - Information contained in shipping papers
 - Proper shipping name
 - UN hazard class
 - 4 digit UN/NA identification number (DOT ID#)
 - Means of indicating or highlighting hazardous materials presence
 - Shipper's & consignee's name & address
 - Emergency contact phone number

WRITTEN RESOURCES

- **MSDS - Material Data Safety Sheets**
 - Required information on the MSDS
 - Material name
 - Chemical formula & chemical family
 - Common names & synonyms
 - Manufacturer's name & emergency number
 - Hazardous ingredients
 - Regulated exposure limits
 - Physical properties data

WRITTEN RESOURCES

- MSDS - Material Data Safety Sheets
 - Required information on the MSDS
 - Fire & explosion data
 - Spill or leak procedure
 - Reactivity data
 - Health hazard data
 - Special procedures & precautions

WRITTEN RESOURCES

- **MSDS - Material Data Safety Sheets**
 - Sources of MSDS
 - Manufacturer
 - Supplier
 - Facility hazard communication plan
 - LEPC - Local Emergency Planning Commission
 - Shipping papers (may be attached)
 - CHEMTREC, PERS, INFOTRAC, or similar agencies

WRITTEN RESOURCES

- MSDS - Material Data Safety Sheets
 - Other MSDS information
 - Prepared by manufacturer
 - No required format
 - Regulated by OSHA
 - Must be provided to LEPC/FD when requested
 - Other printed sources
 - Site surveys or pre-plans
 - Site inventories

SENSES



- Other clues
 - Bystander reports
 - Odors or reports of odors (If you smell it, you are in it)
 - Gas leaks, frosted valving, hissing
 - Vapor clouds, pooled products
 - Dead animals, plants, or person
 - Relief device operation
 - Unusual fire conditions including smoke color, behavior, etc.

SENSES

- **Size up**
 - Lay of the land
 - Land use
 - Scene access
 - Weather conditions
 - Bodies of water
 - Exposure potential
 - Transmission lines (above and below ground)
 - Pipelines
 - Sewer drains
 - Ignition sources
 - Rail lines, highways, airports in vicinity
 - Injured persons (type & extent)
 - Specific building information

DIFFICULTIES IN DETERMINING SPECIFIC NAME

- Shipping papers not available
- Inventories not available
- Contents may be unknown or fly dumped

INFORMATION SOURCES BY INCIDENT TYPE

- Transportation
 - Shipping papers
 - Vehicle operator or crew member
 - Shipper
 - Receiver
 - DOT ERG
 - CHEMTREC
 - Highway vehicle license numbers, ID numbers, company names
 - Rail car reporting marks and numbers
 - Placards & labels

INFORMATION SOURCES BY INCIDENT TYPE



- Fixed facility
 - Facility personnel
 - MSDS
 - Inspections/preplans
 - NFPA 704

VERIFICATION OF INFORMATION



- CHEMTREC/PERS/INFOTRAC
- Contacting shipper, consignee, carrier
- Several resources

Section V



Fixed Facility Concerns

FIXED FACILITIES



- Types of facilities
 - Manufacturing complex
 - Usually a single company complex where one or more products are produced from components
 - Industrial park
 - A complex in which there are multiple companies in a geographical area which are often completely independent of each other

FIXED FACILITIES



- Storage types
 - Warehousing
 - Typical warehousing operations may contain nearly any type of hazard
 - Liquids storage
 - Flammable & non-flammable
 - Poisonous
 - Corrosives
 - Temperature sensitive
 - Pyrophorics – Spontaneously ignites (iron sulfide)

FIXED FACILITIES



- Storage types
 - Gas storage
 - Flammable & non-flammable
 - Poisonous
 - Pyrophorics
 - Cryogenics
 - Raw/bulk material storage
 - Hazards may include nearly any type of hazard

FIXED FACILITIES



- Fixed facility systems
 - Sewer systems
 - Facilities may have run off type systems which simply hold run off from domestic sewers if contaminated or may have process system sewers which collect and return overflow products to processing
 - Utility systems
 - Facilities may have their own steam or power generating plant on site for use by the facility

FIXED FACILITIES



- Fixed facility systems
 - Fire protection systems
 - Sprinklers (wet, dry, or pre-action)
 - Steam systems
 - Foam systems
 - Inert gas systems - Nitrogen, CO₂, etc
 - Halon systems
 - Pull alarm stations
 - Detection systems

FIXED FACILITIES



- Fixed facility systems
 - Personnel systems
 - Eye wash stations
 - Safety showers
 - Wash stations
 - Clean rooms

FIXED FACILITY EMERGENCIES

- Types of emergencies
 - Fires
 - Structural
 - Occupancy/location/life hazard
 - Construction types & characteristics
 - Safety systems and their operations
 - Resources required and available
 - Specialized equipment required
 - Process equipment
 - Product involved
 - Health hazards & risks
 - Environmental hazards
 - Reactions involved
 - Effects on the other parts of the production process

FIXED FACILITY EMERGENCIES

- Hazardous materials incidents
 - Occupancy
 - Differing occupancies will dictate response strategy & tactics
 - Incident specifics
 - Is this an emergency or a significant incident, and is it the fire department's problem or the site's problem to deal with

FIXED FACILITY EMERGENCIES

- Rescues
 - High angle
 - Areas such as petroleum cracking towers and large ovens will require workers to be at undesired elevations with limited access for rescue
 - Confined space
 - Although not all confined space incidents involve a hazardous environment many do. In order to avoid injury or death, responders must take proper precautions including continuous monitoring of the environment of the space for any hazard

FIXED FACILITY EMERGENCIES



- Rescues
 - Medical
 - Concern here must always be given to whether the condition is a normal medical condition or the result from an exposure to some workplace hazard.
Responder safety must be insured

FIXED FACILITY EMERGENCIES



- Emergency responses
 - Pre-planning
 - Types of emergencies - plan for each type of emergency (fire, hazardous materials, rescue)
 - Site plan - know the site's SOPs, level of training, at what point in an incident you are called, what constitutes an emergency to your organization, clear routes to the scene and location information

FIXED FACILITY EMERGENCIES

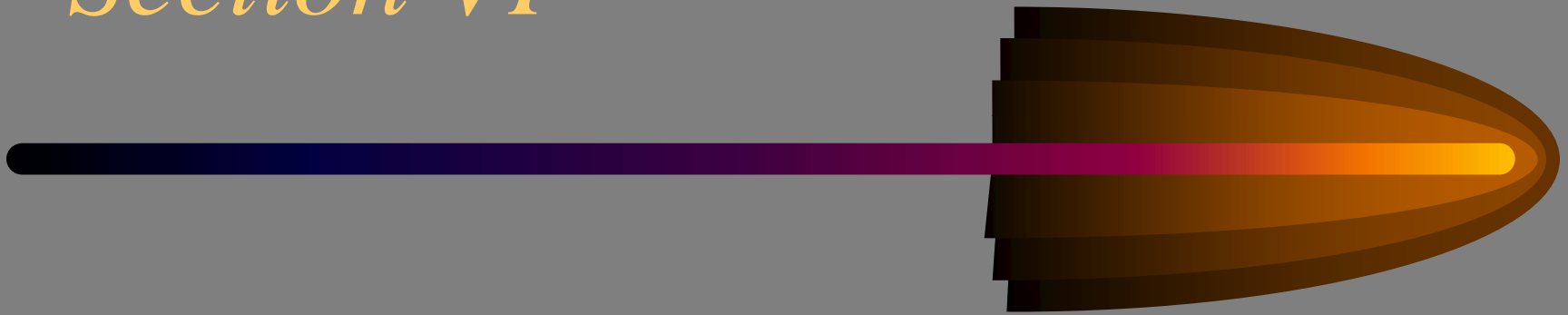


- Emergency responses
 - Dispatch
 - Should be prepared to gather information beyond address for large sites, including specific location, nature of the problem, status of the plant operations, additional resources being sent in.
 - On scene size up
 - Find out what the problem is and what seems to be causing the problem

