Chemical Accident Management

Dr. Omid Kalatpour

CEOH

Preface

- Chemical releases arising from **technological incidents**, **natural disasters**, and from conflict and **terrorism** are common.
- The **International Federation of the Red Cross** has estimated that between 1998 and 2007, there were nearly **3200 technological** disasters with approximately **100,000 people killed and nearly 2 million people affected.**

omidohs@gmail.com

The Epidemiology of Chemical Incidents

- ✓ Since the middle of the twentieth century, chemicals have played an increasing role in the **worldwide economy**.
- ✓ Currently, more than **15 million chemical substances** are commercially available.
- ✓ Approximately **60000 to 70000** chemical substances are in regular use and between **200 and 1000 chemicals** are produced in excess of one tone annually.

omidohs@gmail.com

Examples of chemical incidents worldwide

Year	Location	Description of incident	Consequences
1976	Seveso, Italy	Airborne release of dioxin from an industrial plant	• No immediate human deaths • 3 300 animal deaths • 80 000 animals slaughtered
1984	Bhopal, India	Methyl isocyanate (MIC) leak from a tank	• 3800 immediate deaths • 15 000 to 20 000 premature deaths • 500 000 exposed to the gas
1984	Mexico City, Mexico	Explosion of liquefied petroleum gas (LPG) terminal	• 500 deaths • 6400 injuries
1995	Tokyo, Japan	Deliberate release of a warfare agent	• 12 deaths • 54 critical casualties • Thousands of people affected
2000	Enschede, The Netherlands	Explosion of a fireworks factory	• 20 deaths, 562 casualties • Hundreds of houses destroyed • 2000 people evacuated
2001	Toulouse, France	Explosion of 300–400 tonnes of ammonium nitrate in a fertilizer facility	• 30 deaths • 2500 casualties • 500 homes uninhabitable
2002	Galicia, Spain	Shipwreck of the *Prestige*, causing the release of 77 000 tonnes of fuel	• Estimated clean-up costs of US$ 2.8 billion
2002	Jabalpur, India	Mass poisoning due to the use of pesticide containers as kitchen utensils	• Three deaths • At least 10 hospitalizations
2003	Baton Rouge, USA	Release of chlorine gas from a facility	• No human deaths
2004	Neyshabur, Iran	Train explosion due to mixing of incompatible chemicals	• Hundreds of deaths and casualties among emergency responders and onlookers
2005	Songhua River, China	Plant explosion releasing 100 tonnes of pollutants in the Songhua River	• Five deaths • Millions of people without water for several days
2005	Bohol, The Philippines	Inadvertent use of an insecticide in the preparation of sweets	• 29 deaths • 104 hospitalizations
2005	Hemel Hempstead, England	Three explosions in an oil storage facility (Buncefield depot)	• 43 reported injuries • 2000 persons evacuated
2006	Abidjan, Côte d'Ivoire	Dumping of toxic waste in the city of Abidjan	• 10 deaths, thousands made ill
2006	Panama	Diethylene glycol in a cough syrup	• At least 100 deaths
2007	Angola	Sodium bromide confused with table salt	• At least 460 people ill, most of them children
2008	Senegal	Lead from informal battery recycling	• People exposed with many children showing symptoms of lead intoxication

omidohs@gmail.com

انفجار گاز در Longford استرالیا

حادثه PEMEX مکزیک

حادثه بوپال هند

حادثه پایپر آلفا

omidohs@gmail.com

فقط در چند ماه اخیر!!!!

- انفجار خط گاز گناوه
- آتش سوزی پتروشیمی بوعلی
- آتش سوزی انبار پالایشگاه تهران
- آتش سوزی اتیلن غرب
- انفجار گاز شهران
- آتش سوزی بندر امام
- آتش سوزی انبار پتروشیمی در اتوبان قم
- آتش سوزی پتروشیمی بیستون

Seveso

- July 1976 plume of (**TCDD**) contaminated vapors is released from a **pesticide plant** in the town of Seveso, Italy.
- Some **37,000 people were exposed** to the highest levels ever recorded of a dioxin.
- Over **600 people were evacuated** and several thousand were treated for **dioxin poisoning**, evidenced mainly by **chloracne**.
- Over **80,000 animals were slaughtered** to prevent the toxins entering food chains.

omidohs@gmail.com

Nishapur train disaster

- The **Nishapur train disaster** was a large explosion in the in Iran, on 18 February 2004.
- Over **300 people were killed** and the entire village destroyed, when **runaway train** wagons crashed into the community in the middle of the night and exploded.

omidohs@gmail.com

Hazardous Material

- Any substance or material in a **quantity or form** which poses an **unreasonable risk** to health, safety and property when transported in commerce.

