A Comprehensive Guide to Chemical Security Best Practices

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The Organisation for the Prohibition of Chemical Weapons (OPCW) is the implementing body of the Chemical Weapons Convention (CWC), which entered into force in 1997. As of today OPCW has 190 Member States, who are working together to achieve a world free of chemical weapons. The OPCW Member States share the collective goal of preventing chemistry from ever again being used for warfare, thereby strengthening international security. To this end, the Convention contains four key provisions: 1) destroying all existing chemical weapons under international verification by the OPCW; 2) monitoring chemical industry to prevent new weapons from re-emerging; 3) providing assistance and protection to States Parties against chemical threats; and 4) fostering international cooperation to strengthen implementation of the Convention and promote the peaceful use of chemistry. www.opcw.org

Chemical Security Overview

International Chemical Security Threats and Mitigation Strategies

Overview

- History of the chemical threat
- International controls
- Current chemical threat

World War I – Mass Chemical Weapons Began

Geneva Protocol

Entry into Force: 8 February 1928

- Prohibit the use in war of
  - Asphyxiating, poisonous or other gases
  - All analogous liquids, materials or devices
- Bacteriological methods of warfare

International Controls

International Chemical Control Groups

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Chemical Weapons Convention

The Australia Group

Export Controls

UN Security Council Resolution 1540

Chemical Weapons Convention

- Bans chemical weapons
- Monitors the production, use, and transfer of chemicals that could be associated with chemical weapons.
- First treaty to outlaw an entire class of weapons of mass destruction *and require their elimination*.
- First multilateral arms control treaty to have a significant impact on the private sector.
  - Export/import, declaration, and inspection requirements.
- Open for signature on January 13 - 15, 1993.
- Entered into force on April 29, 1997.

191 States have signed and ratified the CWC

States that have neither signed nor acceded to CWC
Angola
Democratic People's Republic of Korea
Egypt
South Sudan

States that have Signed but Not Ratified CWC
Israel

OPCW Industry Inspections

	State Parties with Declare Facilities	Declared Sites	Inspections Conducted	Sites Inspected
Schedule 1	22	27	226	36
Schedule 2	38	469	570	254
Schedule 3	35	456	336	234
Other Chemicals Production	80	4411	1008	579
Total		5363	2140	1103

What will be the role of OPCW after all chemical weapons have been destroyed?

- International Cooperation in the Peaceful uses of Chemistry
  - Article XI. Economic and Technical Development
- Industry verification and nonproliferation
- Protecting each other

Current chemical threats

Current Chemical Security Threat

- Long history of people deliberately using chemicals to harm others
- Information on how to acquire and deliver them is easy to find:

Industrial Chemicals are Targets of Opportunity

Chlorine

Railroad Accident

Cyanide

Tylenol Poisoning

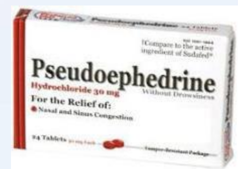
The Chemical Threat

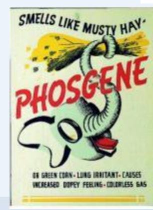
- Other Classes of Chemical Weapons

Psychotomimetic	Incapacitating Agents	Riot Control Agents
Toxins	Toxic Industrial Chemicals (TIC)	Cyanides

Dual-Use Chemicals

Dual use chemicals: Chemicals that can be used for both legal and illegal purposes.





Dual Use Chemicals Exist in Three Categories

- Drug precursors
- Chemical weapons and precursors (CW)
- Explosive precursors

Category	Chemical	Beneficial Uses	Illegal Use
Drug	Pseudoephedrine	Medicine	Methamphetamine
CW	Hydrogen Cyanide	Mining, metal finishing	Hydrogen cyanide poison
Explosive	Ammonium Nitrate	Fertilizer, Mining	Bomb

The Chemical Threat

- Other Classes of Chemical Weapons
  - Dual-Use Chemicals
- Terrorism
  1. Poisonous gas used in closed quarters (subway system, etc.)
  2. Release of a military-grade chemical warfare agent against civilians
  3. Use of toxic industrial chemical against public civilians
  4. Sabotage of a chemical manufacturing plant or storage facility (including a rail tank car)
  5. Targeted use of a chemical agent to assassinate specific individuals

Aum Shinrykio: A Case Study

- Japanese Apocalyptic organization
- Technical Expertise
- Synthesis Accomplished
- Delivery Methods
- Disruption of Tokyo subway system

Aum Shinrykio: A Case Study

- **Sarin attack on Judges in Matsumoto, June 1994**
  - Sarin sprayed from truck at night
  - 7 deaths, 144 injuries
- **Sarin attack on Tokyo subway, March 1995**
  - 11 bags with 600 g each on 3 main subway lines
  - 12 deaths, 3938 injuries
- **Hydrogen cyanide attacks on Tokyo subway, May 1995**
  - Bags of NaCN and sulfuric acid
  - No deaths, 4 injuries

Aum Shinrykio: A Case Study

- Recruited young scientists from top Japanese universities.
- Produced sarin, tabun, soman, VX.
- Purchased tons of chemicals through cult-owned companies.
- Motives: proof of religious prophecy, kill opponents, interfere with legal proceedings and police investigations.

Poisons

Alexander Litvinenko after a "cup of tea" with another former KGB agent

Polonium

Al Jazeera.net: Al-Qaeda 'planned poison plot'

Doha 06 Dec 10

Al-Qaeda members planned to kill Saudi Arabian government and security officials, as well as media workers, by sending poisoned gifts to their offices,

Viktor Yushchenko (Ukraine) - before and after in 2004
Dioxin

Attack or Sabotage of Chemical Facility

- DHS Chemical Facility Anti-Terrorism Standards (CFATS)
  - Ranked by risk – Tier 1 – 4
  - Security Vulnerability Assessments
  - Site Security Plan
  - Inspections
- Historical Motivations
  - Protest or reaction to a single event or incident (Bhopal; Seveso)
  - Disruption of government in power esp. with economic impacts (ICI and DuPont in Northern Ireland)
  - Protest U.S. Foreign Policy
  - Ecological Terrorists

Explaining why the IRA would assassinate leaders of American-owned industries (Du Pont):

We just want to blow the British the hell out of here.

The Chemical Threat

- Other Classes of Chemical Weapons
- Terrorism
  1. Poisonous gas used in closed quarters (subway system, etc.)
  2. Release of a military-grade chemical warfare agent against civilians
  3. Use of toxic industrial chemical against public civilians
  4. Sabotage of a chemical manufacturing plant or storage facility (including a rail tank car)
  5. Targeted use of a chemical agent to assassinate specific individuals
- Explosives (Not an OPCW concern)

Diversion of industrial / laboratory chemicals: Bali bombing

- Chemicals purchased to make bombs
- One ton of potassium chlorate purchased in three transactions from a fertilizer and industrial chemicals store in Jalan Tidar, Surabaya.
  - Claimed he was a chemical salesman.
  - Obtained a false receipt saying he purchased sodium benzoate.
  - Store lacked proper permit to sell this chemical, didn't know the chemical would be used to make a bomb.
- Details of Aluminum powder purchases not known

Sodium azide: Case Study

- Widely available from older automobile airbags
  - 1980s to 1990s
- Poisonous
- Reacts explosively with metals
  - Biological laboratory drains have exploded from discarded waste solutions containing NaN_3 as a preservative.
- Has been found in possession of terrorists

Project Global Shield

Department of Homeland Security and the World Customs Organization and 60 Countries

to prevent the theft or diversion of precursor chemicals that can be used by terrorists to make improvised explosive devices

http://www.dhs.gov/ynews/speeches/sp_1296152572413.shtm

The Chemical Threat

- Other Classes of Chemical Weapons
- Terrorism
  1. Poisonous gas used in closed quarters (subway system, etc.)
  2. Release of a military-grade chemical warfare agent against civilians
  3. Use of toxic industrial chemical against public civilians
  4. Sabotage of a chemical manufacturing plant or storage facility (including a rail tank car)
  5. Targeted use of a chemical agent to assassinate specific individuals
- Explosives (Not an OPCW concern)
- Others chemical concerns

Other Emerging Chemical Threats

- Excess Accumulation and Hazardous Waste
  - Pesticides – DDT, Aldrin, Chlordane
  - Solvents – Gasoline, diesel, chlorinated
  - Leachates – Acid waste, heavy metals
  - Hazardous waste – Metals, paints, solvents.
- Theft and diversion
  - Chemical production
  - Illegal drug production/market
  - Poison

Pesticides: Case Study

- **Widely used in homes and agriculture, but also used to poison people.**

FIGURE. Package of Chinese rodenticide implicated in the poisoning of a female infant aged 15 months — New York City, 2002

Photo/New York City Poison Control Center

- Dushuqiang (Strong Rat Poison)
  - Outlawed in China in the mid-1980s, but was still available
  - Nanjing, China, Sept. 2002
    - 38 people killed by poison in snack-shop food, >300 sick
    - Jealously by rival shop owner
  - Hunan, China, Sept. 2003
    - 241 people poisoned by cakes served by school cafeteria
    - Motive and perpetrator unknown
  - Tongchuan City, Shaanxi, China, April 2004
    - 74 people poisoned by scallion pancakes
    - Motive and perpetrator unknown
  - 5 other incidents reported between 1991 and 2004

Ann. Emerg. Med., Vol. 45, pg. 609, June 2005

Security Threats

What about chemical security?

- Chemical theft
  - Precursors for drugs
  - Precursors for chemical weapons
  - Dual-use chemicals
    - Industrial chemicals
      - Flammable/toxic gases
      - Ammonium nitrate
      - Chlorine
      - Pesticides
- Plant sabotage
  - Deaths, injuries
  - Economic and environmental impact
- Diversion

Abandoned Bhopal Plant
Photo credit: AP/Saurabh Das

Chemical Security Threats

- In-plant threat
  - Sabotage shipments
  - Intentional release
  - Theft
- In-transit threats
  - Hijacking
  - Theft of materials
  - Sabotage
- Attacks on pipelines

http://www.phmsa.dot.gov/hazmat/security

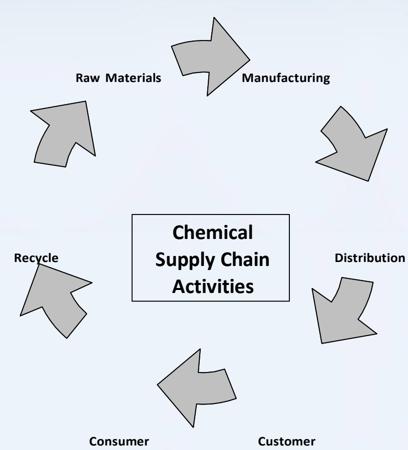
Photo credit: NTSB
Pipeline New Mexico, USA

Transportation Security

- What makes transportation security different?
  - Inside facility
  - Outside facility
- What are the biggest concerns?
  - Adversary controls the environment
  - Detection by the driver

Transportation Risk Management

- Due to the complexity of many supply chains, transportation risk management is a shared responsibility
- Roles and responsibilities may differ for each stakeholder
- Individual activities and actions can impact the risk to the overall chemical supply chain



Topics to Think About

- What controls are there over transport security? Regional? National? Global?
- What control do you have for transport security at you facility?
  - Does the protocol reduce the risks?
  - How often is the risk reviewed?
- Is there a Chemical Distribution Network?
- Is there a national response for transportation chemical incidents?

Goal: Let's not ever need another chemical weapons treaty

Challenges

- New science
- New agents
- Non-state actors

Chemical Issues in Context: The Role of Intent in Nonproliferation and Disarmament Policy

Overview

- Setting the stage…chemical issues in context
  - What constitutes a chemical warfare agent (CWA)?
  - What constitutes chemical warfare (CW)?
- The role of the human element in chemical issues
- Historical use of CW and the "dual-use conundrum"
- CW or not CW? You be the judge….
- Global Chemists' Code of Ethics: Working to shape intent
- Summary

(Ahura Scientific)

What is a Chemical Weapon?

- **Chemical weapons**: the CWC defines 'chemical weapons' as
  - a) **Toxic chemicals** & their **precursors**, **except where intended for purposes not prohibited**…
  - a) Munitions & devices, specifically designed to cause **death** or **other harm** through the toxic properties of those toxic chemicals….
  - a) Any **equipment** specifically designed for use….
- Ricin & saxotoxin listed in CWC & BWTC (no other toxins listed)

"All things are poison and nothing is without poison; only the dose makes a thing not a poison." -- Paracelsus

What Constitutes Chemical Warfare? (Hint: It's Not *Just* About the Chemistry….)

- To be classified as chemical warfare, the substance in question needs to satisfy the following conditions:
  - Must be a **toxic chemical or precursor** to a toxic chemical;
  - Must be used **for purposes prohibited by the CWC**; i.e.
    - It must **cause death, temporary incapacitation or permanent harm**;
    - **Intent to exploit its toxic properties** must accompany its use
  - Types & quantities must be consistent with use as weapon;
  - It must have been used specifically to exploit its toxic chemical properties

Intent to harm must accompany use

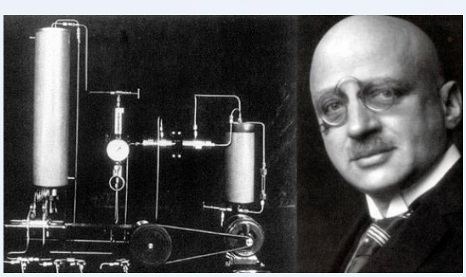
The Human Element in Ethical Chemistry: Walter & Jesse in "Breaking Bad"

Walter: Opportunistic, Egomaniac (AMC)

Jesse: Victim of Circumstance (AMC)

Which came first: the intent or the ricin?

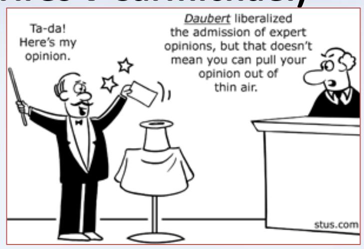
Real-life Examples: Fritz Haber and Universities Attacked by ISIL



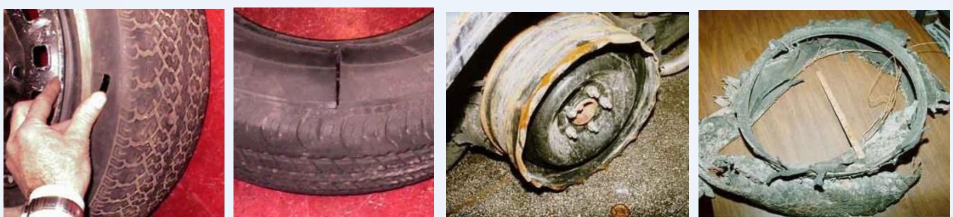
Fritz Haber (Public Domain)

Universities Attacked by ISIL
(Hurriyet Daily News)

Dangers of Cognitive Bias (Kumho Tires v Carmichael)



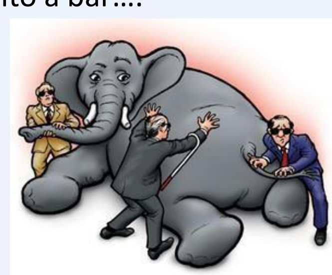
(North Cross School Forensics)



(Charles C. Roberts, Jr)

Dangers of Cognitive Bias, Cont'd

A missiles analyst, a pol-mil specialist, and a "chem-bio" expert walked into a bar….



(Salagram.net)

Cognitive bias can negatively impact collection *AND* analysis; discipline must be employed to avoid it!

Combatting Cognitive Biases in Chemical & Intent Data Collection

- Uncertainty measurements included in reports & analytic judgments
- Intact chain of custody must be evident
- Positive screen must be confirmed with identification & quantitation analysis method
- Specimens archived and retained for future reanalysis by another laboratory if the accused so desires

(Arizona State University)

The Human Element & "Kids' Soccer Game": Impacts on Interagency/International Efforts

- Issues drawing major international attention draw many players
  - National narratives shape cognitive bias in collection efforts & analyses
  - International & interagency partnerships inherently lack coordination & can bump up against each other, impacting their effectiveness
- Inspection support can be spotty and slow, providing space & time for the impact of the human element to grow
- To succeed, you need to understand cultural differences/biases & refrain from mirror-imaging!
- Ultimately, only one thing matters…**What do the data say?**

Case Studies of Historical CW Use

Strategies for Use or Possession of Chemicals as Weapons

- As a demonstration of technical capability/expertise
- Terror/Incapacitation
- Assassination (if head of state, could be act of war)
- Riot Control/Law Enforcement/Area Denial, but…
  - What chemicals are acceptable?
  - What differentiates riot control from attack on adversary?
- Make adversaries believe you actually have chemical weapons
- Poor Man's "Nuke"

(Public Domain)

2 Schools of Thought Dominate History of CW Use (Where you Sit is Where you Stand)

- CW is over-rated, not a big threat
  - "Poison gas caused fewer deaths than bullets." – Fritz Haber, 1921
- CW represents a significant threat & should not be ignored
  - "**...the effect** [of chemical warfare] **is so deadly to the unprepared that we can never afford to neglect the question**." – Gen Pershing, 1920
  - "…**We cannot count upon other nations refraining from the use of gas when it would serve their purpose**." – MG Alden Wait, Chief, CWS, 1946

Ypres, Belgium (April 22, 1915)

- First major battlefield use of chemical warfare was in World War I at Ypres
- Agents
  - Tear gas
  - Mustard
- Toxic industrial chemicals (TICs)
  - Phosgene
  - Chlorine

(Public Domain)

Having Chemical Weapons is Enough (but Necessary): US (post WWII)

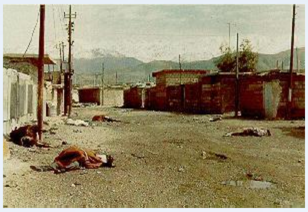
(Artist unknown)

Having CWAs is Enough (Syria pre-2012); Use May be Necessary: Syria Aug 2013 (Sarin)

(International Business Times)

(Washington Times)

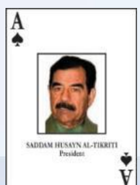
Use of CWAs on own Citizens is Acceptable for Riot Control: Iraq (Project Anfal)



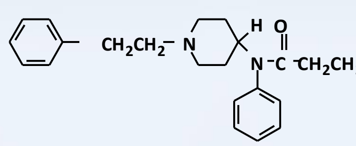
- Project Anfal (Spoils of War), Feb-Sep ‘88
- Sunni enemies: PUK, Ansar al-Islam
- Halabja: 16-18 Mar ‘88
- 5000 died at Halabja out of 80,000
- 50,000 - 182,000 killed

(HAMMER Federal Training Center)

- Submunitions, bombs, rockets
- Mustard, GB sarin, GA tabun, VX



Use for Law Enforcement/Riot Control is Acceptable: Russia, 23-26 Oct 2002



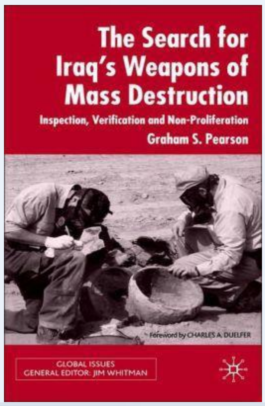
Fentanyl (China White)?
Carfentanil or Alfentanil?

Opiate	Relative Safety Index (LD_{50}/ED_{50})
Fentanyl	277
Remifentanil	33,000

41 Chechen terrorists; 800 in theater
118 hostage deaths

(HAMMER Federal Training Center)

Making Adversaries Believe you Have CWAs is Enough: Iraq (in the 1990s)



(Barnes and Noble)

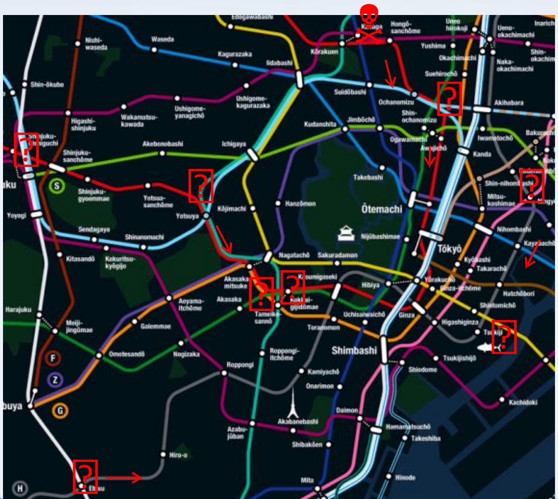
(U.N.)

(U.N.)

Chemical Warfare or Not?

"All things are poison and nothing is without poison; only the dose makes a thing not a poison."
-- Paracelsus

Tokyo Chemical Incident: 20 March 1995



Marunouchi Line
1.Hongō sanchōme to Shin Koenji (1)
2.Yotsuya to Kokkai-gijidōmae (0)

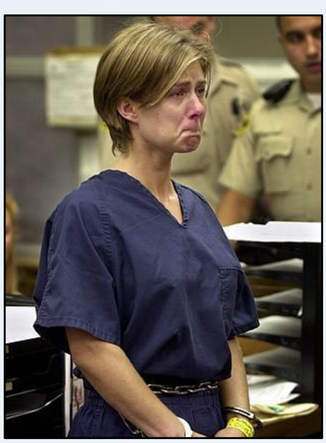
Chiyoda Line
1. Shin ochanomizu to Kasumigaseki (2)

Hibiya Line
1.Kodenmacho to Tsukiji (8, 3 packs)
2. Ebisu to Kasumigaseki (1)

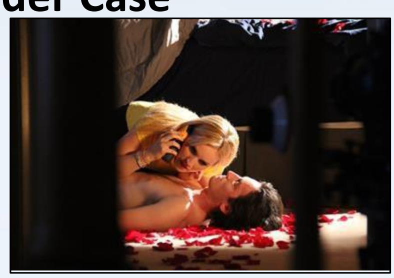
Sarin released
Subway stopped

(HAMMER Federal Training Center)

Nefarious Fentanyl Use by an Individual: The Rose Petal Murder Case



(Herald Sun)



(Public Domain)

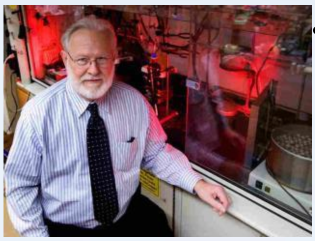
(Herald Sun)

Coalition Explosive Ordnance Teams Exposed to CW in Iraq 2004-2010

(New York Times)

"Dual-use" Conundrum: Can we Impact Intent?

~~"Dual Use"~~ Conundrum: Scientists' Knowledge can be used for Nefarious Purposes



(Associated Press)

- "Our work has changed the conditions in which men live…."
  – J Robert Oppenheimer
- Can't control how our knowledge is used, but we *can* do 2 things:
  - Require adoption of code of ethics
  - Take action to secure relevant knowledge & chemicals

"I was stunned. I had published information that ultimately led to human death."
– David Nichols

GREYCHEMISTRY

Summary

- Intent to harm must accompany proscribed material/equipment
- Addressing intent is key to stopping chem weapon proliferation/use
  - Nonproliferation frameworks cannot be effective if intent not addressed
  - Just as important as securing relevant knowledge & chemicals
- Opportunity due to scientific discovery often precedes intent
- The human element cannot be separated from the practice of science
- The stakes have never been higher!

(Houston Chronicle)

Chemical Safety and Security Overview

What about chemical security?

- Chemical theft
  - Precursors for drugs
  - Precursors for chemical weapons
  - Dual-use chemicals
    - Industrial chemicals
      - Flammable or toxic gases
      - Ammonium nitrate
      - Chlorine
      - Pesticides
- Plant sabotage
  - Deaths, injuries
  - Economic and environmental impact

Abandoned Bhopal Plant
Photo credit: AP/Saurabh Das

What are the threats to chemical security?

- Unlimited access to facilities
  - Chemical storage areas
  - Analytical laboratories
  - Pesticide/chemical waste sites
  - Construction sites
- No controls or security checks on chemical procurement
- Shipping and receiving areas not protected
- Recruit young chemists
  - Tokyo subway Sarin attack

Threats to Cyber Security

- SCADA control software is used by one-third of industrial plants
- Security technology may not work on plant proprietary networks
- Attacks may result in:
  - Loss of process control
  - Loss of production
  - Process safety incidents
- Examples:
  - 2005-Zolob worm shut down 13 Daimler Chrysler plants
  - Queensland, Australia sewage control system

International Resolutions & Organizations

- UN Security Council Resolution 1540
- Australia Group
- Organization for the Prohibition of Chemical Weapons
- American Chemistry Council

Responsible Care Security Code

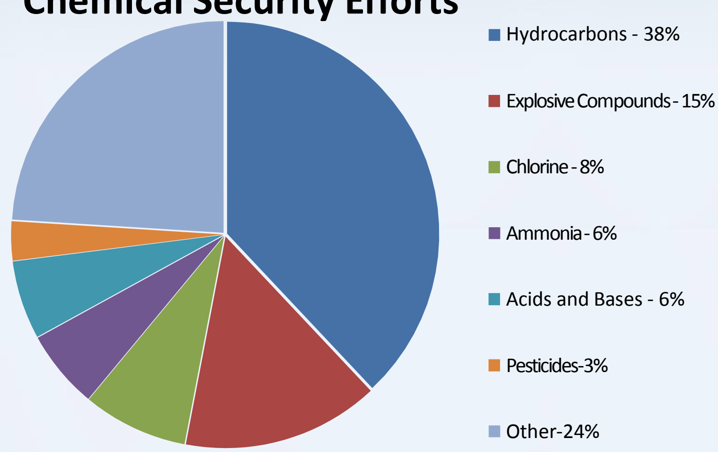
How are chemical safety and chemical security related?

Both Ensure Protection of:

- Workers
- Plant facilities
- Plant processes
- Community
- Environment
- Economy

Principles of Security

Chemical Accidents are a Guide to Chemical Security Efforts



Source: UN APELL Program-(1970-1998)

What is security?





Chemical Industry Security Based on Theft, Release, and Sabotage

- Risk to public health & safety release
  - In-situ release of toxic chemicals
  - In-situ release and ignition of flammable chemicals
  - In-situ release/detonation of explosives chemicals
- Potential targets for theft or diversion
  - Chemical weapons and precursors
  - Weapons of mass effect (toxic inhalation hazards)
  - IED precursors
- Reactive and stored in transportation containers
  - Chemicals that react with water to generate toxic gases

Source: DHS Chemical Security

Security objective

Security intends to prevent *intentional acts* which could result in unacceptable consequences

- Death/Severe Injury
- Chemical contamination
  - People
  - Environment
- Political Instability
- Economic Loss
- Industrial capacity loss
- Negative public psychological effect
- Adverse media coverage

There are Four Categories with the Greatest Impact on Security

- Property – Laptop, jump drive , personal digital assistant
- Vehicles – Facility vehicle, access to areas, passes removed
- Information – Computer access
- Personnel – Identification, access codes

Source: DHS Chemical Security Awareness Training

First Steps in Chemical Security: Low Cost Principles

Chemical Security Awareness

- Property-Vehicles-Information-Personnel
- Work Area - Changes
- Behavior - Suspicious
- Procedures - Followed

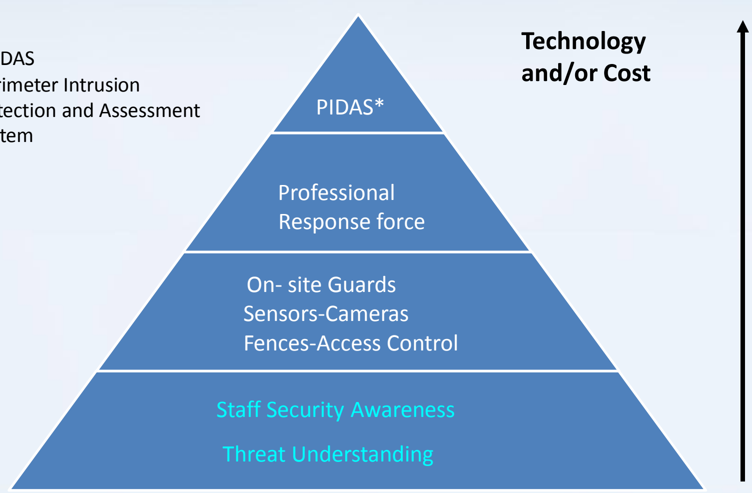
Access Controls

- Have (credential), Know (PIN), Are (biometric*)
- Manual (guards), Automated (machines)

* Can be expensive

Low Cost Security Measures are a Good Start

*PIDAS
Perimeter Intrusion
Detection and Assessment
System



Basic Security Awareness

- Work area changes
  - Hole in fence
  - Suspicious packages
  - Inventory discrepancy
  - Door unlocked
- Symptoms of others behavior who are attempting to compromise security
  - Elicitation
  - Surveillance
  - Ordering supplies

Security awareness is the first step to making your facility safe from malevolent acts

Source: DHS Chemical Security Awareness Training

Awareness - Suspicious Behaviors

- Testing security – walking into, wait for discovery
- Mapping, loitering, staging vehicles
- Taking pictures of security system
- Looking in dumpster
- Trying to enter on your credential
- Asking for user name over the phone or by email
- Asking about plant layout – workers names-schedules

Source: DHS Chemical Security Awareness Training

Security Involves Systematic Diligence- Follow Procedures

- Missing badge
- Leaving workstation unsecured-fire alarm
- Leaving sensitive document
- Bypassing security

Know what to do - who to call
Communicate anything unusual to supervisor

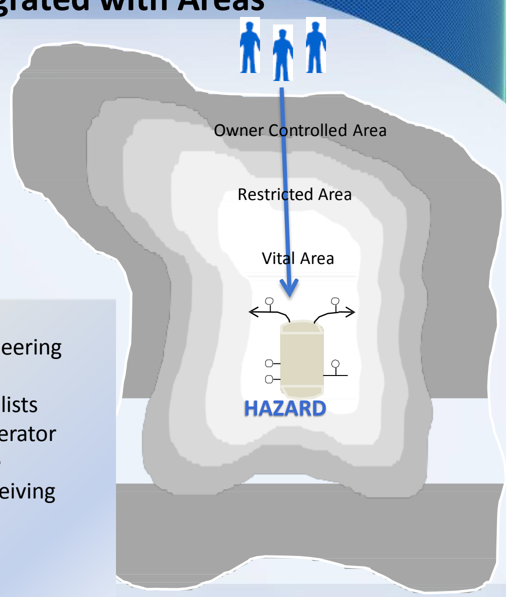
Remember - YOU are the first responder

Source: DHS Chemical Security Awareness Training

Access Control Integrated with Areas and People

Plant locations
Administration
Control rooms
Server rooms
Switchgear
Process Units
Rail / truck yards
Stores

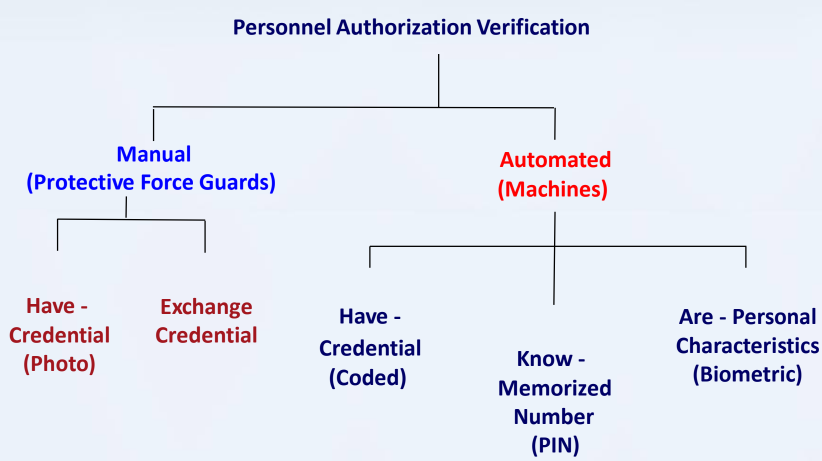
Plant employees
Administration /Engineering
Operations
 Computer specialists
 Control room operator
 Process interface
 Shipping and receiving
Maintenance
Security / Safety
Contractors / visitors

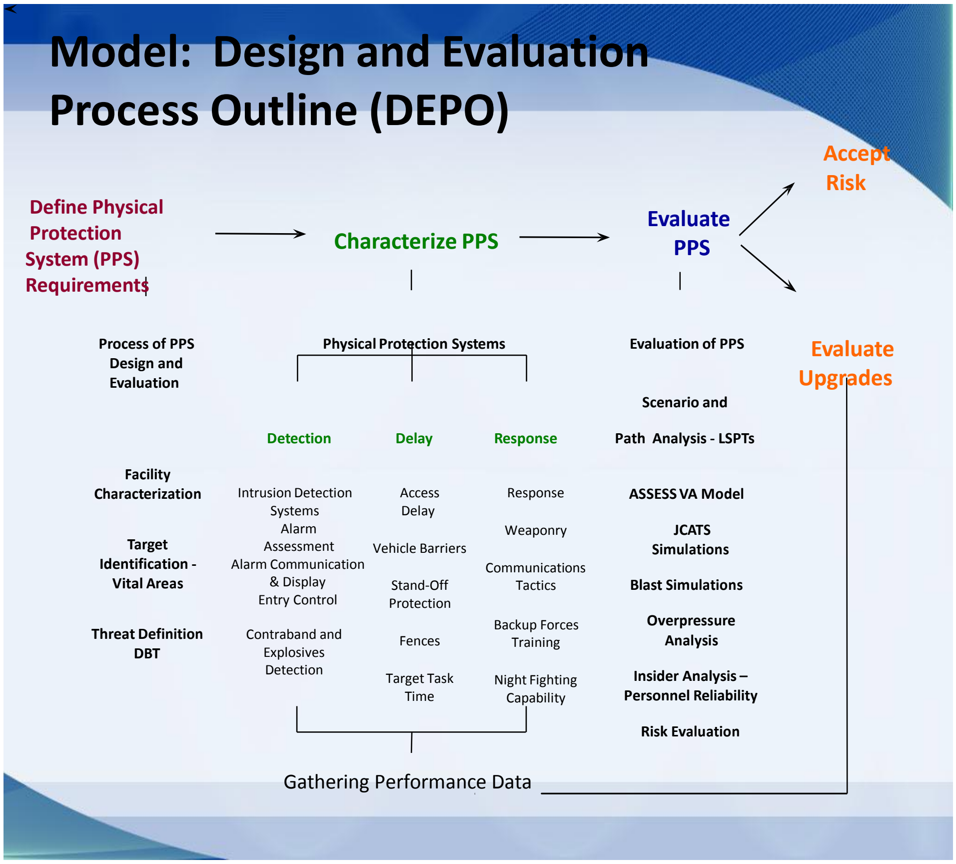


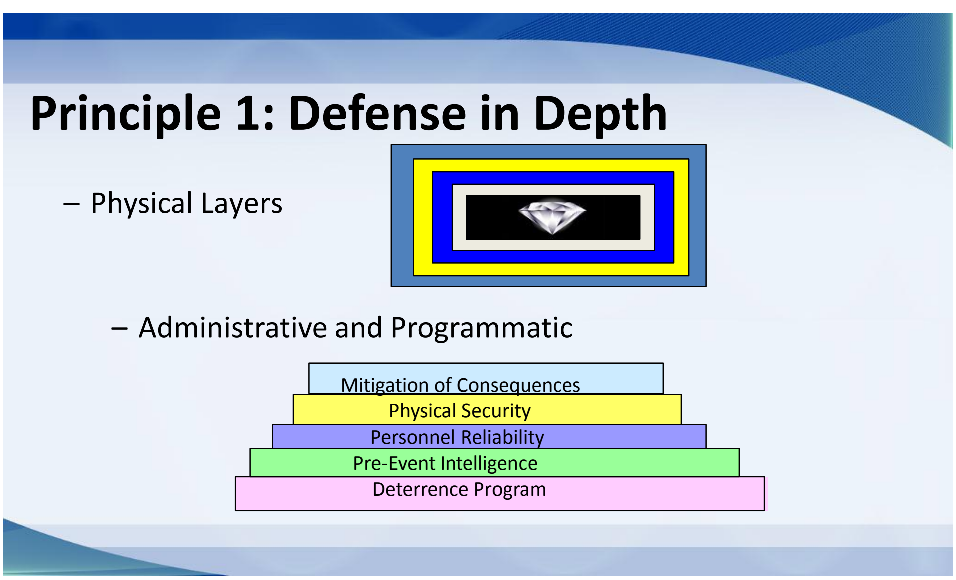
Features of a Good Entry Control System

- Integration with boundary
  - Cannot be bypassed
  - Block individuals until access authorization verified
  - Interfaces with the alarm system
- Integration with the guards/response force
  - Protects guard
  - Area is under surveillance
- Personnel integrate with system
  - Easy to use for entry and exit
  - Accommodates peak throughput (loads)
  - Accommodates special cases

Types of Personnel Entry Control

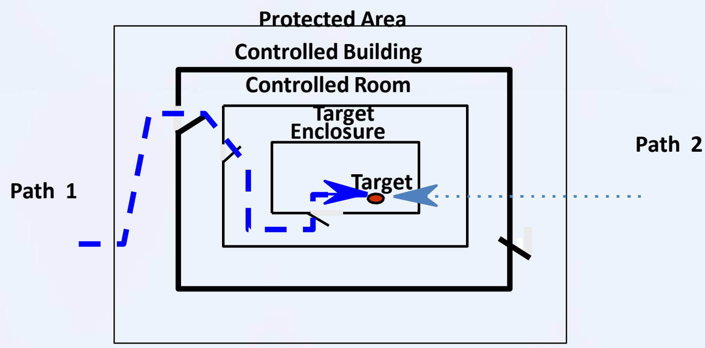



Model: Design and Evaluation Process Outline (DEPO)
Define Physical Protection System (PPS) Requirements
Characterize PPS
Evaluate PPS
Accept Risk
Evaluate Upgrades
Process of PPS Design and Evaluation
Physical Protection Systems
Evaluation of PPS
Scenario and Path Analysis - LSPTs
Detection
Delay
Response
Facility Characterization
Target Identification - Vital Areas
Threat Definition DBT
Intrusion Detection Systems
Alarm Assessment
Alarm Communication & Display
Entry Control
Contraband and Explosives Detection
Access Delay
Vehicle Barriers
Stand-Off Protection
Fences
Target Task Time
Response
Weaponry
Communications
Tactics
Backup Forces
Training
Night Fighting Capability
ASSESS VA Model
JCATS Simulations
Blast Simulations
Overpressure Analysis
Insider Analysis – Personnel Reliability
Risk Evaluation
Gathering Performance Data


Principle 1: Defense in Depth
– Physical Layers
– Administrative and Programmatic
Mitigation of Consequences
Physical Security
Personnel Reliability
Pre-Event Intelligence
Deterrence Program

Principle 2: Balanced Protection

- Physical Layers
- Adversary Scenarios
  - Adversary paths (physical)



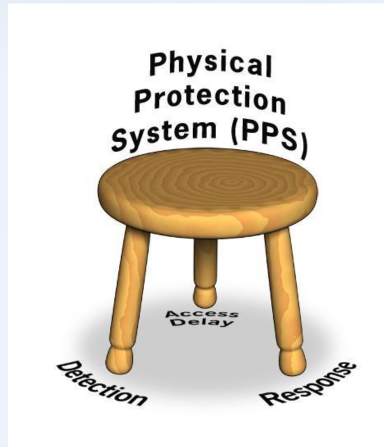
Balanced Protection

- Each Path is composed on many protection elements
  - –Walls, fences, sensors, cameras, access controls, etc…
- Protection elements each possess delay and detection components
  - –For example:
    - Fence delays adversaries *20* seconds, and provides 50% likelihood that adversary is detected
    - Wall delays adversary 120 seconds and provides a 10% likelihood of detection
    - Guard delays adversary 20 seconds and provides a 30% likelihood of detection
- Balanced protection objective:
  - –for every possible adversary path
  - –cumulative detection and delay encountered along path will be the similar
  - –regardless of adversary path

  - –NO WEAK PATH

Principle 3: System Integration

- Detection alerts Response
- Access Delay slows the adversary to provide time for Response
- Response prevents the consequence



Integrated Security





- Contribution to security system of each can be reduced to its contribution to:
  - Detection of adversary or malevolent event
  - Delay of adversary
  - Response to adversary
- Integrated security evaluates composite contribution of all components to these three elements
  - Assures that overall detection is sufficient and precedes delay
  - Assures that adversary delay time exceeds expected response time
  - Assures that response capability is greater than expected adversary

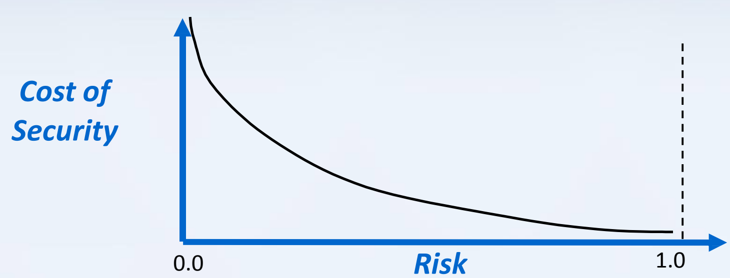
Principle 4: Managed Risk

- How much Security is enough???