FIXED FACILITY EMERGENCIES

- Emergency responses
 - **Integrating organizations**
 - Unified command will be a necessity for working in-site personnel with that of the emergency responders if a safe operation is to be ensured
 - **Warning signs/potential hazards**
 - Trouble alarms
 - Flare stacks
 - Smoke clouds
 - Vapor clouds
 - Changes in operating status

Section VI



**Information and
Response Assistance**

RESOURCE MANUALS

- U.S. Department of Transportation
Emergency Response Guidebook
 - Designed for use in making informed decisions during the initial stages of an incident
 - Identifies products by name, class, UN/NA number, or placard & recommends initial emergency actions including evacuation & isolation distances & first aid recommendations
 - Contains CHEMTREC & CANUTEC phone numbers

RESOURCE MANUALS

- Emergency Handling of Hazardous Materials in Surface Transportation
 - Contains specific commodity information on 3,900 materials
 - Includes ID by Standard Transportation Commodity Code (STCC #)
 - Includes mitigation procedures for EPA listed substances
 - Includes PPE recommendations (after 1993)

RESOURCE MANUALS

- Fire Protection Guide on Hazardous Materials
 - Fire hazards of 1,300 commodities
 - Physical properties listed for many commodities in table format
 - Toxicity data in 416 commodities
 - Hazardous reaction data on mixing of over 3,550 chemicals
 - May require some specialized knowledge/ experience to fully utilize & interpret the wealth of information in the manual

RESOURCE MANUALS



- Farm Chemical Handbook
 - Information on agri-chemicals & pesticides
 - Commodities listed by generic & by trade names

RESOURCE MANUALS

- NIOSH Pocket Guide to Chemical Hazards
 - Information from OSHA and NIOSH
 - Tabular format, ideal for industrial hygiene medical surveillance information
 - Includes names, synonyms, PELs, properties, exposure signs & symptoms, PPE recommendations, spill & disposal techniques & medical monitoring procedures
 - Requires some effort in use of the book & some specialized knowledge to interpret much of the data, however, is a very complete source of initial information

RESOURCE MANUALS

- CHRIS Manuals
 - Contains thorough tabulated information on commodities
 - Convenient notebook form
- Other Sources
 - Computer resources (CAMEO, TOMES)
 - U.S. Geological Survey Maps
 - Aerial photography
 - Remote sensing
 - “Expert” technical advice

TECHNICAL ASSISTANCE

- CHEMTREC/CANUTEC
 - A service of the Chemical Manufacturer's Association which provides immediate advice by telephone/fax to emergency responders 24 hours a day at 1-800-424-9300
 - Has access to computer data bases and quick access to the shipper for detailed assistance and response follow up

TECHNICAL ASSISTANCE

- Other emergency contact agencies
 - PERS & INFOTRAC
 - Private companies providing services similar to those of CHEMTREC
- Outside response agencies
 - Regional response teams
 - National response teams
 - Private sector response/remediation teams
 - Manufacturer's association teams
 - Responsible party's response teams

TECHNICAL ASSISTANCE

- Shipper or manufacturer
 - **Contact**
 - CHEMTREC/CANUTEC, the emergency number provided on the MSDS or the number on the shipping papers may be used to contact the company
 - **Information to be obtained by responders**
 - Names & synonyms of the commodity
 - Physical characteristics of the commodity
 - Safe handling & control procedures
 - Reporting requirements
 - Owner/fiscally responsible party contact

Technical Assistance

- Information required by CHEMTREC includes:
 - Caller's Name and Call Back Number
 - ERG Guide Number in Use
 - Name of Shipper or Manufacturer
 - Carriers I.D.
 - Vehicle I.D. Number
 - Consignee Name and Number
 - Local Conditions

Technical Assistance

- Other Emergency Contact Agencies
- PERS
- INFOTRAC
- Private companies providing services similar to those of CHEMTREC

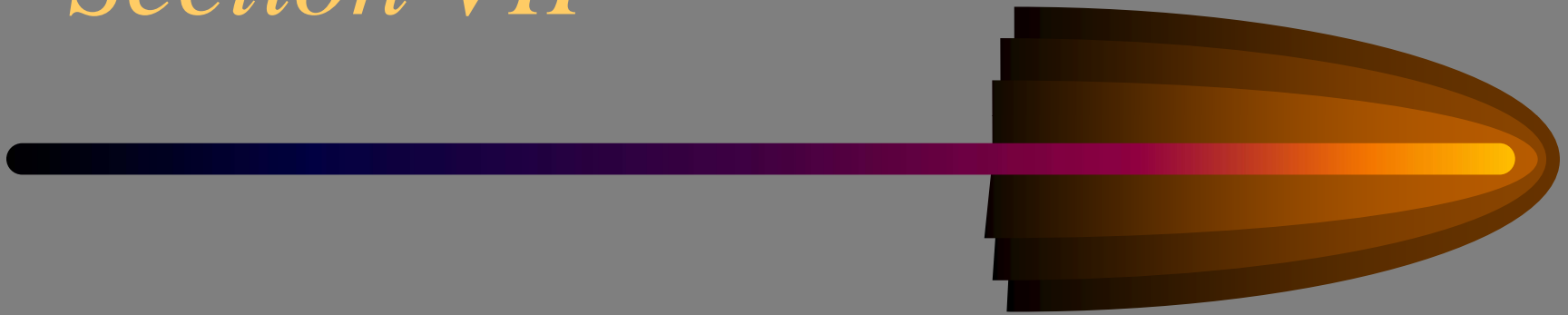
Technical Assistance

- **Outside Response Agencies**
 - Regional Response Teams
 - National Response Teams
 - Private Sector Response/Remediation Teams
 - Manufacturer's Association Teams
 - Responsible Party's Response Teams
- **Shipper or Manufacturer - required to provide 24-hour emergency assistance by 29 CFR 1910.1200**

Technical Assistance

- Shipper or Manufacturer (continued)
 - Contact - Chemtrec/Canutec, the emergency number provided on the MSDS or the number on the shipping papers may be used to contact the company.
 - Information to be Obtained by Responders
 - Names and synonyms of the commodity
 - Physical characteristics of the commodity
 - Safe handling and control procedures
 - Reporting requirements
 - Owner/Fiscally responsible party contact

Section VII



Monitoring

MONITORING & SAMPLING



- Monitoring
 - The nearly immediate characterization of an atmosphere utilizing instrumentation to determine the level or concentration of hazardous materials present
 - Preliminary evaluation of site characteristics
 - 29 CFR 1910.120 © (4) - Required that a hazardous materials site be characterized for the purpose of establishing safety requirements.
 - Perimeter - Will aid in identifying the size of the affected and endangered areas. Assists in setting initial isolation zones.
 - Personal protective equipment (PPE) - Will assist in selection of appropriate PPE.
 - High risk - Preliminary monitoring is usually done by a RECON team. This team **MUST** remember they may not be properly protected for conditions they may face and must act accordingly. **AVOID** contact with the product.