U.S. Department of Transportation

omidohs@gmail.com

Hazardous Chemicals

- Any chemical which presents **a physical hazard** or **a health hazard** to employees.

omidohs@gmail.com

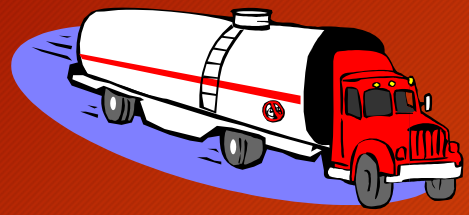
Extremely Hazardous Substances

- Chemicals determined by the US.E.PA to be **extremely hazardous** to a community during an **emergency spill or release** as a result of their toxicities and physical/chemical properties.

EPA/Chemical Emergency Preparedness

omidohs@gmail.com

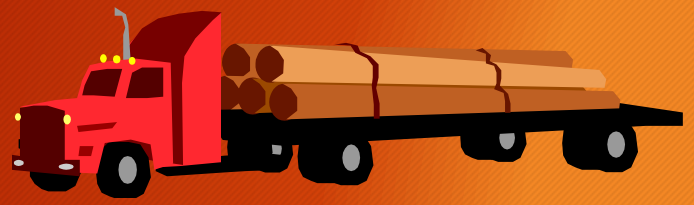
Generator



Transporter

Secondary Consumer

Disposer

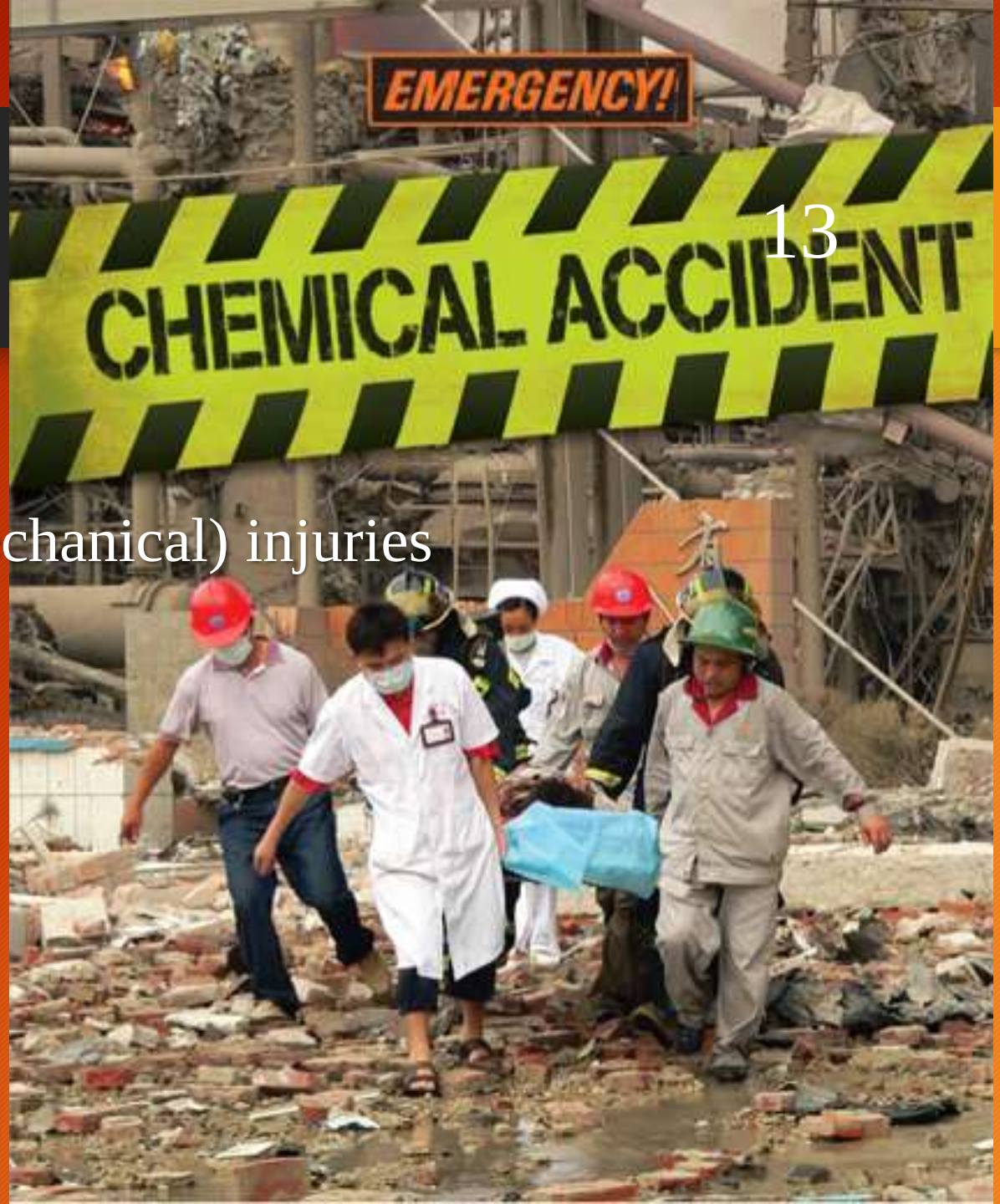


Secondary Transporter

omidohs@gmail.com

Injury Mechanisms

- Fire produces injuries
- An explosion produces traumatic (mechanical) injuries
- Toxicity
- Mental health effects



omidohs@gmail.com

Chemical Incident Scenarios

- ✓ Chemical properties
- ✓ Environmental condition
- ✓ Container properties
- ✓ Ignition sources
- ✓ Weather condition