Cost of Security

Benefit of Security

Managed Risk



- The benefit (risk reduction) increases with increased security investment (cost)
- However, there is a point where the increased benefit does not justify the increased cost

Target Identification

What are possible sources of unacceptable consequences?

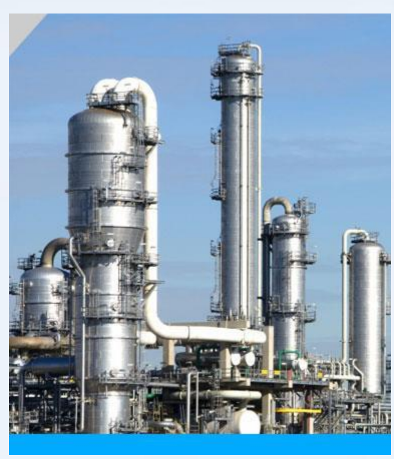
- Dispersal
  - Identify areas to protect
- Theft
  - Identify material to protect

Target Identification

Characterize Types of Targets

- Form
- Storage manner and location
- Flow of chemicals
- Vulnerability of Chemicals
  - Flammable
  - Explosive
  - Caustic

- **Criticality / Effect**
- **Access / Vulnerability**
- **Recoverability / Redundancy**
- **Vulnerability**



The Physical Protection System Must Have a Basis for Design

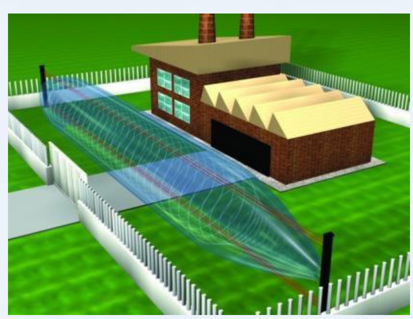
Threat Assessment: An evaluation of the threats- based on available intelligence, law enforcement, and open source information that describes the motivations, intentions, and capabilities of these threats

Design Basis Threat: A policy document used to establish performance criteria for a physical protection system (PPS). It is based on the results of threat assessments as well as other policy considerations

Define the Threats

In physical security:

- Knowing adversary permits customizing security to maximize effectiveness
- As adversary not known, develop hypothetical adversary to customize security
- Hypothetical adversary description should be influenced by actual threat data



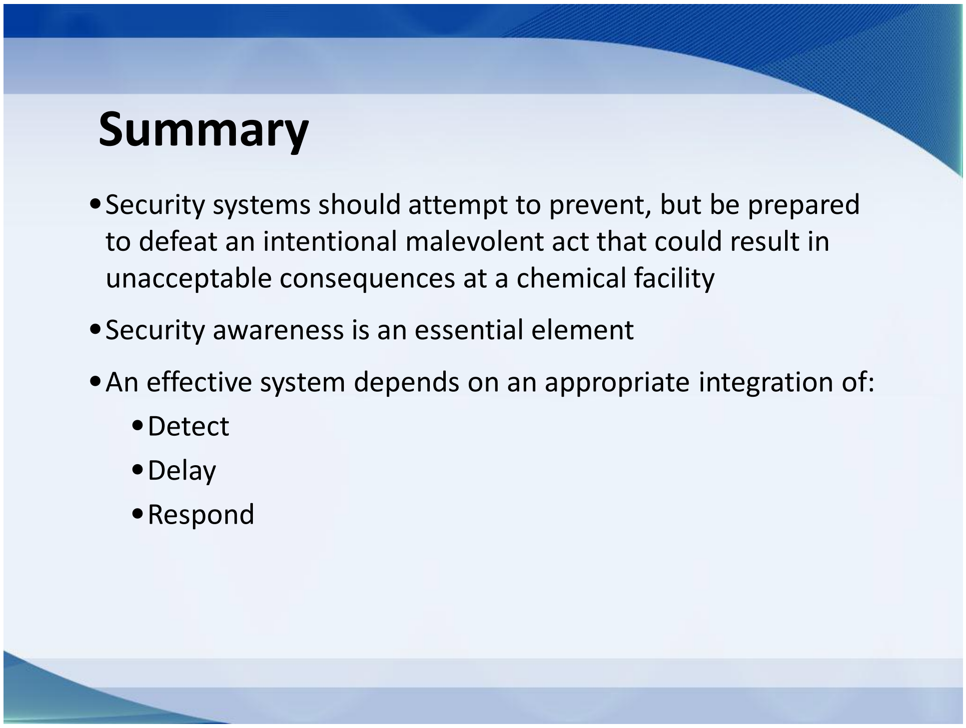
Design Basis Threat

- A Design Basis Threat (DBT) is a formalized approach to develop a threat-based design criteria
- DBT consists of the attributes and characteristics of potential adversaries. These attributes and characteristics are used as criteria to develop a customized security system design.
- The DBT is typically defined at a national level for a State.
- At the facility level, also:
  - Consider local threats
    - Local criminals, terrorists, protestors
  - Consider insider threats
    - Employees and others with access

SECURITY VULNERABILITY CHECKLIST FOR ACADEMIC AND SMALL CHEMICAL LABORATORY FACILITIES

Prepared by the American Chemical Society, Committee on Chemical Safety, Safe Practices Subcommittee

ATTRACTIVENESS AS A POTENTIAL TARGET	N/A	1 *Prepared*	2	3 *Not prepared*
General Awareness Questions				
1. Are there specific hazards present at the facility in sufficient quantity to present an attractive target for terrorists or vandals? Note specific hazards here:	✓			
2. Are you prepared for the potential consequences of an attack?		✓		
3. Have you identified weaknesses in how facility assets are protected? What are they?	✓			
4. Is information protected from the public regarding targetability (nature of chemicals present/ quantities)?		✓		
5. Are storage/transfer areas hidden from off site view?			✓	
6. Have you done what is practical to limit attractiveness as a potential target?	✓			
7. Is there a viable plan for Continuity of Operations should there be a major fire, explosion or power outage?			✓	


Summary
• Security systems should attempt to prevent, but be prepared to defeat an intentional malevolent act that could result in unacceptable consequences at a chemical facility
• Security awareness is an essential element
• An effective system depends on an appropriate integration of:
• Detect
• Delay
• Respond

Chemical Security Workshop

Chemicals of Concern Overview

Objectives

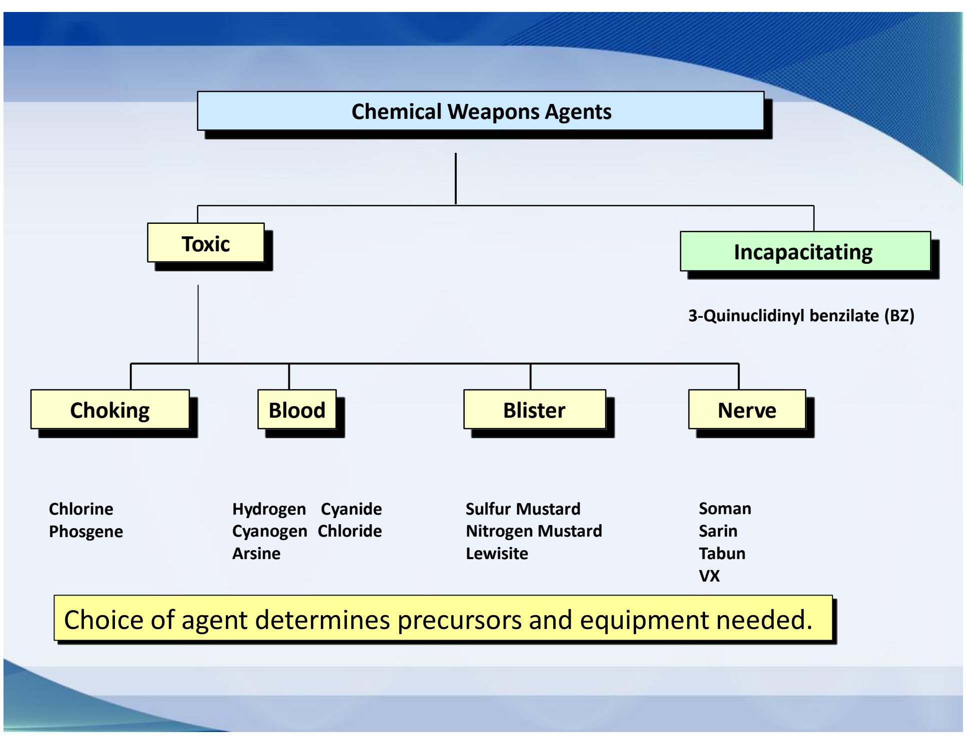
Raise awareness about chemicals of concern

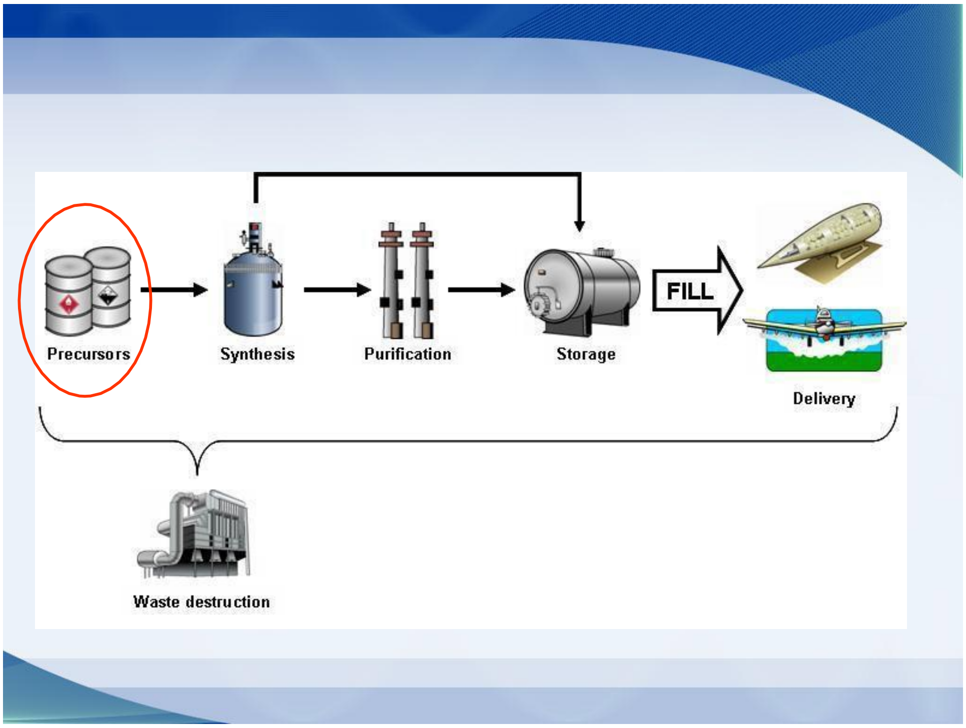
- Chemicals likely targeted for theft or diversion
- Toxic chemicals
- Reactive chemicals

Chemicals of Concern

Chemicals that pose a high risk to safety and security:

- Chemicals likely targeted for theft or diversion
  - Used in production of chemical and biological weapons agents
  - Used in production of illegal drugs
  - Used in production of explosives
- Toxic chemicals
  - Have potential to create significant adverse consequences for human life or health
- Reactive chemicals
  - Have potential to create significant adverse consequences for human life or health when mixed with materials





CW in the Regime Lists

- **Chemical Weapons Convention (CWC): Annex on Chemicals**
  - Chemicals subject to restrictions and monitoring, including import and export declarations
  - Three Schedules, each divided into (A) toxic chemicals and (B) precursors
  - Schedule assignment reflects extent of commercial use and risk of use in CW-related activities
    - Schedule 1: Few or no non-CW uses, high risk
    - Schedule 2: Moderate non-CW uses, significant risk
    - Schedule 3: Numerous non-CW uses, lower but non-zero risk
- **Australia Group (AG)**: **Chemical Weapons Precursors Control List**
  - 63 specific chemical compounds (9/2009)
  - List includes both CWC Scheduled and unscheduled chemicals
- **Wassenaar Arrangement (WA):** ML7.b and c
  - Chemical Warfare Agents: Nerve Agents, Vesicants, Incapacitating Agents, Defoliants
  - Binary Precursors and Key Precursors

CWC: Annex on Chemicals

- The Annex on Chemicals contains three lists ("Schedules") of chemicals subject to monitoring and/or restriction of their production and trade
- Each Schedule contains both CW agents and precursors
- Schedule assignment reflects extent of commercial use and proliferation risk

Schedule	Chemicals	Commercial Uses	Proliferation Risk
1	Nerve and blister agents, toxins; binary precursors	Few or none	**High Risk**
2	Toxic chemicals; precursors for Schedule 1 chemicals or Schedule 2 toxic chemicals	Moderate	**Significant Risk**
3	Blood and choking agents; precursors for Schedule 1 chemicals or Schedule 2 precursors	Extensive	**Risk**

http://www.opcw.org/chemical-weapons-convention/annexes/annex-on-chemicals/

CWC Schedule 1

- Criteria to be taken into account when considering a Schedule 1 assignment
  - Has been developed, produced, stockpiled or used as a CW
  - Poses otherwise a high risk to the object and purpose of the CWC by virtue of its high potential for use in prohibited activities because one or more of the following conditions are met
    - Possesses a chemical structure closely related to that of other Schedule 1 toxic chemicals and has, or can be expected to have, comparable properties
    - Possesses such lethal or incapacitating toxicity as well as other properties that it could be used as a CW
    - May be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of where this stage takes place (facilities, munitions, elsewhere)
  - Has little or no use for purposes not prohibited under the CWC
- Examples
  - Toxic chemicals: Tabun, sarin, VX, sulfur and nitrogen mustards, Lewisites, saxitoxin, ricin
  - Precursors: Chlorosarin, methylphosphonyl difluoride (DF), O-ethyl-O-2-diisoproplaminoethyl methylphosphonite (QL)
    - Also includes general categories of precursors (DF and QL are examples of those categories)

CWC: Schedule 1 Chemicals

A. Toxic Chemicals

		CAS Registry #
(1)	)-Alkyl (<=C10, incl. cycloalkyl) alkyl (Me, Et, n-Pr or i-Pr)-phosphonofluoridates	
e.g. Sarin:	O-Isopropyl methylphosphonofluoridate	107-44-8
Soman:	O-Pinacolyl methylphosphonofluoridate	96-64-0
(2)	O-Alkyl (<=10, incl. cycloalkyl) N,N-dialkyl (Me, Et, N-Pr or i-Pr) phosphoramidocyanidates	
e.g. Tabun:	O-Ethyl N,N-dimethyl phosphoramidocyanidate	77-81-6
(3)	O-Alkyl (H or <=C10, incl. cycloalkyl) S-2-dialkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonothiolates and corresponding alkylated or protonated salts	
e.g. VX:	O-Ethyl S-2-diisopropylaminoethyl methyl phosphonothiolate	50782-69-9
(4)	Sulfur mustards:	
	2-Chloroethylchloromethylsulfide	2625-76-5
	Mustard gas: Bis(2-chloroethyl)sulfide	505-60-2
	Bis(2-chloroethylthio)methane	63869-13-6
	Sesquimustard: 1,2-Bis(2-chloroethylthio)ethane	3563-36-8
	1,3-Bis(2-chloroethylthio)-n-propane	63905-10-2
	1,4-Bis(2-chloroethylthio)-n-butane	142868-93-7
	1,5-Bis(2-chloroethylthio)-n-pentane	142868-94-8
	Bis(2-chloroethylthiomethyl)ether	63918-90-1
	O-Mustard: Bis(2-chloroethylthioethyl)ether	63918-89-8
(5)	Lewisites:	
	Lewisite 1: 2-Chlorovinyldichloroarsine	541-25-3
	Lewisite 2: Bis(2-chlorovinyl)chloroarsine	40334-69-8
	Lewisite 3: Tris(2-chlorovinyl)arsine	40334-70-1
(6)	Nitrogen mustards:	
	HN1: Bis(2-chloroethyl)ethylamine	538-07-8
	HN2: Bis(2-chloroethyl)methylamine	51-75-2
	HN3: Tris(2-chloroethyl)amine	555-77-1
(7)	Saxitoxin	35523-89-8
(8)	Ricin	9009-86-3

B. Precursors

		CAS Registry #
(9)	Alkyl (Me, Et, n-Pr or i-Pr) phosphonyldifluorides	
e.g. DF:	Methylphosphonyldifluoride	676-99-3
(10)	O-Alkyl (H or <=C10, incl. cycloalkyl) O-2-dalkyl (Me, Et, n-Pr or i-Pr)-aminoethyl alkyl (Me, Et, n-Pr or i-Pr) phosphonites and corresponding alkylated or protonated salts	
e.g. QL:	O-Ethyl O-2-diisopropylaminoethyl methylphosphonite	57856-11-8
(11)	Chlorosarin: O-Isopropyl methylphosphonochloridate	1445-76-7
(12)	Chlorosoman: O-Pinacolyl methylphosphonochloridate	7040-57-5

CWC Schedule 2

- Criteria to be taken into account when considering a Schedule 2 assignment
  - Poses a significant risk to the object and purpose of the CWC because it possesses such lethal or incapacitating toxicity as well as other properties that could be used as a chemical weapon
  - May be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2A
  - Poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2A
  - Not produced in large commercial quantities for purposes not prohibited under the CWC
- Examples
  - Toxic chemicals: Amiton, PFIB, BZ
  - Precursors: Dimethyl methylphosphonate (DMMP), methylphosphonyl dichloride (DC), thiodiglycol, arsenic trichloride, benzilic acid (2,2-diphenyl-2-hydroxyacetic acid), pinacolyl alcohol
    - Includes several categories of precursors

CWC: Schedule 2 Chemicals

A. Toxic Chemicals

		CAS Registry #
(1)	Amiton: O,O-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate	78-53-5
	and corresponding alkylated or protonated salts	
(2)	PFIB: 1,1,3,3,3-Pentafluoro-2-(trifluoromethyl)-1-propene	382-21-8
(3)	BZ: 3-Quinuclidinyl benzilate (*)	6581-06-2

B. Precursors

		CAS Registry #
(4)	Chemicals, except for those listed in Schedule 1, containing a phosphorus atom to which is bonded one methyl, ethyl or propyl (normal or iso) group but not further carbon atoms,	
e.g.	Methylphosphonyl dichloride	676-97-1
	Dimethyl methylphosphonate	756-79-6
Exemption: Fonofos:	O-Ethyl S-phenyl ethylphosphonothiolothionate	944-22-9
(5)	N,N-Dialkyl (Me, Et, n-Pr or i-Pr) phosphoramidic dihalides	
(6)	Dialkyl (Me, Et, n-Pr or i-Pr) N,N-dialkyl (Me, Et, n-Pr or i-Pr)-phosphoramidates	
(7)	Arsenic trichloride	7784-34-1
(8)	2,2-Diphenyl-2-hydroxyacetic acid	76-93-7
(9)	Quinuclidin-3-ol	1619-34-7
(10)	N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethyl-2-chlorides and corresponding protonated salts	
(11)	N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-ols and corresponding protonated salts	63869-13-6
Exemptions:	N,N-Dimethylaminoethanol	108-01-0
	and corresponding protonated salts	
	N,N-Diethylaminoethanol	100-37-8
	and corresponding protonated salts	
(12)	N,N-Dialkyl (Me, Et, n-Pr or i-Pr) aminoethane-2-thiols and corresponding protonated salts	
(13)	Thiodiglycol: Bis(2-hydroxyethyl)sulfide	111-48-8
(14)	Pinacolyl alcohol: 3,3-Dimethylbutan-2-ol	464-07-3

CWC Schedule 3

- Criteria to be taken into account when considering a Schedule 3 assignment
  - Has been produced, stockpiled or used as a CW
  - Poses a risk to the object and purpose of the CWC because it possesses such lethal or incapacitating toxicity as well as other properties that it might be used as a CW
  - Poses a risk to the object and purpose of the CWC by virtue of its importance in the production or one or more chemicals in Schedule 1 or Schedule 2B
  - May be produced in large commercial quantities for purposes not prohibited under the CWC
- Examples
  - <u>Toxic chemicals:</u> Phosgene, hydrogen cyanide, cyanogen chloride, chloropicrin
  - <u>Precursors:</u> Phosphorus oxychloride, dimethyl phosphite, triethanolamine, thionyl chloride

CWC: Schedule 3 Chemicals

A. Toxic Chemicals

		CAS Registry #
(1)	Phosgene: Carbonyl dichloride	75-44-5
(2)	Cyanogen chloride	506-77-4
(3)	Hydrogen cyanide	74-90-8
(4)	Chloropicrin: Trichloronitromethane	76-06-2

B. Precursors

		CAS Registry #
(5)	Phosphorus oxychloride	10025-87-3
(6)	Phosphorus trichloride	7719-12-2
(7)	Phsophorus pentachloride	10026-13-8
(8)	Trimethyl phosphite	121-45-9
(9)	Triethyl phosphite	122-52-1
(10)	Dimethyl phosphite	868-85-9
(11)	Diethyl phosphite	762-04-9
(12)	Sulfur monochloride	10025-67-9
(13)	Sulfur dichloride	10545-99-0
(14)	Thionyl chloride	7719-09-7
(15)	Ethyldiethanolamine	139-87-7
(16)	Methyldiethanolamine	105-59-9
(17)	Triethanolamine	102-71-6

Australia Group Control Lists for Chemical Precursors & Equipment

- Chemical weapons precursors
  - 63 Precursors: specific chemical compounds containing phosphorus, sulfur, fluorine, chlorine, etc.
  - List includes both CWC Scheduled and unscheduled chemicals
- Dual-use chemical manufacturing facilities and equipment and related technology and software
  - Manufacturing facilities and equipment
  - Toxic gas monitoring systems and their dedicated detecting components
  - Related technology
  - Software

Manufacturing Facilities and Equipment

- Reaction Vessels, Reactors or Agitators
- Storage Tanks, Containers or Receivers
- Heat Exchangers or Condensers
- Distillation or Absorption Columns
- Filling Equipment
- Valves
- Multi-Walled Piping
- Pumps
- Incinerators

http://www.australiagroup.net/en/index.html

Australia Group Chemical Weapons Precursors Control List (Sept 2009)

1. Thiodiglycol
2. Phosphorus oxychloride
3. Dimethyl methylphosphonate
4. Methylphosphonyl difluoride (DF)
5. Methylphosphonyl dichloride (DC)
6. Dimethyl phosphite (DMP)
7. Phosphorus trichloride
8. Trimethyl phosphite (TMP)
9. Thionyl chloride
10. 3-Hydroxy-1-methylpiperidine
11. N,N-Diisopropyl-(beta)-aminoethyl chloride
12. N,N-Diisopropyl-(beta)-aminoethane thiol
13. 3-Quinuclidinol
14. Potassium fluoride
15. 2-Chloroethanol
16. Dimethylamine
17. Diethyl ethylphosphonate
18. Diethyl N,N-dimethylphosphoramidate
19. Diethyl phosphite
20. Dimethylamine hydrochloride
21. Ethylphosphinyl dichloride
22. Ethylphosphonyl dichloride
23. Ethylphosphonyl difluoride
24. Hydrogen fluoride
25. Methyl benzilate
26. Methylphosphinyl dichloride
27. N,N-Diisopropyl-(beta)-amino-ethanol
28. Pinacolyl alcohol
29. O-Ethyl 2-diisopropylaminoethyl methylphosphonite (QL)
30. Triethyl phosphite
31. Arsenic trichloride
32. Benzilic acid
33. Diethyl methylphosphonite
34. Dimethyl ethylphosphonate
35. Ethylphosphinyl difluoride
36. Methylphosphinyl difluoride
37. 3-Quinuclidone
38. Phosphorus pentachloride
39. Pinacolone
40. Potassium cyanide
41. Potassium bifluoride
42. Ammonium bifluoride
43. Sodium bifluoride
44. Sodium fluoride
45. Sodium cyanide
46. Triethanolamine
47. Phosphorus pentasulphide
48. Diisopropylamine
49. Diethylaminoethanol
50. Sodium sulphide
51. Sulfur monochloride
52. Sulfur dichloride
53. Triethanolamine hydrochloride
54. N,N-Diisopropyl-2-aminoethyl chloride hydrochloride
55. Methylphosphonic acid
56. Diethyl methylphosphonate
57. N,N-Dimethylaminophosphoryl dichloride
58. Triisopropyl phosphite
59. Ethyldiethanolamine
60. O,O-Diethyl phosphorothioate
61. O,O-Diethyl phosphorodithioate
62. Sodium hexafluorosilicate
63. Methylphosphonothioic dichloride

http://www.australiagroup.net/en/controllists.html

Wassenaar Arrangement: Munitions List ML7

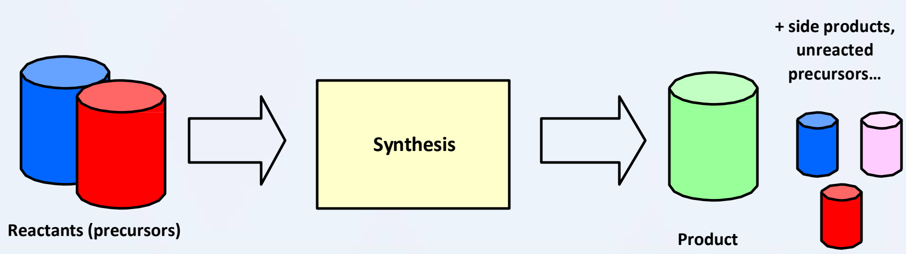
- ML7.b – Chemical toxic agents
  - Nerve agents
  - Blister agents (sulfur mustards, nitrogen mustards, and Lewisites)
  - Incapacitating agents (BZ)
  - Defoliants
- ML7.c
  - CW binary and key precursors (same as those listed on CWC Schedule 1 precursors)

Wassenaar Arrangement Munitions List - ML7

- Chemical or biological toxic agents, "riot control agents," radioactive materials, related equipment, components, and materials, as follows:
  a. Biological agents and radioactive materials "adapted for use in war"…
  b. Chemical warfare (CW) agents, including *Lists of CW nerve, vesicant, and incapacitating agents and defoliants*
  c. CW binary precursors and key precursors, as follows: *[CWC Schedule 1B precursors]*
  d. "Riot control agents," active constituent chemicals and combinations thereof
  e. Equipment specially designed or modified for military use, for the dissemination of any of the following and specially designed components therefor:
     1. Materials or agents controlled by ML7.a, b, or d; or
     2. CW made up of precursors controlled by ML7.c
  f. Protective and decontamination equipment, specially designed or modified for military use, components and chemical mixtures.

Chemical Synthesis

- **Terminology**
  – <u>Reactants:</u> Chemical starting materials that react together (precursors)
  – <u>Products:</u> Desired chemicals produced by the reaction
- **Not as simple as A + B → C**
  – Must manage multiple variables for successful chemical production



Precursors: CW Ingredients

- CW precursors are the chemical starting materials for making CW agents
- Many CW precursors have legitimate uses in industry and therefore are sold commercially

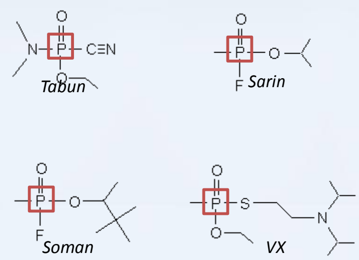
Agent	General types of precursors
Choking	Chlorine compounds
Blood	Cyanide or arsenic compounds
Blister	Nitrogen, sulfur, chlorine, arsenic compounds
Nerve	Phosphorus, sulfur, fluorine and cyanide compounds and amines/alkanolamines
Incapacitating	Complex organic compounds

Precursors

- Many controlled CW precursors, particularly CWC Schedule 3B compounds, are widely produced for numerous legitimate commercial applications
- *Each precursor has its own set of applications*, but general examples of uses include:
  - <u>Phosphorus compounds:</u> Agrochemicals, flame retardants, hydraulic fluid/lubricating oil additives, plastics additives
  - <u>Sulfur compounds:</u> Lubricant additives, rubber vulcanization, dehairing hides, inks & dyes, insecticides
  - <u>Cyanide compounds:</u> Mining, metallurgy, nylon, pigments
  - <u>Fluorine compounds:</u> Fluorocarbons, fluoropolymers, etching, cleaning
  - <u>Amines and alkanolamines:</u> Surfactants, water treatment, textiles, solvents

Phosphorus Compounds

- Definition
  - Selected organic and inorganic compounds containing the element phosphorus
- CW uses
  - Nerve agent precursors
    - Nerve agents are phosphorus compounds themselves, so phosphorus-containing precursors are critical to nerve agent production



Chemical structures of nerve agents, each containing a phosphorus atom (P)

Phosphorus Compounds AG Control List

<u>Schedule 1B</u>
- Methylphosphonyl Difluoride (DF)
- Ethylphosphonyl Difluoride
- O-Ethyl 2-Diisopropylaminoethyl Methylphosphonite (QL)

<u>Most Common</u>
- Phosphorus Oxychloride
- Dimethyl Methylphosphonate
- Dimethyl Phosphite (DMP)
- Phosphorus Trichloride
- Trimethyl Phosphite (TMP)
- Diethyl Phosphite
- Triethyl Phosphite
- Phosphorus Pentachloride
- Phosphorus Pentasulphide

<u>Others</u>
- Methylphosphonyl Dichloride (DC)
- Diethyl Ethylphosphonate
- Diethyl N,N-Dimethylphosphoramidate
- Ethylphosphinyl Dichloride
- Ethylphosphonyl Dichloride
- Methylphosphinyl Dichloride
- Diethyl Methylphosphonite
- Dimethyl Ethylphosphonate
- Ethylphosphinyl Difluoride
- Methylphosphinyl Difluoride
- Methylphosphonic acid
- Diethyl methylphosphonate
- N,N-Dimethylaminophosphoryl dichloride
- Triisopropyl phosphite
- O,O-Diethyl phosphorothioate
- O,O-Diethyl phosphorodithioate

There are 29 phosphorus compounds on the AG Control List. **http://www.australiagroup.net/en/precursors.html (Sept '09)** The CWC Schedules list additional phosphorus compounds.

Phosphorus Compounds

Chemical	Appearance
Phosphorus trichloride	Clear, colorless fuming liquid
Phosphorus oxychloride	Clear colorless liquid
Trimethyl phosphite	Clear colorless liquid
Dimethyl methylphosphonate	Clear colorless liquid
Phosphorus pentachloride	Colorless to pale yellow solid

Phosphorus pentachloride

- Hazards
  - Toxic, corrosive, flammable, etc.
- Target organs
  - Eyes, skin, respiratory system
- Exposure symptoms
  - Irritation/burns of eyes, skin, nose, throat
  - Pulmonary edema

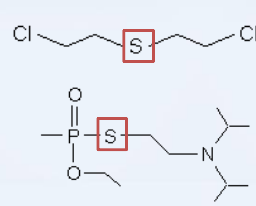
Phosphorus trichloride

***Phosphorus trichloride* truck leak**

23

Sulfur Compounds

- Definition
  - Selected organic and inorganic compounds containing the element sulfur
- CW uses
  - Precursors for nerve and blister agents



Mustard Gas

VX

Chemical structures of blister and nerve agents containing a sulfur atom (S)

Sulfur Compounds – Commercial Uses

- Industrial uses of controlled sulfur compounds are mainly for
  - Lubricant additives
  - Rubber vulcanization
  - Dehairing hides
  - Inks & dyes
  - Insecticides
  - Organic synthesis & pharmaceuticals

Compound	Typical uses	Controls
Sodium sulfide	Leather tanning…	AG
Sulfur dichloride	Insecticides, lubricant additives, rubber…	3B/AG
Sulfur monochloride	Lubricant additives, rubber, erasers…	3B/AG
Thiodiglycol	Inks and dyes, plastics…	2B/AG
Thionyl chloride	Chlorinating agent, lithium batteries…	3B/AG
N,N-Diisopropyl-(beta)-aminoethane thiol	Organic synthesis, veterinary pharmaceuticals	2B/AG

Cyanides

Chemical	Appearance
Hydrogen cyanide and cyanogen chloride	Colorless liquids or gases
Sodium cyanide and potassium cyanide	White, granular or crystalline solid

Sodium and potassium cyanide powders may be compressed into blocks for safety

- Cyanides may have a bitter almond odor
  - Odor is not always present and may be detectable by only some people
- Hazards
  - CW agents or precursors
  - All are highly toxic
- Target organs
  - Central nervous system, eyes, skin
- Exposure symptoms
  - Lightheadedness, confusion, anxiety
  - Rapid breathing, nausea, vomiting
  - Feeling of neck constriction and suffocation
  - Skin and eye irritation and ulceration

Cyanide spills in lake and marine environments result in fish kills

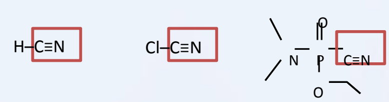
Cyanides – Additional Information

- Cyanide is CN (carbon–nitrogen)
- Commercial uses
  - Hydrogen cyanide: Production of nylon, plastics, resins, and other cyanides
  - Cyanogen chloride: Metal cleaners, ore refining, production of herbicides
  - Sodium cyanide: Gold mining, electroplating, steel treatment
  - Potassium cyanide: Electroplating, production of pigments

Name	CAS	Risk
Hydrogen cyanide	74-90-8	Blood agent
Cyanogen chloride	506-77-4	Blood agent
Sodium cyanide	143-33-9	CW precursor
Potassium cyanide	151-50-8	CW precursor

Sodium Cyanide

- Definition
  - Sodium cyanide is composed of the element sodium and the cyanide functional group (C≡N)
  - Sodium cyanide is commercially available as a white solid (pure) or in a water solution
- CW uses
  - Can be used in the preparation of cyanide-containing blood and nerve agents
    - Blood: Hydrogen cyanide and cyanogen chloride
    - Nerve: Tabun



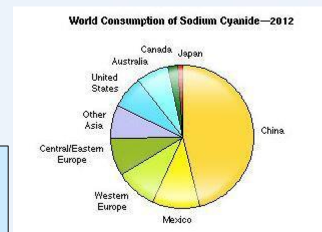
Chemical structures (left to right) of hydrogen cyanide, cyanogen chloride, and tabun, all of which contain the cyanide group

Sodium Cyanide Commercial Uses and Resources

- The gold mining industry is the primary consumer of sodium cyanide
  - Approximately 78% of sodium cyanide is used for gold and silver processing
  - This application often requires large (ton) quantities of sodium cyanide
- Other major applications
  - Chemical synthesis (pharmaceuticals, polymers, dyes, etc.)
  - Electroplating (gold, silver, brass, copper, zinc)
  - Steel-hardening

Primary Use	Regions
Gold extraction	Australia, China, North America, South Africa, South America
Chemical synthesis	Europe, Japan

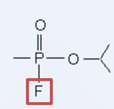
IHS Chemical: Chemical Economics Handbook 2012



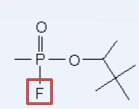
Approximately 640 thousand metric tons of sodium cyanide were consumed worldwide in 2009, with a value of approximately US $1 billion

Fluorine Compounds

- Definition
  - Seven inorganic compounds containing the element fluorine
    - Hydrogen fluoride
    - Ammonium bifluoride
    - Potassium fluoride
    - Potassium bifluoride
    - Sodium fluoride
    - Sodium bifluoride
    - Sodium hexafluorosilicate
- CW uses
  - Precursors for nerve agents that contain a fluorine atom



Sarin



Soman

Chemical structures of nerve agents containing a fluorine atom (F)

Fluorine Compounds – Commercial Uses

- Many industrial uses of controlled fluorine compounds based on
  - Corrosiveness (cleaning/etching)
  - Ability to insert fluorine atoms into other molecules
- Examples of applications using fluorine compounds
  - Fluoropolymer and fluorocarbon manufacturing
  - Water and toothpaste additives
  - Cleaning and laundering
  - Glass etching
  - Semiconductor industry

Hydrogen Fluoride (HF)