MONITORING & SAMPLING

- Monitoring
 - Operational monitoring
 - 29 CFR 1910.120 (h) (2) - Requires monitoring for hazmat environments during initial entry operations.
 - Identify hazardous conditions - Keep personnel informed of conditions in which they are working.
 - Different areas - Operational monitoring will allow workers to detect changes in their environments.
 - New discovery - Operational monitoring will allow workers to detect undiscovered environments.
 - Dynamic scene - To keep abreast of conditions, monitoring should be done.
 - Final monitoring
 - Evaluate hazard potential - Provides final evaluation of the hazards.
 - Document final conditions - Documents termination conditions at an incident.

MONITORING & SAMPLING



- Sampling
 - Actual capture & analysis of a small piece of the environment in question
 - Proper sampling equipment & technique (Proper equipment and techniques are required to ensure safe retrieval of the sample, while ensuring the integrity of the sample.)
 - Proper sample identification (Samples must be identified by sampler, date, time and specific location of sample taken if the information provided by the sample is to be of use on the site. Typically, large numbers of samples are taken during the same entry.)

MONITORING DEVICES

- General monitor characteristics
 - Direct reading
 - Instruments used by emergency responders are typically those which provide information to the user at the time of contact, thereby directly reading the atmosphere (as compared to taking a sample and bringing it some place else for analysis.)

MONITORING DEVICES

- General monitor characteristics
 - Safety of devices
 - Monitoring devices should be safe as per the NFPA National Electrical Code for environments where there is potential for an air fuel mixture in proper proportion to ignite
 - Explosion proof - device in which electrical equipment is encased in a rigidly built container so that it will withstand the internal explosion of a flammable mixture.
 - Intrinsically safe - device in which the electronic equipment are incapable of releasing sufficient energy (under normal/unusual situations) to cause flammable atmosphere to ignite.
 - Purging - device in which the electrical equipment is totally enclosed in an inert environment under a slight positive pressure from a reliable source.

MONITORING DEVICES

- General monitor characteristics
 - Safety certification
 - Devices should be certified by a qualified agency as to the level of safety provided (UL).
 - Suited for need
 - It is important that the instruments used by the responders be easily transported, rugged, and easy to use

MONITORING DEVICES



- Performance characteristics
 - Reliability
 - Device should produce similar results with different operators employing the same procedures when encountering the same environment
 - Sensitivity
 - Device should have the ability to differentiate between environments of differing levels of contaminants as needed

MONITORING DEVICES

- Performance characteristics
 - Range
 - Device should have capabilities in the proper range in which it is expected to operate
 - Detection limit
 - Devices will have upper and lower limits of detection
 - Selectivity
 - Device should be able to detect the commodity desired with little interference

MONITORING DEVICES

- Performance characteristics
 - **Response time**
 - Device should provide users with information in a timely manner
 - **Calibration**
 - Devices will need to be calibrated from time to time
 - **Relative response**
 - Since devices are calibrated to a specific chemical environment when they are used to monitor other chemical environments they respond with a slightly different response

MONITORING DEVICES



- Types
 - Oxygen indicators/sensors
 - Senses oxygen enriched & deficient environments
 - Combustible gas indicators (CGIs)
 - Senses flammable/explosive environments
 - Photo ionization detectors (PIDs)
 - Senses many organic & some organic vapors and can be used as a general device or for a specific chemical if the environment has been previously characterized

MONITORING DEVICES



- Types
 - Flame ionization detectors (FIDs) or organic vapor analyzers (OVAs)
 - Senses organic vapors such as a general survey device or specifically in conjunction with specialized techniques such as gas chromatography
 - Radiation monitors
 - Senses ionizing radiation

MONITORING DEVICES



- Types
 - pH devices
 - Senses the relative corrosiveness of an environment
 - Colorometric tubes
 - Senses specific chemicals or classes of chemicals in the air by reacting with the atmosphere drawn through the tube to changing colors

MONITORING DEVICES

- Monitoring procedures
 - Priorities (must be set at incidents)
 - Corrosive vapor
 - May damage instrumentation rendering it useless
 - Radioactivity
 - Devices may not detect all types of radiation and are not necessarily safe for flammable environments
 - Flammable atmosphere
 - Must be identified to protect responders, especially when operating in PPE which provides limited or no flash protection

MONITORING DEVICES

- Monitoring procedures
 - Priorities
 - Oxygen levels
 - Must be identified to ensure life safety and identify environments which will enhance combustion
 - Corrosive liquids
 - Must be identified in order to properly protect responders, the public, and the environment
 - Other hazards
 - Every effort must be made to identify all types of environments hazardous to the responder

MONITORING DEVICES

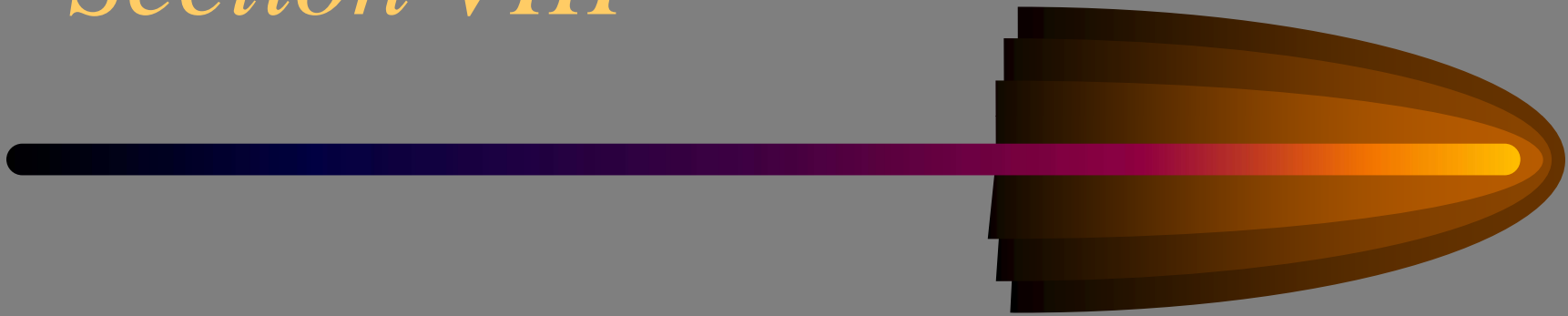


- Monitoring procedures
 - Procedural guidelines
 - Buddy system
 - Responders should operate as teams of two or more, even during RECON operations
 - Safety briefings
 - Members should always be briefed on the situation, potential hazards, and tasks to be performed
 - Communications
 - Members need to have a means of communication & an auxiliary method (such as hand signals).

MONITORING DEVICES

- Monitoring procedures
 - Procedural guidelines
 - Egress
 - Means of emergency egress should be identified
 - Decontamination
 - Responders must have decontamination capabilities prior to sending personnel into an area which exposure is possible
 - Safe work practices
 - Safe practices such as approaching from the upwind, uphill side of the incident, not walking in products, etc. should be followed at all times

Section VIII



Personal Protective Equipment

CATEGORIES OF PERSONAL PROTECTION

- Thermal
 - Protection designed to protect the user from the effects of exposures to high heat or fire condition, or possibly low heat (cold) conditions (not designed for chemical protection)
 - Structural fire fighting gear - approved for structure firefighting- not direct flame contact or heavy heat
 - Proximity suits -use with flammable/combustibles
 - Entry suits - short duration flame contact 30-40 sec.
 - Flash protective CPC - limited flash and chemical protection

CATEGORIES OF PERSONAL PROTECTION



- Mechanical
 - Designed to protect the worker from mechanical harms such as bumps, scraps, cuts, etc.
- Chemical
 - Designed to protect the user from the effects of hazardous chemicals (no thermal protection)