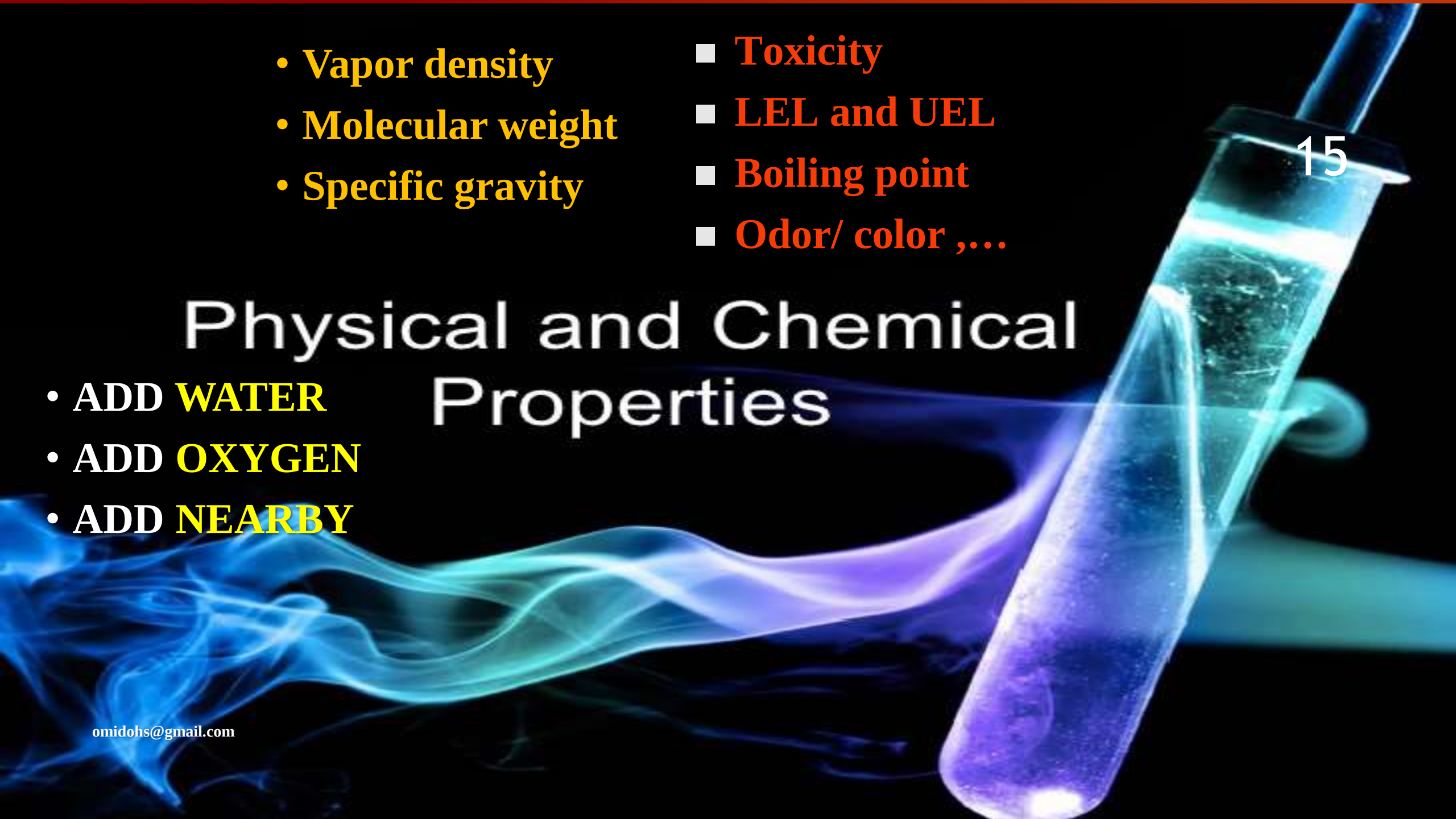
omidohs@gmail.com

Physical and Chemical Properties

- Vapor density
- Molecular weight
- Specific gravity

- Toxicity
- LEL and UEL
- Boiling point
- Odor/ color ,…

- ADD **WATER**
- ADD **OXYGEN**
- ADD **NEARBY**



omidohs@gmail.com