- Hydrogen fluoride (HF)
  - Colorless gas
- HF also available in a water solution known as "hydrofluoric acid"
  - Clear corrosive liquid
- Hazards
  - Toxic and corrosive
  - HF is a CW precursor
- Target organs
  - Eyes, skin, respiratory system, kidneys, liver, skeletal system
- Exposure symptoms
  - Irritation and burns to skin, eyes, other mucous membranes
  - Breathing difficulties, pulmonary edema
  - Delayed kidney, liver, bone damage

Hydrogen fluoride in an ISO tank

Hydrofluoric acid

Hydrogen Fluoride (HF) – Commercial Uses

- Typical uses of HF vary according to its specifications, for example:

Anhydrous HF

- Fluorocarbon production
- Fluoropolymers
- Chemical derivatives
- Petroleum alkylation
- Uranium conversion
- Pesticides and herbicides

HF Acid

- Surface treatment of aluminum
- Stainless steel and titanium pickling
- Etching/frosting of glass
- Feedstock for chemical derivatives
- Rare metal processing
- Cleaning of industrial plants and buildings

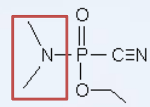
Semiconductor applications require ultra-high-purity ("electronic grade") products

Other Fluorine Compounds

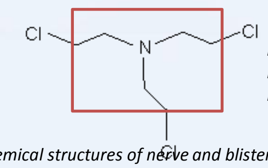
Examples of uses	Ammonium bifluoride	Potassium bifluoride	Potassium fluoride	Sodium bifluoride	Sodium fluoride	Sodium hexafluoro-silicate
Alkylation or polymerization catalysts		•	•	•		
Cleaning/disinfecting (buildings, industrial plants, etc.)	•			•		
Dental preparations					•	
Drinking water fluorination					•	•
Fluorine gas production		•				
Glass or enamel etching/processing/production	•	•			•	•
Metallurgical applications	•	•	•	•	•	•
Oil well acidification	•					
Pesticides			•		•	•
Pharmaceutical preparation			•			
Preservatives (wood, adhesives, zoological specimens, etc.)	•	•	•	•	•	•
Production of soldering agents/fluxes/welding agents		•	•		•	
Textile industry	•			•	•	•

Amines and Alkanolamines

- Definition
  - <u>Amines:</u> nitrogen atom connected to three hydrogen or carbon-based groups
    - Dimethyl<u>amine</u>
    - Diisopropyl<u>amine</u>
  - <u>Alkanolamines:</u> amines and alcohol (OH) groups connected by carbon chains
    - Triethan<u>olamine</u>
    - Diethyl<u>aminoethanol</u>
  - Salts of amines and alkanolamines also appear on control lists
    - Dimethylamine hydrochloride
    - Triethanolamine hydrochloride
- CW uses
  - Precursors for nerve and blister agents
    - Many agents have nitrogen atoms connected to carbon chains



Tabun



Nitrogen Mustard HN-3

Chemical structures of nerve and blister agents showing amine components

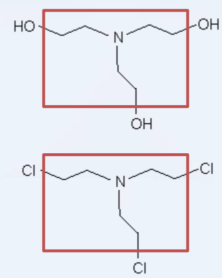
Amines and Alkanolamines

Amines and alkanolamines often have alkaline and/or buffering characteristics

Precursor	Main commercial uses	Controls
Diisopropylamine	Herbicides, corrosion inhibitors, solvent, intermediate	AG #48
N,N-Diisopropyl-(beta)-amino-ethanol	Pharmaceuticals, corrosion control, inks, coatings	AG #27, CWC 2B
Diethylaminoethanol	Water treatment/corrosion inhibitors, textile finishing agents, fabric softeners	AG #49
Dimethylamine	Water treatment chemicals, solvents, crop protection chemicals, pharmaceuticals	AG #16
Dimethylamine hydrochloride	Pharmaceuticals	AG #20
Ethyldiethanolamine	Pharmaceuticals, crop protection chemicals, flocculants, plastics	AG #59, CWC 3B
Methyldiethanolamine	Acid removal from natural gas, photographic chemicals, pharmaceuticals	CWC 3B
Triethanolamine	Personal care products (soap, shampoo, cosmetics, etc.), cleaners, metalworking fluids	AG #46, CWC 3B
Triethanolamine hydrochloride	Buffers, toiletries	AG #53

Triethanolamine (TEA)

- Definition
  - Triethanolamine is an alkanolamine composed of a nitrogen atom attached to three identical ethanol groups
  - Colorless to pale amber liquid
  - Common commercial specifications are 85% TEA and 99% TEA, which exceed the 30% concentration limit for mixture controls
- CW uses
  - Precursor for the blister agent nitrogen mustard HN-3
    - TEA differs from HN-3 by only the terminal chlorine groups

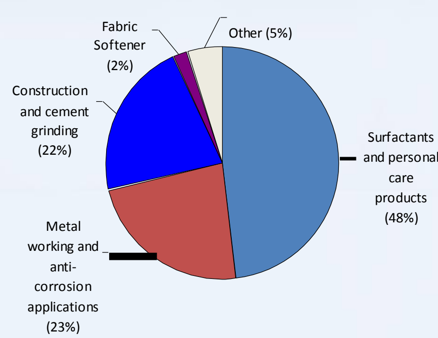


TEA

HN-3

Triethanolamine (TEA) Commercial Uses and Resources

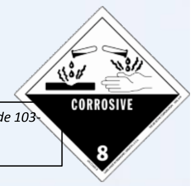
- Typical uses of TEA include
  - Detergents/surfactants
  - Personal care products (soap, shampoo, cosmetics, lotion)
  - Textile additives
  - Natural gas processing
  - Cement/concrete additives
  - Metalworking (cleaners and cutting fluids)
  - Production of adhesive, rubber, agricultural, and photographic chemicals
  - Production of urethane foams
- Both commercial 85% and 99% TEA can be used for some of these applications



Data from DOW Chemical: http://www.dow.com/productsafety/finder/tea.htm

Toxic Industrial Chemicals (TICs)

- TICs are industrial chemicals that could cause harm if released
  - Not as highly toxic as nerve agents
  - TICs can pose a variety of hazards
  - Chemical: corrosive, cancer-causing, reproductive hazards, lung irritation, etc.
  - Physical: flammable, combustible, explosive, or reactive
- TICs are manufactured, stored, and transported worldwide, and thus pose a threat due to combination of toxicity and availability
- TICs also may be referred to as Toxic Industrial Materials (TIMs)



Source: *Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders (NIJ Guide 103-00, October 2001), National Institute of Justice: http://www.ncjrs.gov/pdffiles1/nij/189724.pdf; OSHA website on TICs: http://www.osha.gov/SLTC/emergencypreparedness/guides/chemical.html*

TIC Hazard Indices

- High Hazard
  - Widely produced, stored, or transported
  - High toxicity
  - Easily vaporized
- Medium Hazard
  - May rank high in some of these categories, but lower in others (e.g., number of producers, physical state, or toxicity)
- Low Hazard
  - Not likely to be a hazard "unless specific operational factors indicate otherwise"

Source: *Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders (NIJ Guide 103-00, October 2001), National Institute of Justice: http://www.ncjrs.gov/pdffiles1/nij/189724.pdf*

High Hazard TICs

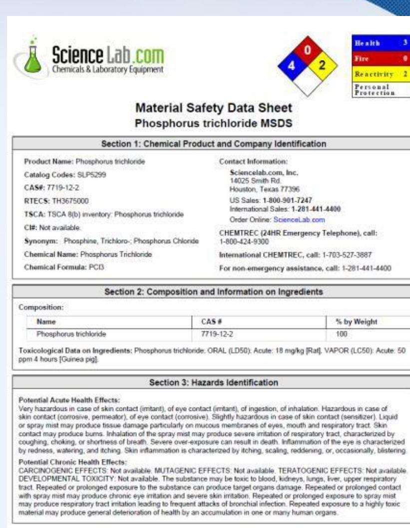
Ammonia	**Arsine**	**Boron trichloride**
Boron trifluoride	**Carbon disulfide**	**Chlorine**
Diborane	**Ethylene oxide**	**Fluorine**
Formaldehyde	**Hydrogen bromide**	**Hydrogen chloride**
Hydrogen cyanide	**Hydrogen fluoride**	**Hydrogen sulfide**
Fuming nitric acid	**Phosgene**	**Phosphorus trichloride**
Sulfur dioxide	**Sulfuric acid**	**Tungsten hexafluoride**

Source: *Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders (NIJ Guide 103-00, October 2001), National Institute of Justice: http://www.ncjrs.gov/pdffiles1/nij/189724.pdf*

Safety Information

Safety Data Sheet:

1. Identification
2. Hazard(s) information
3. Composition / information on ingredients
4. First-aid measures
5. Fire and explosion data
6. Accidental release measures
7. Handling and storage
8. Exposure control/personal protection
9. Physical and chemical properties
10. Stability and reactivity data
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other


ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	0
Reactivity	2
Personal Protection	

Material Safety Data Sheet
Phosphorus trichloride MSDS

Section 1: Chemical Product and Company Identification

Product Name: Phosphorus trichloride
Catalog Codes: SLP5299
CAS#: 7719-12-2
RTECS: TH3675000
TSCA: TSCA 8(b) inventory: Phosphorus trichloride
CI#: Not available.
Synonym: Phosphine, Trichloro-; Phosphorus Chloride
Chemical Name: Phosphorus Trichloride
Chemical Formula: PCl3

Contact Information:
Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396
US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**
Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300
International CHEMTREC, call: 1-703-527-3887
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Phosphorus trichloride	7719-12-2	100

Toxicological Data on Ingredients: Phosphorus trichloride: ORAL (LD50): Acute: 18 mg/kg [Rat]. VAPOR (LC50): Acute: 50 ppm 4 hours [Guinea pig].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, lungs, liver, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Globally Harmonized System

- The **Globally Harmonized System of Classification and Labeling of Chemicals** (**GHS**) is an internationally agreed-upon system, created by the UN
- Classifies chemicals based upon
  - Physical hazards
  - Health hazards
  - Environmental hazards

http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

Acute Toxicity Hazard Categories

Exposure Route	Category 1	Category 2	Category 3	Category 4	Category 5
Oral (mg/kg body weight)	5	50	300	2000	5000
Dermal (mg/kg body weight)	50	200	1000	2000	5000
Gases (ppm V)	100	500	2500	20000	
Vapors (mg/L)	0.5	2.0	10	20	
Dusts and mists (mg/L)	0.05	0.5	1.0	5	

Source: *Globally Harmonized System of Classification and Labeling of Chemicals (GHS);*
http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev02/English/00e_intro.pdf

Acutely Hazardous Chemicals (GHS Category 1)

Acrolein	2-Aminopyridine	Arsenic pentafluoride gas	Arsine gas	Benzyl chloride	Boron trifluoride
Bromine	Chlorine	Chlorine dioxide	Chlorine trifluoride	Cyanogen chloride	Decaborane
Diazomethane	Diborane	Dichloroacetylene	Dimethylmercury	Dimethyl sulfate	Dimethyl sulfide
Ethylene chlorohydrin	Ethylene fluorohydrin	Fluorine	2-Fluoroethanol	Hexamethylene diiosocyanate	Hydrogen cyanide
Hydrogen fluoride	Iron Pentacarbonyl	Isopropyl formate	Methacryloyl chloride	Methyl acrylonitrile	Methyl chloroformate
Methylene biphenyl isocyanate	Methyl fluoroacetate	Methyl fluorosulfate	Methyl hydrazine	Methyl mercury	Methyl trichlorosilane

Chemicals of Interest

- U.S. Department of Homeland Security Chemicals of Interest
  - Release-Toxic, Release-Flammable, Release-Explosive Chemicals
  - Theft and Diversion Chemicals
  - Sabotage and Contamination Chemicals

- List of chemicals of interest included in Appendix A of the U.S. Code of Federal Register 6 CFR Part 27

Chemical Security Culture Overview

Overview

- Define safety and security culture
- Evolution of chemical security culture
- Chemical security model
- Compare and contrast safety and security
- Discuss security vulnerability assessments and chemical hazard evaluations
- Discuss conflicts between safety and security

Culture – One Definition

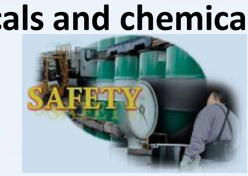
The assembly of

- Characteristics
- Beliefs
- Attitudes

that reflect a society's capacity for learning and transmitting knowledge to succeeding generations

Chemical Safety Culture

The overall intent and effort to keep people safe from chemicals and chemical accidents.



"That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, chemical plant safety issues receive the attention warranted by their significance".

Based upon:

- Openness
- Transparency
- Information Sharing

Ensure that human actions are consistent, appropriate, and correct and human error is minimized or prevented.

Chemical Security Culture

The overall intent and effort to protect chemicals from nefarious individuals.

"The assembly of characteristics, attitudes, and behavior of individuals, organizations, and institutions which serves as a means to support and enhance chemical security."

Based upon:

- Compartmentalization
- Secrecy/Confidentiality
- Classification

Relies heavily on the trustworthiness, honesty, and integrity of individuals not to perform malicious acts.

Safety vs. Security

Key distinction between ***safety and security***:

- Preventive safety analysis aims at identifying vulnerabilities in the design and control philosophy

  Safety Risk = Likelihood of accident × Consequence

- In contrast, security is the degree of protection against danger, damage, loss, and crime.
- For a high-risk chemical facility many ***security measures will relate to physical protection, safeguarding an asset from unauthorized access and acts of malevolence***

Security Risk = Threat × Vulnerability × Consequence

Synergy Between Safety and Security

- Shared principal objective of *"the protection of people, society, and the environment from the effects of harmful chemicals"*
- Shared Attributes:
  - Recognized values
  - Leadership needed for success
  - Accountability
  - Personal dedication and accountability
  - Questioning attitudes, but rigorous approaches to actions
  - Learning and experience driven
  - Best when fully integrated into the system
- Both require a coordinated response

Some Differences

Security

- Considers unintentional acts
- Emphasizes open information management
- Involves only organizations related to chemical

Safety

- Considers deliberate acts
- Emphasizes confidentiality management
- Involves organizations not related to chemical

Sometime the two can conflict such as in emergency egress

Evolution of Chemical Security Culture Often Begins with Safety Culture

Individual commitment to safety
- Personal accountability
- Questioning attitude
- Safety communication

Management commitment to safety
- Leadership accountability
- Decision making
- Respectful work environment

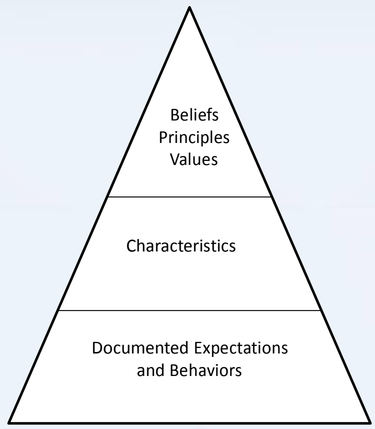
Management systems
- Continuous learning
- Problem identification and resolution
- Environment for raising concerns
- Work processes

Evolution of Chemical Security: Engaging the Technical Community

- Physical security personnel traditional role
- Scientists, technicians, and engineers
- Support staff within facilities
- Academic component

Factors Influencing Security Culture

- **Beliefs, Principles and Values**
  - Board, managers and workforce
  - Ultimate sources of actions
- **Characteristics**
  - Five sub-categories
    - Leadership and Motivation
    - Accountability
    - Professionalism and Competency
    - Integration
    - Learning and Improvement
- **Documented Expectations and Behaviors**
  - Key to senior leaders- LEAD BY EXAMPLE
    - Open meetings, regular briefings, awards programs, acknowledgement, etc.



Chemical Security Model: Beliefs and Attitudes

- Intangible
- Developed through experience
- Developed over time
- Affect individual behaviour
  - ultimately affect chemical security effectiveness
- Important for security personnel and also others in organization

Chemical Security Model: Principles

- Instilled by managers into organization
- Seen as guiding decisions of management
- Principles for guiding decisions and behavior are:
  - Motivation
  - Leadership
  - Commitment and responsibility
  - Professionalism and competence
  - Learning and improvement

Chemical Security Model: Management Systems

- Visible security policy
- Clear roles and responsibilities
- Performance measurement
- Work environment
- Training and qualification
- Work management
- Information security
- Operation and maintenance
- Continual determination of trustworthiness
- Quality assurance
- Change management
- Feedback process
- Contingency plans and drills
- Self-assessment
- Interface with the regulator
- Coordination with off-site organizations

Summary

- Chemical security culture must resonate throughout an organization
- Responsibility lies with the individual
- Technical staff vital to developing good security culture
- Lead by example
- Adoption, diligence, and communication are keys to success

Responsible Science Overview

Overview of Responsible Science for Chemical Practitioners

Session Objectives

- Discuss specific vulnerabilities associated with sensitive information and the role of information security in supporting chemical security.
- Explore best practices for protecting sensitive information
  - On the Internet
  - In scientific collaboration, business transactions and when publishing
  - On travel
  - In the workplace

Defining the Terms: Responsible Science

- A set of shared attitudes, values, goals and practices that characterizes both individual and organizational commitment to honest, verifiable, safe, ethical and peaceful scientific research for the common good.

- A fully functioning responsible science framework includes adoption of internationally recognized practices for chemical safety and security as well as compliance with national arms control and nonproliferation commitments.

Defining the Terms: Chemical Security

- A combination of technical and administrative controls to deter, detect, delay, and respond to an intentional, malevolent chemical event.
- Chemical security intends to prevent intentional acts which could lead to unacceptable consequences.

Defining the Terms: Information Security

- An element of chemical security that represents a collective set of shared attitudes, values, goals and practices to protect sensitive information, in both tangible and intangible forms, from both active exploitation by hostile parties and inadvertent release.

Session Overview

Introduction to Chemical Security, Dual-Use Information and Information Security

- Responsible Science and the Role of Chemical Security
- The Role of Information and Expertise in Chemical Security and Responsible Science
- The Spread of Chemical Information for Peaceful and Non-Peaceful Use from World War I to the Present
- Chemical Security and Nonproliferation Framework
- Dual-Use Chemicals, Equipment, Expertise and Research
- Information Security Vulnerabilities and Best Practices
- Scientific Ethics in Grant and Proposal Writing

Government Regulations: Chemical Security

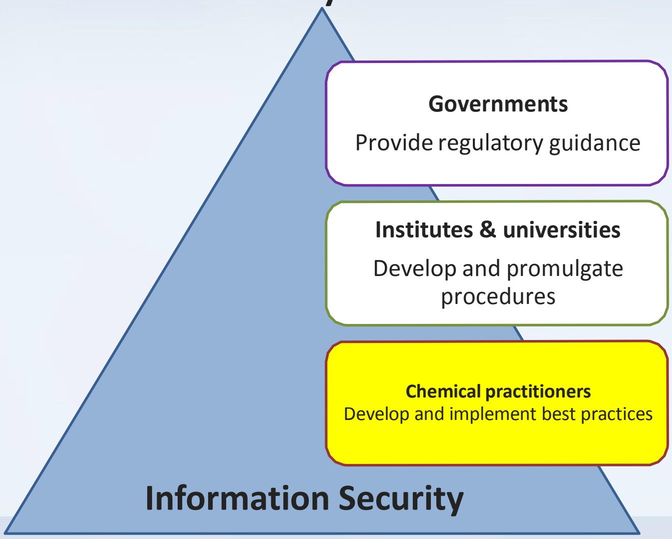
- Differ from country to country
- Legislation needed to fulfill requirements under the Chemical Weapons Convention
  - Each country passes appropriate laws
  - Each country must declare and track certain chemicals
- United Nations Security Council Resolution 1540
- Other export control legislation

Components of Chemical Security At the Facility Level

- Physical security of site
- Personnel management
- Information security
- Management of chemical security activities
- Allocation of chemical security responsibilities
- Development of emergency plans
- Chemical security training

Goal: To ensure that we don't accidently help a criminal or terrorist obtain dangerous chemicals.

The Role of Individual Practitioners in Chemical Security



Chemical Security at Your Level: Responsible Science

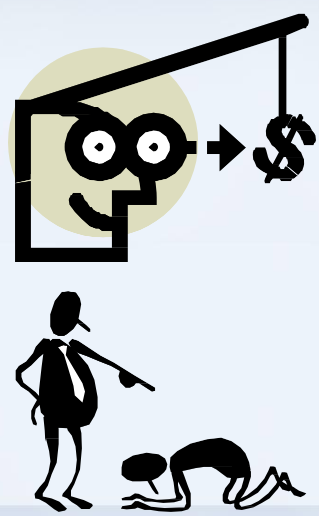
- Chemical professionals use their scientific knowledge in a responsible manner.
- Chemical educators need to train their students to use their scientific knowledge in a responsible manner.

What is the Threat?

- Threat classes:
  - Outsiders—no authorized access
  - Insiders—authorized access
  - Collusion—between Outsiders and Insiders

What Might Motivate Adversaries?

- Terrorists
  - Ideology
- Criminals
  - Financial
- Activists
  - Ideology
- Insiders
  - Ego
  - Ideology
  - Revenge
  - Financial benefit
  - Coercion



Modern Terrorism Threats

- Trends in terrorism tactics suggest that terrorists are now, more than ever, interested in mass-casualty attacks.
- There is renewed attention on the possibility of terrorism incidents involving chemicals used as weapons, along with conventional explosives.

The Role of Information Management in Chemical Security and Responsible Science

Case Studies from the Nuclear Sciences

Chemists' Obligations to Protect Sensitive Knowledge

Elements of Information Security

1. A heightened awareness of the sensitive nature of your expertise and related disciplines
2. An understanding of the vulnerabilities of sensitive information in both tangible and intangible forms
3. A familiarity with best practices to protect sensitive information from both active exploitation by hostile parties and inadvertent release.

The Role of Expertise in the Use of Chemicals as Weapons

Chemical Materials + Expertise = Chemical Weapon

Since chemical practitioners possess sensitive expertise and information others can use for harm, these practitioners themselves have the power to prevent its misuse.

Careless or Complacent Insiders Can Unintentionally Help Hostile Outsiders

- With the best intentions, insiders may inadvertently provide access or sensitive knowledge to outsiders whose intentions are not good.
- Information technology continues to change, making chemical security ever more challenging.

Information Leaks and Human Error: An Example from the Nuclear Field

U.S. Manhattan Project during World War II

This wartime research project generated over 1,500 leak investigations involving unauthorized disclosures of information.

- These leaks were due to:
  - Employees mishandling information
  - Violations of regulations
  - Lack of system controls and procedures
  - Adversaries' weapons programs benefited from this knowledge.
  - U.S. experts learned information security due to this experience.

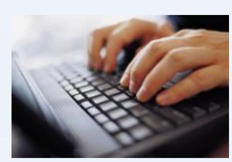
Ref: OpenNet at https://www.osti.gov/opennet/manhattan_district.jsp

Employees are the greatest threat for data breaches. Many breaches are unintentional.

Information Leaks Today: Consequences

- Information protection is more important than ever in today's electronic age.
- It's also harder than ever.

- The existence of documents in electronic format and the capacity for storing and transmitting such material have made information sharing easy.
- Not all information is meant to be shared. The "leaker" may intend to share it with only one person.
- <u>Once released, information can spread rapidly in an uncontrolled fashion.</u>



Scientists' Obligation to Protect Sensitive Knowledge Under International Law

- The Chemical Weapons Convention (CWC) contains legal obligations undertaken by your government to prevent chemical proliferation.
- United Nations Security Council Resolution 1540 requires all States to take security steps related to weapons of mass production.

Appropriate protection of sensitive knowledge is more than a good idea. It's required by these legal instruments.

Case Study 1 (Nuclear)

- Role of Early Scientists in Spreading Nuclear Information

1914: Author H.G. Wells was the first to envision a nuclear weapon in his novel, *The World Set Free.* Wells thought he was writing fiction.

1932: James Chadwick discovers neutrons.

1932: Enrico Fermi was the first to fission uranium, but didn't fully realize the consequence of his discovery. He received the Nobel Prize in 1938.

1933: Leo Szilard: The concept of a nuclear chain reaction "suddenly occurred" to him while walking. For six years, he kept it secret to prevent Hitler from getting it and persuaded others to do the same.

1934: Joliot-Curie group produces the first radioactive substance, ^{30}P

1936: Leo Szilard assigns the patent for a chain reaction to the British Admiralty to ensure its secrecy.

1937: The Joliot-Curie Group made the same discovery as Szilard and published their findings.

Early Scientists Differed on Protecting Sensitive Nuclear Information

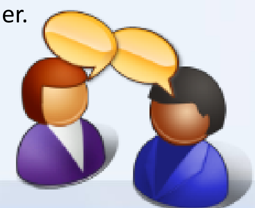
- Leo Szilard kept secret the concept of a nuclear chain reaction and persuaded others to do the same.
  - Leo Szilard said H.G. Wells' novel *The World Set Free* was the inspiration for his research on chemical fission, although Wells had thought he was writing fiction.
- The Joliot-Curie group made the same discovery but published their findings.

Scientists Grapple with Protecting Nuclear Information After World War II

- After World War II, scientists and governments continued to express concerns about the spread of sensitive nuclear information.
  - Acheson-Lilienthal Report (1946)
  - Baruch Plan proposed destruction of the U.S. nuclear stockpile (1946)
  - International Atomic Energy Agency established (1957)
  - Nuclear Nonproliferation Treaty (opened for signature in 1968)
  - Since the 1970's, increased control over nuclear material.

Large Group Discussion: Chemical Security, Your University & You

- The head of your research group is a scientist you respect. While you are working late, he offers you you an opportunity to work on a prestigious new project developing "alternative riot control agents" to be used for "crowd control."
- He asks you to work after-hours, and offers to pay you a bonus. The client will also buy new, state-of-the-art equipment for your research group as part of this project.
- Perhaps this offer is quite legitimate. You have no particular reason to distrust your colleague. You have worked well together.
- What questions should you ask your colleague? (Based on your questions, the trainer may—or may not—provide additional information.)
- Who else can you ask for help?
- How do you respond?



Scientists' Obligations Under the International Chemical Weapons Nonproliferation Framework

- The Chemical Weapons Convention
- United Nations Security Council Resolution 1540

Chemical Weapons Convention (CWC)

- International treaty which bans the development, production, stockpiling, transfer and use of chemical weapons.
  - Entered into force in April 1997 with 87 State Parties participating.
  - Today: 188 nations have joined, including Iraq.
  - 2 others have signed.
  - Only 4 have not taken any action.
    - Each nation enacts appropriate laws.
    - Each nation agrees to assist other Member States.

Organization for the Prohibition of Chemical Weapons (OPCW)

- International group headquartered in The Hague, Netherlands.
  - http://www.opcw.org
- Promotes international cooperation in peaceful uses of chemistry.
- Each member state can request assistance from other member states in the event of a threat or attack, including chemical terrorism.
- Assistance can take the form of expertise, training, materials, and/or equipment.

CWC Prevents Spread or Production of New Chemical Weapons

- States declare and agree to inspections of many other chemical facilities, depending on chemical type and amount produced.
- Over 3,000 inspections have taken place at 200 chemical weapon-related and over 850 industrial sites on the territory of 79 States Parties since April 1997.
- Worldwide, over 5,000 industrial facilities are subject to inspection.

What Does the CWC Mean for You as a Scientist?

- The treaty prohibits you from developing, producing, acquiring, stockpiling, or retaining chemical weapons. This includes all research, development, testing, and weaponization of chemical agents.
- You may not transfer (directly or indirectly) chemical weapons to anyone else.
- You may not use chemical weapons or prepare to use them in war.
- You may not assist, encourage, or induce other states to engage in these prohibited activities.
- You may not use riot control agents (e.g., tear gas) as a method of warfare.

UN Security Council Resolution 1540

- Unanimously passed on 28 April 2004.
- Member States:
  - must not support non-State actors (e.g., terrorists or criminals) in developing, acquiring, manufacturing, possessing, transporting, transferring or using chemical, chemical or biological weapons and their delivery systems.
  - must establish domestic controls to prevent the proliferation of nuclear, chemical and biological weapons and their means of delivery, including by establishing appropriate controls over related materials.
- Enhanced international cooperation is encouraged to promote universal adherence to existing international non-proliferation treaties.

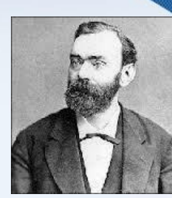
Dual-Use Chemistry and Responsible Science

Dual-Use Chemicals
Dual-Use Research of Concern Which
Information Should Be Protected? The
Scientist's Dual-Use Dilemma

Unintended Consequences from Research:

Alfred Nobel & the Invention of Dynamite

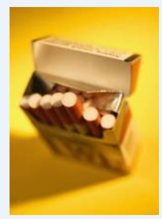
- Alfred Nobel: Swedish industrialist, engineer & inventor
- His construction work and his brother's death in an explosion inspired him to invent safer new methods for blasting rock—a peaceful application of technology.
- He invented dynamite (specifically, the stabilization of nitroglycerine on an absorbent) and patented it in 1867 for mining purposes.
- Nobel's intentions were good, but dynamite became a dual use technology that has been used for harm.



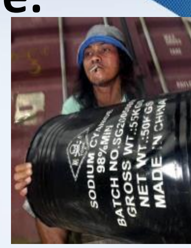
Chemical Dual-Use Awareness

- Dual use chemicals: Chemicals used in industry or everyday life that can also be used to cause harm.

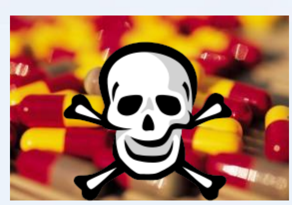





Dual-Use Chemical Example: Cyanide



- Widely used in mining and metal plating industries, but also a well-known poison.
- Product tampering*
- Tylenol capsules
  - Laced with potassium cyanide
  - 7 deaths, fall 1982, Chicago, Illinois, USA
  - Led to tamper-proof product packaging
- Popular with criminals and terrorists because it is relatively easy to obtain
- Hydrogen cyanide is a chemical weapon agent.



* "Tylenol Crisis of 1982." Wikipedia, The Free Encyclopedia. 22 Nov 2007, 06:04 UTC. Wikimedia Foundation, Inc. 28 Nov 2007 <http://en.wikipedia.org/w/index.php?title=Tylenol_Crisis_of_1982&oldid=173056508>.

Dual-use Chemical Example: Pesticides

- Dushuqiang (Strong Rat Poison)
  - Outlawed in China in the mid-1980s, but still available
  - Nanjing, China, Sept. 2002
    - 38 people killed by poison in snack-shop food, >300 sick
    - Jealously by rival shop owner
  - Hunan, China, Sept. 2003
    - 241 people poisoned by cakes served by school cafeteria
    - Motive and perpetrator unknown
  - Tongchuan City, China, April 2004
    - 74 people poisoned by scallion pancakes
    - Motive and perpetrator unknown

FIGURE. Package of Chinese rodenticide implicated in the poisoning of a female infant aged 15 months — New York City, 2002

Photo/New York City Poison Control Center

Widely used in homes and agriculture, but also used to poison people.

Dual-Use Research: A Concern Across Multiple Scientific Disciplines

- "Research that, based on current understanding, can be reasonably anticipated to provide knowledge, products, or technologies that could be directly misapplied to pose a threat to public health and safety, agricultural crops and other plants, animals, the environment, or materiel."

-U.S. National Science Advisory Board for Biosecurity

Which Information Should You Protect?

- You may receive regulatory or classification guidance from your government on information to protect.
- Your institute or laboratory management may issue procedural guidance on which information to protect.
- Your client (the funder of your work) may give such guidance. Sometimes it's specified in a grant or contract.
- In some cases, the leader of your work team or project manager may be the main source of such guidance.
- Or there may be no guidance. You, your work team, colleagues and managers may have to determine together which information to protect.

Some Potentially Sensitive Subject Areas

Consider and consult managers prior to release.

- Security information concerning chemical facilities, including physical, computer and information security
- Proprietary or business sensitive information
- Intellectual property (for instance, if a patent is pending)
- Personal information about yourself or colleagues (passport numbers, home addresses, financial information, passwords)
- Any aspect of your work related to national security or designated by your government, institute or management as a sensitive or "closed" subject.
- Information about explosives, even for peaceful use

More Potentially Sensitive Subject Areas

- Location of toxic or CWC scheduled chemicals, even in small quantities
- Location and details of laboratory equipment that facilitates work with toxic or CWC scheduled chemicals
- Any information about malevolent dispersal of toxic or hazardous material
- Information about environmental releases of toxic or hazardous materials

Conflicts Between Chemical Safety and Security: The Dual-Use Dilemma

Science generally means sharing information widely, but this may not always be advisable

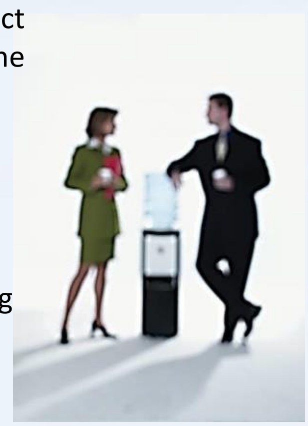
- Safety
  - Label everything so people can recognize hazardous chemicals.
  - Let community and especially emergency responders know what chemical dangers are there.
  - Share knowledge about chemical hazards so people know to be alert.
- Security
  - Labels help identify targets for theft or attack.
  - Sharing locations of chemicals can publicize targets for theft or attack.
  - Sharing knowledge of chemical hazards could inspire harmful behavior (copy-cat criminals).

Information Management Vulnerabilities and Best Practices

Information Elicitation Techniques
The Online Environment
Publication, Collaboration and Peer Review
Business Transactions and Intellectual Property

What is Elicitation?

- The strategic use of conversation to extract information from people without giving the feeling that they are being interrogated.
- Sensitive chemical and information is vulnerable to elicitation.
- Elicitation is sometimes called social engineering: the art of manipulating people into performing actions or divulging sensitive information.
- Elicitation can happen anywhere.

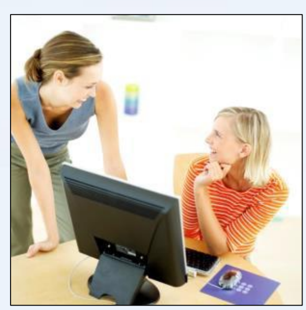


How Does Elicitation Work?

- It's a conversation with a hidden purpose.
- Someone attempts to collect information without raising suspicion that particular facts are sought.
- A skilled elicitor can obtain valuable information you may not intend to share.
- Elicitation can involve cover stories or multiple individuals.

Elicitation Vulnerabilities for Chemical Practitioners

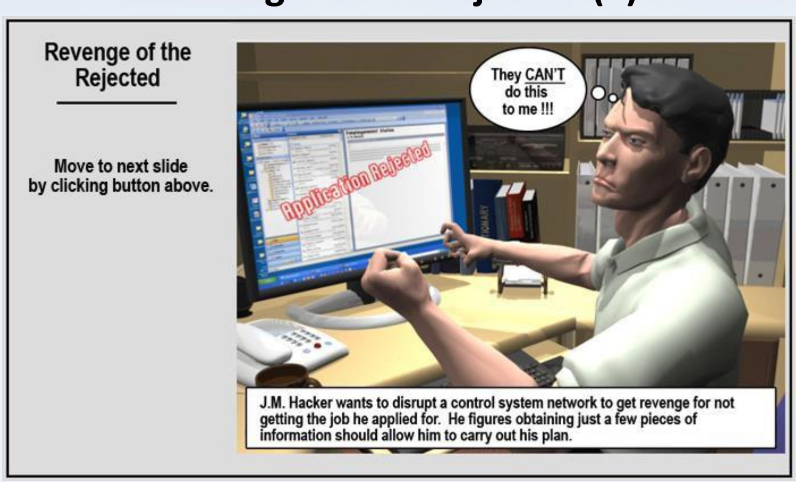
- Chemical practitioners embrace a culture of information sharing via free and open exchange with others.
- Collaboration is necessary for success.
- Like any professional, we want to be polite and helpful, appear well informed, be appreciated, and not appear foolish.
- For all these reasons, we may say more than we should.