CATEGORIES OF PERSONAL PROTECTION

- Respiratory
 - Designed to protect the user from the effects of toxic or adverse atmospheres
 - SCBA - Positive pressure self-contained breathing apparatus (provides highest level of respiratory protection.) (limits movement in confined areas)
 - SAR - Positive supplied air respirators (provides highest level of respiratory protection - less bulky, indefinite air supply) (impairs mobility due to air line, requires attendant, air line limit of 300 feet, vulnerable to damage and contamination.)
 - APR - Air purify respirators (enhanced mobility, lightweight) (cannot be used in IDLH environments, limited span of protection, protects only to a certain concentration level of the specific chemical or class)

CHEMICALLY PROTECTIVE CLOTHING



- Chemically protective suits
 - Vapor protective suits (fully encapsulating suit)
 - Protection from chemicals outside the suit by prohibiting solid, liquid, & vapor from entering the suit
 - Splash protection suits
 - Provide protection from liquid splash during operations (chemical burns, rashes, absorption)

CHEMICALLY PROTECTIVE CLOTHING



- Chemically protective suits
 - Support function protective clothing
 - Provides liquid splash protection similar to that of the splash protection suits, but are recommended only for operations in the warm zone due to the construction characteristics

CHEMICALLY PROTECTIVE CLOTHING



- EPA level ensembles
 - Level A - highest form of respiratory, skin, eye, & mucus membrane protection
 - Positive pressure SCBA or SAR
 - Fully-encapsulating suit (vapor suit)
 - Inner & outer chemical resistance gloves
 - Chemically resistant boots (steel toe & shank)
 - Intrinsically safe radio
 - Recommended: long underwear (cotton), coveralls, hard hat

CHEMICALLY PROTECTIVE CLOTHING

- EPA level ensembles
 - **Level B - highest level of respiratory protection with lesser (splash) protection for the skin**
 - **Minimum required level of protection for initial entry into uncharacterized sites**
 - Positive pressure SCBA or SAR
 - Chemically resistant clothing (splash protection)
 - Inner & outer chemical resistant gloves
 - Chemically resistant boots (steel toe & shank)
 - Intrinsically safe radio
 - Recommended: coveralls, hard hat, outer chemical booty

CHEMICALLY PROTECTIVE CLOTHING

- EPA level ensembles
 - **Level C - used when in a known environment where requirements for APR have been met & exposure to skin & is unlikely**
 - Full face APR
 - Chemically resistant clothing (splash protection)
 - Inner & outer chemical resistant gloves
 - Chemically resistant boots (steel toe & shank)
 - Intrinsically safe radio
 - Recommended: coveralls, hard hat, outer chemical booty, escape mask

CHEMICALLY PROTECTIVE CLOTHING



- EPA level ensembles
 - Level D - primarily a work uniform and should not be worn where respiratory or skin hazards exist
 - In general, turn out gear is Level D for a fire fighter, with the added protection of an SCBA, which is part of the normal “work uniform” of the fire fighter

CHEMICALLY PROTECTIVE CLOTHING



- Characteristics
 - Construction materials
 - Non-elastomers
 - Tyvek garments
 - Coated tyvek garments
 - Elastomers
 - Polyvinyl chloride
 - Neoprene
 - Polyethylene
 - Nitrile
 - Polyvinyl
 - Viton

CHEMICALLY PROTECTIVE CLOTHING

- Chemical resistance of chemical protective clothing (chemicals may enter a garment by:
 - Penetration
 - Movement of the hazardous chemical through openings in the garment such as through seams, zippers, valve enclosures, pin holes, or other imperfections in the materials
 - Degradation
 - Physical decomposition of the material due to exposure to chemicals, use, or ambient conditions

CHEMICALLY PROTECTIVE CLOTHING

- Chemical resistance of chemical protective clothing
 - Permeation
 - Actual movement of the chemical through the material at the molecular level
 - Permeation rate - how much material will permeate through a given thickness of the chemical protective garment in a given time
 - Breakthrough time - time it takes a chemical to pass through the material which is affected by:
 - Temperature rises
 - Chemical Mixes (as chemicals mix, permeation becomes unpredictable)
 - Previous Exposure (permeation may continue after removal from outside of suit, breaking through during other uses or storage)

USE OF CHEMCIALLY PROTECTIVE CLOTHING



- Types of suits
 - Limited use
 - Multi-laminate layer suits designed to be used & discarded - reuse not recommended
 - Multi-use suits
 - Thicker, more durable garments which are designed to be reused, however exposure to certain chemicals will damage the suit and require its disposal.

USE OF CHEMICALY PROTECTIVE CLOTHING



- Limitations of use
 - Cardiovascular fitness
 - Use of PPE will strain the cardiovascular system too the limits of the user (medical evaluations are required)
 - Thermal stress (be aware of signs and symptoms)
 - Heat stress
 - Cold stress
 - Mental strain
 - Produces psychological effects & may aggravate conditions such as claustrophobia

Heat Stress

- Heat Rash - Inflammation of the skin
- Heat Cramps - Cramps in the extremities or abdomen due to depletion of water/electrolytes of the body
- Heat Exhaustion - mild form of heat stroke, profuse sweating, cold clammy skin and pale appearance
- Heat Stroke - severe (sometimes fatal) condition where sweating has stopped, skin hot and dry, temp elevated, pulse is rapid and convulsions or unconsciousness may result

Cold Stress

- Frostnip - white or blanche skin color
- Superficial Frostbite - skin feels frozen with a white waxy appearance. Skin below will remain soft and bouncy
- Deep Frostbite - skin becomes gray or blue, feeling frozen. Skin below will be frozen, lacking feeling and not rebounding to touch

USE OF CHEMCIALLY PROTECTIVE CLOTHING



- Safety precautions
 - Buddy systems
 - Must always travel & work in at least a team of two
 - Required by OSHA
 - Back-up personnel
 - Personnel ready to assist in the event of an emergency involving the initial work team must be staged. Equal sized team and equally protected.
 - Required by OSHA (2in 2 out)

USE OF CHEMCIALLY PROTECTIVE CLOTHING

- Safety precautions
 - Safe work practices
 - Approaching sensibly (from uphill and upwind using binoculars)
 - Moving with calculated & deliberate movements
 - Utilizing appropriate monitoring equipment
 - Stay aware of the surroundings including potential means of egress and changes in the conditions
 - Ensuring decontamination facilities & egress routes prior to work
 - Take precautions to ensure responder safety during search & rescue activities. Do not create additional victims out of responders.

SCBA

- Components of an SCBA
 - Cylinder assembly - holds the air supply & is the main weight of the breathing apparatus. Has a cylinder valve to control contents. Available in various pressures and various amounts of air (cu. Ft):
 - 2216 psi, 45 cu. ft. Rated at 30 mins/12-18 minutes
 - 3000 psi, 66 cu. ft. Rated at 45 mins/20-30 minutes
 - 4500 psi, 45 cu. ft. Rated at 30 mins/12-18 minutes
 - 4500 psi, 88-90 cu. ft. Rated at 60 mins/ 35-45 minutes
 - Harness assembly - holds the breathing apparatus to the user & consists of a back plate and straps