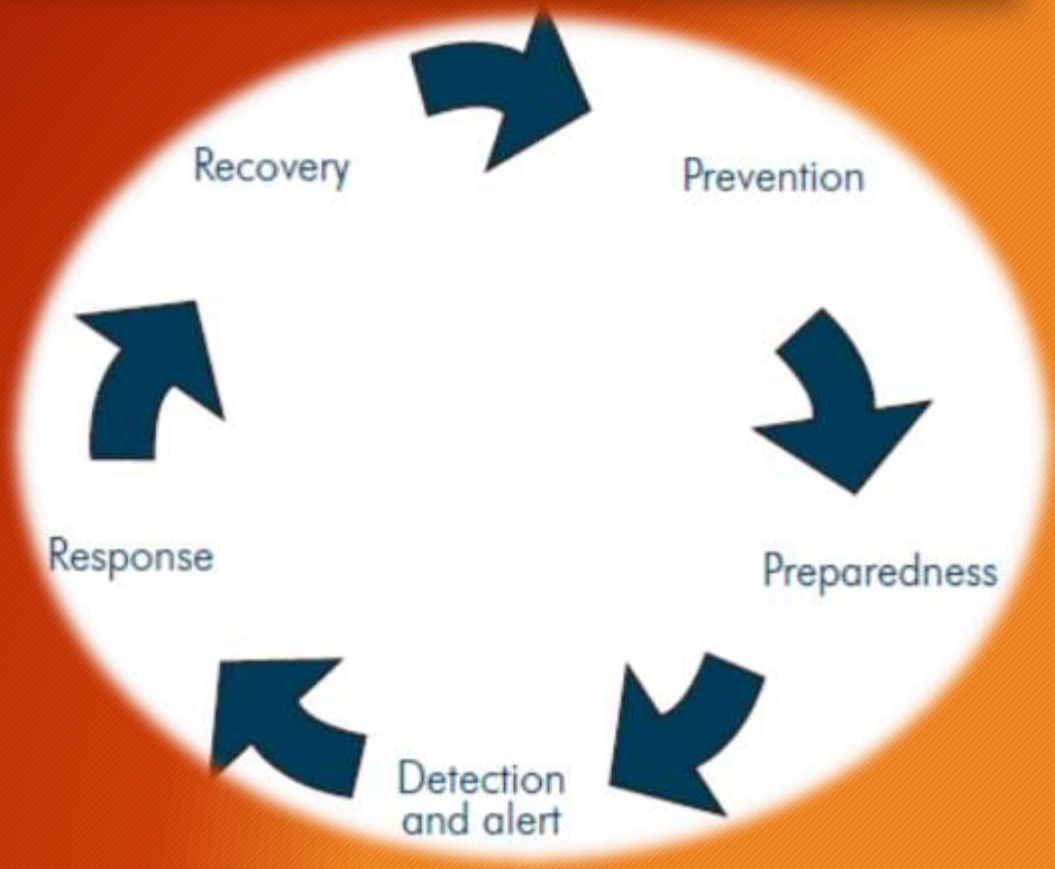
Examples of Incident Scenarios

1. Sudden evident outdoor release of gas or vapor
2. Sudden evident outdoor release of an aerosol
3. Sudden evident release to contact media other than air
4. Fire in a large building
5. Explosion
6. Disease outbreak
7. Silent releases