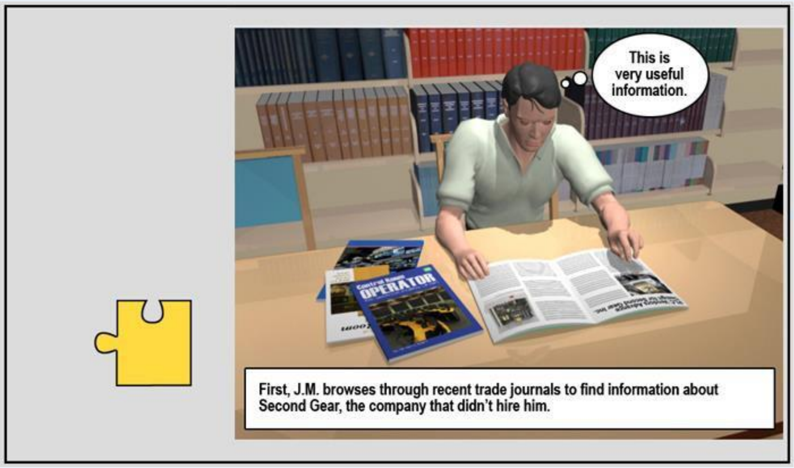
Elicitation Techniques

- Handout 1 in your folder contains numerous examples of elicitation techniques and how they may be used.
- Take a few minutes to review the techniques.
- Consider whether you have had similar conversations. Many of those conversations may be innocent. The appearance of harmlessness is one reason elicitation is so effective.
- **Would any of these tactics be obvious to you?**

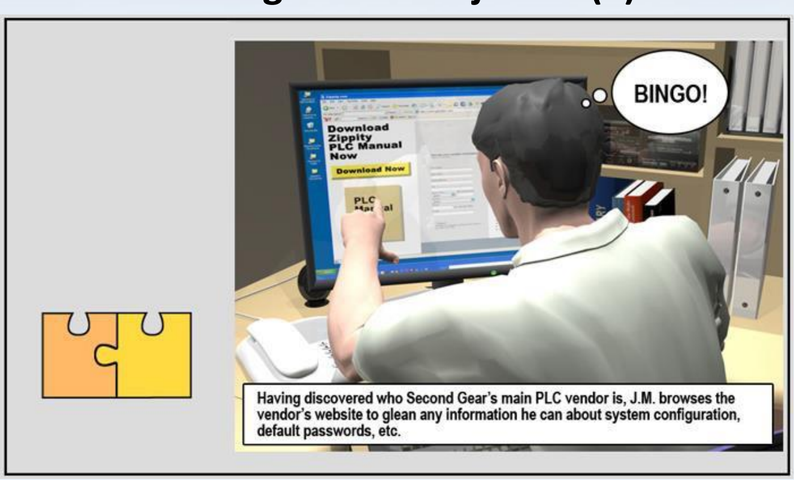
Revenge of the Rejected (1)



Revenge of the Rejected (2)

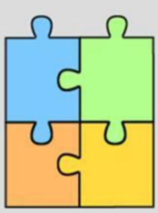


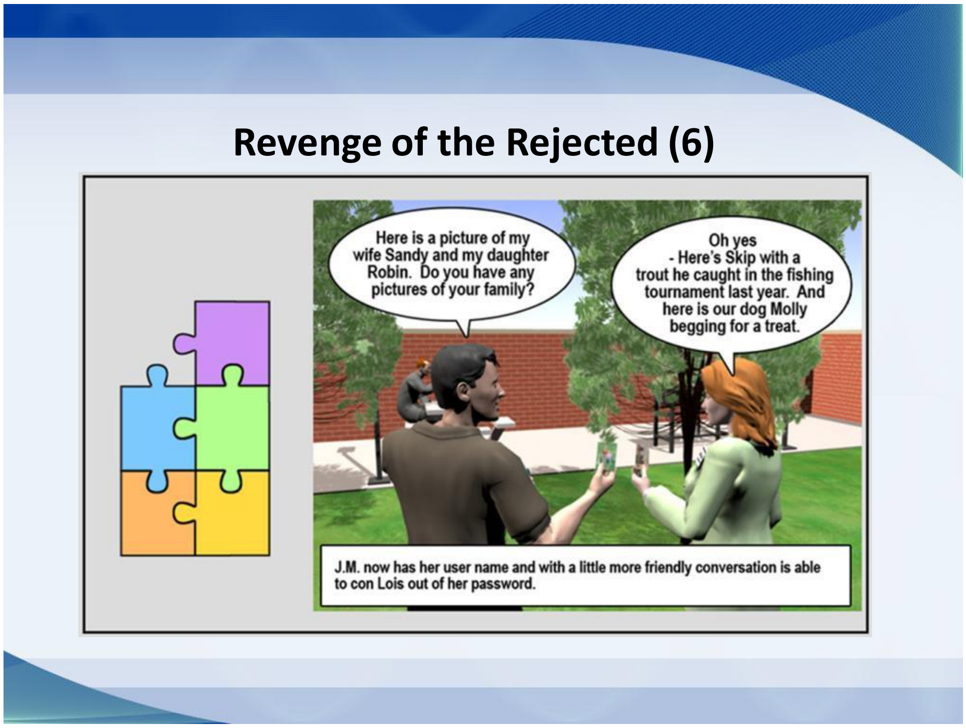
Revenge of the Rejected (3)

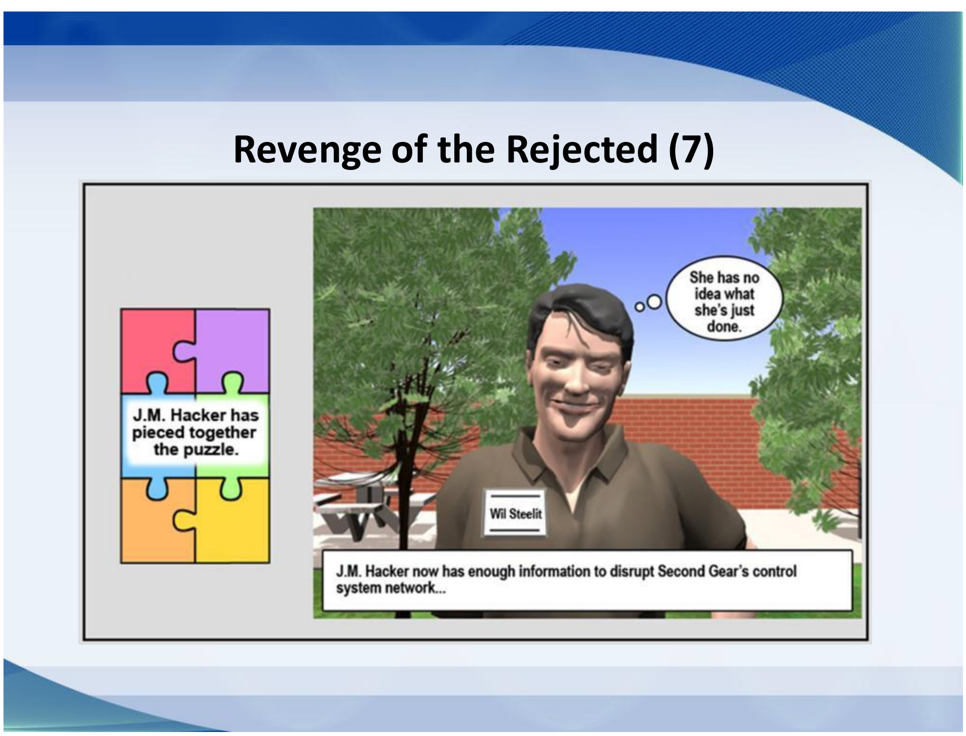


Revenge of the Rejected (4)

Revenge of the Rejected (5)

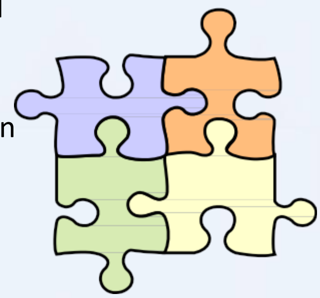



Revenge of the Rejected (6)
Here is a picture of my wife Sandy and my daughter Robin. Do you have any pictures of your family?
Oh yes - Here's Skip with a trout he caught in the fishing tournament last year. And here is our dog Molly begging for a treat.
J.M. now has her user name and with a little more friendly conversation is able to con Lois out of her password.

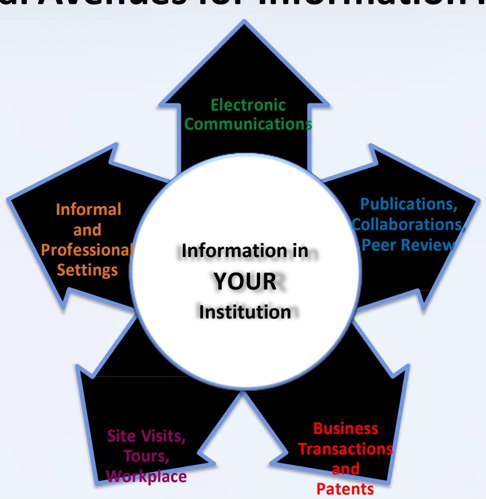

Revenge of the Rejected (7)
J.M. Hacker has pieced together the puzzle.
She has no idea what she's just done.
Wil Steelit
J.M. Hacker now has enough information to disrupt Second Gear's control system network...

Key Points on Elicitation

- Be aware of the "mosaic effect." An adversary can harvest harmless pieces of information from many public sources and create an association between separate pieces of data that can be used for harm.
- What you know may be more valuable than you think.
- Be aware of attempts to solicit information.
- Ask yourself who needs to know?
- Report such occurrences based on your organizational guidelines.

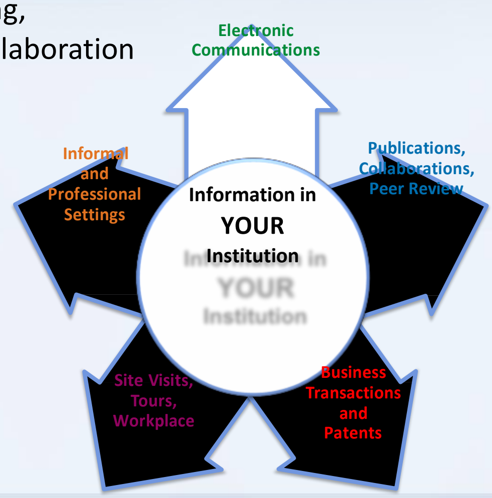


Potential Avenues for Information Release



Electronic Communications: Vulnerabilities

- Email, Social Networking, Online Collaboration



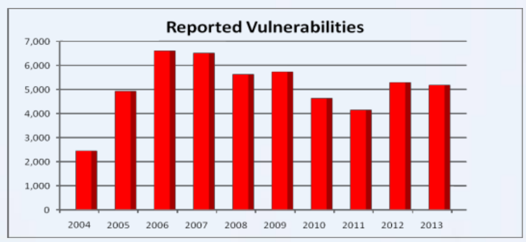
Types of Electronic Communication

Both the institute and the individual have responsibilities for knowledge protection when communicating in digital form.

- Emailing
- Texting
- Instant messaging
- Video conferencing
- Webinars
- Social network sites (e.g., Facebook, LinkedIn)
- Blog (web log) sites

Facts About Cyber Threats

- Unprotected computers on the Internet will be attacked and compromised within 10 minutes.
- On average, over 8 million spam and virus-carrying emails are stopped every month with proper security.
  - About 63% of all incoming mail is malicious.
  - Only about 37% is valid mail.



What is Elicitation?

- A virus is a self-executing program that attaches to a program or file and spreads from computer to computer, typically via email.
- A worm, like a virus, is designed to self-replicate from one computer to another. It takes control of computer features that transport information (e.g., email).
- Trojans are computer programs that appear to be useful software, but compromise security and cause significant damage.
- A denial of service is an attack intended to overload a website, rendering it so slow it is inoperable.
- **Malware can destroy data, slow down or crash your computer, steal information, and affect other users.**

Surfing the Internet

- **Consider the ways scientists find information via the Internet.**
- Electronic journals
- Industry, Institutions, Organization Websites
- Wikipedia-type websites
  - Browsing can be important for research. However, malware can be downloaded simply by clicking on a pop-up window or visiting a website that looks innocent.
  - Information that is found in the public domain (e.g., Internet) can still be sensitive. Not all publicly available data is harmless.
  - Cloud services (in which data is maintained and backed up remotely and made available to users over the Internet) are a useful technology. But you could be providing information to a third party without your knowledge or consent.

Phishing in Electronic Communications

- *Phishing* is e-mail falsely claiming to be legitimate to trick you into providing sensitive information.
  - The e-mail provides a link to a phony web site that looks legitimate.
  - The user may be asked to update personal information, such as passwords, national identification numbers, bank account numbers.
- *Spear-phishing* is organization or person focused and can look like it comes from organizations or people you know.

Defining the Terms: Social Networking

- An online community of people with a common interest who use a website or other technologies to communicate and share information and resources.
- A website or online service that facilitates this communication. Also called social media.
- Internet-based social networking has revolutionized how we connect, both personally and professionally.

Common examples:
Facebook, LinkedIn, Twitter, Reddit, VK

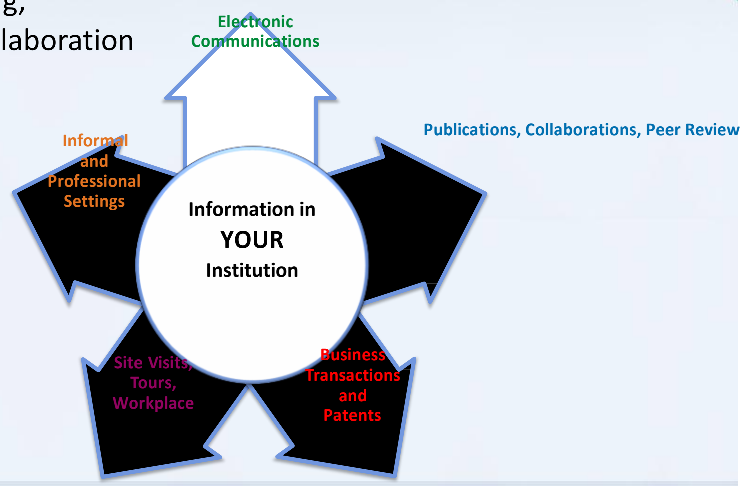
Blog

Summary: Social Networking Vulnerabilities

- Once information is posted online, it is never again private.
  - Even with high security settings on the website, personal information and posts may be leaked.
- Released information may damage scientists and their institute.
  - The more an individual shares, the more likely an adversary can impersonate the individual and trick others into sharing sensitive information, downloading malware, or providing access to restricted sites.
- Predators, hackers, criminals and terrorists patrol social networking sites looking for information and people to exploit.
- Turn on privacy settings and opt out of sharing personal information with the application, such as your geographical location.

Electronic Communications: Best Practices

- Email, Social Networking, Online Collaboration



Best Practice: Strong Passwords

- Easy passwords are easily guessed. They're the top reason computer accounts are compromised.
- Strong passwords:
  - At least eight characters long.
  - Do not contain your user name, real name, company name, family/pet names
  - Do not contain a complete word.
  - Are significantly different from previous passwords.
  - Contain mixed case, numbers, and special characters (#, %, *, @, etc)

2013's Top Weak Passwords

Rank	Password	Change from 2012
1	123456	*Up 1*
2	password	*Down 1*
3	12345678	*Unchanged*
4	qwerty	*Up 1*
5	abc123	*Down 1*
6	123456789	*New*
7	111111	*Up 2*
8	1234567	*Up 5*
9	iloveyou	*Up 2*
10	adobe123	*New*
11	123123	*Up 5*
12	admin	*New*
13	1234567890	*New*
14	letmein	*Down 7*
15	photoshop	*New*
16	1234	*New*
17	monkey	*Down 11*
18	shadow	*Unchanged*
19	sunshine	*Down 5*
20	12345	*New*
21	password1	*Up 4*
22	princess	*New*
23	azerty	*New*
24	trustno1	*Down 12*
25	000000	*New*

Best Practices for Data Access

- Be wary of downloading files, software or apps from unknown sites.
- Do not receive files from unknown media (stray CDs, thumb drives whose origins are unknown).
- Use an anti-malware program and update it regularly. Scan all files received, from all sources, for malware.
- Do not enter personal or sensitive information into insecure web sites.
- Verify the site uses security (https) and lock icon.
- Clear your browser's cookies and personal information regularly.

Best Practices for Email

- Be suspicious when receiving unsolicited e-mail from unknown sources or domains (the portion following the @ symbol).
- Business email sent from free email accounts (e.g., Yahoo, Hotmail) may be legitimate or suspect.
- Email can incorrectly appear to come from someone you know.
- If an email seems suspicious, do not open attachments or click on any links. Delete the email, forward it to your institute's computer security specialist, or call the sender to verify.
- Keep multiple email accounts to separate your professional from your personal network.
- Rather than clicking on a link in an email, type the URL in the web browser or use a bookmark.

Best Practices for Social Networking

- Be alert for unsolicited or unexpected connection or “Friend” requests. *Have you met this person or interacted before?*
- Be alert for unsolicited or unexpected workshop or journal requests. *Do you know the source or host organization?*
- <u>The best course of action is simply to delete.</u>
- Notify computer security for institute-wide blocking.

Protecting Your Lab from Malware: Best Practices

- Implement institute policies to prohibit staff from installing their own software. If no policy exists, avoid installing your own software. Warn colleagues of the consequences.
  - If possible, install computer protections to prevent staff from uploading their own software.
- Ensure critical computers, lab equipment and instrumentation do not have Internet access.
- Advocate for cyber monitoring to detect 1) attempts to extract information from the system, and 2) attempts to change the system configuration.

Best Practices:
Protecting Sensitive Digital Information

- Connect computers to the Internet through safe networks.
- Delete information from your computer when no longer necessary. Minimize sensitive information stored on a laptop when traveling.
- Never share passwords.
- Have a unique password for different websites.
- Use encrypted USB drives or encrypt individual files.
- Lock computer screens when unattended (screen saver).
- Notify your institute immediately when data is lost (i.e., USB).

More Best Practices:
Protecting Sensitive Digital Information

- Ensure your computer screen is not visible when working in a public place (i.e. plane, café) or that you are not working with sensitive information in public places.
- Place printers and monitors so they face away from doors and windows to restrict casual viewing.
- Use only institute-approved devices and computers and use institute email (e.g., cloud services, file storage, sharing sites).
- Use care when using public computers and networks such as those provided by hotels.

High-Quality, Free Anti-Virus Software

- AVG: www.avg.com
- Avast: www.avast.com
- Malwarebytes: www.malwarebytes.org
- CCleaner (not an anti-virus, but cleans up everything else) https://www.piriform.com/ccleaner
- Recent review: free anti-virus software http://www.pcmag.com/article2/0,2817,2388652,00.asp

Spam Filters for Free Email Accounts

- Yahoo paid email service "MailPlus" ($29.95 per year)—much better spam filters. Service improving over time.
  - Machine learning—bases its spam filtering on your actions and preferences (what you block)
  - Allows you to set up dummy addresses when subscribing to newsletters or public groups. If you discontinue the subscription, the dummy email address vanishes
- Yahoo and Hotmail: block individual spams using "spam" in the drop-down menu and select "Settings—Block Addresses" and add to your "blocked senders" list
- Blocking spam on Yahoo: https://help.yahoo.com/kb/stopping-spam-yahoo-mail-sln3227.html

Preventing Someone from Pretending to be You on Social Media

- Many social media sites have policies against impersonating others. If someone does it, report them. Their account will be frozen.

- On a blog or private page, report it to the moderator. Then go onto the site and comment that this person is not you.
  - You can privately or publicly ask the person impersonating you to stop. Sometimes it works.
  - Report what's happening on all your social media sites so everyone knows. Usually, the impersonator will stop.
  - Ask your friends and followers to add statements supporting you on the site and on your real pages.

Publications, collaborations, proposals, grants and peer review

- Vulnerabilities & Best Practices

Collaboration and Scientific Publications

- **Information losses can occur through:**
- Publishing sensitive information in journals
- Oral presentations at professional meetings
- Poster sessions
- Inquisitive audience questions (Q&A)
- Requests for information after a recent
  - Publication
  - Presentation or poster session
  - Brochure or flyer distribution
- Collaborations, joint publications, data swapping, experiments involving other institutes.
- **Protecting information is challenging since scientists are often encouraged—or even pressured—to publish.**

Best Practices Prior to Collaboration

During brainstorming, proposal writing, and project planning, chemical practitioners can make key decisions to ensure sensitive information is protected. Researchers have many options:

- Perform collaborative risk assessment with partners
- Assess benefits vs. costs of the collaboration
- May choose not to develop the proposal or accept the project
- Modify research and papers to avoid sensitivities and protect sensitive chemical and research
- Negotiate scope of work or contract to clarify that sensitive research findings will not be disclosed.
- Limit circulation, redact a portion of the results, or delay publication while sensitive information is assessed.

Case Study: Scientific Publications
H5N1 Case Study – Lessons Learned

- Researchers from Netherlands and the U.S. conducted genetic engineering experiments on an avian flu virus to support vaccine development and disease surveillance.
  - The U.S. National Science Advisory Board for Biosecurity became concerned that detailed description of materials and methods could help bioterrorists engineer a human-transmissible strain that could kill millions.
  - Led to ethical debate over how much to publish.
- The rapid spread of information over the Internet, coupled with the rise of "do it yourself" science, mean the nature of the threat has changed. A terrorist group, or even an individual wishing to do harm, can use openly available information to do great harm.

http://www.nature.com/news/the-risks-and-benefits-of-publishing-mutant-flu-studies-1.10138

Large Group Discussion:
Scientific Publications

H5N1 Case Study – Nature Article on Bird Flu

- How would releasing this information advance the science?
- How would releasing this information have the potential to cause harm?
- What would be the most ethical decision to make in this case? Should the information be published? Why or why not?
- What else could have been done, earlier in the process, to manage the risk?

Best Practices for Review Prior to Information Release

- Institutes should establish a formal review process for all information prior to its release.
- Since most of the publication process is digital, use as appropriate the same security practices as previously discussed under electronic communications.

Write → Review → Revise → Release

Timely review of documents early in the publication process will help ensure deadlines are met.

Communicating Research Results: Publication Best Practices

- Modify papers to avoid sensitivities and protect sensitive research.
- Limit circulation, redact a portion of the results, or delay publication while sensitive information is assessed.
- All material leaving the university (even in draft form) should undergo an information release process, including:
  - Journal articles, posters, project reports, conference papers, slide shows for presentations.
- Develop and implement university guidance on what information to protect and how to protect it.
- Don’t forget export controls apply to collaboration with foreign partners. This includes foreign citizens visiting or living in your country and any information transmitted electronically to foreign partners.

Best Practice for Collaboration, Peer Review and Protecting Information

- All material leaving institute (even in draft form) should undergo an information release process, including:
  - Journal articles,
  - Posters, and
  - Slide shows for formal presentations.
  - Project reports and deliverables
- Develop institute guidance on what information to protect and how to protect it.
- When responding to requests for information think about information security and "need to know".
- When collaborating with professionals from outside your institute remember to protect information.
- Don't forget that export controls apply to collaboration with foreign partners.

Business Transactions and patents

- Vulnerabilities & Best Practices: Contracts, Requests for Proposal, Licensing

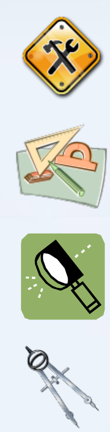
Pathways of Information Loss During Business Transactions

- Requests for goods or services can reveal information about scientific work.
  - Subsequent dialogue can inadvertently reveal sensitive information.
- Requests for proposals can reveal technologies, capabilities, experience and expertise.
- Communication with potential clients, partners and vendors can cause inadvertent knowledge loss.
- Intellectual Property, know-how and trade secrets can be compromised.

Tools to Protect Information in Business Transactions

The same tools that protect information for business purposes can protect sensitive information.

- Licensing agreements define user rights, prevent reverse engineering and protect trade secrets.
- Patents protect a technology or innovation from use by others in a specific region for a specific period of time.
  - Until you file your application, don't disclose the idea.
- Confidentiality and non-disclosure agreements can be used to protect information in a private or business meeting, even with colleagues from the same institute.
  - All parties should sign the agreement before disclosing.



Protecting Information Prior to Business Transactions

- Licensing agreements, patents, and non-disclosure agreements should be reviewed to ensure you are not inadvertently including sensitive information.
- Request an export control review from the designated expert at your institute.
  - If you don't know the expert, consult your manager. If they don't know, ask a respected senior scientist at your institute how export control reviews are handled.
  - As a last resort, discuss with your management and colleagues, contact one of the trainers for this workshop, or consult the other resources provided during this workshop.

Protecting Information During Foreign Business Transactions

Sharing data with:

- Students from a foreign country
- Visiting scientists from another country
- A colleague at your institute who retains foreign citizenship
- A foreign collaborator

Could constitute an export control violation.

Prior to initiating any foreign:

- Contract
- Information exchange
- Request for proposal
- Teaming agreement
- Licensing agreement

Request an export control review from a designated expert at the laboratory.

Laws vary. You may be permitted to share information with experts from certain countries, but not others. An export control reviewer can help.

Best Practices for Protecting Intellectual Property

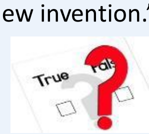
- Innovation is one main determinant of business and scientific success.
- From the moment an idea is born, treat it as a secret.
- An invention is useful, novel, and non-obvious.
- Protecting your idea as a trade secret preserves your right to patent later on, and protects dual-use knowledge.
- Remember: an invention may be intended for peaceful use, but there may be sensitive components.
- The same procedures that protect Intellectual Property also protect sensitive chemicals and other information.

- **Website of the World Intellectual Property Organization:** http://www.wipo.int

Exercise (True or False):

Misperceptions about Protecting Intellectual Property

- Statement 1:
  - “If I have a trade secret, I should privately agree with my colleagues to keep it quiet. That is enough protection for now.”
- Statement 2:
  - “Patent information is secret. I have no real way of knowing who holds a patent or the details of their invention.”
- Statement 3:
  - “At a scientific conference or meeting with a potential partner, I can safely discuss the details of my new invention.”



Site Visits, Tours, the Workplace: Vulnerabilities and Best Practices

- Offices, Laboratories, Research Facilities

Who Visits Your Research Facility?

- Collaborators
- Customers, clients and funders
- Subcontractors
- Equipment technicians, electricians*
- Custodial staff*
- Delivery persons*
- Friends and family
- Government officials
- Foreign visitors
- Emergency responders (first aid, firefighters)*

*Don't forget these "non-obvious" visitors. We tend to trust them.

Vulnerabilities in the Workplace

Information losses can occur when:

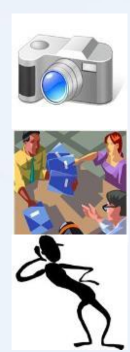
- Disposing of information in waste bins
- Leaving documents in copy machine or printer
- Leaving Lab notebooks in the open
- Leaving computer screens and instrument displays switched on and facing doorways and windows
- Holding Conversations in hallways or break areas
- Leaving file cabinets or doors unlocked
- Holding meetings with the door open
- Using speaker phones

Don’t Forget the “Virtual Visitor”

Information losses/leaks can occur through:

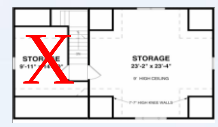
- Peer-to-peer or desktop sharing (screen sharing, remote presentations, collaboration tools like Google Docs)
- Webcams
- Videoconferences
- It may not be obvious the camera or microphone is running!
- Visitor cell phones (recording, photos, microphone)
- “Lurkers” during teleconferences

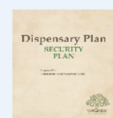
Do you know who is listening?



Best Practices Before Site Visits and Tours

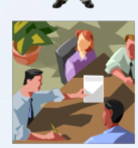
- Shrouding equipment and lab instruments
- Locking office doors and/or file cabinets
- Letting others know a visitor is present
- Locking computer screens
- Restricting camera and recordings
- Limiting access to specific rooms or areas
- Performing background checks for visitors
- Conducting visitor briefing prior to tour
- Developing a site visit security plan
- Reviewing security practices with colleagues and staff (especially junior staff who engage the visitor).





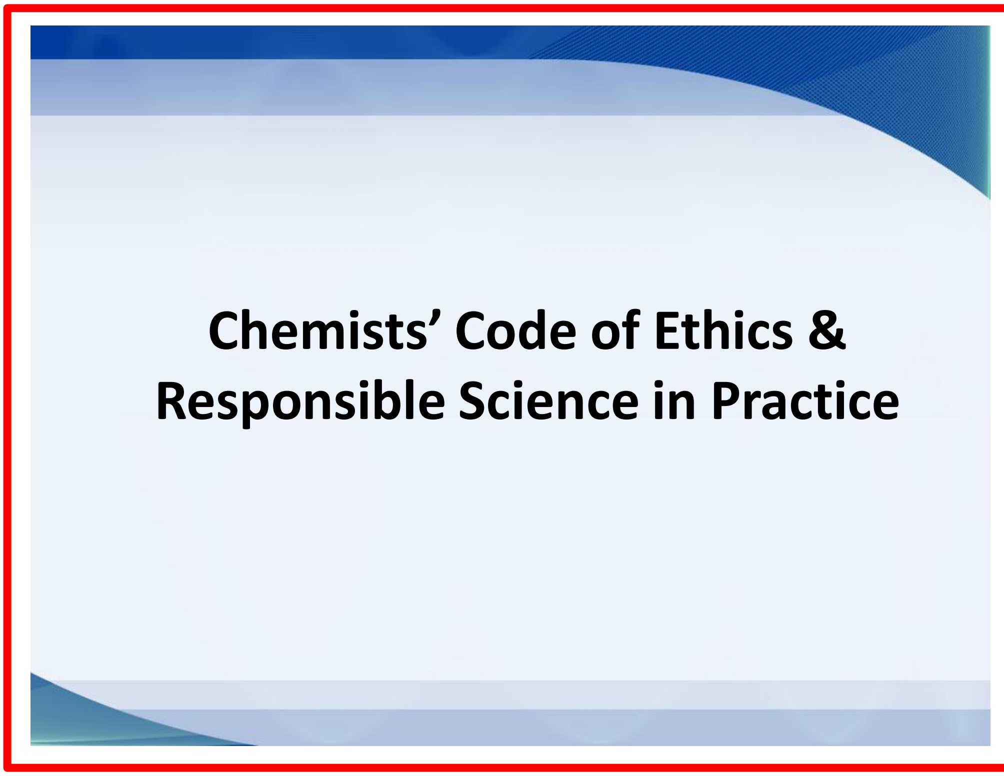
Best Practices During Site Visits and Tours

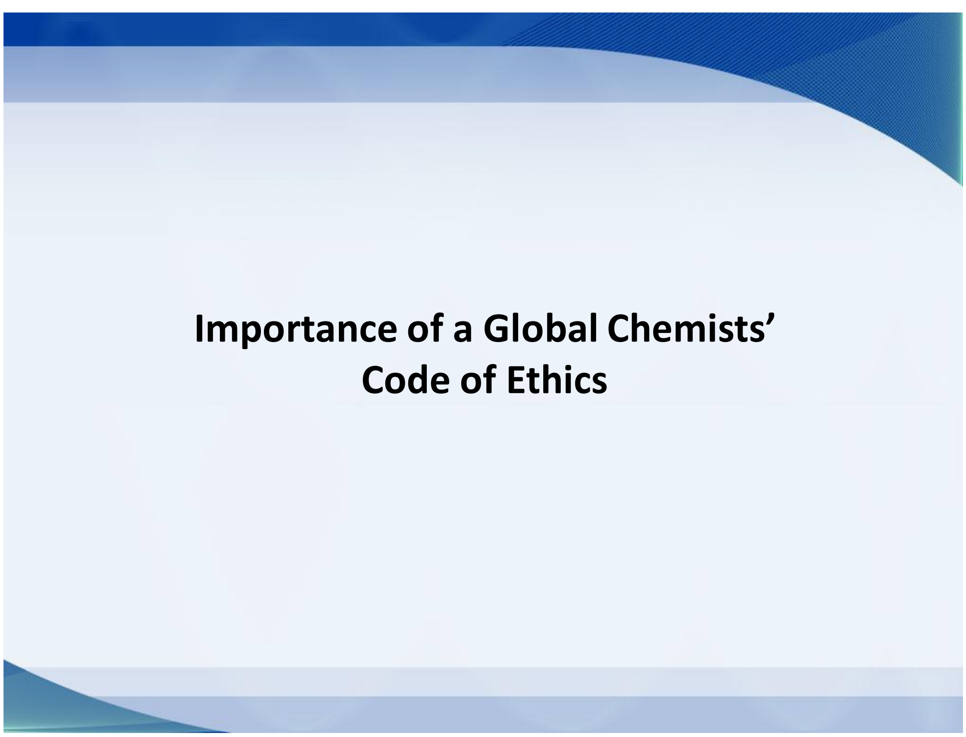
- Ensure maintenance personnel and other visitors are escorted at all times.
- Ensure distinct, visible visitor badges are worn.
- Make sure visitors have a need to know before releasing information.
- Be mindful of the presence of visitors when having discussions with colleagues in hallways or on the phone.



Best Practices in Your Laboratory

- Know your environment. Be aware of your surroundings. Take appropriate action when something seems unusual.
- Be aware who is behind you or lingering nearby, who may try to follow you inside.
- Limit access to information to those who need to know.
- Do not leave critical documents or computers unattended in an accessible area.
- Only store, use, or discuss sensitive information in private places.
- Maintain physical control over information when not in use (e.g., locked office, file cabinets, desks, bookcases) to prevent unauthorized access.
- Lock computers (engage password protected screen-saver) when leaving.
- Supervise the use and maintenance of your computer and lab equipment.


Chemists' Code of Ethics &
Responsible Science in Practice


Importance of a Global Chemists'
Code of Ethics

Overview

- Protecting the environment, public and coworkers
- The role of the human element in chemical issues
- Case studies in ethical chemistry
- Preventing chemical terrorism – taking back our profession
- Code of ethics introduction & outreach
- Large group discussion

Protecting the Environment, Public and Coworkers

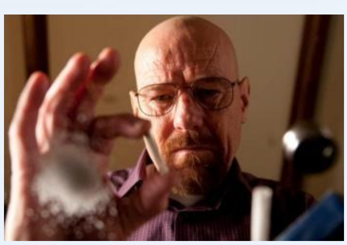
- Human health and technological development are closely connected.
- Scientific research activities have the potential to negatively impact the environment.
- Environmental degradation can cause or worsen health problems in ourselves and others.
- Health services organizations depend on safe water and food supplies and sanitation.

Responsible Care®
OUR COMMITMENT TO SUSTAINABILITY

Chemists' Responsibilities

- Chemical practitioners have legal and ethical responsibilities to protect the environment.
- If you use pesticides in your work, you must take reasonable precautions to:
  - Protect others' health,
  - Protect the environment
  - Avoid polluting water sources
- Look for ways to change chemical processes to minimize environmental impacts.
- The environment is an asset we should strive to continuously improve

Human Element in Ethical Chemistry: Walter & Jesse in "Breaking Bad"

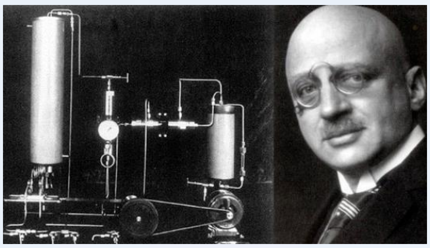


Walter: Opportunistic, Egomaniac

Jesse: Victim of Circumstance

Which came first: the intent or the ricin?

Real-life Examples: Fritz Haber and Universities Attacked by ISIL



Fritz Haber (Public Domain)

Universities Attacked by ISIL
(Hurriyet Daily News)

Ethics in Chemistry Case Studies

Source: <u>The Ethical Chemist</u> by Jeffrey Kovac

Press Conference

- You and your research group are working on new high-temperature superconductors.
- In this field new results appear every week.
- Your group made a new class of materials that superconduct at liquid nitrogen temperatures.
- You kept the work secret and the work will be sent for publication tomorrow.

Source: The Ethical Chemist

Press Conference, continued

- Now that you are finished you report the discovery to your department chair.
- The department chair tells the university research office, who suggests a press conference to announce the discovery.
- What should you do?

Source: The Ethical Chemist

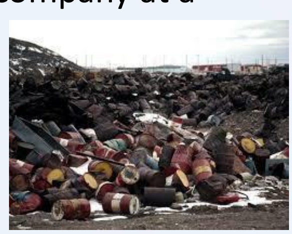
Dangerous Waste

- Your company regularly dumps a chemical into a local river.
- Early tests indicate the chemical is a carcinogen.
- Your department head refuses to stop dumping because altering the process would be costly and the government does not regulate the release of this chemical.

Source: The Ethical Chemist

Dangerous Waste, continued

- You have thought of a way to remove the chemical and dispose of it safely.
- When you discuss it with your supervisor, he tells you if they remove the chemical now, before everyone has to remove it, it will put the company at a competitive disadvantage.
- What should you do?



Source: The Ethical Chemist

Supervisor in Training

- You just started a new job where you oversee 5 chemists working on a dangerous chemical reaction.
- Training for this job includes 4 weeks working with an experienced manager of the same process.
- Your trainer is amazed at how quickly you are learning how to deal with commonly occurring problems.

Source: The Ethical Chemist

Supervisor in Training, continued

- At the start of the 4th week, your trainer becomes sick and needs to go home.
- No other qualified manager is available to fill in.
- Your trainer continues working but the next day still feels ill and asks you to fill in for the day and to tell anyone who asks that he just left for a moment.
- What should you do?

Source: The Ethical Chemist

Code of Ethics Toolkit for Your University

Code of Ethics Toolkit

- U.S. National Institutes of Health created a code of conduct toolkit.
- Useful in thinking about how to responsibly do dual-use research.
- Goal: build a community of scientists who are aware of, and who take responsibility for, dual-use research.
- The full toolkit can be found online.

Tools for Getting Started

- Assess the need (what needs to be changed?)
- Assess feasibility and support.
- Recruit leaders and champions.
- Define the process.

Tools for Formulating a Code

- Determining the content: key responsibilities
- Determining the content: examples
- Navigating extremes of generality/specificity
- Drafting, vetting and finalizing the code

Tools for Disseminating a Code

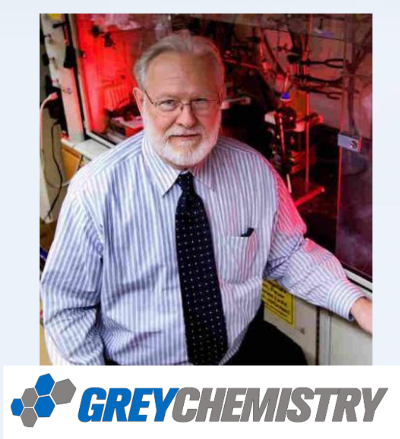
- Developing a dissemination plan
- Utilizing existing venues
- Designing educational interventions

Tools for Evaluating a Code

- Confronting challenges of determining impact
- Utilizing realistic measures for code evaluations
- Many other realistic measures
- So…how shall we begin?

Outreach on Global Chemists' Code of Ethics

Scientists' Knowledge can be Used for Nefarious Purposes



"Our work has changed the conditions in which men live…."

– J Robert Oppenheimer

Can't control how our knowledge is used, but we can do 2 things:

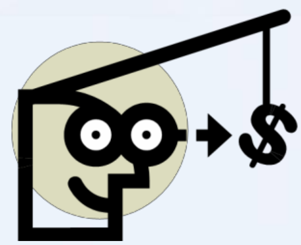
- Require adoption of code of ethics
- Take action to secure relevant knowledge & chemicals

"I was stunned. I had published information that ultimately led to human death."

– David Nichols

Code of Ethics Outreach Summary

- Addressing intent is key to stopping production of weaponized chemicals.
- Opportunity due to scientific discovery often precedes intent .
- The human element cannot be separated from the practice of science.
- The stakes have never been higher!



Large Group Discussion:
Code of Ethics Project

Large Group Discussion: Chemists' Code of Ethics

- What factors may help or hinder adopting a code of ethics in your institution?
- What topics discussed in this workshop should be addressed in a code of ethics?
- What topics were not discussed that should be included?

What Aspects of a Chemist's Job Should be Addressed in a Code of Ethics?

Categories of a Chemist's Work:
Category 1: Conducting Research

Questions to consider under Category 1:

- Are there areas in your research or daily work where you face conflicts of interest? (A conflict of interest is a situation that has the potential to undermine a person's impartiality due to the possibility of a clash between the person's self-interest and professional interest or public interest).
- If you become aware of a conflict of interest, what do you do?
- What should we tell our students if they ask about synthesis of illegal drugs, explosives and chemical weapons?
- How should a chemist or chemical engineer respond to a request from the government to conduct research on chemical weapons?
- What professional responsibilities does a chemist have when conducting research?