SCBA

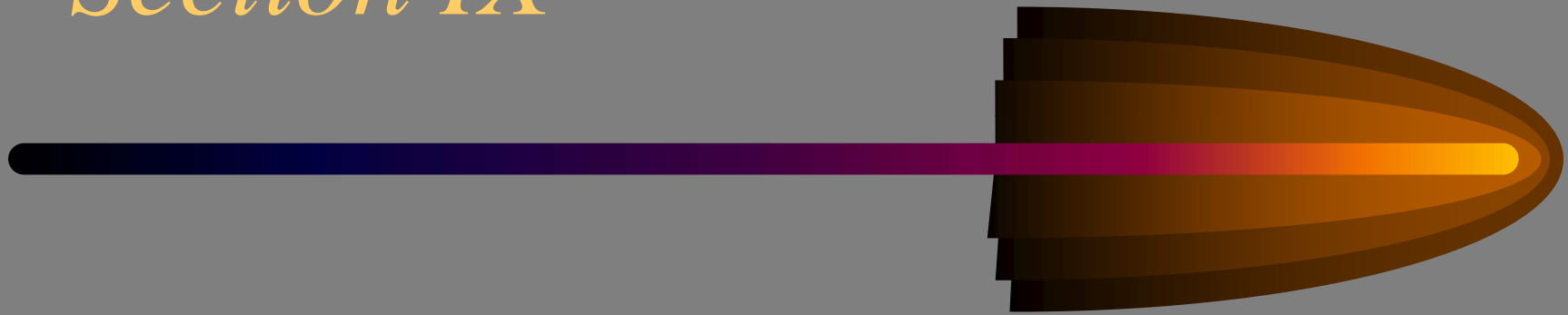
- Components of an SCBA
 - Regulator assembly - reduces the pressure in the cylinder to a breathable pressure while delivering a flow of air to the face piece. It supplies slight positive pressure to the face piece of the user.
 - Bypass or purge valving - used in case of main line regulator failure
 - Quarter service alarm - sounds when one quarter of air supply is left
 - Gauge - units may contain a pressure gauge on the regulator
 - Face piece assembly - delivers the breathable air to the face
 - Lens
 - One way exhalation valve
 - Adjustable webbing
 - Speaking diaphragm
 - Delivery (supply) tube from regulator



SCBA

- Use of SCBA
 - Donning, doffing, and use of SCBA should be done in accordance with manufacturer's recommendations
- Care of SCBA
 - Cleaning, inspection, and maintenance of SCBA should be done in accordance with manufacturer's recommendations. Service of SCBA should only be done by qualified individuals.

Section IX



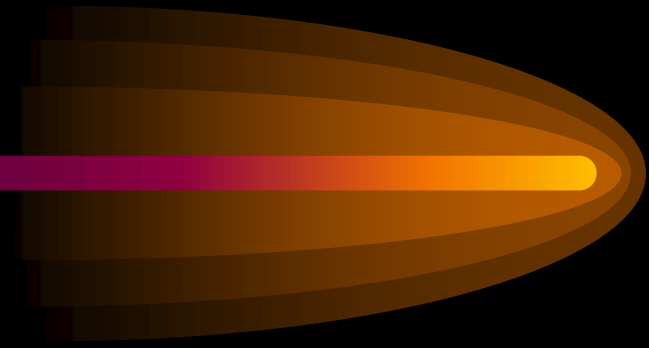
**Incident Assessment,
Analysis and Evaluation**

Incident Assessment, Analysis and Evaluation - the 4 steps

- Analyzing the problem- Every good solution starts with a good evaluation of the problem. Without a clear definition of the problem, responders will flounder at solving it.
- Analysis can be broken down into two distinct activities.
 - Gathering Information
 - Predicting the Course of Events

Incident Assessment, Analysis & Evaluation - the 4 steps

- Gathering information
 - Size-up
 - Initial Observations of the Scene
 - Surround Conditions
 - Material Behavior (Where is it going)
 - Container Behavior (What is it doing)
 - What is the Degree of Hazard Present
 - Initial information gathering
 - Materials Involved and Their Characteristics (Hazards)
 - Incident History
 - Present Incident Status
 - Pathways of Dispersion (Actual or Potential)
 - Populations and Properties at Risk
 - Site concerns
 - Site Access
 - Terrain
 - Geology and Hydrology



Incident Assessment, Analysis & Evaluation - the 4 steps

- Predicting the course of events - behavioral modeling
 - Identify the type of stress causing the problem
 - Thermal. Stressed by heat
 - Mechanical. Stressed by some mechanical means such as being struck by a vehicle
 - Chemical. Stressed by a chemical reaction such as over pressurization of a container due to a reactive chemical being in the wrong container and reacting.

Incident Assessment, Analysis and Evaluation - the 4 steps

- Predict/identify the type of breach causing the problem
 - Disintegration. A violent explosion or total smashing of a container, such as a glass bottle.
 - Runaway Linear Cracking. A small crack appears in a stressed container and rapidly develops into a large crack.
 - Closures Open Up. Closures, such as relief devices or valves which are part of the container design, open
 - Punctures. Breaches punched into the container by devices such as a fork lift, a crane or a rail car coupling
 - Splits or Tears. Failure of the container caused by a mechanical tearing of the container or failures of seams and welds.

Incident Assessment, Analysis and Evaluation - the 4 steps

– Predict/identify the type of release

- Detonation. Basically an explosion.
- Violent Rupture. BLEVEs (boiling liquid expanding vapor explosions) and SHITs (sudden heat induced tears)
- Rapid Relief. From relief of conditions in the container through relief points, such as safety relief valves. May be long or short in duration.
- Spill or Leak. Gradual flow through openings, such as splits or tears.

Incident Assessment, analysis and Evaluation - the 4 steps



- Predict/identify the dispersion pattern (once commodities escape from their containers, they travel in one of several of the following geometric patterns:
 - Hemisphere
 - Cloud
 - Plume
 - Cone
 - Stream
 - Pool
 - Irregular Pattern

Incident Assessment, analysis and Evaluation - the 4 steps



- Predict/identify the length of exposure (once the material is out and on the move, we must predict the likely duration of the exposure)
 - Short Term. Minutes to hours.
 - Medium Term. Days to weeks.
 - Long Term. Months to years.

Incident Assessment, Analysis and Evaluation - the 4 steps

- Predict/identify the hazard causing harm (once the exposure has been predicted, the type of physical and health damage done to the exposed areas must be predicted)
 - Thermal - burns.
 - Mechanical - Damage caused by being struck by flying objects or by other mechanical means
 - Poisoning - Toxic invasion of persons and environments
 - Corrosive - Degradation of tissues and metals
 - Asphyxiation - Simple and chemical
 - Radiation - Radiation injuries and contamination
 - Etiological - Caused by living organisms

FOUR GENERAL ACTIVITIES

- Planning the response
 - Harm - Evaluate options in terms of harm already done, predicted harm occurring during the implementation, and the overall harm predicted.
 - Life Loss/Injury
 - Property Loss/Damage
 - Environmental Damage
 - Financial Loss
 - Tapes & Time - Evaluate the resources and time which is available for response
 - Training - Is the required Training level present?
 - Apparatus - Is the appropriate Apparatus present?
 - Personnel - Is there sufficient number of trained response Personnel?
 - Equipment - Do the trained personnel have the proper Equipment?
 - Safety - If the answer is yes on all counts, we have the necessary resources to implement the response option Safely
 - Time - Remember actions will take time and consider this when choosing options

Incident Assessment, Analysis and Evaluation - the 4 steps



- Evaluation of the response progress (as the incident proceeds, the progress of our actions must be evaluated. Progress can lead to one of two results:
 - Control of the incident is being gained
 - The incident is intensifying