omidohs@gmail.com

The Disaster Management Cycle

1. Prevention
2. Preparedness
3. Detection and alert
4. Response
5. Recovery



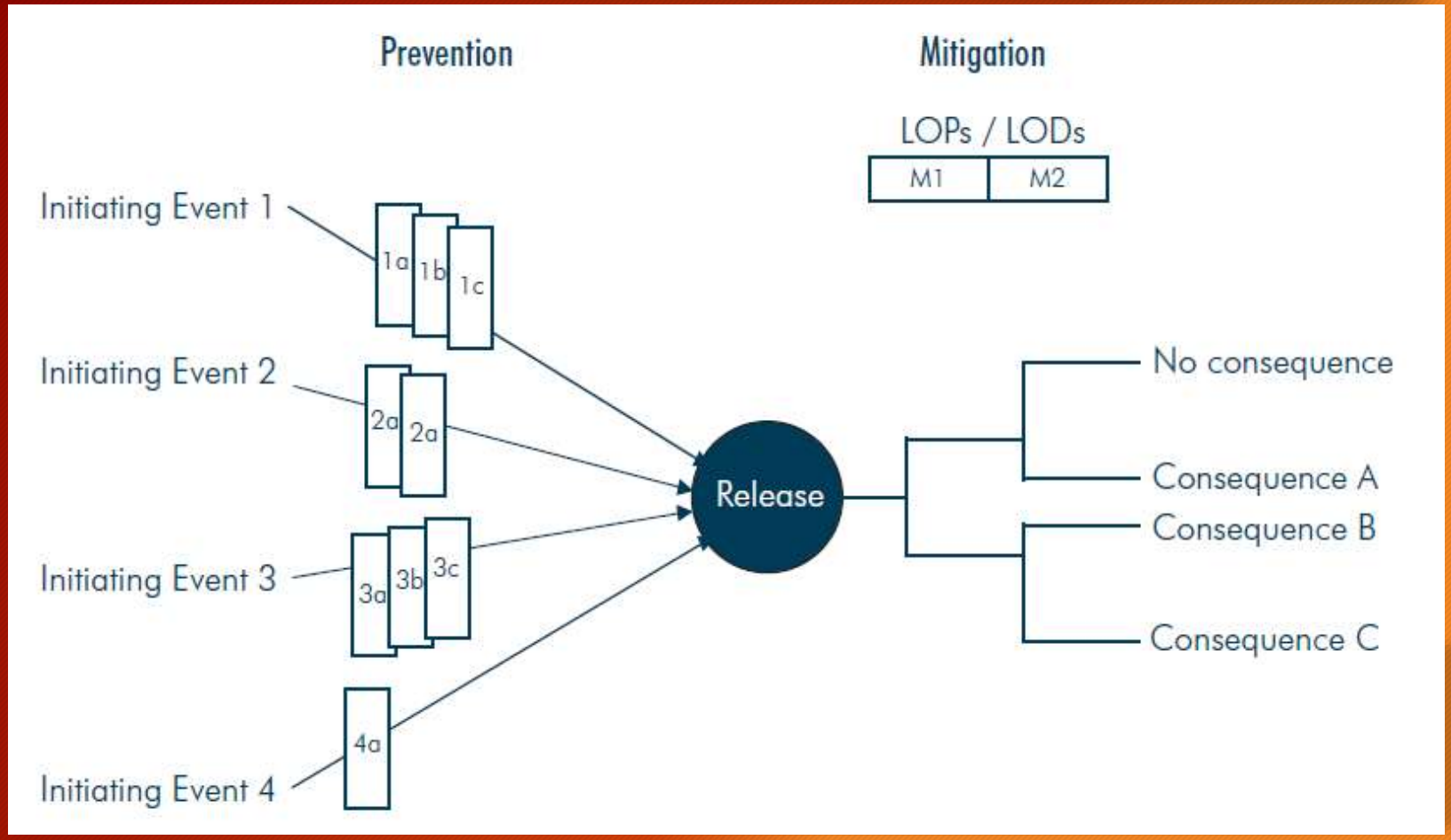
omidohs@gmail.com

Prevention

1. Protection layers
2. Scenario analysis and impact assessment
3. Policy, legislation and enforcement
4. International regulations and tools
5. Prevention of chemical hazards for the public

omidohs@gmail.com

Prevention- Scenario analysis



omidohs@gmail.com

Prevention- Policy, legislation and enforcement

- Land-use planning
- Licensing of hazardous sites and transport routes
- Building regulations
- Control of chemical transportation and storage
- Labor health and safety
- Establishment hazardous site database
- Control of waste disposal sites
- Control of contaminated environment
- Emergency planning and response
- Inspection of hazardous sites and transportation

omidohs@gmail.com

Global Regulations

- UN Recommendations
- IATA Dangerous Goods Regulations (DGR)
- International Maritime Dangerous Goods Code (IMDG Code)
- International Carriage of Dangerous Goods by Rail (RID)
- Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

omidohs@gmail.com

United States

- **Department of Transportation (DOT)** regulates hazmat transportation.
- **OSHA-** Hazardous Waste Operations and Emergency Response (**HAZWOPER**).

omidohs@gmail.com

Superfund

- Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA**) referred to as the **SUPERFUND** law
- Established for the **cleanup of toxic waste** sites
- Set the groundwork for the regulating **response to chemical emergencies**
- **Superfund Amendments and Reauthorization Act (SARA)**

omidohs@gmail.com

Planning Groups

- State Emergency Response Committee (SERC)
- Local Emergency Planning Committees (LEPC)

omidohs@gmail.com

LEPC

- Chemical name
- Storage location
- Quantity
- Emergency Contact
- EHS

- Receives **chemical storage information**
- Ensures **local resources are adequate**
- Becomes **focal point** community awareness
- Ensures **local responder training**
- Evaluates **annual emergency plan**

Emergency Planning And Preparedness

A. Gathering Useful Information
B. Preparation of A Chemical Incident Response Plan
C. Community Impact Assessment
D. Incident Command
E. Communication
F. Building Human Capacities