Suggested wording regarding conduct of research

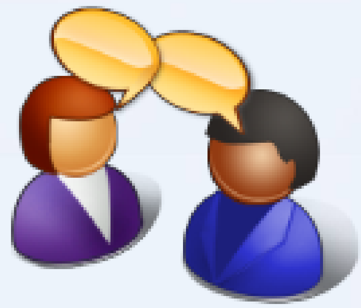
Global Code of Ethics Project Next Steps

- Obtain interested scientists' inputs on topics to cover and suggested language to use via ACS website (Aug-Sep 2015)
- Use inputs to plan workshop & develop first draft of code (Sep-Oct 2015)
- Engage OPCW national authorities to broaden the reach of the project & encourage implementation (ongoing)*

Capstone Practical Exercise

Capstone Practical Exercise: Small Group Discussion

- Would a code of ethics be helpful to you based on your experiences in your institution (see handouts)?
- If so, how?
- What challenges do you foresee?



Chemical Security Management Best Practices

Chemical Security Workshop

Graded Approach to Chemicals of Specific Concern

Graded Approach

- Method used to determine where to assign appropriate resources using a risk-based approach
- Facility/Activity requirements are applied in a manner consistent with
  - Hazards and complexity of the work
    - Safety, Safeguards, Security
    - Types of Hazards
- Assess relative risk to:
  - Workers, environment, public
  - Facility
  - Programmatic mission
  - Corporation and the client

Overview of the Process

1. Examine Jobs and Processes

2. Identify Hazards

3. Characterize Safety/Security Risks

4. Assess Risks

Allocate Resources (Safety and Security) Based on Graded Approach

Graded Approach

Two key components:

- Hazards analysis
- Risk assessment

Hazard vs. Risk

- There is a difference between ***hazard*** and ***risk***
  - Hazard
    - Something that has the potential to do harm
- Is there a hazard in this picture? If so, what type?
- Is it a risk? If so, how much of a risk?
  - Depends on the situation

Risk Basics: Hazard vs. Risk

- What is wrong?
  - Improperly stored chemicals
- What are the possible scenarios?
  - Spills/leaks
  - Uncontrolled chemical reactions
  - Fire
- What is the likelihood?
  - Factors that lead to an event
    - Bottles fall from top of cabinets
    - Electrical spark
- What are the consequences?
  - Other factors and things that follow an event
    - Chemical spills/contamination, exposure to hazardous materials, evacuation

Hazard

Risk

Define Hazards

- Chemical Hazards
- Physical Hazards
- Other

Chemical Hazards

– Toxicity
  - Principles of toxicity
  - Acute toxicity
  - Irritants, allergens and corrosives
  - Organ-targeting
  - Carcinogens

– Reactivity

– Dual-Use Chemicals of Concern (COCs)

Chemical Hazards: Principles of Toxicity

Toxicity Depends on Dose

Chemical	Beneficial Dose	Toxic Dose
Aspirin	300–1000 mg	1000–30,000 mg
Vitamin A	500 units/d	50,000 units/d
Oxygen	20% in air	50–100% in air
Water	~1–2 L/day	~13 L

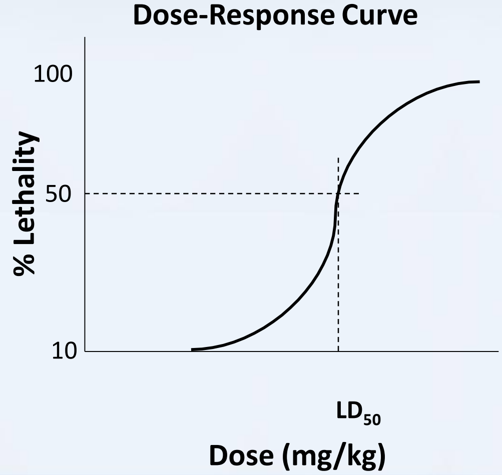
"All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy."
-- Paracelsus (1493–1541)

Chemical Hazards: Principles of Toxicity

Toxicity is Measured by Lethality

- LD_{50} (mg/kg)
  - "Lethal Dose 50%"

Dose-Response Curve



Chemical Hazards: Principles of Toxicity

- An extremely wide range of toxicities exists

Agent	LD_{50} (mg/kg)
Ethanol	7060
NaCl	3000
Formaldehyde	800
Caffeine	192
Nicotine	1
Dioxin	0.0001

2004, Viktor Yushchenko was poisoned with dioxins
http://news.bbc.co.uk/2/hi/health/4041321.stm

Toxicity depends on a variety of factors

Chemical Hazards: Principles of Toxicity

- Acute
  - Cause harm right away
- Chronic
  - May only see effects after extended exposure, or later in life after repeated exposures

Chemical Hazards: Acute Toxins

- Includes highly toxic chemicals/poisons
  - Phosgene
  - Strychnine
- Includes common lab chemicals
  - Cyanides
  - Cl_2

Need to ensure safety and security when using and storing acute toxins

Chemical Hazards: Irritants, Allergens, and Corrosives

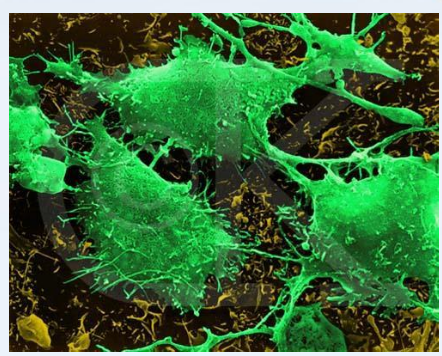
- Irritants
  - Effects are local and reversible
- Allergens (and sensitizers)
  - Cause a reaction of the immune system
- Corrosives
  - Effects are local
  - Acids and bases
    - pH ≤ 2 or ≥ 12.5
  - React with and damage living tissue

Chemical Hazards: Organ-Targeting

- Neurotoxins
  - Ethanol, Hg, CS_2, xylene, *n*-hexane
- Reproductive and developmental toxins
  - Harm fertility or reproductive ability
  - Harm fetus
- Other organs
  - Liver, kidneys, lungs, etc.

Chemical Hazards: Carcinogens

- Chronically toxic
  - Vinyl chloride (liver cancer)
  - Asbestos (mesothelioma)
- Carcinogenicity of most chemicals is untested
  - Precautions taken may consider amount and frequency of use
- Treat known carcinogens as particularly hazardous



http://www.alternative-cancer.net/images/Cancer_cell,%20brain.jpg

Chemical Hazards: Reactivity

- Water-reactive
- Pyrophoric materials
- Incompatible chemicals
  - Combination leads to reactive or toxic hazards
    - Concentrated/powerful reducing agents
    - Concentrated/powerful oxidizing agents

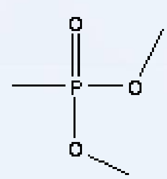
http://science.pixeladdiction.co.uk/?page_id=57

Chemical Hazards: Chemicals of Concern (COCs)

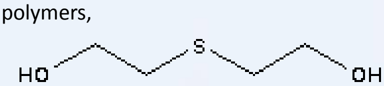
- Dual-Use
  - Peaceful
    - Research, production
  - Not peaceful
    - Diversion, sabotage

Examples:

1. Dimethyl methyl phosphonate (DMMP)
   - Flame retardant
   - Nerve agent precursor



2. Thiodiglycol
   - Dyes/inks, cosmetics, pharmaceuticals, polymers, coatings, etc.
   - Mustard gas precursor



Chemical Hazards: COCs

- Presence or suspected presence of COCs in your facility could make you and your institution a target

Example: Chicago, USA, 2002

- Joseph Konopka arrested in steam tunnels under the University of Illinois
- Had NaCN on him and a stockpile of stolen chemicals including NaCN and KCN hidden in subway
- Sentenced to 13 years in prison for “possessing a chemical weapon” and other charges

http://articles.cnn.com/2002-03-12/us/chicago.cyanide_1_cyanide-in-chicago-subway-sodium-cyanide-chicago-police?_s=PM:US

http://articles.chicagotribune.com/2004-01-04/features/0401040453_1_tunnels-urban-exploration-city-hall

Physical Hazards

- Fire
- Explosion
- Compressed Gases
- Cryogens, Pressure, and Temperature
- Electrical
- Mechanical and Other

Risk Basics: Definition

- Risk is a function of
  - Probability that an incident will occur (**likelihood**)
  - Severity if the event occurs (**consequence**)

Activity: Risk Perception

- On the next page…
- Rank each action or technology according to your perception of its RISK
  - A rank of 1 means riskiest
  - A rank of 15 means least risky

Take about 10 minutes to do this

* Adapted from Slovic et al. "Facts and Fears: Understanding Perceived Risk." In R. C. Schwing and W. A. Albbers, Jr. (eds.) Societal Risk Assessment: How Safe is Safe Enough? New York: Plenum, 1980, 181-216.

Rank these Items (#1- #15) by Risk Level

- Police work
- Commercial Air
- X-rays
- Mountain climbing
- Prescription antibiotics
- Alcoholic beverages
- Nonnuclear electric power
- Railroads
- Smoking
- Pesticides
- Motor vehicles
- Spray cans
- Bicycles
- Swimming
- Nuclear power

Activity: Risk Perception

College Students[1]

1. Nuclear power
2. Smoking
3. Pesticides
4. Motor vehicles
5. Alcoholic beverages
6. Police work
7. Spray cans
8. Traveling by commercial flight
9. X-rays
10. Nonnuclear electric power
11. Prescription antibiotics
12. Mountain climbing
13. Railroads
14. Bicycles
15. Swimming

Experts[2]

1. Motor vehicles
2. Smoking
3. Alcoholic beverages
4. X-rays
5. Pesticides
6. Nonnuclear electric power
7. Swimming
8. Bicycles
9. Travelling by commercial flight
10. Police work
11. Railroads
12. Nuclear power
13. Prescription antibiotics
14. Spray cans
15. Mountain climbing

1 Thirty US college students participated in this study
2 A group of fifteen risk assessment professionals in the US

Risk Basics: Definition

College Students

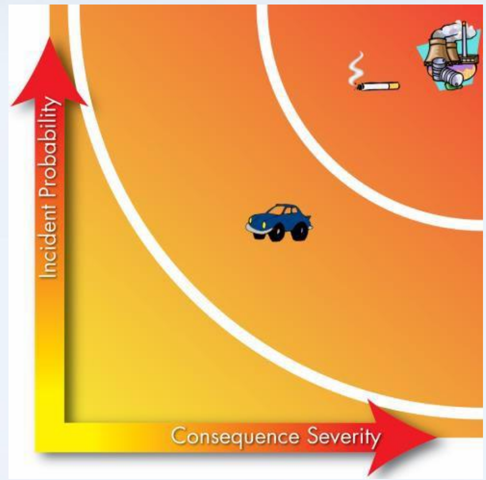
1. Nuclear Power
2. Smoking

4. Motor Vehicles

Experts

1. Motor Vehicles
2. Smoking

12. Nuclear Power



Activity: Risk Perception

- What do you think may have influenced your risk assessment besides your best guesses regarding ***likelihood*** and ***consequence***?

- Emotional Risk Perception Factors (examples)
  - Involuntary vs. Voluntary
  - Immoral vs. Moral
  - Unfamiliar vs. Familiar

What ***should*** be the basis for your professional Risk Assessment of Chemical Safety and Security?

Risk Basics: Safety and Security

- Risk concept
  - Applies to both Chemical ***Safety*** and Chemical ***Security***

- Safety Incident
  - Spill
  - Accidental exposure
  - Uncontrolled reaction

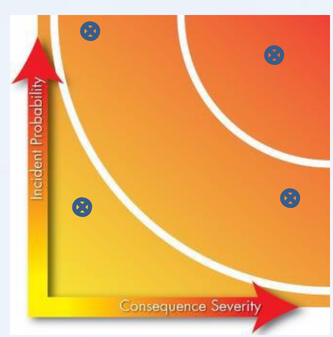
- Security Incident
  - Theft or diversion of dual-use chemicals
  - Intentional release
  - Sabotage

Safety Risk Characterization

1. Low
   - Procedures are routine; staff is trained and experienced; materials used are mostly benign and/or present in small amounts only
   - An incident would not likely be an emergency

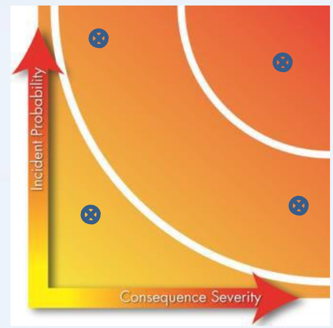
2. Moderate
   - Procedures are not routine; staff may be partially trained or have limited experience; materials are reactive, flammable, toxic, and/or present in moderate quantity
   - An incident could constitute or develop into an emergency

3. High
   - Procedures are novel or extremely delicate; staff may be untrained or inexperienced; materials are highly reactive, toxic, explosive and/or present in large quantities
   - An incident would be a life and facility-threatening emergency



Security Risk Characterization

1. Low
   - Assets are possibly targets for theft or diversion
   - Consequences of loss or release are minimal
2. Moderate
   - Assets are attractive for theft or diversion due to monetary value or dual-use
   - Consequences could threaten the public; misuse could be harmful or even lethal to a small number of people, and would certainly damage the institution, its programs, and reputation
3. High
   - Assets are very valuable or hard to acquire dual-use materials
   - Consequences of misuse could result in harm or death to many people



Safety and Security Risk Characterization

- What are the benefits of characterizing risks?
- Can risks ever be reduced to zero?
- What does it take to reduce risk?
  - Are resources for risk reduction limitless?

Characterizing risks is a necessary step toward responsible and effective allocation of finite resources to reduce risk to acceptable levels

Risk reduction measures should always be applied in a <u>graded</u> manner

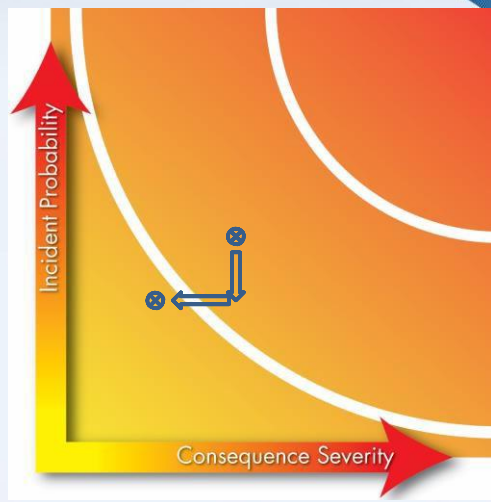
- **Large effort made to reduce high risks**
- **Smaller effort made to reduce low risks**

Risk Basics: Reduction

- Types of controls
  - Administrative
  - Operational
  - Engineering
  - PPE

- Decrease likelihood

- Decrease consequence



Chemical Safety Risk Assessment: Overview

Chemical Safety Risk Assessment

1. Examine jobs and processes

- Analyze for each step in the process
  - Who, what, where, when, and how?
    - Could exposure occur?
    - Could an accident occur?

Chemical Safety Risk Assessment

1. Examine jobs and processes

Example: Precipitation of gold from cyanide solution

- 2 junior researchers in the laboratory with only minimal training and not accustomed to using PPE
- About twice a week, zinc powder is added to 100 mL of an aqueous, 0.10 M sodium cyanide solution containing dissolved gold
- The gold precipitates and is collected by filtration
- Work is performed on a crowded open benchtop alongside work on another project that involves preparing numerous HCl solutions

Chemical Safety Risk Assessment

2. Identify hazards

- On the basis of materials and equipment present

Example: 100 mL of a 0.10 M sodium cyanide solution

- Acute toxin
  - Harmful exposure can occur through ingestion, absorption through broken skin, or inhalation upon conversion to HCN gas by reaction with an acid

Chemical Safety Risk Assessment

3. Characterize safety risks

Example: regular work with sodium cyanide solutions

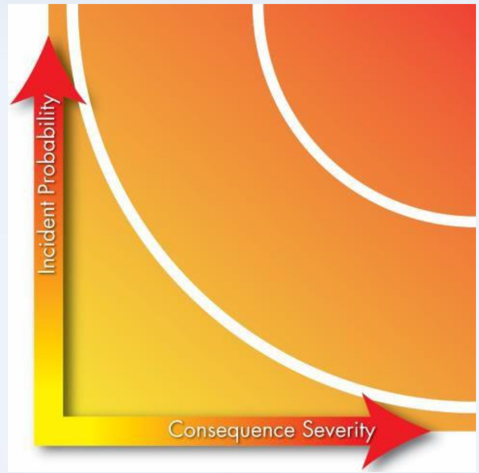
- What are the factors affecting the likelihood of exposure?
  - Do you think the likelihood of exposure is low, moderate, or high?
- What are the factors affecting the consequences of exposure?
  - Do you think the consequences of exposure are low, moderate, or high?

Chemical Safety Risk Assessment

3. Characterize safety risks

On the basis of *likelihood* and *consequence*, are the risks of exposure to NaCN low, moderate, or high?

Why?



Chemical Safety Risk Assessment

4. Are risks acceptable?

- Would you feel safe if you were doing this work?
  - Why/why not?
- Are current controls and practices reducing risk of exposure to acceptable levels?
  - Why or why not?
- Are there national standards for occupational exposure to cyanide?
- Are there other limits imposed by the institution?
  - If you don’t know, how can you find out?
  - What do you do if there are not established limits?

Chemical Safety Risk Assessment

5. **Implement additional control measures** to reduce safety risks to acceptable levels

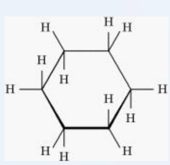
- What controls are needed to reduce the risk of exposure?
  - Substitution
  - Engineering
  - Administrative
  - PPE

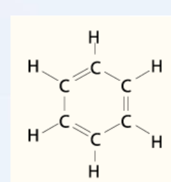
Controls

Change the process

eliminate the hazard

(e.g. Lower process temperature)





Substitution

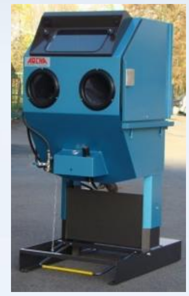
less-hazardous substance

(e.g. - cyclohexane for benzene)

Engineering Controls

Enclose the hazard,

- Use a barrier or
- Ventilate
  - Dilution ventilation
  - Local exhaust ventilation (LEV)



Administrative Controls

Personal Protective Equipment: PPE

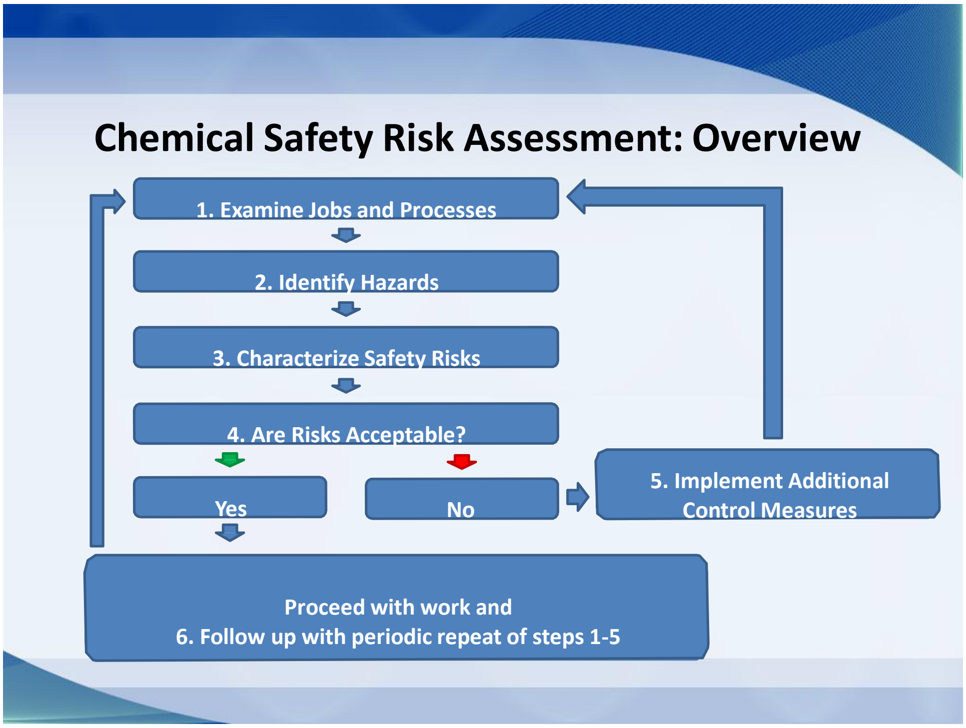
- PPE is the *least* desired control
- Does not eliminate the hazard
- Depends on worker compliance
- May create heat stress

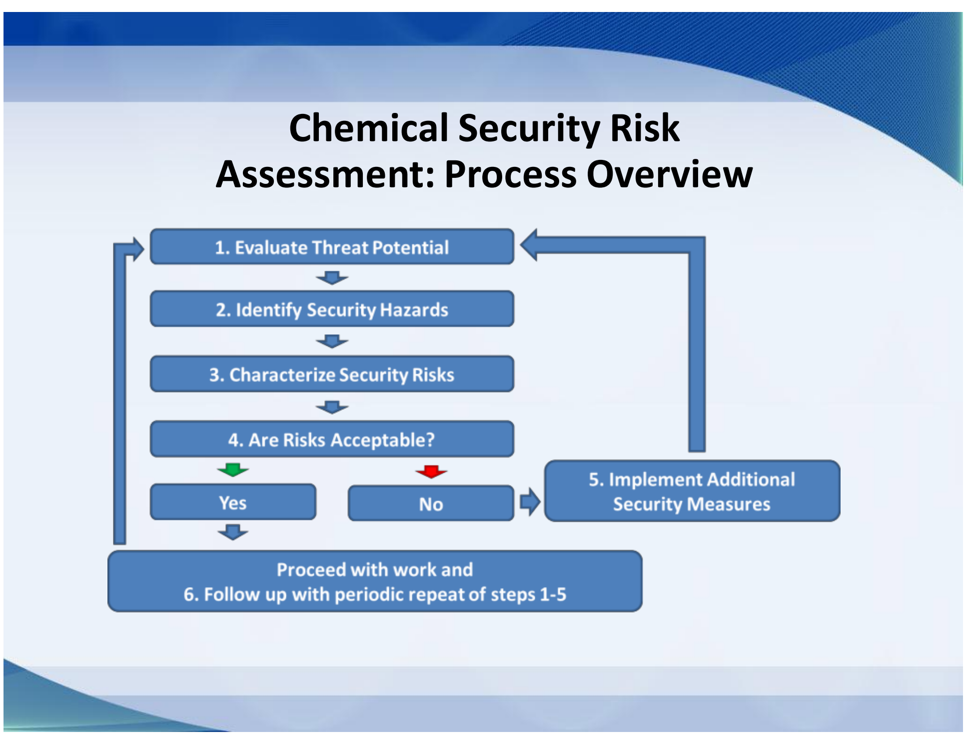


Chemical Safety Risk Assessment

6. **Follow up** with periodic repeat of steps 1-5

- Have practices or people changed?
- Could further improvements be made?
- How often should follow-up assessments be performed?


Chemical Safety Risk Assessment: Overview
1. Examine Jobs and Processes
2. Identify Hazards
3. Characterize Safety Risks
4. Are Risks Acceptable?
Yes
No
5. Implement Additional Control Measures
Proceed with work and
6. Follow up with periodic repeat of steps 1-5


Chemical Security Risk Assessment: Process Overview
1. Evaluate Threat Potential
2. Identify Security Hazards
3. Characterize Security Risks
4. Are Risks Acceptable?
Yes
No
5. Implement Additional Security Measures
Proceed with work and
6. Follow up with periodic repeat of steps 1-5

Chemical Security Risk Assessment

1. Evaluate threat potential
   - Adversaries
     - Motivation
     - Capabilities
     - Opportunity
       - o Outsiders—no authorized access
       - o Insiders—authorized access
       - o Collusion—between Outsiders and Insiders
   - Actions
     - Sabotage
     - Theft
     - Work Disruption
   - Assets

Chemical Security Risk Assessment

2. Identify security hazards - Assets
   - Information
   - Equipment
   - Expertise
   - Materials/chemicals
     - Need a working inventory
     - Need an understanding of materials/chemicals
       - oLikelihood and Consequences of malicious use
         - Ease or difficulty
         - Quantity
         - Location
         - How they are used

Chemical Security Risk Assessment

3. Characterize security risks
   - Create and analyze scenarios
     - Adversary
     - Action
     - Asset

     - What factors affecting the likelihood of a security incident?
       - Do you think the likelihood is low, moderate, or high?

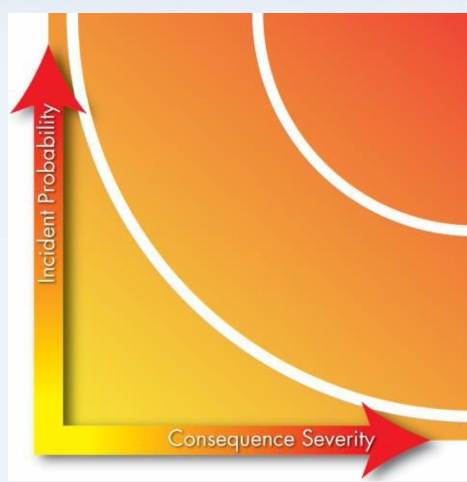
     - What are the factors affecting the consequences of a security incident?
       - Do you think the consequences are low, moderate, or high?

Chemical Security Risk Assessment

3. Characterize security risks

On the basis of *likelihood* and *consequence*, are the security risks low, moderate, or high?

Why?



Chemical Security Risk Assessment

3. Characterize security risks

- Is it possible to analyze, protect against, or even think of every possible scenario?
  - No
- So what should be done?

Chemical Security Risk Assessment

4. Are risks acceptable?

- If you are accountable for the security of the assets, how do you establish an acceptable level of security risk?
  - Are there national security standards?
  - Are there other limits imposed by the institution?
    - If you don't know, how can you find out?
    - What do you do if there are not established limits?

Chemical Security Risk Assessment

5. Implement additional control measures where needed to reduce security risks to acceptable levels

- What controls are needed to reduce the security risks?
  - Administrative
  - Operational
  - Engineering

Chemical Security Risk Assessment

6. **Follow up** with periodic repeat of steps 1-5

- Have scenarios changed?
- Could further improvements be made?
- How often should follow-up assessments be performed?

Chemical Security Risk Assessment: Overview

Chemical Security Risk Assessment

- Main points
  - Likelihood of a security threat scenario may be higher than you think
    - Of chemical, biological, nuclear, and radiological materials, ***chemicals*** are used maliciously ***the most often***
  - Consequences can range from low to high

Chemical Security Risk Assessment

Example : Pseudoephedrine

Legitimate use

- A common ingredient in cold medicines

Misuse

- Synthesis precursor to crystal methamphetamine
- USA, 2002, clandestine meth labs
  - Caused 194 fires, 117 explosions, and 22 deaths
  - Cost $23.8 million for cleanup
  - Dumped chemicals harm environment
- Processing illegal drugs requires a variety of chemicals
  - Global terrorism can be funded by illegal drug activity

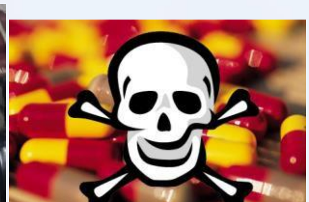
US DEA, http://www.deadiversion.usdoj.gov/pubs/brochures/pseudo/pseudo_trifold.htm, accessed Dec 2007.

Chemical Security Risk Assessment

Example: Cyanide

Legitimate use

- Mining and metal plating industries



Misuse

- Poison and precursor to HCN, a CW agent
  - Popular with criminals and terrorists because it is relatively easy to obtain
  - USA, 1982, cyanide added to Tylenol capsules
    - Killed 7 people
    - Led to tamper-proof packaging

"Tylenol Crisis of 1982." Wikipedia, The Free Encyclopedia. 22 Nov 2007, 06:04 UTC. Wikimedia Foundation, Inc. 28 Nov 2007 <http://en.wikipedia.org/w/index.php?title=Tylenol_Crisis_of_1982&oldid=173056508>.
Therence Koh/AFP/Getty Images

Chemical Security Risk Assessment

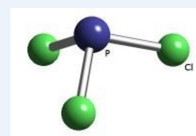
Example: Phosphorous Trichloride

Legitimate use

- Precursor for production of chemicals used in flame retardants, herbicides, plasticizers, insecticides
- Chlorinating agent
- Organic synthesis

Misuse

- Precursor for Nerve Agents
- Aum Shinrikyo: Japan 1994-1995
  - Produced sarin and other chemical weapons
  - Killed ~20 and injured over 4000



http://www.opcw.org/news/article/the-sarin-gas-attack-in-japan-and-the-related-forensic-investigation/

Chemical Security Risk Assessment

Example: Ammonium Nitrate

Legitimate use

- Agriculture
- ANFO ingredient (industrial explosive)

Misuse

- ANFO ingredient (used maliciously)
- USA, 1995, bombing of federal building in Oklahoma City
  - 168 killed, including 19 children, and almost 700 injured
- Also used by other groups around the world

http://www.fbi.gov/about-us/history/famous-cases/oklahoma-city-bombing

Chemical Security Risk Assessment

Example: Acetone, Hydrogen Peroxide, and Acid

Legitimate uses

- Too numerous to list

Misuse

- Precursors to TATP
- London, 2005, bus and subway suicide bombings
  - 52 killed, over 770 injured
- Multiple other bomb plots around the world
  - Invisible to detectors for nitrogen-based explosives

http://en.wikipedia.org/wiki/Acetone_peroxide

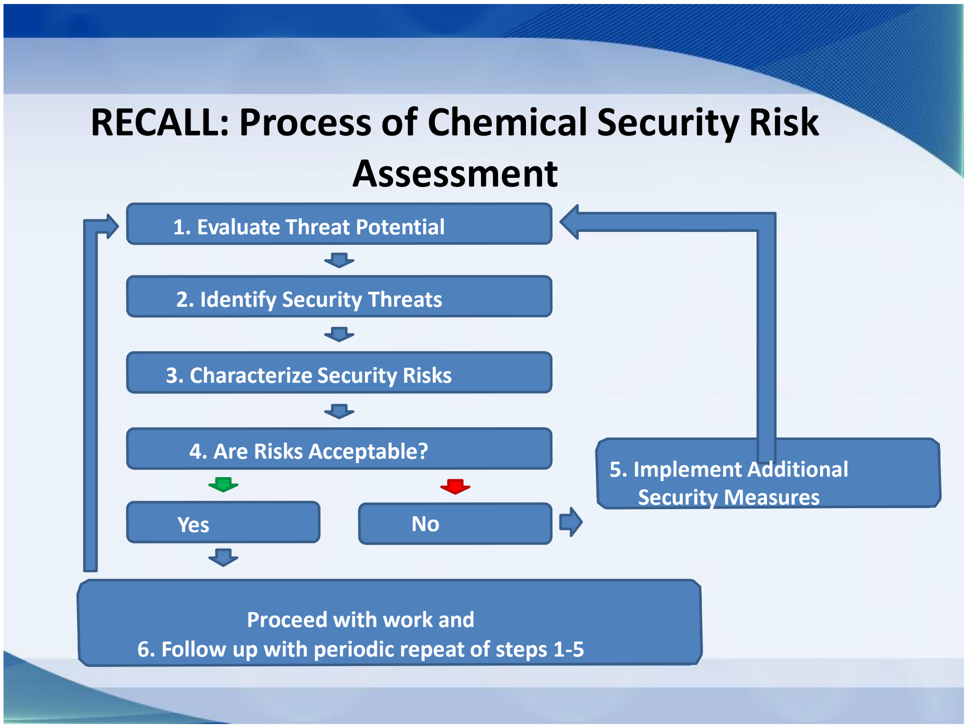
Conclusions

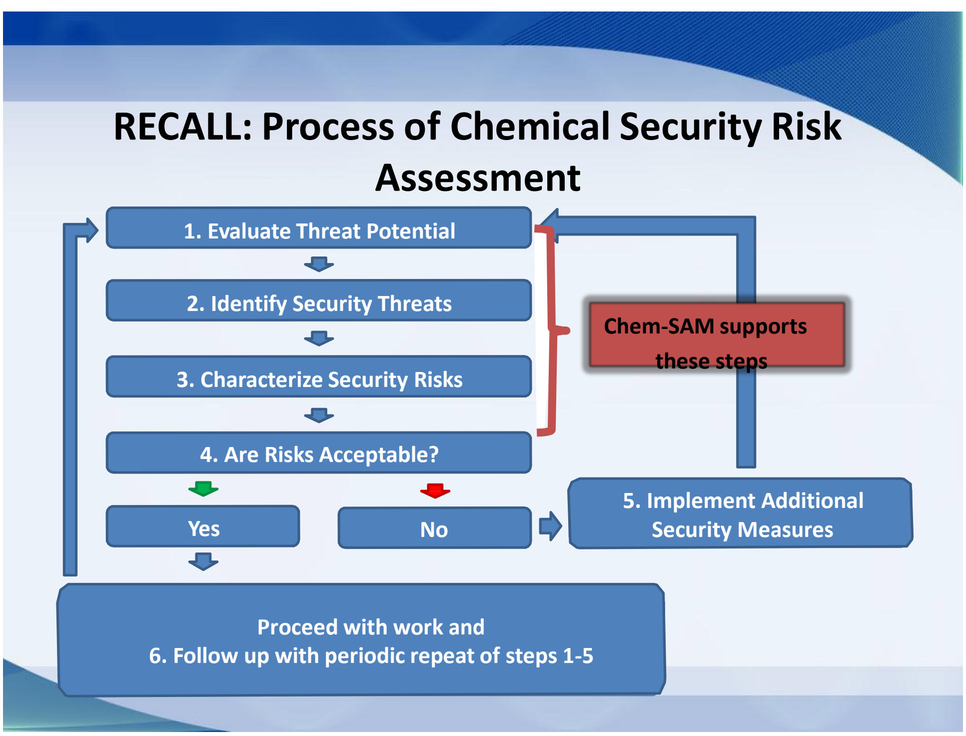
- Risk is a function of Likelihood and Consequence
  - Applies to both safety and security
- Chemical facilities need to be ***safe***, ***secure***, and ***productive***
  - Assessing and characterizing chemical safety and security risks allows controls to be applied in a **graded** manner
    - Larger efforts toward reducing high risks
    - Smaller efforts toward reducing low risks

Chemical Security Assessment Chem-SAM Introduction and Demo

Chem-SAM

- The Chem-SAM software tool is designed to support conducting a technical assessment of chemical security risks


RECALL: Process of Chemical Security Risk Assessment
1. Evaluate Threat Potential
2. Identify Security Threats
3. Characterize Security Risks
4. Are Risks Acceptable?
Yes
No
5. Implement Additional Security Measures
Proceed with work and
6. Follow up with periodic repeat of steps 1-5


RECALL: Process of Chemical Security Risk Assessment
1. Evaluate Threat Potential
2. Identify Security Threats
3. Characterize Security Risks
4. Are Risks Acceptable?
Chem-SAM supports these steps
Yes
No
5. Implement Additional Security Measures
Proceed with work and
6. Follow up with periodic repeat of steps 1-5

Identify Security Threats (Chem-SAM)

Insider | Outsider

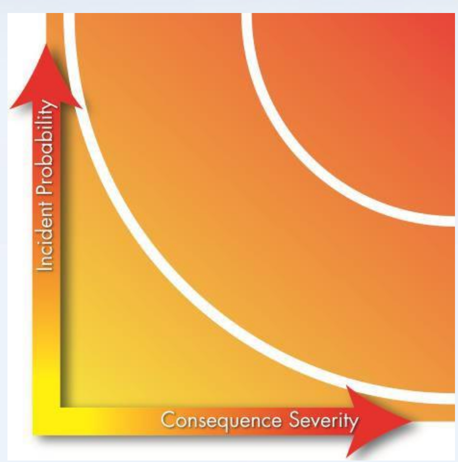
Theft

Sabotage

Near populated or industrial areas

Characterize Security Risks

- Risk is a function of
  - Probability that an incident will occur (**likelihood**)
  - Severity if the event occurs (**consequence**)



Risk = *f* (Likelihood, Consequence)

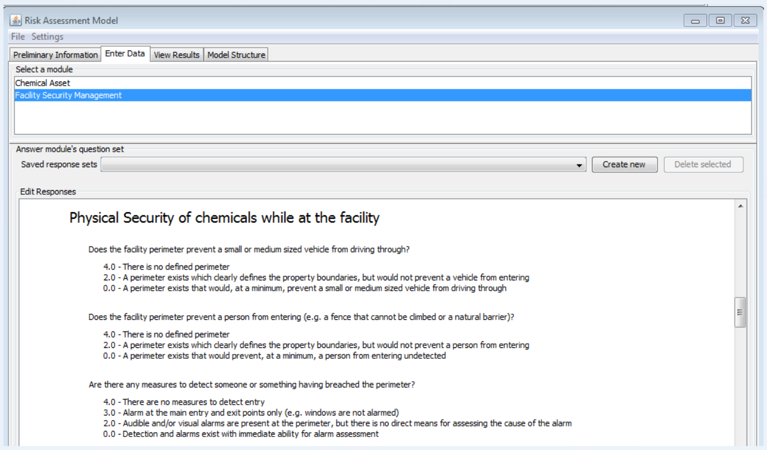
Characterize Security Risks (Chem-SAM)

- Chem-SAM risk is a function of:
  - Likelihood
    - Attractiveness of the chemical for misuse
    - Potential for successful theft/diversion of the chemical based upon facility characteristics
  - Consequences
    - Impact to human health and/or facility of misuse of the chemical

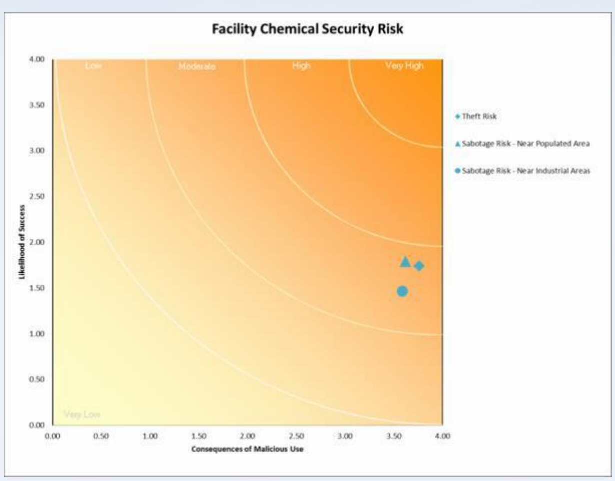
How does it work?