Evaluation of the Response

Progress

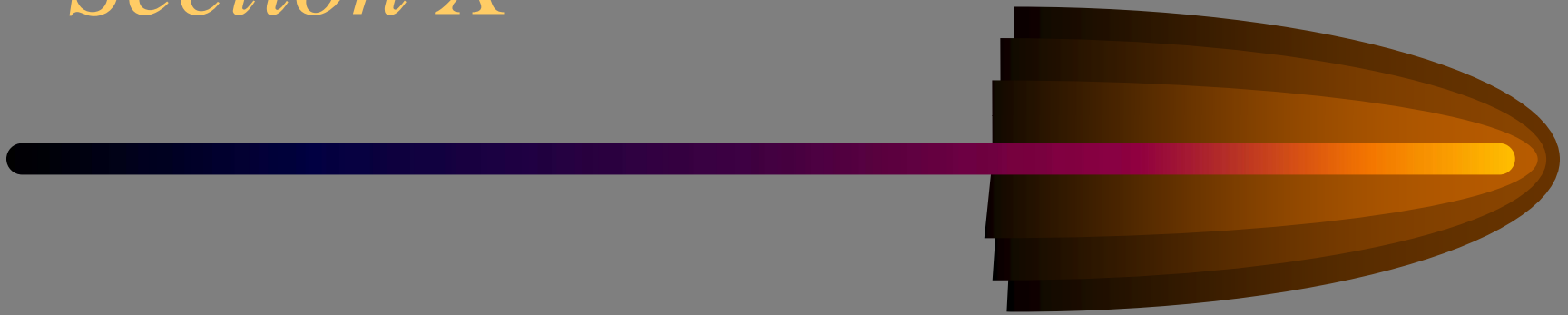


- Control of the Incident is being Gained
 - Response objectives are being met and we should continue with our course of action. This information should be communicated through the established and known chain of command.

Evaluation of the Response Progress

- The Incident is Intensifying.
 - Objectives are not being met and we must return to the analysis step of the process. It may be possible that the most prudent response option at this point is the PULL BACK from the incident. This should be given serious consideration if the incident is continuing to deteriorate or is showing no signs of improvement. This info should be communicated through either the established chain of command or through appropriate established and known emergency procedures to all responders (such as air horn blasts or a radio message.)

Section X



Defensive Control Options

SELECTION OF A RESPONSE (CONTROL) OPTION

- **Change applied stress** (May move stressed container, remove the stressor or shield the system from the stressor)
- **Change the breach event** (May include activating the relief devices or in general having a more favorable type of release)
- **Limit the quantity released** (May include changing the container position so the breach is in a place that will limit release quantity.)
- **Alter product movement** (Limit the affected area by techniques such as diking, damming, diverting. Etc.)
- **Limit the exposure** (May include providing shelter, evacuations, or PPE)
- **After harm event** (Decontaminate, provide prompt medical attention, limit degree of exposure)

CATEGORIES OF MATERIAL CONTROL ACTIONS



- Containment
 - Sealing or containing the material inside its original container, typically through offensive actions involving product contact
- Confinement
 - Limiting the spread of materials released to a specific geographical area by defensive actions involving no planned contact with materials

SPECIFIC MATERIAL CONTROL TECHNIQUES

- Absorption/adsorption
 - Physical combination of one substance with another. Typically, a liquid penetrating the interior of a solid (absorbing) like a liquid into a sponge OR a certain type of liquid interacting with the surface of the solid which holds the material due to an interaction at the molecular level. Booms, vermiculite Pigs, pads and pillows are examples of these.

Specific Material Control Techniques



- Dike, damming, retention, diversion
 - Use of materials (usually earthen) to block progress of material, hold material in a specific spot, or to divert it onto a path which is more favorable in terms of harm produced.

Specific Material Control Techniques



- Dilution
 - The process of using a diluent (usually water or air) to lessen the concentration of the contaminate to acceptable levels. Remember that the material is still out there, just not as concentrated in one spot after dilution.

Specific Material Control Techniques



- Vapor dispersion
 - Movement of hazardous vapors via water supply. Runoff may be a problem in this situation.

Specific Material Control Techniques

- Vapor suppression (blanketing)
 - Reduction or elimination of vapors emanating from a spill through the most efficient method of application of a specially designed agent. Foams are a good example here, although in general, **FIREFIGHTING FOAMS ARE NOT EFFECTIVE FOR MANY CHEMICALS - SPECIALIZED FOAMS ARE REQUIRED.**

SPECIFIC MATERIAL CONTROL TECHNIQUES



- Fire suppression
 - Foam anatomy
 - (Foam is a stable aggregation of bubbles, with very low density and a tenacious ability to cover horizontal surfaces. Foam requires water, foam concentrate and air.)

SPECIFIC MATERIAL CONTROL TECHNIQUES



– How foam works

- Smothers - Prevents fuel and air from mixing and forming a flammable atmosphere
- Cools - Lowers the temperature of the burning material
- Suppresses vapors - Prevents release of flammable vapors from the liquid surface
- Separates - Produces a barrier between the fuel and air

SPECIFIC MATERIAL CONTROL TECHNIQUES

- Fire suppression
 - Types of foam
 - Protein - Dense, protein based foams with high stability and heat resistance, good burnback characteristics but susceptible to fuel saturation. Biodegradable after dilution as well as non-toxic
 - Fluoroprotein - Dense, protein based foams with high stability and heat resistance, superior burnback and a high resistance to fuel saturation and compatible with dry chemical agents. Biodegradable after dilution and non-toxic
 - AFFF - Aqueous Film Forming Foams are synthetic material foams. They spread quickly producing a continuous aqueous layer of solution under the foam, which is self-healing. Biodegradable and non-toxic.

SPECIFIC MATERIAL CONTROL TECHNIQUES

– Types of foam (continued)

- ATC - Alcohol Type Concentrate is a foam type which is resistant to breakdown when used on water soluble, water miscible, or polar solvents, creating a membrane over the products
- AFFF/ATC - Combines the characteristics of both types of foam and is used in 6% solution on polars and 3% on hydrocarbons
- Hazardous Materials Concentrate - Vapor mitigating foams which vary in composition depending on use. One type is ATC which has been produced to provide lengthened effectiveness as a foam on toxics, flammables and corrosives
- High expansion - Foams which are extremely low density, ideal for control of Class B or A fires in confined areas or those areas with difficult access. Very susceptible to wind and other weather conditions

SPECIFIC MATERIAL CONTROL TECHNIQUES

- Fire suppression

- Equipment

- Proportioning device - A device used to place the proper amount of foam concentrate into the hose stream. May be an eductor (in-line or bypass) or an around the pump proportioner
 - Hose - Simply to move the foam solution to the place of application and the source of air
 - Nozzle - The application device and in most cases a device which will add air to (aspirate) the solution mixture.

- Matching of equipment - Foam systems are sensitive to flows and pressures, thereby requiring careful matching of equipment in order to yield quality foam

SPECIFIC MATERIAL CONTROL TECHNIQUES

- **Fire suppression**

- Application - Once the proper concentrate is selected for the application, and technique will greatly affect the success of foam operations
 - Rates - Application rates for AFFF/ATC foam are dependent on the commodity
 - 0.10 GPM/sq ft at 3% for hydrocarbons
 - 0.16 GPM/sq ft at 6% for polar commodities
 - Techniques - There are 3 techniques for applying foam to a flammable liquid fire. All 3 avoid application of the stream directly to the surface of the material. This keeps the fire from spreading and splashing the materials.
 - Bounce - Banking of an object and allowing foam to roll down the object onto the commodity
 - Roll - Striking the surface in front of the commodity and allowing the foam to roll onto the commodity
 - Cascade - Raining the foam down gently onto the commodity