omidohs@gmail.com

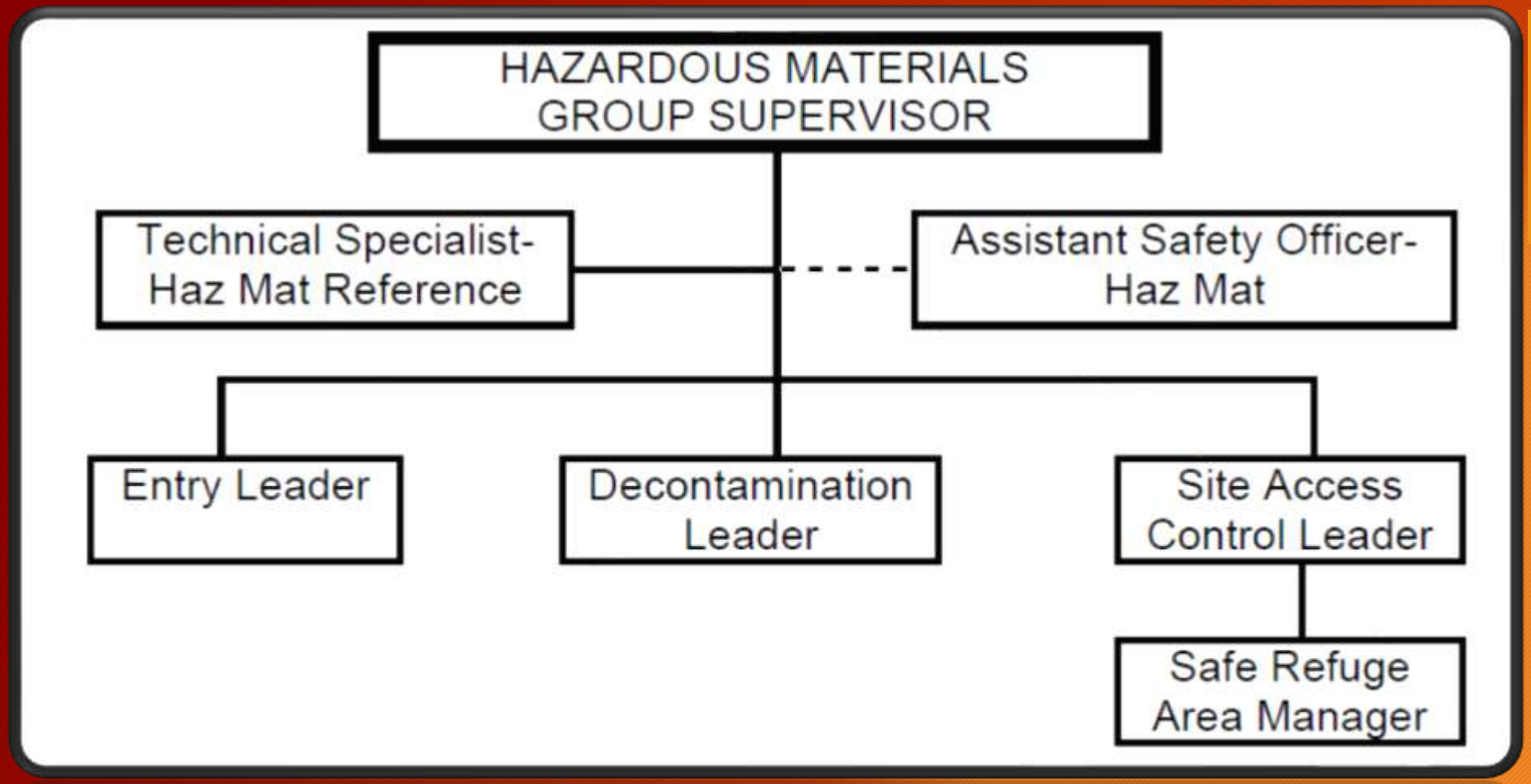
Response Plan

1) Alerting
2) Assess the incident
3) Communication
4) Resources assigning
5) Describe ICS
6) Coordinate inter-agency relationships
7) Control Measures
8) Isolation, Sheltering and Evacuation
9) Decontamination and Recovery