- Based on a Multi-Objective Decision Analysis (MODA) framework
  - Objectives defined and weighted by chemical and security subject matter experts
  - User provides ‘scores’ for each objective based upon their unique situation
  - Software has built in mathematical operations to characterize the risk based upon likelihood and consequences
- The user:
  - Defines the chemical assets
  - Characterizes facility security management

Data Collected Through a Comprehensive Set of Questions



Results presented graphically

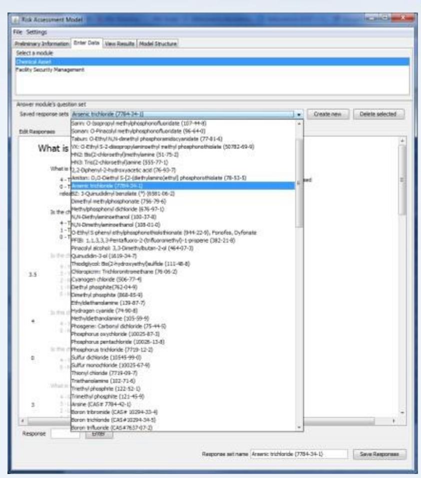


The Software

- Windows or OS x supported
- Captures management documentation for proper record keeping as advocated by Responsible Care©

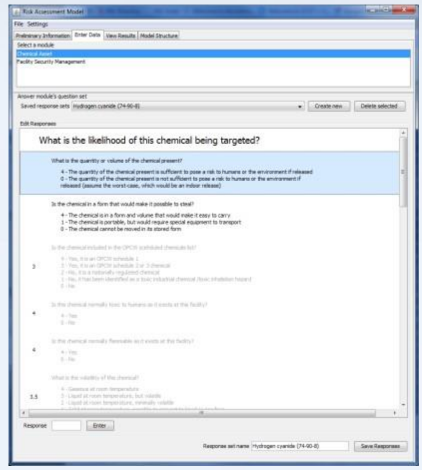
Chemical Assets

- Over 100 chemicals have been pre-loaded into the system



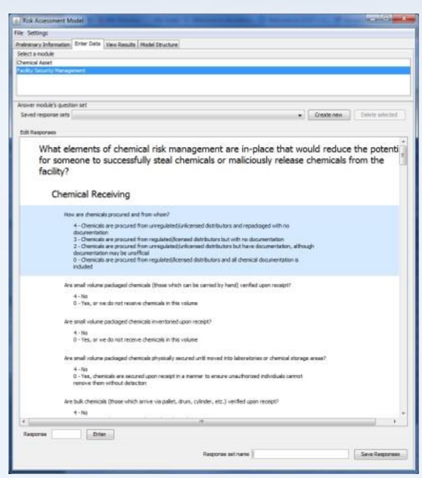
Chemical Assets

- Provide the quantity of any of the provided chemicals pre-loaded at your facility
- Enter a new chemical for assessing additional chemicals
- Save your updated answers



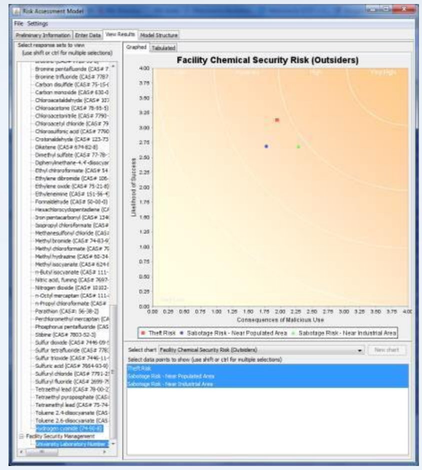
Facility Security Management

- Answer the questions regarding your facility's security management
- Save the answers for your facility



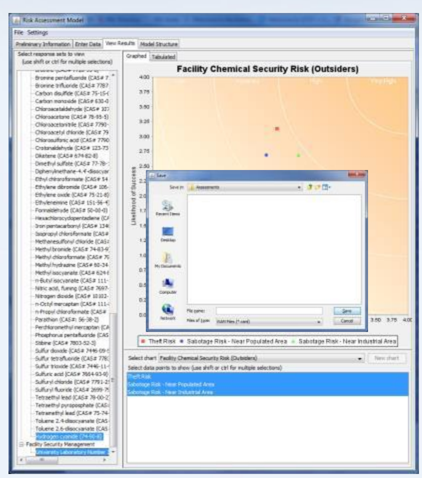
View Results

- Select your chemicals
- Select your facility/laboratory
- View the risks



Saving the Assessment

- Save your responses
- Save in an assessment folder



Are Risks Acceptable?

- Working with management and other key stakeholders determine if the risks are acceptable or unacceptable

- For unacceptable implement risk mitigation measures

Another Assessment

- Load the assessment responses to update or review

Or

- Create a new assessment

Software and Resources

- http://csp-state.net/
  - Resources tab
    - Tools
      - Chemical Risk Management Self-Assessment Model (Chem-SAM)

Chem-SAM

- A tool for chemical security risk assessment
  - Easy to use
  - Small-to-medium enterprises
  - Technical risk assessment
    - Well characterized factors
    - Objective and rational
  - Prioritize risks
    - Facilities
    - Chemicals
  - Communicate risks

The Chemical Distribution System and Its Focus on Supply Chain

Module Overview: Chemical Distribution System

- Overview of Supply Chain
- Overview of international Responsible Care best practices
- Chemical Security Policy and Program
- Summary, Conclusions, and Evaluations

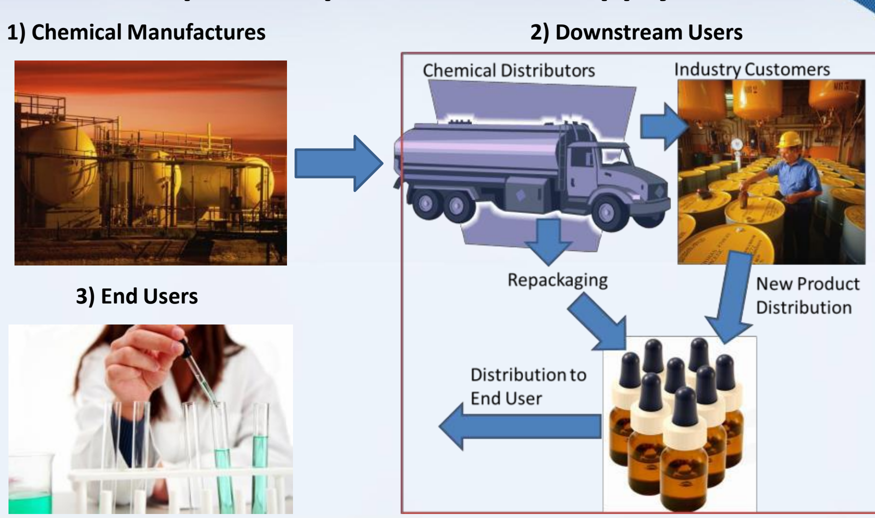
Supply Chain: Basics

- Three main Parts:

1) Chemical Manufactures
2) Downstream Users
   - Chemical Distributors
   - Company/Industry Customers
3) End Users

Can be simple or complex process (each part can have multiple steps in the supply chain)

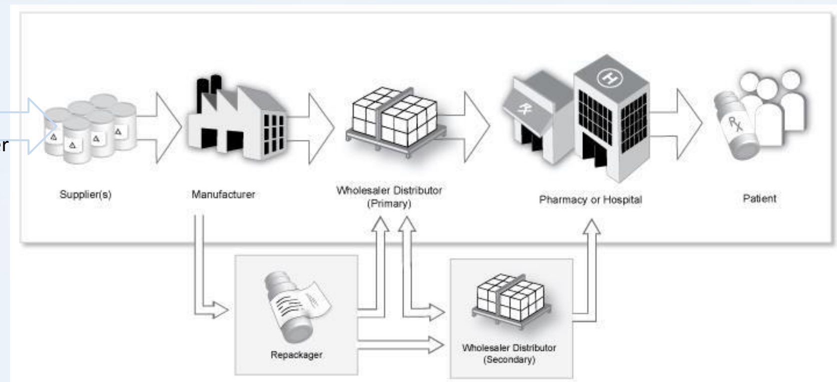
Example: Simple Chemical Supply Chain



Example: Complex Supply Chain

- Multiple/varied downstream users

Chemical Manufacturer



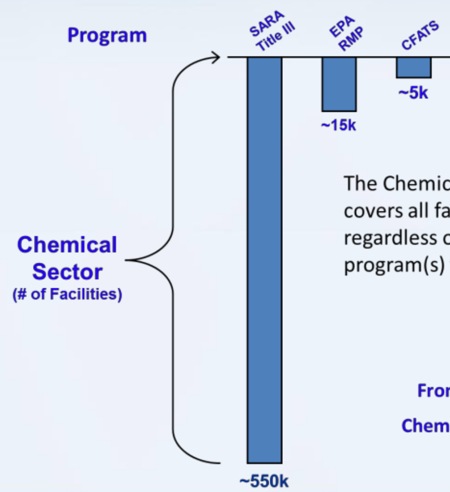
http://www.fda.gov/Drugs/DrugSafety/DrugShortages/ucm277626.htm

Risk Basics: Definition

Risk in the chemical supply chain are dependent upon:

- Incident Probability
- Consequences

Chemical Sector Size in the US



The Chemical Sector-Specific Plan (SSP) covers all facilities within the Sector regardless of which, if any, regulatory program(s) to which they belong.

From - DHS Overview of the Chemical Sector-Specific Agency

March 2011

Chemical Distribution System

- Definition: The system for chemical distribution to the end user
- Chemical distributors are a key link in the chemical supply chain
- Distributors Main Roles in the supply chain:
  - Local Expertise
  - Sales and Marketing
  - Repackaging

Distributor Responsibilities

- Know your customer
- Resell chemicals safely and securely on behalf of the manufactures
  - Health, safety, environmental, and security information
- Local bulk storage
  - Large and small containers
- Repackaging capabilities
- Continuous shipments/deliveries
  - Large and small
- Specialty blending/mixtures to meet customer needs

Responsible Distribution Security

- Cargo/Chemical Security:
  - Physical storage and Transportation (en route) vulnerabilities
  - Protect again theft and diversion by selecting carriers who demonstrate ability to secure cargo
- Product Stewardship Security:
  - System to qualify customers

Chemical Distribution: Security Measures

- Constantly evaluate security measures and enhancing security of the facility
  - 24-hour guard service
  - Perimeter: concrete barriers, fences, trenches, lighting
  - Detection: surveillance cameras, security alarms, intruder detectors, tamper indicators
  - Limited facility access
  - Cargo GPS tracking
  - Employee security training
  - Security audits and inspections

Distributors Network and Resources

- North America and EU have local networks to help inform and train downstream users
  - Help provide guidance for successful of the requirements of the REACH and CLP Regulations
  - Provide guidance for a framework for health, safety, environmental, and security aspects of handling, storing, and delivering chemicals
  - Some associations and networks are specific to industry type:
    - Pharmaceutical/medical, Petrochemical, Agricultural

CHEMCATS – Chemical Suppliers

- "Chemical Catalogs Online", produced by CAS
- Database containing information about commercially available chemicals and their worldwide suppliers.
  - More than 68 million commercially-available products
  - More than 885 suppliers
- Links with SciFinder for Pricing and Availability
- Only stock chemical available for general sale is acceptable for listing
  - No on-demand synthesis or non-chemical items (supplies, kits, animal tissue)

CHEMTREC®

- Around-the-clock communications center

Immediate access to thousands of chemical product specialists and hazardous materials experts

- A telecommunications system for virtual emergency response team, links on-scene responders with chemical experts, transportation companies, and medical experts
- An electronic library of over 5 million Safety Data Sheets (SDS);
- Access to advice from medical experts and toxicologists for emergency medical treatment assistance.
- Interpretation for more than 180 languages

http://www.chemtrec.com/

TRANSCAER®

Voluntary effort in USA that helps communities prepare and respond to hazardous material transportation incident.

- Planning
- Training
- Drills
- Hazmat safety training along railway
- National conferences
- State coordinators

http://www.transcaer.com

TRANSportation Community Awareness and Emergency Response

CHEMLIST® Database

- "Regulated Chemicals Listing", produced by CAS
- Chemical substances that are regulated in key markets across the globe
- identifying-in one place-the regulatory requirements for a specific substance from many of the world's most significant regulated substances lists

http://www.cas.org/content/regulated-chemicals

National Association of Chemical Distributors (NACD) Security Code

- Develop security programs that address security of the member's facility and the transportation of chemicals.
- Scrutinize for-hire motor carriers using selection criteria that includes a carrier's ability to secure chemicals in transportation, including defense against diversion, theft, or hijacking.
- Qualify customers purchasing chemicals as prescribed by government regulations and
- Verify implementation of security measures by an independent third-party verification firm.

Chemical Distribution: Laws and Regulations

- International (EU, UN, and EC) and Country Specific
  - Import/Export
  - Transportation
  - Chemical Safety Information (labeling/packaging)
- Ultimate goal:
  - **Safety and Security** for people, community, government, and the environment

How GHS impacts countries without existing regulations

- Many challenges exist with implementation of a national GHS action plan
  - What is the appropriate legal framework for adopting/implementing the GHS?
  - What government agencies should be involved? Are there ministries/agencies ready to implement and maintain the GHS?
  - How will stakeholder cooperation and support for implementing the GHS be managed?
- UNITAR and ILO (under the guidance of UN GHS Sub-Committee) to develop technical assistance to write new regulations using the GHS elements.
  - pilot implementations have begun in a few countries

Open Discussion

- Who are your country or local distributors?
- Do you have a network for distributors?

Chemical Transportation Security

Objectives

- Understand high-level concerns regarding the transport security of chemical materials
- Recognize that threats exist during transport
- Acknowledge there are potential consequences of the malicious use of chemical materials
- Understand risk reduction strategies
- Identify elements of a Transportation Security Plan for the secure transport of high consequence chemicals

Chemical Transportation

- An essential, complex element in the chemical supply chain, but also its most vulnerable point
- Consider different types of chemical transportation:
  - In-plant
  - Local
  - Domestic
  - International transport
- Inherent safety and security risks

Chemical Transportation Security Risks

- In-plant threat
  - Sabotage
  - Intentional release
  - Theft
- In-transit threats
  - Hijacking
  - Theft of materials
  - Sabotage of conveyance
- Attacks on pipelines

Photo credit: PressTV

From 2011-2013, the Yemen Department of Oil and Minerals sustained approximately $5 billion in losses due to acts of sabotage.

Need for Chemical Material Transport Security

- Transport is the most vulnerable phase in the life cycle/supply chain
  - Material is moving in the public domain
  - Packaged
  - Loaded a conveyance
- If conveyance is seized, it could be used to quickly move the material to hidden locations for ***further processing*** or to ***high consequence locations for dispersion or coercion***

Adversaries know this!

Safety doesn't equal Security

- The emphasis for chemical has been on safety, but ***now there is a recognized need*** to address security as a priority

Safety and security are different:

Safety
- protecting people from the dangers of the material

Security
- protecting the materials from **people** who may want to use it for malicious purposes

Protecting the Public

- Since transport occurs in the public domain they are away from dedicated security and response forces
- Transport routes/times/plans may be compromised
- The adversary can
  - Pick the location for his attack
  - Pre-position personnel and weapons
  - Control the situation

Potential Malicious Acts

- Theft and use of a chemicals to make a weapon
- Sabotage of a facility or transport of chemical materials
- Theft of chemical materials for dispersal, exposure, or coercion

As security professionals, we need to "red team" possible scenarios adversaries may take, and then plan appropriate security measures and responses

Transportation Security Threats

Plant Security

- Include internal transfers in plant security plan
- Limit access to facilities and shipping information
  - Secure transportation equipment
- Keep an inventory of hazardous materials
  - Use tamper resistant seals
- Personnel Security
  - Background checks
  - Identification cards or badges

Transportation Security Threats

In-transit Security

- Vehicle travels on unprotected public roads, rail or sea
- Surroundings are constantly changing
- Sabotage or theft is not detected until in progress
- One person responsible for transport
- Typically there are no security personnel accompanying shipment

Consequences

- Loss of Life
- Injuries
- Mass Evacuations
- Loss of Public Trust
  - Confidence in government's ability to properly regulate and ensure public safety
- Loss of infrastructure use
- Property damage
- Environmental damage
- Institutional impacts
  - Loss of business
  - Regulatory penalties / fines
  - Negative public relations / press

Consider all that could go wrong and the consequences when making hazardous shipments

Complexity

- Current complexity in chemical transportation increases risk
  - International and country-specific regulations
  - Thousands of regulated hazardous materials with different hazard classes
  - Different modes of transportation -- road, rail, air, marine, pipeline – have different requirements
  - Different chemicals have different packaging…and it might be different in different locations

Safety and Security Standards and Training

The US DOT regulates drivers:

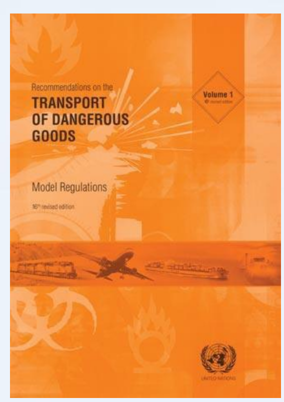
- Driver qualifications
- Years of service
- Equipment standards
- Driving and parking rules
- Alcohol and controlled substances
- Financial responsibility
- Operational requirements

HAZMAT training required for:

- Personnel who prepare, load/unload, or transport hazardous materials.

Transportation Risk Management Regulatory Framework

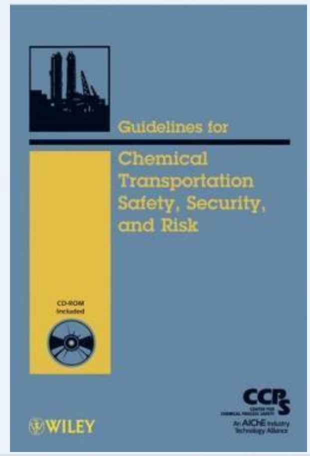
- Management systems should adhere to regulations and accepted international transportation standards.
  - UN Model Regulations
  - International Maritime Organization (IMDG Code)
  - International Air Transport Association (IATA)



Center for Chemical Process Safety (CCPS) Risk Management Publication

- Covers transportation safety, security and risk management
- Provides tools and methods to assist transportation professionals and other stakeholders
- Presents a comprehensive framework for managing transportation risks
- Introduces practical techniques for screening, identifying, and managing higher-level risks
- Emphasizes the need to balance safety with security

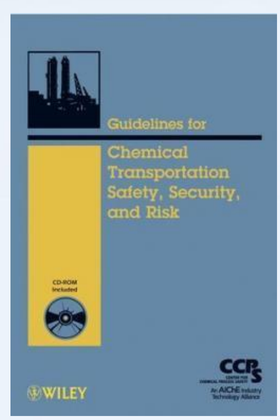
CCPS (2008). Guidelines for Chemical Transportation Safety, Security, and Risk Management.



CCPS Transportation Risk Management (TRM)

The CCPS TRM process includes the following elements:

- Primary Management System
- Identification and prioritization of hazards
- Risk Analysis
- Risk Reduction
- Program Sustainability



Transportation Risk Management

TRM follows a general risk management model

1. Identify and prioritize the transportation safety and security hazards for your facility
2. Risk Analysis: Estimate the level of risk for each scenario

   Risk = f(scenario, consequence, likelihood)

3. Risk Evaluation: decide on the level of risk reduction
4. Risk Reduction: Apply mitigation (controls) to reduce the risk to the appropriate level

Are we appropriately protected throughout the whole supply chain?

Transportation Security Vulnerability Assessment

2. Assess modes and quantities

- Air
- Waterway
- Rail
- Road
  - Vehicle
  - Cart or bicycle
- Hand carry

- How much are we transporting?
- And how frequently?

Transportation Security Vulnerability Assessment

Security Readiness Reviews, accompanied with ***appropriate corrective actions*** ensure that:

- A sound Security Management System is in place
- Requirements of the transport security plan will be satisfied
- Deficiencies in the security system are identified and corrected
- Implemented security measures will provide adequate:
  - Deterrence
  - Detection
  - Delay
  - Response
- The security measures are in place
  - are balanced
  - provide adequate defense in depth

Operational Planning

- Shipment Identification and Communication
- Physical Protection Measures
- Operational Readiness Review
  - Evaluation of accident history and transportation safety plans
  - Certifications/licensing
  - Condition of equipment
  - Confirm the following:
    - Proper communication
    - Appropriate PPE for spill response
    - Spill containment kits on board
    - Emergency Contact Information on board
- Safety and security training of personnel

Communications

- Communicate material being transported
- Properly and fully identify material, use proper, full chemical name
  - no abbreviations
  - ID codes, e.g., UN Numbers
- Specify quantities, concentrations, number of containers
- Indicate specific hazard class
- Include emergency information
  - Contact names and 24/7 phone numbers
- Proper universal symbols

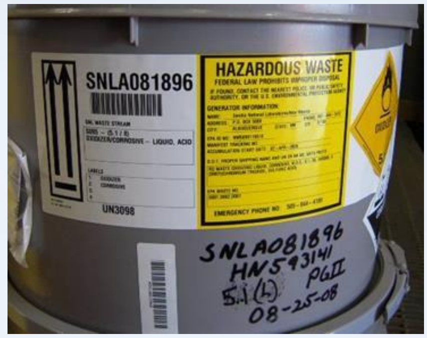
Communication Documents

- Safety Data Sheets
- Shipping order
- Bill of lading
- Manifest
- Full shipper, receiver addresses
- Packing and labeling certification
- Verification of receipt
- Follow up documentation
  - Incident/accident reports

http://worldamazingpictures.files.wordpress.com/2010/09/worlds-biggest-ship-accidents-6.jpg?w=400

Transportation Labels

- Identify material
  - Proper, full chemical name
  - ID codes (e.g., UN number)
  - Quantities, concentrations, number of containers
- Hazard class according to regulations
  - Transport symbols
- Emergency information
- Contact names and phone numbers
- Languages



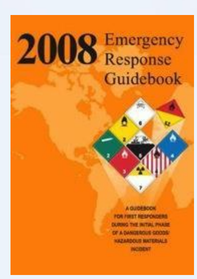
Emergency Communication

Emergency Response Guidebook (ERG)

- Interactive internet version:

http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/ergmenu.aspx

- Developed jointly by:
  - US DOT, Transport Canada, Secretariat of Communications and Transportation Mexico
- For first responders to transportation incident
- Guide to quickly identify material classification
- Protect initial responders and public



Transportation Security: Protective Measures

High risk shipments require high-level controls and enhancements!

Fundamental security measures:

- Deterrence
- Detection
- Delay
- Response

…as they relate to transportation security

Physical Protection Measures: Deterrence

- Enhanced packages, locks and tie-downs
- Communications and escorts
- Effective policies and procedures
- Consistent adherence to proper policies and procedures





Physical Protection Measures: Detection

Sensors/Alarms

- Intrusion detection
  - Door sensor (balanced magnetic switch)
  - Closed circuit camera
  - Tamper indicating devices (TIDs)
- Alarms
  - Visual/audible alarm from cargo vehicle
  - Remote alarm notification
- Communications
  - GPS / Geo-fencing
  - Duress signals




Physical Protection Measures: Detection Example

Physical Protection Measures: Delay

Delaying material access, movement, or removal

- Locks
- Secure tie downs
- Secure packages
- Vehicle Disablement





Physical Protection Measures: Response

Criteria:

- Coordinated, timely and effective
- Good communications
- Capabilities to manage mass casualty
  - Both security and safety related events

Objective:

- Prevent loss of material from authorized control
- Use contingency plans for emergencies/unusual events

Response capability is greatly enhanced with proper planning, outreach, training, and coordination

Transportation Security

Summary

- Chemical transportation vulnerabilities
- Chemical transportation complexities
- The adversary has the advantage
- Risk management and vulnerability assessments
- Threat reviews
- Operational planning and communication
- Physical protection measures

Physical Protection Systems Definitions, Concepts, and Infrastructure

Objectives

- Define physical security systems
- Identify the elements of an effective system
- Discuss the principles of security
- Introduce specific implementation examples

Physical Protection System Terminology

Security: a combination of technical and administrative controls to deter, detect, delay, and respond to a malicious event

Malicious event examples: industrial espionage, direct facility attack, insider theft, employee strike, unauthorized access

Physical Protection System Terminology (cont.)

Operations: actions with the goal to produce, transfer, experiment with, store, and maintain products, materials, and work-in-process

This implies non-intrusive controls and limited accountability with the objective of reducing overall costs

Conflict

Operations and security have different goals and are often in conflict

Objective of Physical Security

Physical security intends to prevent acts of theft or sabotage which could result in unacceptable consequences

- Death/Injury
- Unintended chemical release diversion
- Political instability
- Economic loss
- Industrial capacity loss
- Negative publicity
- Adverse media coverage

Physical Protection System Integration Objectives

A good **physical protection system** is an integrated system of activities, systems, programs, facilities, and policies which provides the protection of information, matter, materials, property, emergency, safety, and security equipment

Principles to ensure effective security include:

1. Defense in depth
2. Balanced security
3. Integrated security
4. Managed risk

What Kinds of Chemical Facilities Need Security?

Potential consequence severity will determine which facilities need to be secured

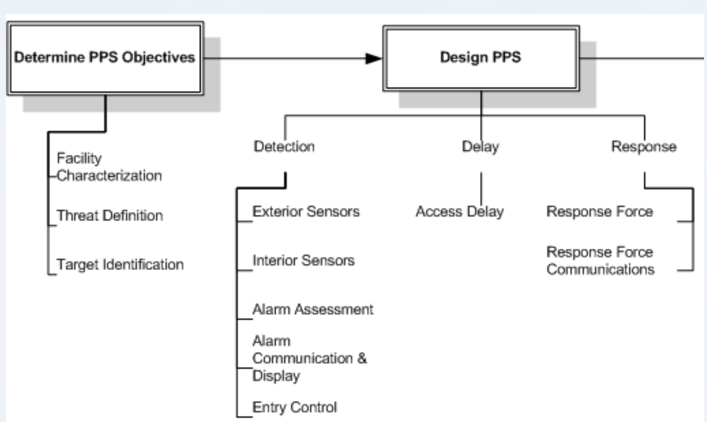
- Small-scale research laboratories
  - Many different chemicals used in small amounts
- Large-scale manufacturing plants
  - Limited types of chemicals used in large amounts

Deterrence

- A deterrent is used to discourage an adversary from attempting an assault by making a successful assault appear very difficult or impossible
- This can be accomplished by:
  - Warning signs (beware of dog)
  - Visual technology (cameras, real or fake)
  - Invisible but publicized technology
  - Visible patrol

Three Critical Factors for Physical Protection System (PPS) Design

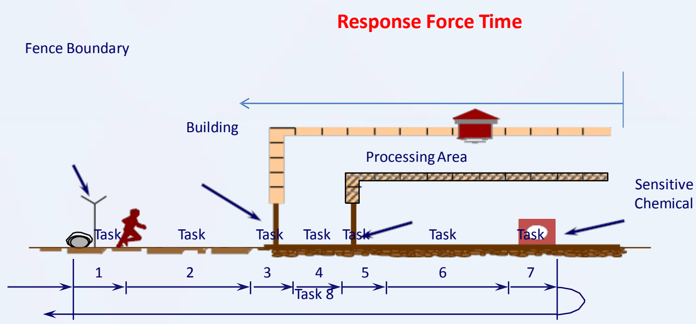
- Detection
- Delay
- Response



Source: Garcia, 2007

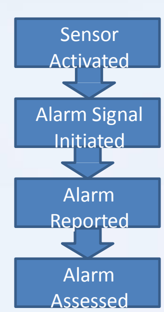
Physical Protection System Design

For a successful system design, the total time for detection, delay, and response must be less than adversary task time to complete his or her goal



Adversary Detection

- Detection is the recognition of a security situation brought about by the assessment of a valid alarm
  - A sensor and/or personnel react to a stimulus to initiate an alarm
  - The alarm is then assessed and reported to initiate a response
  - Humans are the central component to successful detection (and the primary failure point)



Intrusion Sensors

- Intrusion detection elements consist of exterior and interior intrusion sensors, video observation, entry control, and alarm communication elements
- The intrusion detection boundary is a sphere enclosing the protected item
- The objective is to detect unauthorized access into the protected perimeter

Types of Exterior Intrusion Sensors

For Installation on Fencing

- Vibrating Fence Sensory - Electro-mechanical or piezoelectric transducers are used to detect vibrations induced onto a fence.
- Fiber Optic Cables - Used to detect fence disturbance by either loss of continuity of light within the fiber core or by using techniques of interference to measure a disturbance.
- Taut Wire - Uses micro-switches installed on barbed wire fencing or fence fabric such that changes in the tension cause the switch to be activated.

Exterior or Interior Intrusion Sensors

Video Motion Detection and Surveillance

- Video motion systems detect changes in the monitored area by comparing the current scene with a previously recorded scene. Pixel changes correspond to some sort of movement in the detection zone. Unique in that the same system can be used for both detection and assessment.

Exterior or Interior Intrusion Sensors

Passive Infrared Intrusion Detection Sensors (PIRs)

- Passive, visible, line-of-sight , and volumetric
- Emit no energy and detect radiant thermal energy differences
- When elements sense a variation in temperature, an alarm condition is reached

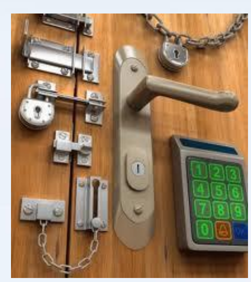
Adversary Delay

Delay: The element of a physical protection system designed to slow an adversary after they have been detected to allow time for assessment and deployment of response forces to defeat adversary.

It is important to note that <u>delay is effective only after detection</u>

Delay

- Increasing the number of delay elements, increases the probability of interdiction if proper detection elements are in place
- The more types of delay elements placed in the adversary path, the more tools the adversary must bring to defeat them



There is a trade-off however –
More delay can impact and slow day to day operations

Types of Access Delay Elements

- Passive delay elements
  - Doors, walls, floors, ceilings
  - Fences, gates, vehicle barriers
  - Locks, cages, packaging
- Active delay elements
  - Guards
  - Smoke screen

Adversary Path Selection

- The adversary will typically chose the path of least resistance with consideration being given to:
  - distance to the target,
  - amount of obstacles to overcome,
  - required resources to defeat the physical protection security measures.
- The longer <u>after detection</u> it takes for the adversary to reach the target, the better chance response forces have in interdicting the threat.

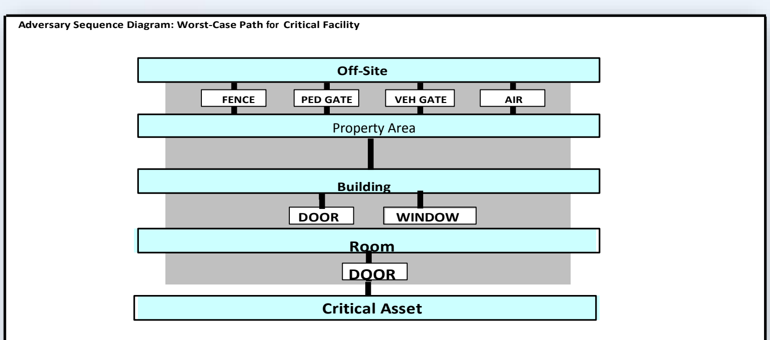
Traverse Time

The time it takes for the adversary to successfully defeat/pass a delay element

- Considerations:
  - The adversary may take as long as they need to defeat a delay element if not detected
  - It is critical to place detection sensors intermixed with delay elements

Adversary Sequence Diagram

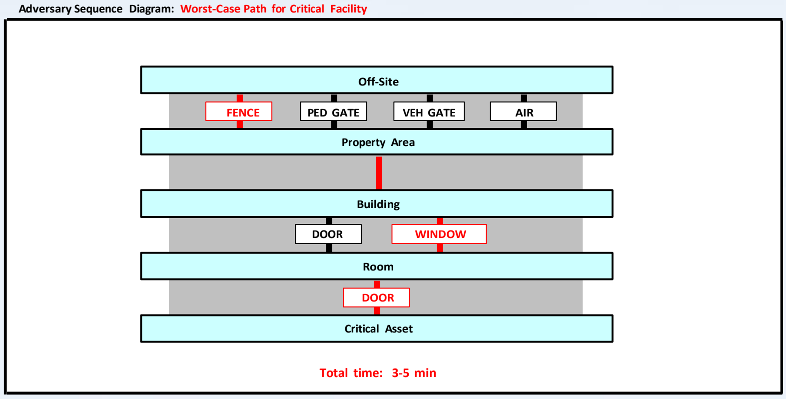
An adversary sequence diagram is used to determine the worst-case path for a facility



Sample Adversary Sequence Diagram

Chosen path by the adversary

Adversary Sequence Diagram: Worst-Case Path for Critical Facility



Estimate of Adversary Sequence Interruption

Sequence Number	Adversary Task	Would Detection Occur?	Delay Time (Seconds)	Response force Time (Seconds)	
1	Cut Fence	No	60	Mean	300
2	Run to Building	No	60		
3	Open Door	Yes	45		
4	Run to Vital area				
5	Open Door				
6	Sabotage Target				
7					
8					
9					

When Detection Occurs the Response time Starts

Response must interdict the adversary prior to them reaching their target

Guard Force Response

Response is the element of a PPS designed to counteract adversary activity and interrupt a threat

- Timely response – interdicted before escape
  - On-site guards
  - External response forces

But if the response ***is not timely***, the situation changes

- Post-event (recovery) – loss of target material
  - Local police
  - Military

Effective Response

- An adversary is interrupted when confronted by the response force
- The adversary is neutralized when they retreat or are defeated
- It is important for the response force to practice deployment at a specific facility
  - Training/drills/exercises
  - Awareness of the layout and hazards in the facility

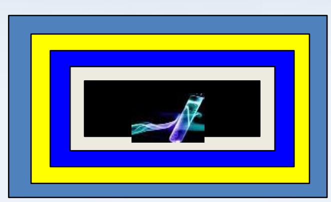
Principles of Physical Security

General principles followed to help ensure effective, appropriate security

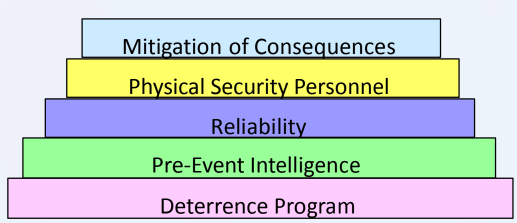
1. Defense in depth
2. Balanced security
3. Integrated security
4. Managed risk

Principle 1: Defense in Depth

- Layers
  - Physical

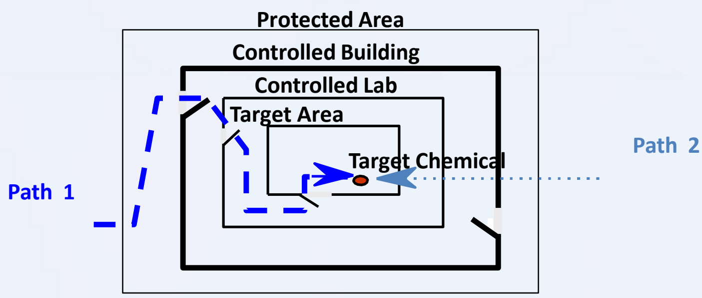


  - Administrative and Programmatic



Principle 2: Balanced Protection

- Physical Layers
- Adversary Scenarios
  - Adversary paths (physical)



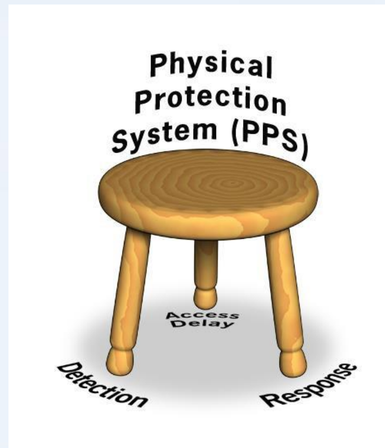
Balanced Protection (cont.)

- Each path is composed of many protection elements
  - Walls, fences, sensors, cameras, access controls, etc…
- Protection elements each possess detection and delay components

  For example:
  - Fence delays adversaries 20 seconds, and provides 50% likelihood that adversary is detected
  - Wall delays adversary 120 seconds and provides a 10% likelihood of detection
  - Guard delays adversary 20 seconds and provides a 30% likelihood of detection
- Balanced protection objective:
  - Evaluate for every possible adversary path
  - Assess cumulative detection and delay regardless of adversary path
  - Ensure NO weak path

Principle 3: Integrated Security

- Detection alerts response
- Access delay slows the adversary to provide time for response
- Response attempts to prevent the adversary from causing the consequence



Integrated Security (cont.)




- Must assess how each element of the security contributes to:
  - Detection of adversary or malicious event
  - Delay of adversary
  - Response to adversary
- Integrated security evaluates total contribution of all security components to the following:
  - Assures that overall ***detection*** is sufficient and precedes delay
  - Assures that adversary ***delay*** time exceeds expected response time
  - Assures that ***response*** capability is greater than expected adversary

Principle 4: Managed Risk

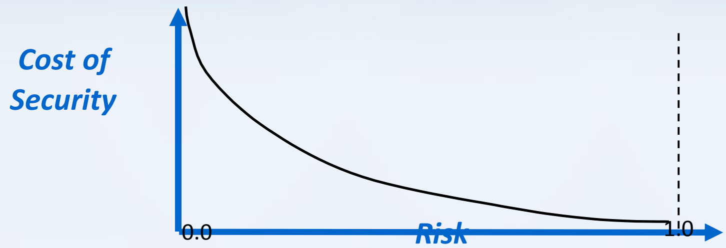
How much security is enough?

Managed Risk

- Benefits of Security is Reduced Risk
- What is Risk?
  - Risk = Consequence Severity * Probability of Consequence
- What is Security Risk?
  - Probability of Consequence Occurrence
    - Frequency of attempted event

      X
    - Probability of successful attempt
  - Probability of successful attempt is
    - 1 - Probability of security system effectiveness

Managed Risk (cont.)