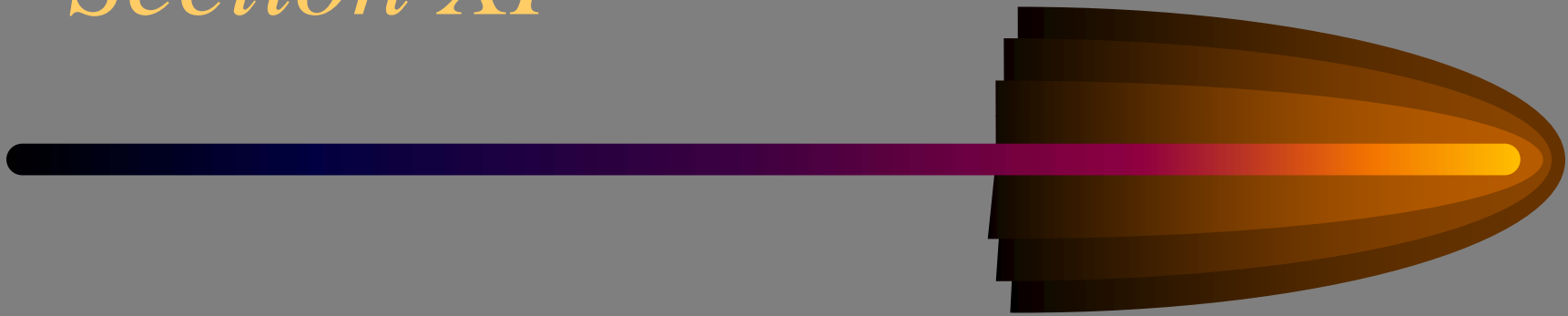
SPECIFIC MATERIAL CONTROL TECHNIQUES

- Emergency remote shutoff devices
 - Utilizing the emergency shutoffs on MC 331 and MC 306 tanks may prove to be a valuable control technique at incidents involving such vehicles
 - Location (at the front and rear of the vehicle)
 - Operation (mechanically (MC 306 and MC 331) and by heat activation (MC331))

SAFETY BRIEFINGS

- Any time a responder is operating on a scene defensively, they should be briefed accordingly. The safety briefing should include:
 - Preliminary evacuation information
 - Hazard identification
 - Site description
 - Tasks to be performed
 - Length of time allowed for tasks
 - Requisite PPE
 - Required monitoring
 - Notification of identified risks
 - Signs & symptoms of exposure

Section XI



Control Zones and Decontamination

CONTROL ZONES

- Hot zone (exclusion zone)
 - High hazard area. Personnel in this zone are in the immediate danger zone; everything which enters the zone is considered contaminated and must be decontaminated. Personnel must be equipped with appropriate PPE and properly trained for operation in this zone.
- Warm zone (decontamination reduction corridor)
 - Lesser degree of hazard & a buffer zone between hot & cold zones, it is considered cold until responders contaminate it. It contains the entry and decontamination corridors, and requires personnel to have proper PPE and training to be in the zone.
- Cold zone (support zone)
 - Safe haven containing no chemical hazards and is the location of Command and support functions. CARE MUST BE TAKEN TO KEEP THIS AREA FROM BECOMING CROSS-CONTAMINATED.

CRITERIA

- Zones can be set up by using information from one or more resources
 - The DOT Emergency Response Guidebook
 - CHEMTRE/CANTUEC
 - Other printed resources, such as MSDS or Emergency Handling of Hazardous Materials in Surface Transportation (American Association of Railroads)
 - Monitoring results
 - Site concerns
 - Ample room to operate
 - Shelter for operations
 - Access to utilities
 - Other physical characteristics of the site

DECONTAMINATION

- Purpose of decontamination
 - Protect responders (Reduce effects from hazardous materials on initial responders not properly protected)
 - Protect victims (Reduce effects from hazardous materials on exposed victims)
 - Limit the spread of contamination (Protect responders and the environment from secondary contamination)
- Contamination
 - Unrecognized (Contact with materials prior to material's identification of the material as hazardous)
 - Underestimation (Inadequate evaluation of a material's hazardous characteristics prior to contact)
 - PPE (Use of PPE in a hazardous atmosphere)

DECONTAMINATION

- Contamination (cont.)
 - Control zones (Lack of proper control zones, allowing persons to enter contaminated atmosphere unannounced)
 - Cross contamination (Contact with contaminated persons or with equipment that is contaminated)
 - Work related (Contamination from work in the product which is planned and unavoidable (done by technicians))
- Types of decontamination
 - Avoidance (The simplest method of decontamination is to never become contaminated. This is done by setting and observing control zones and following safe work practices)
 - Emergency/gross (Decontamination performed to immediately decontaminate personnel and victims during serious or life-threatening injury or when delaying decontamination will aggravate the condition of the victim. This offers limited protection to personnel and victims)
 - Formal decontamination (Typically a slower, well-planned removal of contaminants from personnel and/or equipment which takes place in the contamination reduction corridor)

EMERGENCY DECON PROCEDURES

- Set up (Emergency decon should be set up upon arrival of the initial responding unit and may be as simple as a booster line at a makeshift pool made from a tarp, pike pole, and two pieces of hard suction. Primary concerns are in setting the emergency decon in an area that will allow for control of runoff and minimize the exposure to others)
- Method (Emergency decon typically involves a crude flushing with copious amounts of water, and stripping followed by medical treatment and transport)
- Limitations (May not be complete, thereby exposing victims further and posing the possibility of secondary exposure to those who come in contact with the victim)

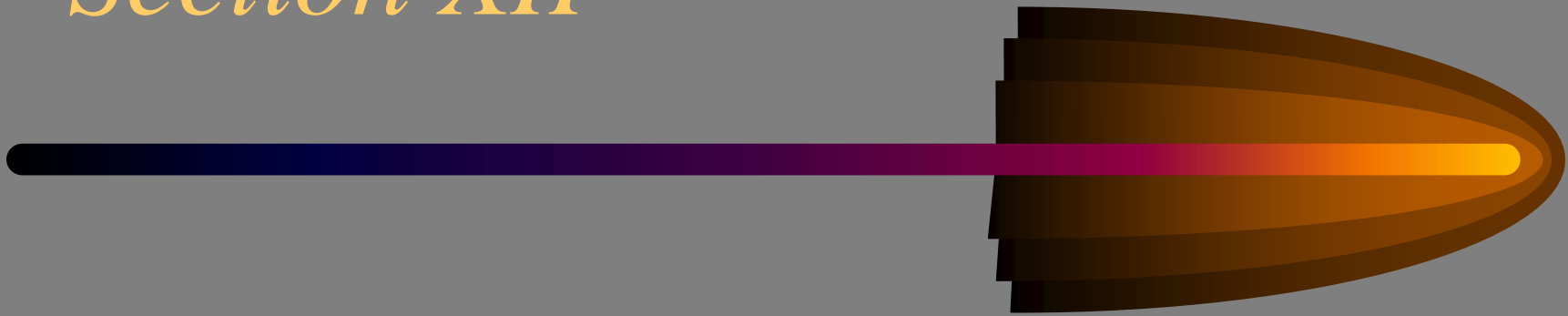
FORMAL DECON PROCEDURES

- Set up considerations
 - Plan (The plans should contain provisions for:)
 - Emergency decontamination (Set up an emergency decon area or utilize one which is present on site)
 - Formal decontamination (The formal decon plan may vary in size, the number of steps and method depending on situation)
 - Briefing of personnel (Briefed on setup, decon tasks to be performed and tasks that are necessary)
 - PPE requirements (Decon requirements will be specified, typically at the level of personnel being deconned or one level below)
 - Monitoring in the decon corridor (Provisions for monitoring should be made to ensure safe work environment on the decon reduction corridor)
 - Evaluation of decontamination (There is currently no method for the absolute conformation of decontamination on site. However, monitoring equipment, pH strips and visual inspection can be used to evaluate the job. Samples can be sent to laboratories post-facto to evaluate the effectiveness)