Protection Level

OSHA vs. NFPA 1994 Comparison Chart

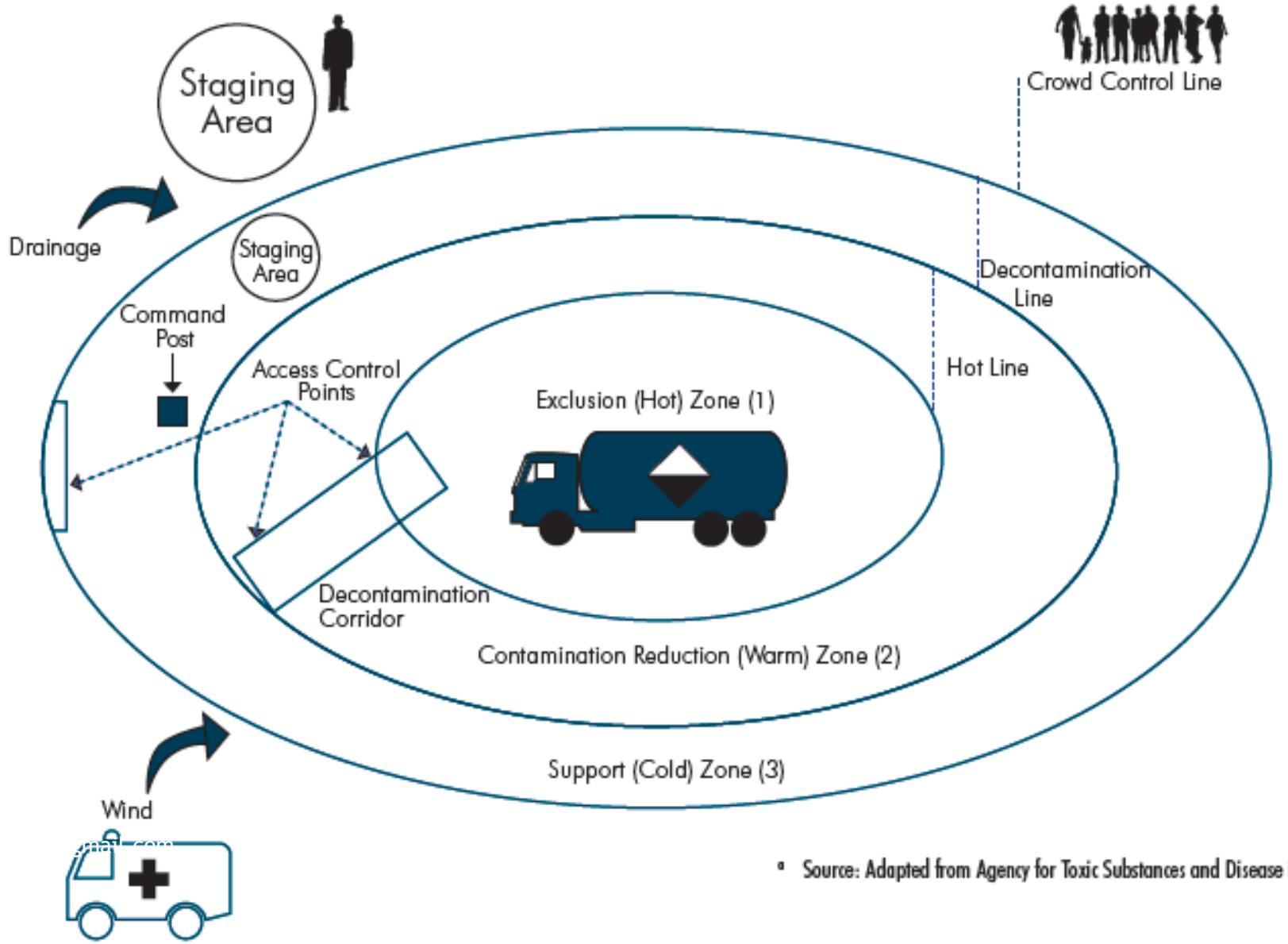
OSHA-Defined Threat	OSHA Level	NFPA 1994 Class	NFPA-Defined Threat
Airborne and liquid concentrations are at or above IDLH* requiring the highest level of protection for both respiratory system and skin.	**Level A:** User and SCBA are fully encapsulated within the suit.	NA	NA
Airborne concentrations are at or above IDLH* requiring the highest level of protection for respiratory system. Liquid concentrations are below IDLH* allowing for a lesser level of skin protection.	**Level B:** User is encapsulated within the suit, while the SCBA is contained outside.	**Class 2:** User is encapsulated within the suit, while the SCBA is contained outside.	Airborne and liquid concentrations are at or above IDLH* requiring the highest level of protection for both respiratory system and skin.
Airborne and liquid concentrations are below IDLH* allowing for a lesser level of respiratory and skin protection.	**Level C:** User is encapsulated within the suit and using an APR or PAPR.	**Class 3:** User is encapsulated within the suit and using an APR or PAPR.	Airborne and liquid concentrations are below IDLH* allowing for a lesser level of respiratory and skin protection.
Nuisance, Non-Chemical "Powder" Contamination	**Level D:** Use of basic shield PPE such as coveralls, disposable outer boots, safety glasses. Dust filter required for radiation contamination.	**Class 4:** User is wearing a dust filter APR and basic shield PPE such as coveralls, disposable outer boots, safety glasses.	Nuisance, Non-Chemical "Powder" Contamination



omidohs@gmail.com

[1] *Managing hazardous materials incidents.* Agency for Toxic Substances and Disease Registry, 2001 (http://www.atsdr.cdc.gov/MHMI/index.html).

FIGURE 8: CHEMICAL INCIDENT ZONING[a]



[a] Source: Adapted from Agency for Toxic Substances and Disease Registry (ATSDR) 2001.