- The benefit (risk reduction) increases with increased security investment (cost)
- However, there is a point where the increased benefit does not justify the increased cost

Requirements-Driven Security

- Design Constraints
  - Understand Operational Conditions
- Design Requirements
  - Consequences to be prevented
    - Identify Targets to be protected
  - Define Threats against which targets will be protected



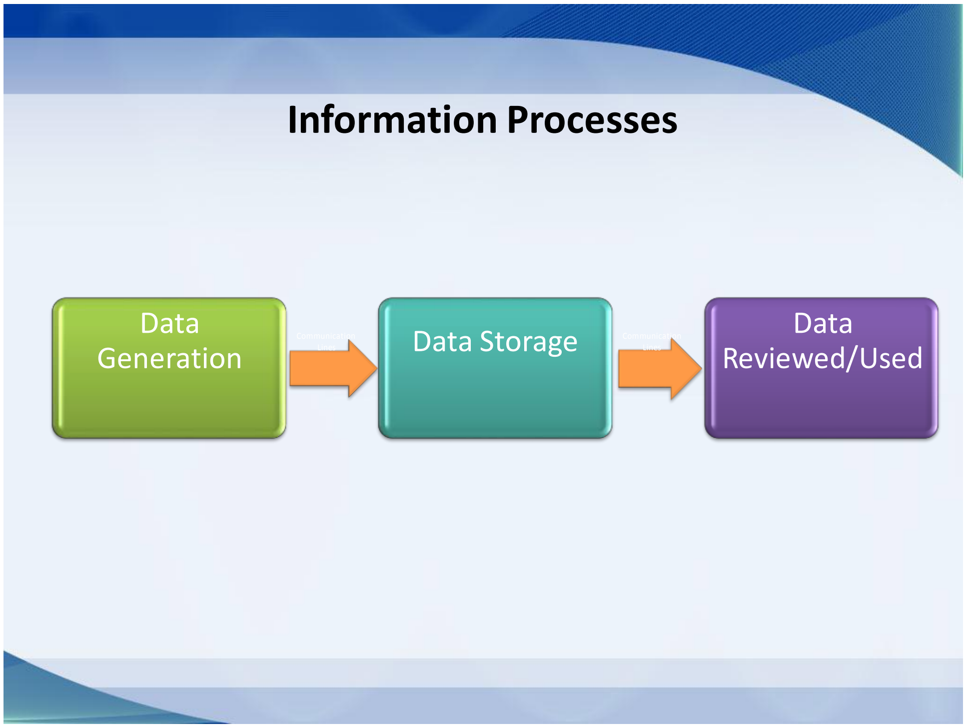
Summary

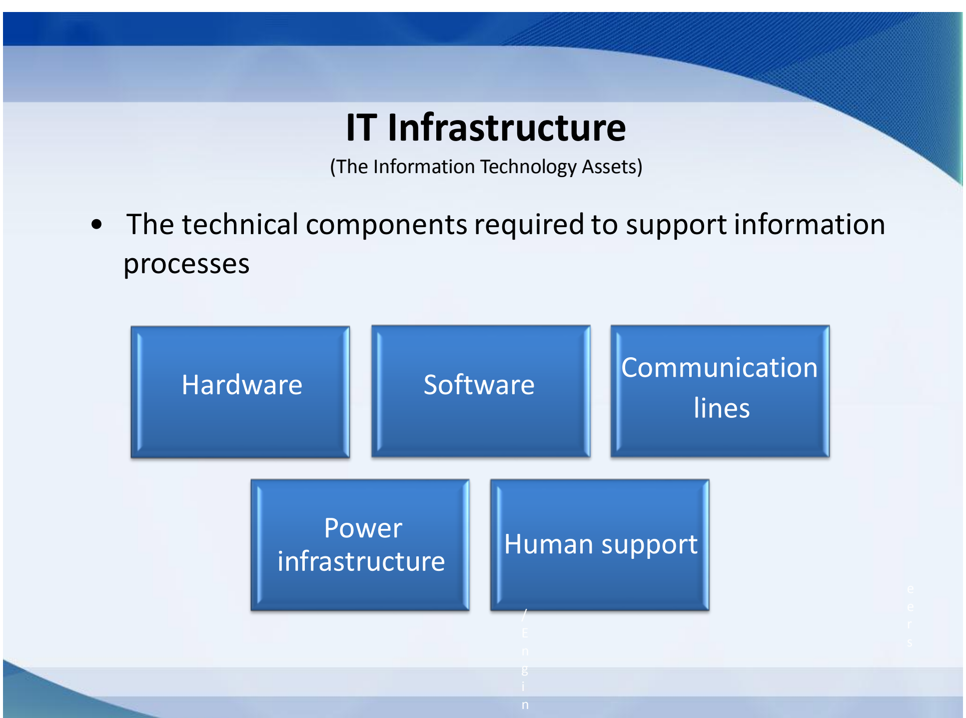
- Security systems should attempt to prevent but be prepared to defeat an act that could result in unacceptable consequences at a chemical facility
- Security awareness is an essential element
- An effective system depends on an appropriate integration of:
    - Detection
    - Delay
    - Response
- Principles for security can lead to more effective security system
    - Defense in depth
    - Balanced security
    - Integrated security
    - Managed risk

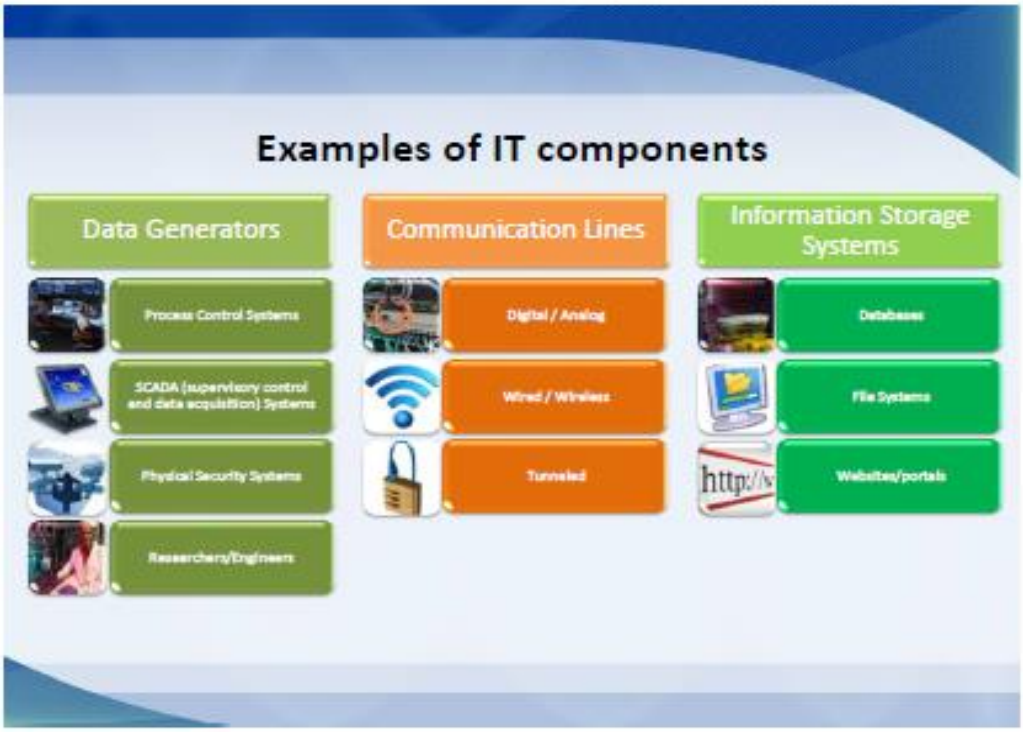
Aspects of IT Security: Information Management and Security

Overview

- Information Processes
- IT Infrastructure and components
- Threats to IT infrastructure
- Information Assurance
- Information Risk Assessment
- Information Security
- Resources


Information Processes
Data Generation
Data Storage
Data Reviewed/Used


IT Infrastructure
(The Information Technology Assets)
• The technical components required to support information processes
Hardware
Software
Communication lines
Power infrastructure
Human support


Examples of IT components
Data Generators
Process Control Systems
SCADA (supervisory control and data acquisition) Systems
Physical Security Systems
Researchers/Engineers
Communication Lines
Digital / Analog
Wired / Wireless
Tunneled
Information Storage Systems
Databases
File Systems
Websites/portals


Threats to IT infrastructure
Data Generators
• Altering control data to make a system preform the wrong function (Cracking)
• Altering the reporting data so system provides false data (Hijacking)
• Blocking data to inhibit control or reporting (Denial of Service)
Communication Lines
• Hijacking information
• Detecting system reporting pattern
• Inserting false information
• Denial of Service
Information Storage Systems
• Loss of data (Denial of Service, direct deletion, or equipment failure)
• Alteration or release of information (Cracking and/or Hacking)

Threats Types and Definitions

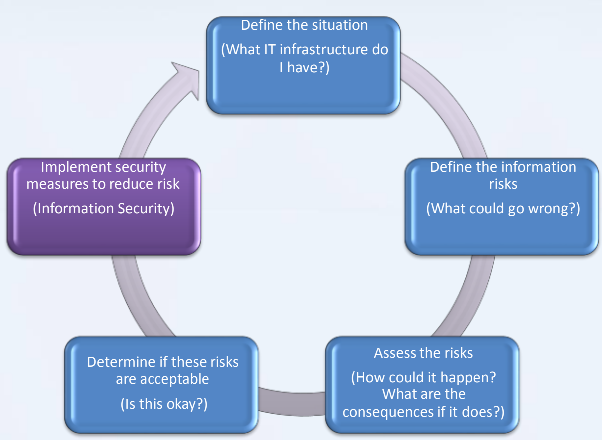
Type	Definition
Hacker	Person who gains authorized/unauthorized access to a computer WITHOUT the intention of causing damage
Cracker	Person who gains unauthorized access to a computer WITH the intention of causing damage

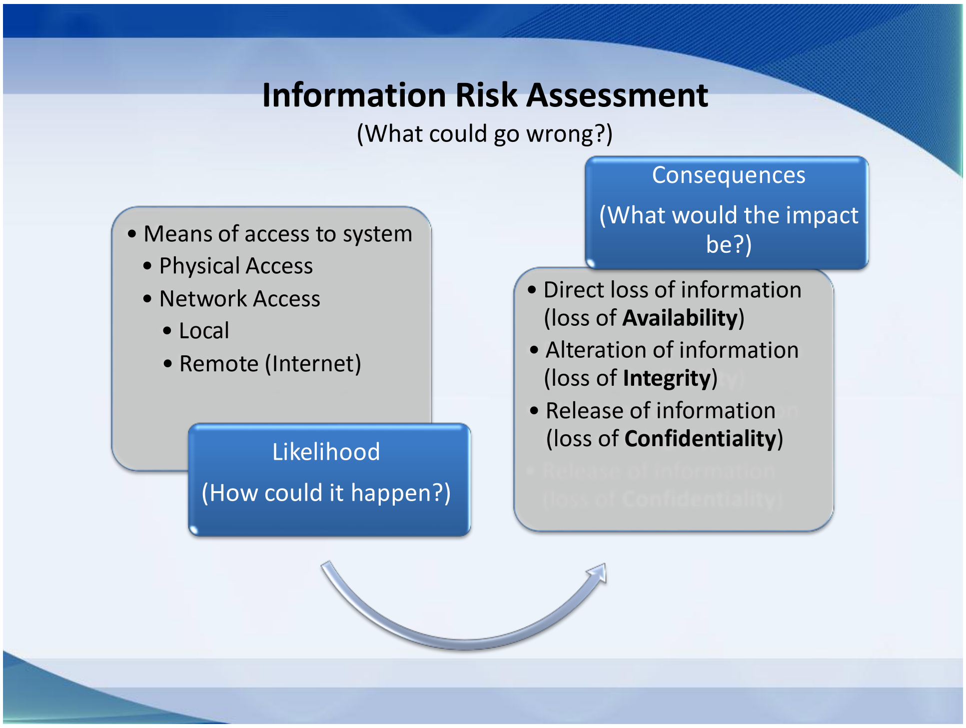
Method Type	Method Definition
Hacking	Gaining of access (wanted or unwanted) to a computer or networked system, copying, or creating data WITHOUT the intention of destroying data or maliciously harm
Cracking	Method by which a person who gains unauthorized access to a computer WITH the intention of causing damage

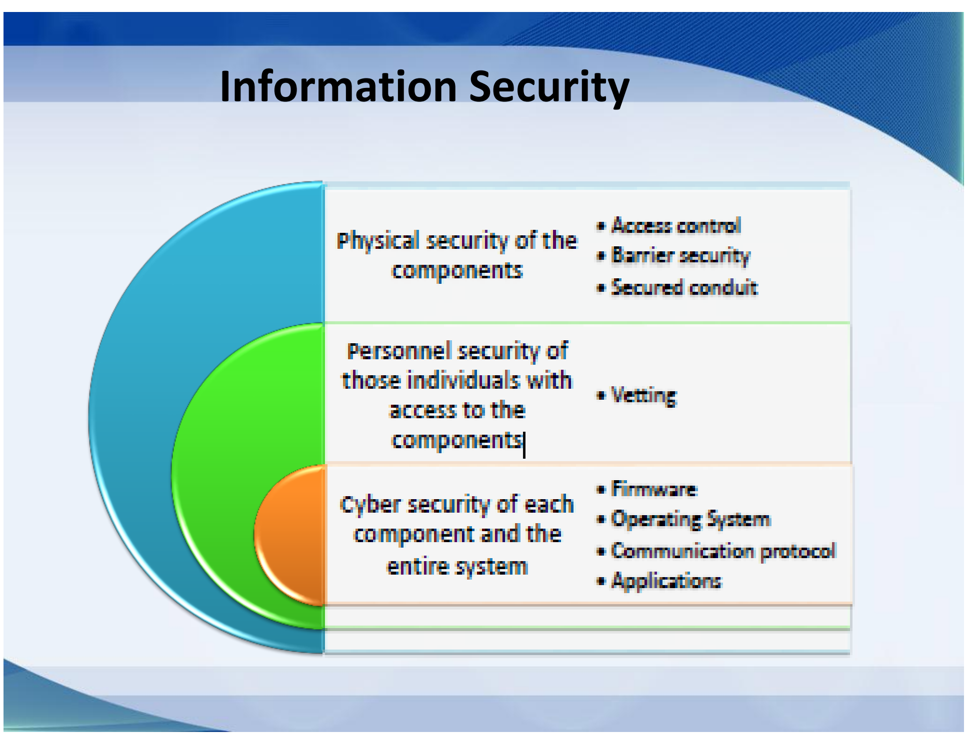
- Hacking and hackers are commonly mistaken to be the bad guys most of the time.
- Crackers are the ones who create virus, cracks, spyware, and destroy data.

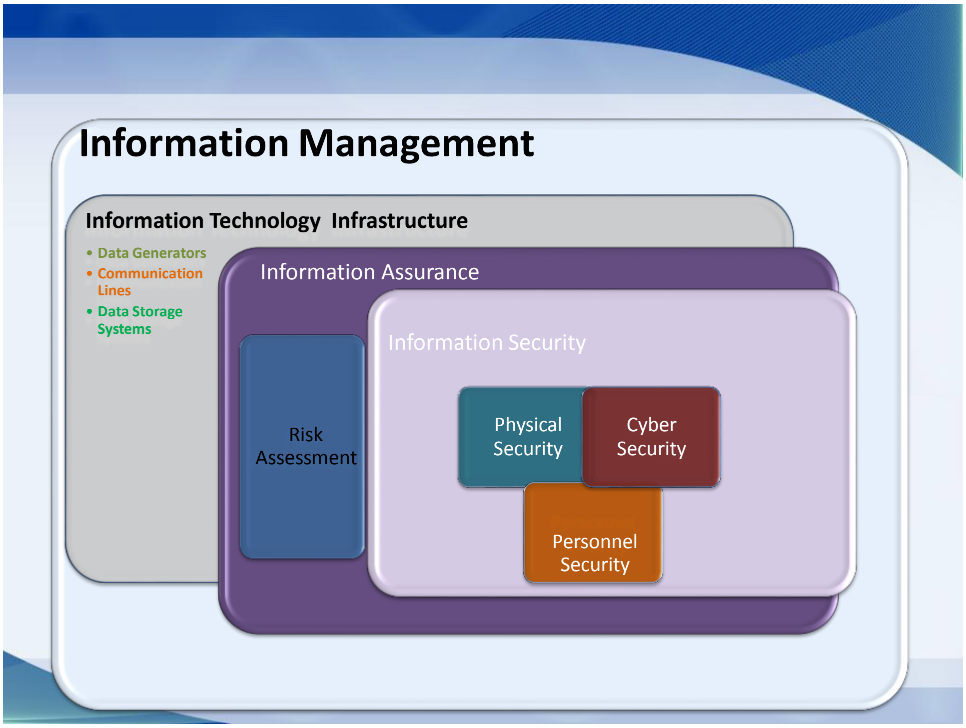
Information Assurance

(Defines the processes needed to protect and defend the information)




Information Risk Assessment
(What could go wrong?)
Consequences
(What would the impact be?)
• Means of access to system
• Physical Access
• Network Access
• Local
• Remote (Internet)
• Direct loss of information (loss of Availability)
• Alteration of information (loss of Integrity)
• Release of information (loss of Confidentiality)
Likelihood
(How could it happen?)


Information Security
Physical security of the components
• Access control
• Barrier security
• Secured conduit
Personnel security of those individuals with access to the components
• Vetting
Cyber security of each component and the entire system
• Firmware
• Operating System
• Communication protocol
• Applications



Resources

- http://ics-cert.us-cert.gov/Standards-and-References
- http://csrc.nist.gov/publications/PubsFIPS.html
- http://www.iso27001security.com/

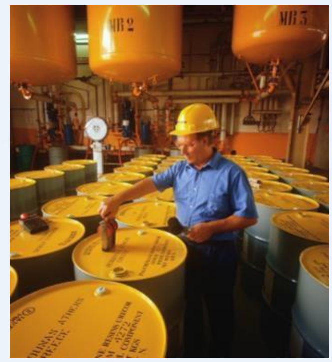
Fundamentals of Chemical Inventory Management

Definitions

- Inventory
  - Database that tabulates the chemicals in the lab
    - Can include materials, Synthesized products and samples
- Inventory (and tracking) system
  - Procedures and tools to update information and storage locations
- Inventory Management
  - Entire process involved in tracking inventory items throughout the life cycle (procurement through disposal)

Key Principles: Chemical Inventory Management System (CIMS)

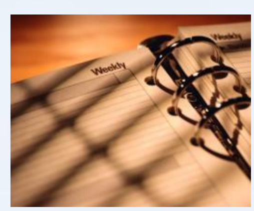
- Set of policies, procedures, and tools for chemical management
- "Living" database of chemical inventory
  - Updated with procurement, transport, use, and disposal
- Requires training, maintenance, and inspection
- Control access to database
- Ensure control and accountability
  - Designate chemical owners
  - No orphan chemicals
- Meet regulatory and institutional requirements



Inventory Management: System

<u>Simple log book or paper system</u>

- When would this be adequate?
  - Small laboratory or department
  - Few chemicals, low turnover
  - Few or no regulatory/reporting requirements
- Advantages?
  - Very low initial cost
  - No technical support needed
- Disadvantages?
  - Very difficult to maintain, easily bypassed
  - Can only track a limited amount of information
  - Difficult to control access to information
  - Limited productivity and efficiency benefits, and cost savings



Inventory Management: System

Spreadsheet or simple computer system

- When would this be appropriate?
  - Medium size laboratory or department
  - Moderate number of chemicals, moderate turnover
  - Some regulatory/reporting requirements
- Advantages?
  - Low initial cost
  - Can track more information
  - Some productivity and efficiency benefits, and cost savings
- Disadvantages?
  - Difficult to maintain, may be bypassed
  - May be difficult to control access to information

Inventory Management: System

Advanced computer or web-based system with barcodes

- When would this be appropriate?
  - Large laboratory or department
  - Many chemicals, high turnover
  - Many regulatory/reporting requirements
- Advantages?
  - Excellent productivity and efficiency benefits, and cost savings
  - Can track a lot of information
  - Excellent information access control
- Disadvantages?
  - High initial cost and in some cases ongoing cost
  - Still requires a commitment to maintain accuracy

Advanced System Features

- Web-based, Networked
  - System and database are on a central server
  - Users access the system through the internet or internal network
    - Can accommodate many users simultaneously
    - Protects information
- Extensive database
  - Automated features such as report generation
  - Storage compatibility
  - Surplus sharing program
  - May be integrated with procurement, training, and waste tracking

Chemical Inventory Basics

- **Database fields**
  - Chemical or tradename
  - CAS number
  - Hazards
  - Ingredient list
  - Owner/ purchaser
  - Location/organization
  - Dates: Order/received/expiration
  - Amounts: ordered, remaining, used
  - Lot numbers
- **Searches and Reports:**
  - Find an (M)SDS
  - Chemical Inventory Search
  - Chemical Regulatory Reports
  - Find Chemical Storage Locations
- **System-generated Alerts**
  - Expiration
  - Hazardous or reportable materials

123456

J.T.Baker

Fisher Chemical

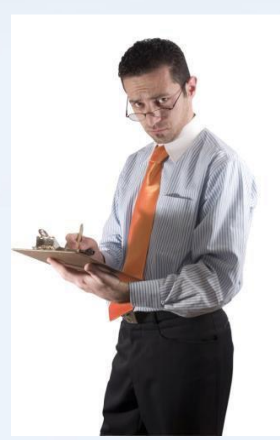
Inventory Management: Database

- The Database - information collected and tracked by the inventory system
- Varies from small to large, simple to complex
  - Individual amounts and algorithms to calculate total amounts
- Selection of database system depends on regulations and tracking interests
  - The size of the database may dictate how advanced your inventory management system needs to be

- Examples:
  - For synthesis labs
    - Enter synthesis products into inventory, or
    - just label properly
  - For Numerous Samples or Standards
    - Keep track of individual vials after preparation, or
    - Track batches, or
    - Just label properly

Inventory Management: Physical Inspection

- Inventory Audits/Reconciliation
- Assures accuracy of inventory database
- Provides visual assessment of chemical condition
- Should be done once or twice a year
  - More often for COCs



Inventory Management: Reporting

- Use of a computer/web-based system makes reporting easier
- Helps coordinate with emergency responders
- Inventory reports may be required by law or by institution policy
  - Based on location
  - Quantities of chemicals purchased or used
  - Price
  - Expiration
  - Transport
  - COCs

- 1994, California State University, Northridge
  - Magnitude 6.7 earthquake, epicenter a few km from campus
  - Fires in science buildings allowed to burn because chemical inventory/hazards unknown

Image courtesy: P.W. Weigand, California State University Northridge Geology Department,
Image source: Earth Science World Image Bank http://www.earthscienceworld.org/images

Inventory Management: Reporting

- A spreadsheet may be useful for emergency responders
- Use spreadsheet to create a summary of chemical hazards
  - For Institution
  - For building
  - For individual labs
    - Useful when making hazard door signs

Inventory Management: Access Control

- Different levels of access to inventory system and database
  - Students
  - Faculty, staff researchers
  - Department heads, system administrators
  - Chemical safety and security officers, centralized procurement

- Insider threat
  - Personnel management
  - Procurement
  - **Inventory management**
    - **Chemical Owner**
    - **Physical Inspection**
    - **Data protections**

- Outsider Threat
  - **Restrict access to information about COC locations and physical security**

Inventory Management: Examples/Demonstration

Barcode	Location	Date In	Name	Cas #	State	Quantity	Units	Container	Hazards/Alerts
AQ879816	124/2	2/12/2011	Sulfuric Acid	7664-93-9	Liquid	500	mL	Glass	acid
AQ879817	122/1	5/24/2003	Ferric Chloride	7705-08-0	Solid	500	gram	Metal Can	toxic, corrosive
AQ879818	124/3	1/1/2001	Oxygen	7782-44-7	Gas	5	m^3	Gas Cylinder	flammable
AQ879819	121/A	6/24/2005	Acetone	67-64-1	Liquid	1	L	Plastic	flammable
AQ879820	122/2	2/7/1998	Diethyl Ether	60-29-7	Liquid	1	L	Plastic	peroxide former
AQ879821	124/1	5/8/1996	Magnesium	7439-95-4	Solid	100	gram	Metal Can	flammable
AQ879823	121/B	5/30/2005	Pinacolyl Alcohol	464-07-3	Liquid	26	kg	Glass	CWC sch 2
AQ879824	121/A	10/24/2002	Sodium Cyanide	143-33-9	Solid	5	gram	Glass	toxic

- What key information is missing?
  - Owner

- For synthesis labs
  - Enter synthesis products into inventory or just label properly?

Group Discussion: Current Inventory Management

Group Discussion: Current Inventory Management

- What is your current inventory management system?
- What improvements would you like to see?

- **Please refer to handout**:
  – "Group Discussion: Current Chemical Inventory Management System (CIMS)"

Challenges Discussion

Challenges Discussion

- Return to your groups of 4-5
- Discuss with your group to answer the questions:
  1. Select a challenge topic for your group
  2. What are some of the challenges you face in this topic?
  3. What do you need to fix some of your challenges?
- Write down your answers and be prepared to share with the whole group

Take about 15-20 min

Challenge Discussion Topics

Procurement?

Chemical Storage?

Chemical Security?

Chemical Usage?

Chemical Disposal?

Chemical Transportation?

Emergency Response?

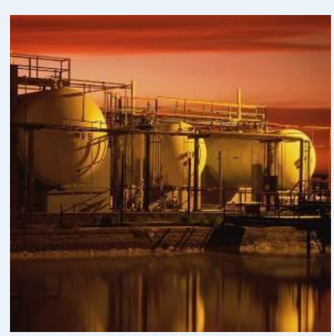
Chemical Storage

Storing Your Chemicals

- Storage Risk Management
- Storage Facility Design
- General Guidelines
- Reactive Chemicals
- Compressed Gas Cylinders
- Examples
- Access Control

Chemical Storage: Risk Management

- What chemicals are needed?
- Where will chemicals be stored?
- What are the hazards associated with chemical storage?
- Have the hazards been evaluated?
- Storage facility design considered?
- What measures can be taken to mitigate risk?

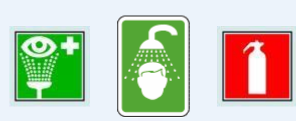


Chemical Storage: Risk Management

- *Select the type of storage on basis of:*
  - Quantity
  - Concentration
  - Chemical properties
    - State: gas, liquid, or cryogenic
    - Flammability
    - Toxicity
    - Reactivity
  - Storage conditions
    - Temperature and pressure

Storage Facility Design

- Secondary containment for spills or releases
- Fire detection, alarms, and suppression systems
- Safety and emergency response equipment
- Adequate ventilation
  - General ventilation
  - Local exhaust ventilation for transfers
- Access controls
- Alarms/sensors



Chemical Storage: General Guidelines

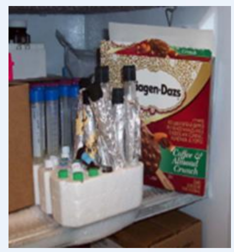
- Separate incompatible chemicals
- Separate flammables and explosives from ignition sources
  - Flammable storage cabinets
- Large containers on bottom shelves
- All containers properly labeled and closed

Chemical Storage: General Guidelines

- Wipe-off outside of container before returning to storage area
- Secure Chemicals of Concern
- Use secondary containment
  - Label with compatibility group
- Fasten storage shelves to wall or floor
- Shelves should have a lip and/or rod

Chemical Storage: General Guidelines

- **Do Not Store Chemicals**
  - On top of cabinets
  - On the floor
  - In hoods
  - Where there are wide variations in temperature, humidity or sunlight
  - In hallways
  - With food



Storage: Reactive Chemicals

- Water reactive, pyrophoric, oxidizers
- Peroxide-forming
  - Ethers, butadiene, tetrahydrofuran
  - Store in tightly closed original container
  - Avoid exposure to light, air, heat
  - Crystals or discoloration? Do not move or open container
  - Test for peroxides before using
    - Especially if distilling/concentrating
  - Know when to dispose
    - Mark when opened
    - Dispose even if unused

Storage: Compressed Gas Cylinders

- Secure (chain/clamp) and separate gas cylinders
- Screw down cylinder caps
- Store in well-ventilated area
- Separate and label empty cylinders
- Separate incompatible gases

Storage: Refrigeration

- Types
  - Ordinary, household refrigerator/freezers
    - **Are <u>NOT</u> safe for flammables**
  - Flammables-safe refrigerator or freezer
    - May contain flammables, but are NOT safe to be in areas with flammable vapors
  - Explosion-proof storage
- Proper refrigerator/freezer labeling
- Precautions
  - Stable power
  - Not all refrigerants are completely safe
    - Toxicity, flammability, and physical hazards
- Do not store peroxide formers in a refrigerator
- Defrost occasionally to prevent chemicals from becoming trapped in the ice formations

Storage: Drums

- Store drums in areas protected from moisture and high temperatures
- Maintain an inventory of drums
  - Safety data sheets
  - Label drum contents
  - Date waste drums
  - Test for peroxide-forming chemicals regularly
- Inspect drum storage areas for:
  - Corrosion
  - Bulging drums

Storage: Access Control

- Access limitations depend on the material or information
  - More control of access if chemicals of concern are present
- Lock areas, rooms, cabinets
  - Control of keys
- Label areas “Authorized Personnel Only”
  - Means of identifying authorized personnel
    - Challenge unfamiliar people in restricted areas
- Authorized personnel
  - Trusted, background check
  - Trained
  - Legitimate need

Storage: Good and Bad Examples

Chemical Storage

Conclusions

- It is possible to make chemical storage safer and more secure
- Safe and secure chemical storage requires
  - Space
  - Time
  - Training
  - Equipment
- Difficulties may be mitigated by operational controls
  - Substitution
  - Source reduction
- Can get help from an inventory system that tracks hazard classes

The Insider Threat

Objectives

- Define insider
- Characterize the insider threat
- Identify unique insider issues
- Discuss insider findings
- Address ways to mitigate the insider threat

Insider Definition

- An insider is any person who has ***authorized access*** (either escorted or unescorted) to ***controlled areas***
- Insiders may include:
  - Employees
  - Former employees
  - Contractors/Consultants
  - Suppliers
  - Visitors
  - Industrial collaborators
  - Inspectors

Insider Threat

An insider becomes a threat when he/she misuses his or her position/access. The threat posed by an insider can be:

- Intentional
  - based on insider intent and motivation
- Unintentional
  - Based on insider negligence/complacency

The Unintentional Insider Threat

Mitigating techniques include:

- Protecting information;
- Restricting 'need to know' of sensitive information;
- Safeguarding sensitive materials/technologies;
- Training of all personnel regarding elicitation, smart social engineering, and information security

Pre-Conditions of an Intentional Insider

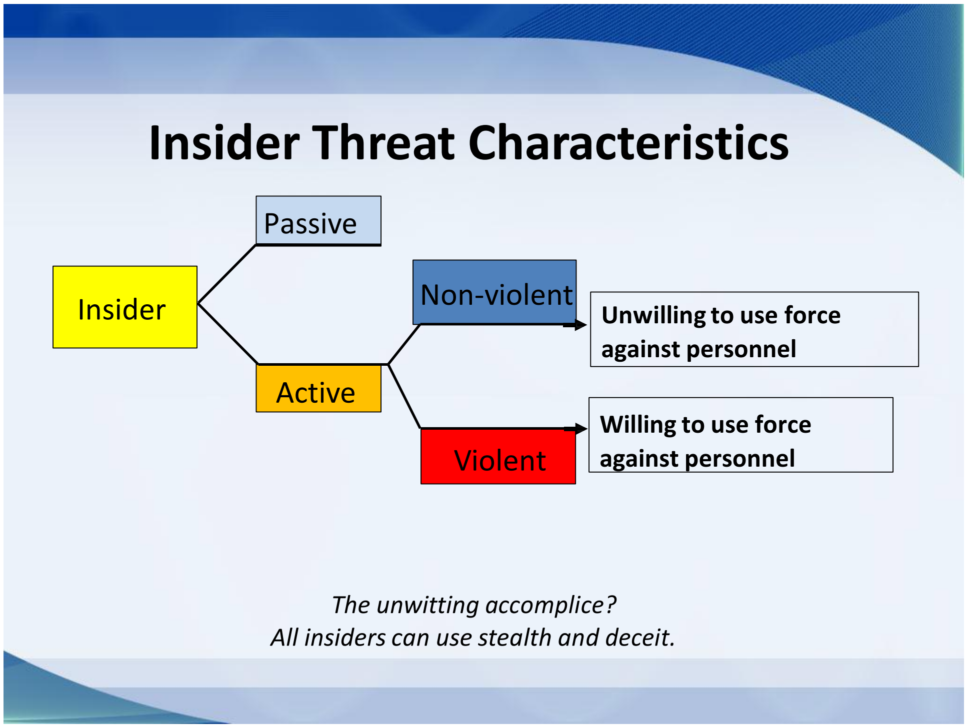
- Motive or need to be satisfied through the crime
- Ability to overcome inhibitions:
  - Moral values
  - Fear of being caught
  - Loyalty to employer or co-workers
  - Risk-taking behaviors
- Trigger that sets the betrayal in motion
- Opportunity to commit the crime
  - Poor and/or lax security practices

Insider Motivations

- Financial
- Animosity
- Excitement
- Blackmail/coercion
- Divided loyalties
- Arrogance
- The big three!
  - Greed
  - Disgruntlement
  - Revenge

Trigger

- Personal or professional event
- Stress pushing the individual to the "breaking point"
  - React negatively and criminally
  - React negatively without malicious action
  - React to stress in a positive manner



Insider Threat Characteristics

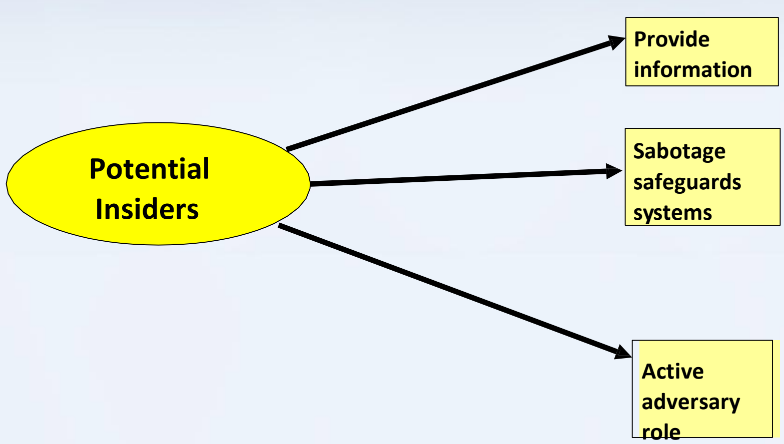
Insider Category	Characteristic
1. Passive	Provides information to a colluding adversary or an outside group
2. Active	Conducts physical acts alone or in collusion with others

And the active insider can be violent or non-violent

Insider Threat Characteristics

Insider Category	Characteristic
1. Active, non-violent	May tamper with and use limited covert force against safeguards; ***is not willing to be identified***
2. Active, violent	Uses overt force and tools against system elements or personnel to increase chances of success

The Insider Action



Regardless whether the insider is colluding or coerced, the breach and the result is the same

Insider Threat Event Study Findings

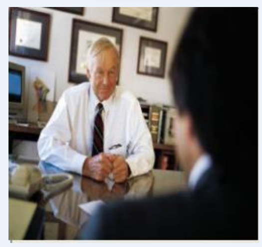
- Most insider events ***were triggered by a negative event*** in the workplace
- Most perpetrators had ***prior disciplinary issues***
- Most insider events were ***planned in advance***
- ***Only 17%*** involved individuals ***with special access***
- 87% of the attacks ***used simple methods*** that did not require any advanced knowledge
- 30% of the incidents took place at the insider's home using remote access (cyber related) to the organization's network

Mitigation at the Pre-Condition Stage

- Awareness of employee activities
- Provide resources for employees to seek help with difficult circumstances
- Require that employees work together so that they are not isolated
- Provide training to management and other employees to help recognize aberrant behavior

Management Practices to Mitigate Risk

- Screen personnel
- Monitor employee behavior
- Implement physical and administrative controls



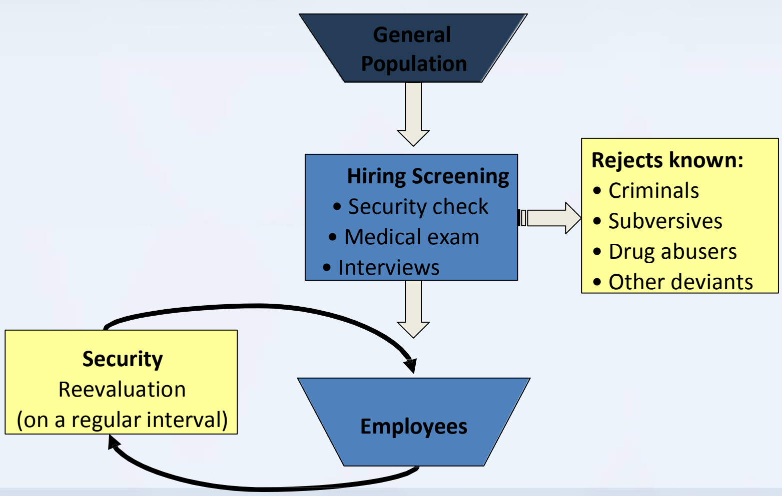
Response to Motive

- Provide resources for employee counseling
- Provide training for managers to intervene constructively in employee's circumstances
- Monitor employee's behavior to detect hostile actions early

Personnel Screening

- Initial background screening
- New-hire/rehire and periodic screening (may include things like)
  - Financial records check/government records disclosure
  - Substance abuse screening
  - Criminal activity
- Screening for suspected cause

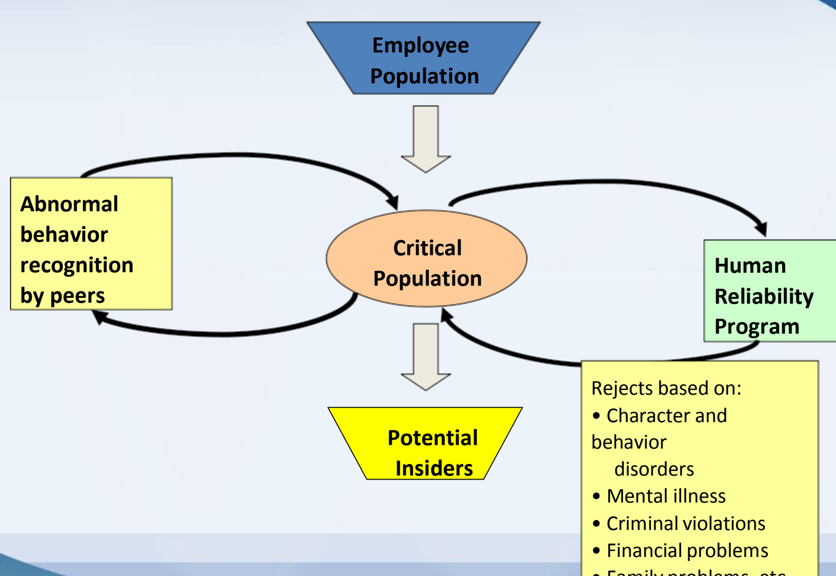
Personnel Screening Process



Employee Behavior Monitoring

- Managerial and coworker observation
  - Identify and report unusual behavior
- Security surveillance
- Performance evaluations
  - Work rules compliance

Employee Behavior Monitoring



Physical and Administrative Controls

- Administrative
  - Audits/Inspections
  - Least-user privileges
  - Change of employment status
- Tracking and monitoring
  - Cyber
  - Physical access
- Compartmentalization of information
- Physical protection systems
- Use of escorts

What Can You Do?