FORMAL DECON PROCEDURES

- Set up considerations
 - Methods (Safety **MUST** rule the decon process)
 - Physical removal (Washing with soap/water, rinsing, wiping, vacuuming, etc., and leads to the deposit of the material in the decon pool and the removal or significant reduction of contaminant on the suit. The most commonly used method is multiple station washing with a mild soap and water solution followed by rinsing)
 - Chemical (These methods involve the chemical reaction of the contaminant with a decon agent which will neutralize or otherwise render the hazard harmless. The disadvantage with this method is in performing chemical reactions on the surface of PPE while a responder is still inside it. This may damage the PPE or create heat which can burn the personnel. Additionally it requires in-depth knowledge of chemistry and several exotic solutions. In general this is not a recommended procedure for personnel)
 - Combination (Use of both physical and chemical methods in conjunction to decontaminate personnel)

Section XII



**Incident Command System /
Incident Management System**

THE INCIDENT MANAGEMENT SYSTEM

- Purpose

- Flexible incident management (modular management system which is flexible in size)
 - Span of control (3-7 persons)
 - Division of functional levels (setting strategic goals, setting tactical objectives, performing tasks)
- Unified purpose (unified decision-making process and authority giving a unified direction to the response)
- Roles & responsibilities (defined roles and responsibilities and accountability for actions)
- Lines of communication (provides for communication and accountability and safety of personnel)
- Common procedures (ensures responders are “on the same page” with common terminology, procedures and transfer of command)

THE INCIDENT MANAGEMENT SYSTEM

- System structure
 - Five command functions
 - Command (Sets overall direction of operation. **MUST BE STAFFED** as required by 29 CFR 1910.120)
 - Staff (Assists Command in duties, operates with the authority of Command)
 - Hazardous Materials Safety Officer (Responsible for overall safety at scene. Must be staffed as required by 29 CFR 1910.120 (see section 2))
 - Information Officer (Disseminates information on the incident)
 - Liaison (Coordinates interaction with outside agencies and entities)
 - Operations (Management of tactical operations)
 - Planning (Collects/evaluates incident info, prepares response options)
 - Logistics (Provides service and support needs to Operations)
 - Finance (Deal with financial issues of budgeting, payments, documentation and procurement)

THE INCIDENT MANAGEMENT SYSTEM

- System structure
 - Role of the hazardous materials safety officer
 - The most tasked person on the scene
 - Obtaining briefings from Command, Incident Safety Officer and the Hazard Sector Officer in the hot zone)
 - Directs the preparation of the site safety plan (This plan is required at incidents and ensures that safety considerations are being constantly checked)
 - Advises command and sector officers (Primary advisor on all safety issues)
 - Monitors safety (Monitors any deviations for site plan or unsafe conditions, suspending or altering operations which are unsafe while keeping Command informed of these issues)
 - Safety briefings (oversees safety briefings of all personnel)

THE INCIDENT MANAGEMENT SYSTEM

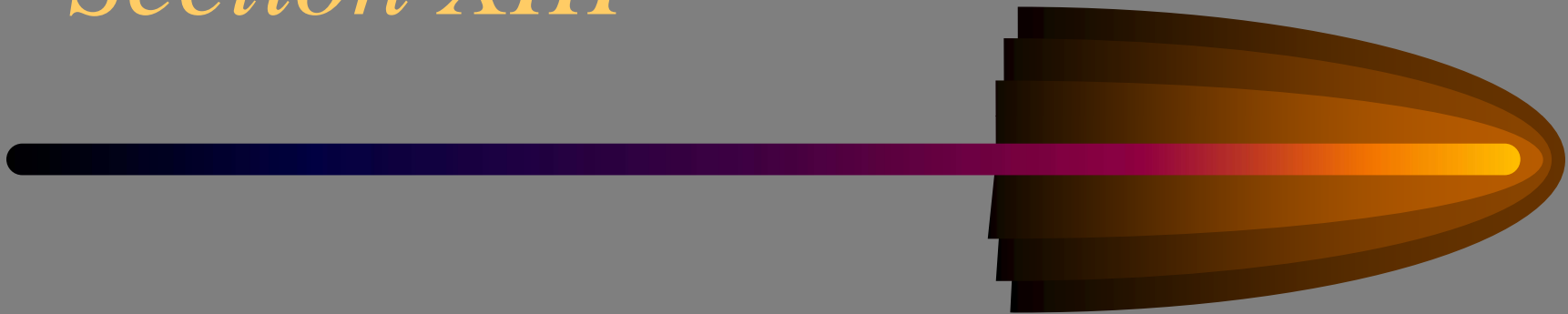


- System structure
 - Major elements of the system
 - Branch (Greatest capability to control personnel)
 - Division (Smaller subcommand by geographic location)
 - Group (Same size as Division, based on function of the unit, not the location)
 - Companies (Smallest working units of the system)

THE INCIDENT MANAGEMENT SYSTEM

- First responder role in IMS (Set a command post)
 - Should be Stationary (in one place)
 - Located in safe position (not to be moved)
 - Clearly marked
 - Have controlled access (isolated from media/distractors)
 - Be sheltered with a vantage point if possible
 - Begin response sequence (Begin scene assessment, implement initial defensive actions, notify proper authorities)
 - Isolate - Set perimeters and deny entry to protect responders and public
 - Identify - Begin the identification process
 - Notify - Begin notification of proper authorities
 - Mitigate - Begin control or rescue operations as safely permitted. SET UP EMERGENCY DECON IMMEDIATELY!!
 - Request resources (Based on local response plan and SOPs, initiate deployment of resources. Resources take time to obtain, the early call will get resources on scene that much earlier)

Section XIII



Termination

TERMINATION



- Issues to be addressed
 - Has the area been isolated?
 - Is the product contained, confined, and/or stabilized?
 - Have proper notifications been made?
 - If the answer to these questions is yes, then the emergency is over

TERMINATION

- Termination consists of three parts
 - Debriefing
 - Conducted before releasing companies from the scene
 - Short duration (not more than 15 minutes)
 - Say “thank you” or “job well done”
 - Informs responders of symptoms of exposure
 - Identifies equipment that must be deconned or disposed of
 - Identifies unsafe conditions
 - Assigns someone to follow up & conduct a post-incident analysis & critique

TERMINATION

- Termination consists of three parts (cont.)
 - Post-incident analysis
 - Purpose
 - Reconstruct the incident to establish a timeline of actions taken to mitigate a situation
 - Done by administrative person who also serves as a contact person for private sector

TERMINATION



- Termination consists of three parts (cont.)
 - Post-incident analysis (cont.)
 - The analysis would examine
 - The implementation of incident command & scene control
 - Effectiveness of tactical operations
 - Availability of resources
 - Adequacy of support services
 - Effectiveness of Emergency Response Plan (ERP)
 - Evaluation of training

TERMINATION

- Termination consists of three parts (cont.)
 - Critique
 - Purpose
 - To develop recommendations for improving emergency response
 - Should be attended by all first responders and chief officers who respond, plus a critique leader
 - Helps find problems in planning, training, hazard identification, and safety concerns

TERMINATION

- Termination consists of three parts (cont.)
 - Critique (cont.)
 - OSHA 29 CFR 1910.120 (q)
 - Requires a critique to be done after each incident
 - Not to be used as a “blame session” but serves as a way of “self-improvement from lessons learned”
 - One leader must conduct critique and must ensure:
 - Direct answers to direct questions
 - Individual observations are shared with the group
 - Sector officer observations are shared with the group
 - Total time is limited to 60 to 90 minutes
 - The incident is summarized from start to finish