- Be alert
- Don’t be paranoid, but report concerns
- Screen your personnel
- Assess your vulnerabilities
- Be aware of aberrant behavior indicators

Training as a Mitigation Technique

Security awareness training and education can thwart the insider

- Seek out training opportunities
- Create unique and innovative training
- Bring external experts to your organization
- Make training relevant and interesting
- Use case studies whenever possible

Additional Insider Threat Reduction Measures

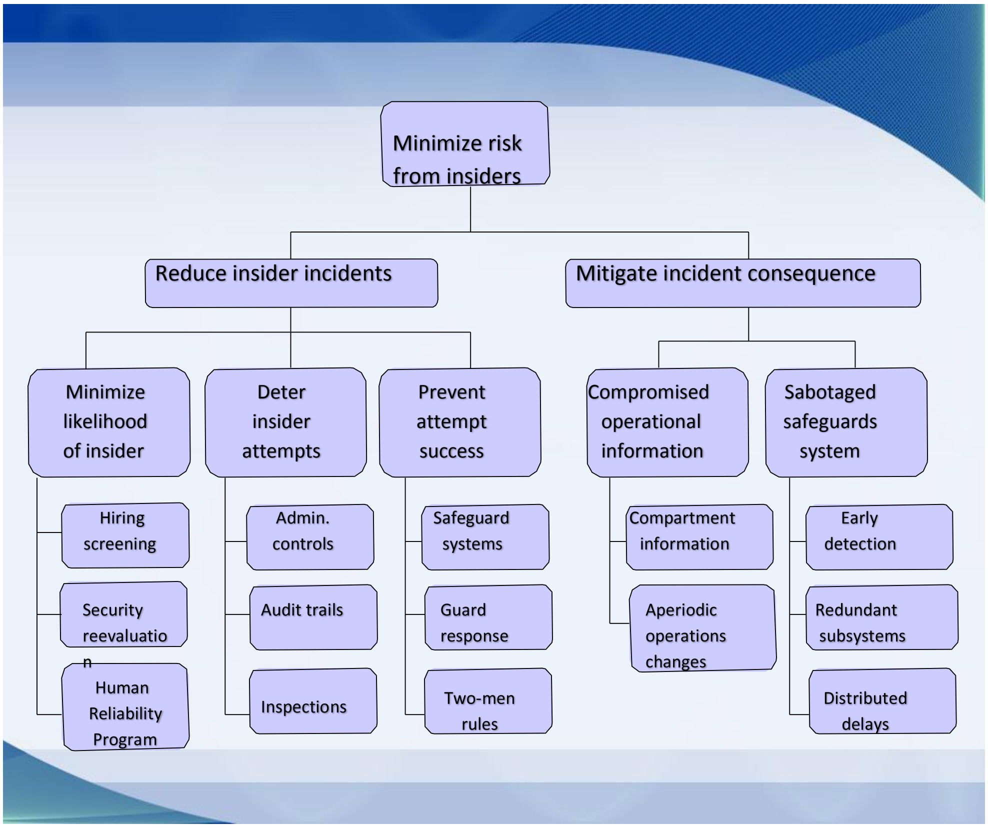
- Stress evaluation
- Drug testing
- Compartmentalization of facility/work area
- Random inventory assessment
- Prosecution of violations
- Operational security program

Response to Insider Actions

- Pre-Event
  - Report, question, and prosecute
- Post-Event
  - Respond – needs to be rapid
  - Follow emergency response plans
  - Report, question, and prosecute

Current Controls

- Outsider threat
  - In-depth controls and physical barriers, both adequate and effective
- Insider Threat
  - Administrative controls
  - Observational awareness
  - Strong security culture



Summary

- Insider threat presents unique problems
- Proactive programs will help identify and deter potential insiders
- Continuous observation and employee awareness are critical mitigation elements

Chemical Anti-Terrorism Awareness Program (CATAP)

Overview: Elements of CATAP

1. Anti-terrorism awareness
2. Anti-terrorism preparedness and planning
3. Identify targets and critical asses
4. Identify and assess likelihood of threats
5. Assess severity of consequences
6. Protective measures
7. Evaluate effectiveness of safeguards
8. Identify and implement improvements

Antiterrorism Awareness

- Chemical facilities can be targeted by terrorists
- Attacking chemical institutes enables access to materials and expertise required to make a bomb
- Safe and secure response to terrorist attack starts well before such an attack occurs
- Careful planning and preparation can minimize the chance of being attacked and mitigate any damage should an attack occur
- First step: thorough security vulnerability assessment followed by action to minimize/eliminate vulnerabilities

Security Vulnerability Assessment Defined

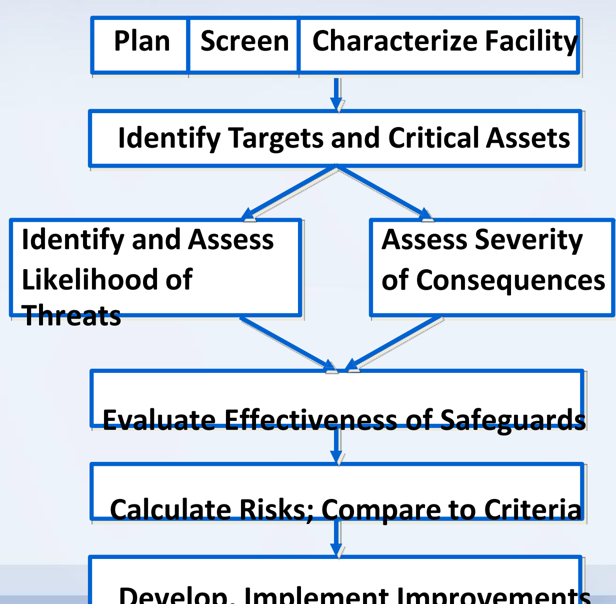
Security Vulnerability Assessment (SVA):

- A systematic evaluation process in which qualitative and/or quantitative techniques are applied to detect vulnerabilities and to arrive at an effectiveness level for a security system to protect specific targets from specific adversaries and their acts.

SVA Objectives

- Detect vulnerabilities (weaknesses) in a facility's ability to protect critical assets against adversaries
- Design security systems to achieve a desired level of effectiveness
  - Physical protection systems
  - Cyber security protection systems
- Can also extend to mitigation systems
  - Emergency response
  - Fire protection etc.

SVA Process



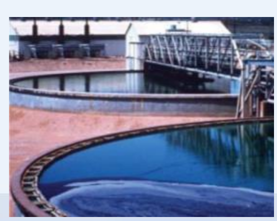
Beginning the SVA Planning Process

- Requires management commitment of resources
- Generally performed by a knowledgeable team
- May require specialized resources or experts
- Will involve data and information collection
- May require months to fully complete
- Should have a means of updating

See Garcia 2003 for getting started, collecting data

System Characterization: SCOPE

- Carefully define what is included and excluded from the SVA.
- For example, for a wastewater system, the scope may include either or both of:
  - Collection system (e.g., sewer mains to plant inlet)
  - Treatment plant



Categories of Possible Targets

- **Property** – Laptop or desktop computer, jump drive, personal digital assistant, television, etc.
- **Vehicles** – Facility vehicle, access to areas, passes removed
- **Information** – Computer control access, stored data, intellectual property
- **Personnel** – Identification, access codes

Original list from DHS Chemical Security Awareness Training

Examples of Possible Targets

Wastewater system key vulnerabilities:

- Collection systems
- Treatment chemicals
- Key components of treatment plant
- Control systems
- Pumping/lift stations

U.S. GAO report GAO-05-165

Wastewater plant - disinfection chemicals

Sulfur Dioxide

Liquid Chlorine

Examples of Possible Targets

Other possible targets:

- Key personnel
- Valuable assets (e.g. catalysts, copper)
- Vehicles
- Personal computers

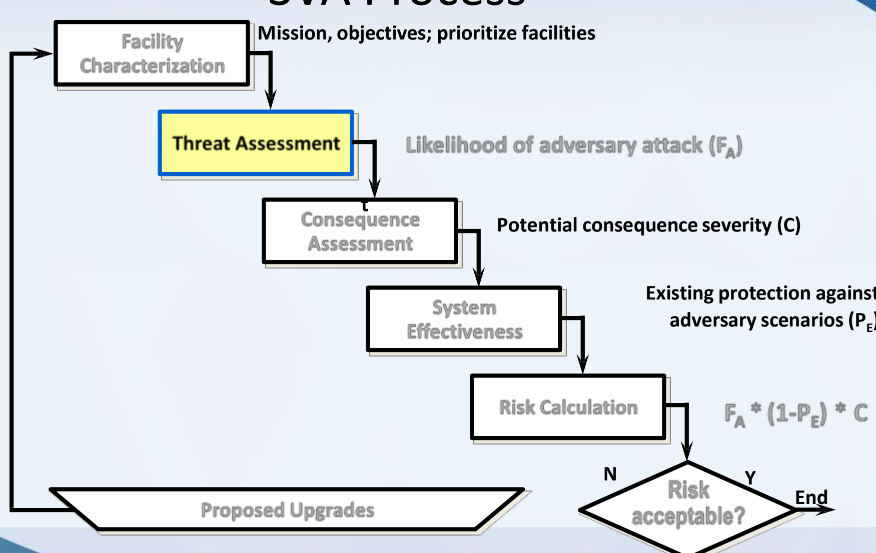
Keep in mind the plant's mission statement and success criteria when brainstorming targets and critical assets.

SVA Group Exercise

- Write down at least 6 possible targets of malevolent human actions at a chemical plant (or at your university).

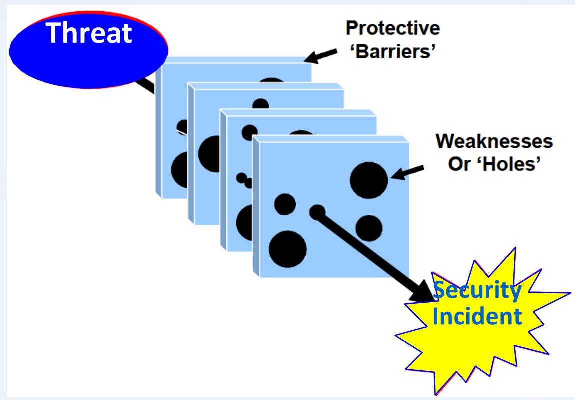
1	4
2	5
3	6

SVA Process



The "Swiss Cheese" Model

- The **threat assessment** identifies what security threats are present and how likely they are to initiate attacks on specific targets.



Threat Assessment: Motivation

- Motivation
  - Political, ideological, financial, personal
  - Willingness to get caught or die
- Intention
  - Theft, sabotage
  - **Other:** Stop operations, social disruption, political instability, economic harm

Threat Assessment: Capabilities

- Capabilities
  - Numbers
  - Weapons, equipment, tools
  - Explosives
  - Knowledge, skills, training
  - Tactics
  - Transportation methods
  - Insider assistance

Threat Assessment: The Adversary

Identify all potential threats

(intentional, malevolent human actions)

- **E.g.:**
- **Vandals**
- **Gangs, thieves**
- **Computer hackers**
- **Militia / Paramilitary**
- **Environmental terrorists**
- **Rogue international terrorists**
- **Insider threats; disgruntled employee**

Group Discussion

- What are some examples of **insider threats**?
- What makes the *insider* threat particularly difficult to analyze and protect against?
- What are some things that can be done to protect against *insider* threats ?

Assess Likelihood of Attack

Key considerations affecting likelihood:

- Presence in the area of the facility
- Access to the facility
- Stated/assessed intent to conduct attack
- History of attacks/threats
- Credible information indicating adversary has actually targeted facility
- Capability to achieve successful attack

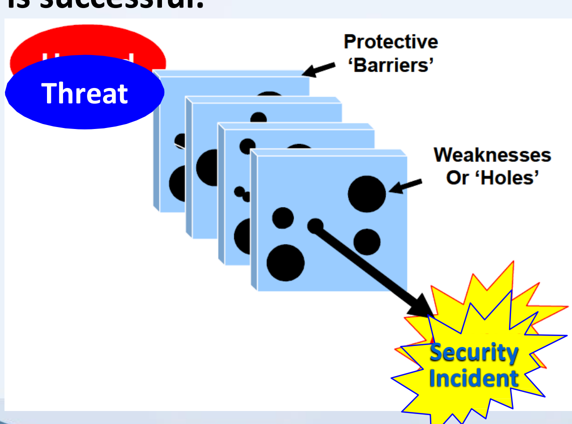
Consequence Severity

<u>Potential consequence</u> severity (C) is assessed as the potential impact if an attack <u>is</u> successful.

- Must consider intent and capabilities of each specific threat
- Can be evaluated as a matrix of threats vs targets or as a listing of scenarios
- Consider screening out those with lesser severity

Consequence Assessment

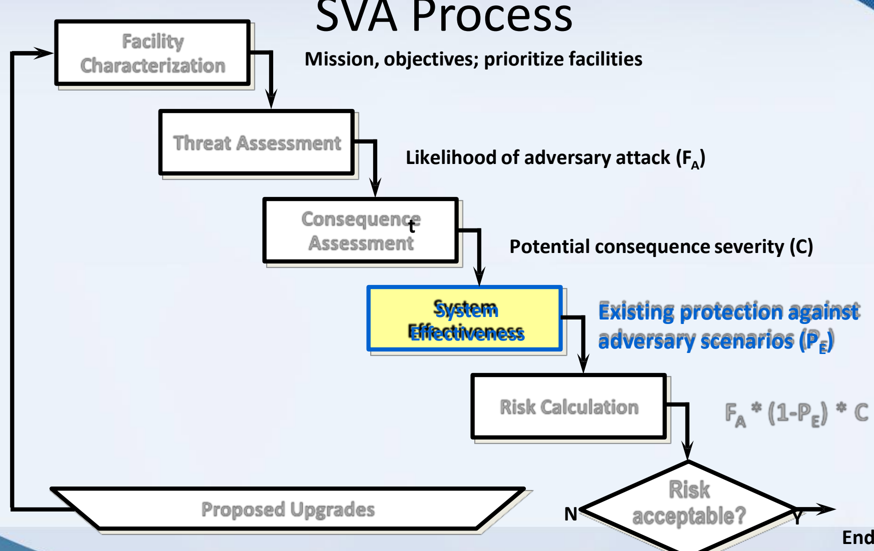
The consequence assessment determines <u>how severe the impacts can be</u> if an attack on a target is successful.



Types of Consequences

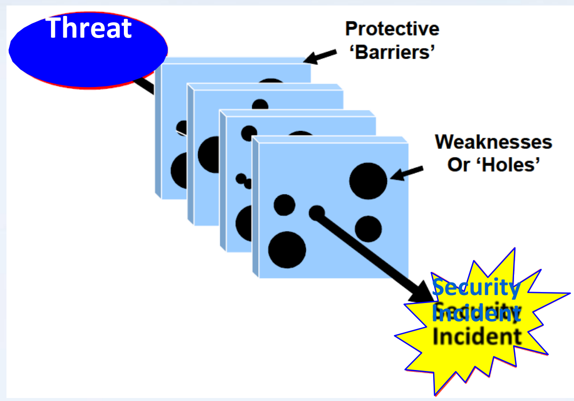
- Chemical release impacts:
  - Fires
  - Explosions
  - Toxic gas releases
- Theft of chemicals for release or use elsewhere (e.g., precursor chemicals)
- Financial and business impacts
  - Business interruption
  - Property damage
  - Trade secrets/information lost
- Fear and panic

SVA Process



System Effectiveness

The **system effectiveness** assessment determines how good the barriers are to keep an attack from being successful.



Safeguards Effectiveness

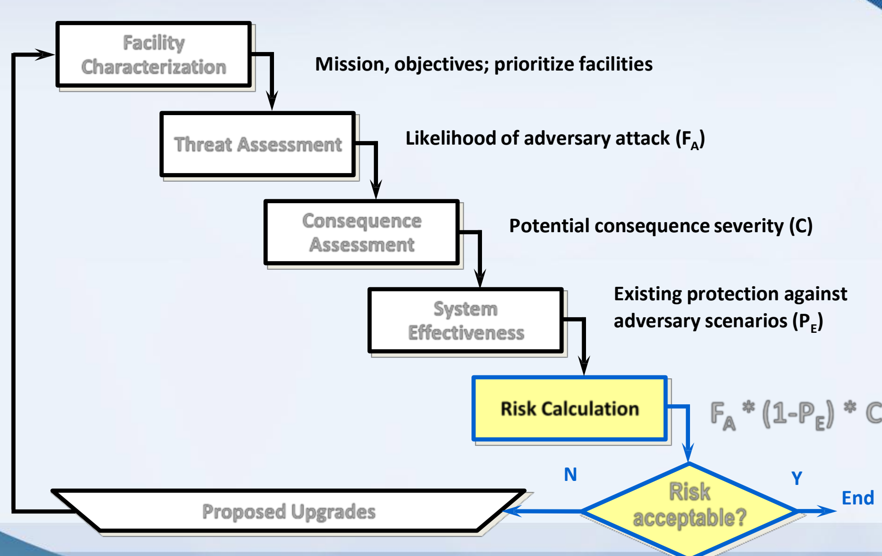
- The effectiveness of safeguards is maintained by **performance testing**.
- If any safeguard is not tested and maintained, do not count on it working!

Group Discussion

How can the performance of these physical protection system components be ensured?

- Closed-caption television camera system
- Security guards' visual detection
- Perimeter fence
- Access-control door locks
- Response force

SVA Process



Develop and implement improvements

- Address specific vulnerabilities identified in the SVA
- Address scenarios assessed to pose the highest security risk

Possible improvements

- Tendency: Add more physical safeguards (fences, cameras, locks, etc.).
- First priority: Make sure what you have will work.
  - Performance testing
  - Drills, tabletop exercises
- Also a priority: Make the facility inherently safer.
  - Minimize
  - Substitute
  - Attenuate
  - Simplify, limit effects, etc.

SVA Report

The SVA is generally captured in a report and/or management presentation containing:

- Objectives
- Team
- Approach
- Data and Analysis
- Results and Conclusions
- Recommended improvements

Updating the SVA

Keep in mind:

- "The search for static security, in the law and elsewhere, is misguided. The fact is, security can only be achieved through constant change, adapting old ideas that have outlived their usefulness to current facts."

- William O. Douglas, as quoted in Garcia 2003

Safety and security elements are mostly the same for hazards

Security threats are intentional and malevolent

Threat of:

- Release of hazardous material
- Destruction of critical assets
- Harm to key personnel
- Vandalism
- Theft,etc.

Threats are Caused by Adversaries

Threat of:

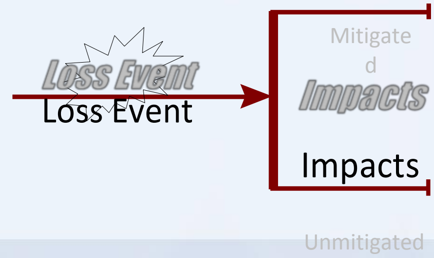
- Release of hazardous material
- Destruction of critical assets
- Harm to key personnel

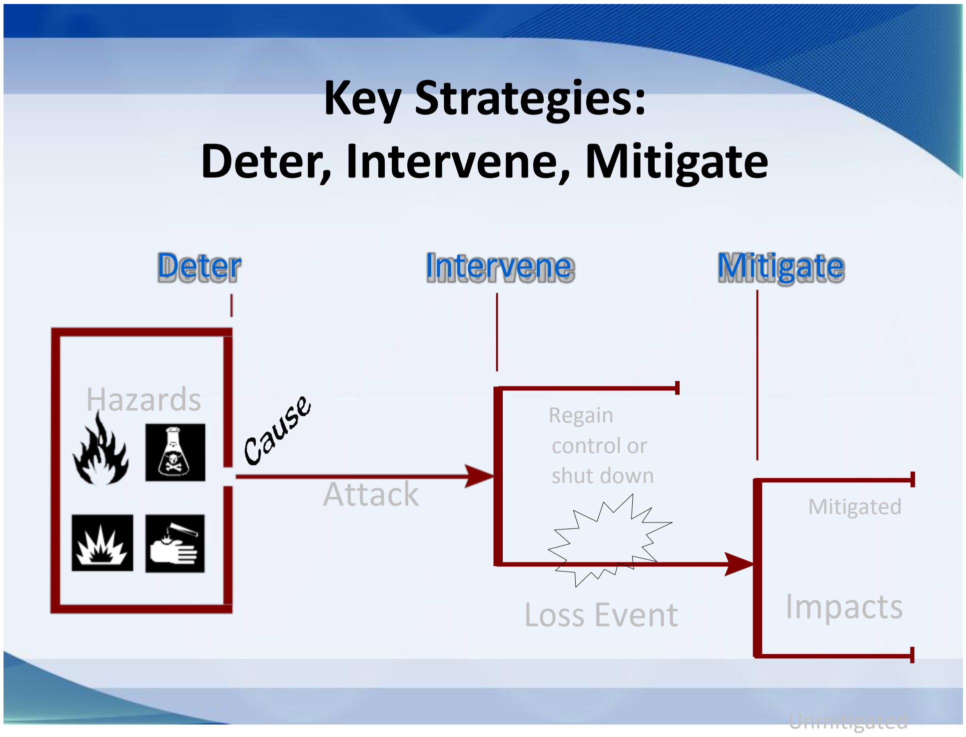
- Vandalism
- Theft
- Etc.

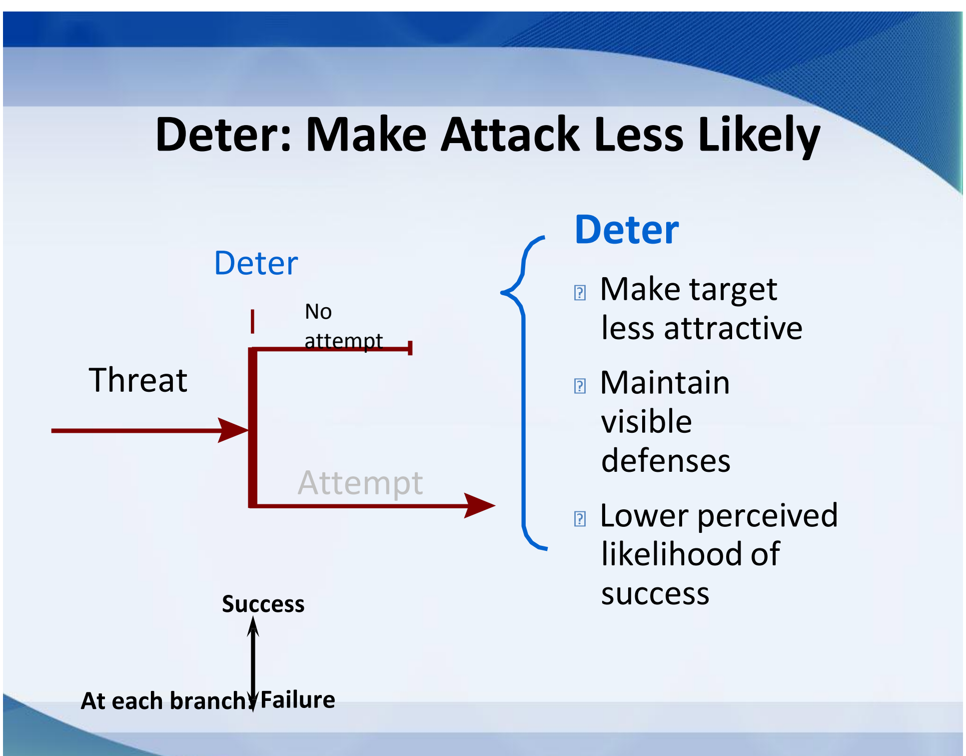
By:

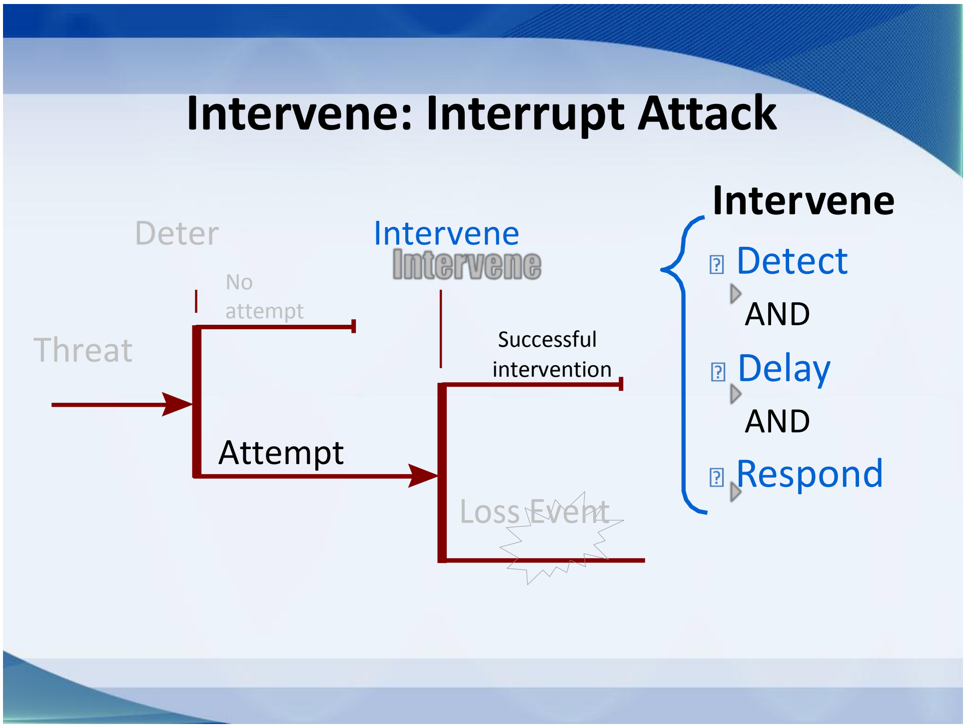
- Vandal
- Gang, thief
- Militia / paramilitary
- Environmental terrorist
- Rogue international terrorist
- Insider threat; disgruntled employee

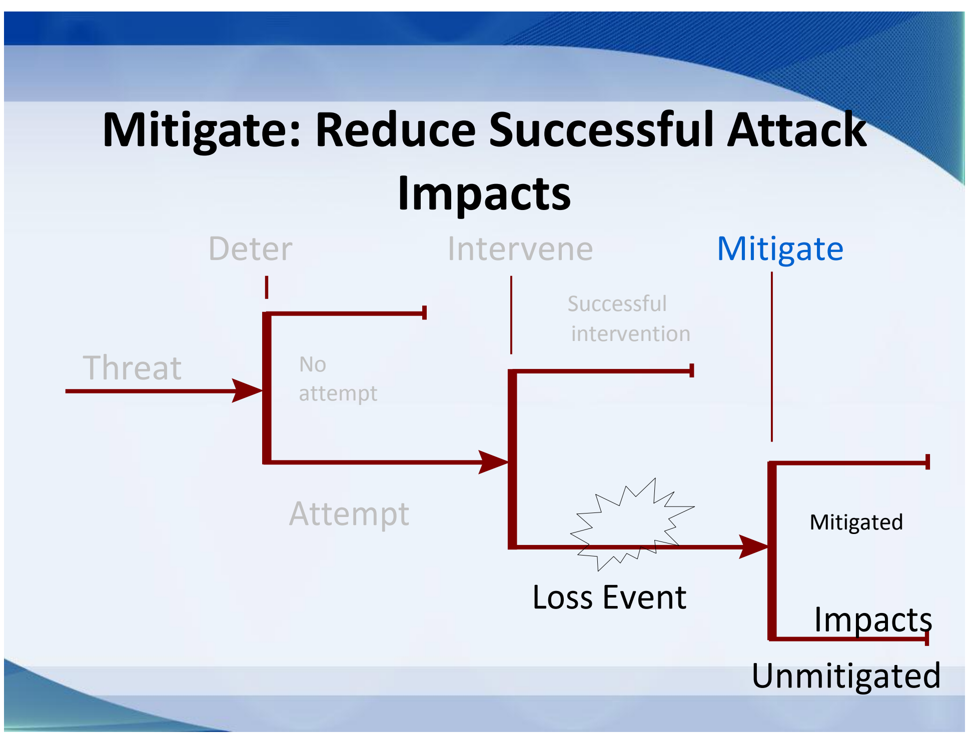
Impacts are Similar




Key Strategies:
Deter, Intervene, Mitigate
Deter
Intervene
Mitigate
Hazards
Cause
Attack
Regain
control or
shut down
Loss Event
Mitigated
Impacts
Unmitigated


Deter: Make Attack Less Likely
Deter
No
attempt
Threat
Attempt
Success
At each branch:
Failure
Deter
Make target less attractive
Maintain visible defenses
Lower perceived likelihood of success


Intervene: Interrupt Attack
Deter
Intervene
Intervene
No attempt
Threat
Successful intervention
Attempt
Loss Event
Intervene
Detect
AND
Delay
AND
Respond


Mitigate: Reduce Successful Attack Impacts
Deter
Intervene
Mitigate
Successful intervention
Threat
No attempt
Attempt
Mitigated
Loss Event
Impacts
Unmitigated

Summary of CATAP

1. Anti-terrorism awareness
2. Anti-terrorism preparedness and planning
3. Identify targets and critical asses
4. Identify and assess likelihood of threats
5. Assess severity of consequences
6. Protective measures
7. Evaluate effectiveness of safeguards
8. Identify and implement improvements

4

Prevent, Detect, and Disrupt Chemical Attacks

Collective Protection

Tactical Planning Process
for Chemical Incidents

Terminal Learning Objective

Apply the elements of tactical mission planning for a successful resolution of a chemical incident.

colorado.gov

Enabling Learning Objectives

1. Principles of Chemical/hazardous material tactical planning
2. Planning process and procedures as they apply to hazardous material tactical planning, protection, and practice/rehearsal
3. Elements of a tactical warning order, operations order, and supplemental order
4. Safety planning pertaining to the tactical planning process

Principles of Hazardous Materials Tactical Planning

US Army

- Acquiring good information/intelligence
  - Essential Elements of Information (EEI)
  - Other Intelligence Requirements (OIR)
- Anticipating actions of terrorists / criminals
- Timely dissemination of decisions and orders
- Rapid decision-making

Decision Making and Tactical Planning

- Understand the problem
- Assemble all available facts
- Seek out all courses of action to reach a solution
- Consider each course of action and identify obstacles
- Mission statement elements
  - Who
  - What
  - When
  - Why
  - Where

Receive Mission

- Notification of an incident
- Analyze the mission
  - Determine specified and implied tasks
- Delegate planning functions to staff
- Begin planning

Situation Elements


SAIC

- Task organization
- Weather and light considerations
- Responding force information
- Crisis site information
- Hazardous materials information
- Suspect(s) information

Situation Elements
Hazardous Materials Information

- Chemical agent involved
  - Type
  - Size
  - Description
- Current disposition of hazardous materials
- Handling requirements
- Potential for release
- Type of harm presented
- Protection measures required (e.g., Level C personal protective equipment)
- Health hazards
- Locations and methods of decontamination

Mission

- Clear and precise statement of overall purpose:
  - Who
  - What
  - When
  - Where
  - Why

Execution

- Three main areas:
  1. Concept of operations
  2. Special instructions to each team
  3. Coordinating instructions

Concept of the Operation

- Heart of operations order
- Commander’s overall vision of how the operation is to be conducted

Coordinating Instructions

- Used for special instructions pertaining to two or more response units and includes:
  - Movement information
  - Environmental considerations
  - Critical information requirements
  - Time schedule
  - Evacuation routes and procedures
  - Areas of safe refuge
  - Rally points

Equipment

- Equipment
  - Equipment common to all
  - Personal Protective Equipment (PPE) as needed

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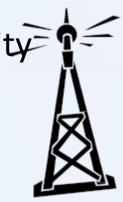
Support

- Detailed support plans for operation
- Site security and control
- Decontamination
- Emergency medical treatment and first aid
- Safe distances and places of refuge
- Suspect handling plan
- Agencies involved

SAIC

Command and Communications

- Command
  - Location of command post during operation
  - Other centers of command
  - Chain of command for operation/lines of authority
- Communications
  - Radio frequencies, signals, codes
  - Emergency alerting and response procedures



Issue the Operations Order

- Short briefing
  - Concept of operations
- Standard Operations Order format
- Use maps, sketches, diagrams, models, sand tables, chalkboards
- Issue order to all members participating in operation

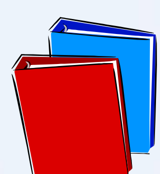
Inspect and Rehearse

NCBRT 2012

- Inspect equipment and personnel
  - Ensure equipment is present
  - Ensure personnel understand roles
- Supervise full dress rehearsal, if situation permits
  - If not, talk through response actions
- Require brief back by emergency response teams

Supplemental Order

- Disseminate changes to the operations order
- Same format as operations order
- No need to issue a new operations order
- Affect only the specified section of the operations order



Strategic Safety Considerations and Planning Elements (1 of 2)

1. Pre-emergency planning/coordination with outside parties
2. Personnel roles, lines of authority, training, and communication
3. Emergency recognition and prevention
4. Safe distances and places of refuge
5. Site security and control
6. Evacuation routes and procedures

Strategic Safety Considerations and Planning Elements (2 of 2)

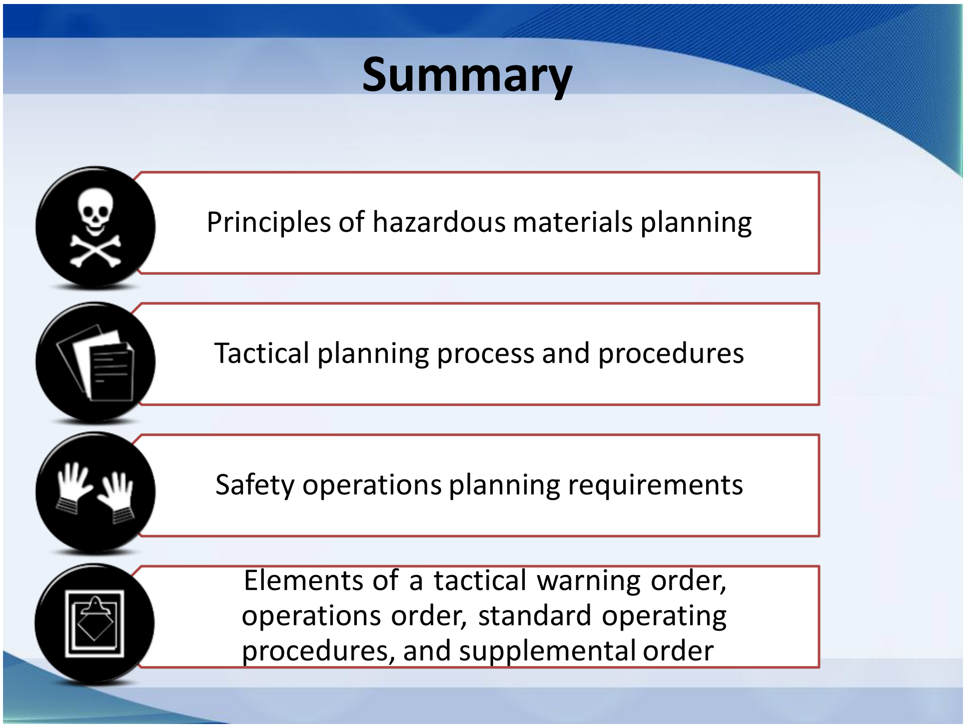
7. Decontamination
8. Emergency medical treatment and first aid
9. Emergency alerting and response procedures
10. Critique of response and follow-up
11. PPE and emergency equipment
12. Local/state emergency response plan

Other Plan Requirements: Tactical (1 of 2)

- Emergency Action Plan, Site Safety and Health Plan, Incident Action Plan
  - Goals and objectives
  - Unity of command
  - Communications plan
  - Agent involved
  - Type of harm presented

Other Plan Requirements: Tactical (2 of 2)

- Protection measures to be implemented
- Signs and symptoms of exposure
- Location and methods of decontamination
- PPE required
- Emergency evacuation procedures
- Location of safe areas of refuge
- Rally points


Summary
Principles of hazardous materials planning
Tactical planning process and procedures
Safety operations planning requirements
Elements of a tactical warning order, operations order, standard operating procedures, and supplemental order

Collective Protection

Protection Plans: Command and Communication Strategies for Chemical Incidents

Topics

- Human factors: stress, processing challenges and managing fear during any crisis.
- Importance of weapons of mass destruction incident response planning and preparation
- Developing a Crisis Communications Plan PRIOR to any emergency.
- Key decisions and policies required by a weapons of mass destruction incident

Crisis Communications—Human Factors

- Communicating during a crisis different from doing so under normal circumstances
- Hear, see and process information and environment differently
- Acutely focused on own priorities
- Treat public with respect
- Explain processes
- Delegate tasks

http://thegrio.com/2010/08/26/slideshow-iconic-images-of-hurricane-katrina/#s:katrina-slideshow-jpg

Crisis Communications—Human Factors

- Due to “tunnel vision”: imperative to keep BOTH operational instructions and public messages clear, simple and consistent
- Follow-up communications
  - Frequent
  - Calm
  - Empathetic
- Develop an effective Command Structure

Possible Target Sites in Your Community

- What are the probable targets in your jurisdiction?
- What unique problems do these targets present to emergency responders and the general public?
- What are the estimated numbers of persons that could be affected in the event of a weapons of mass destruction attack?

Potential Target Sites

- Airports
- Shopping malls
- Research/Medical facilities
- Theaters
- Seaports

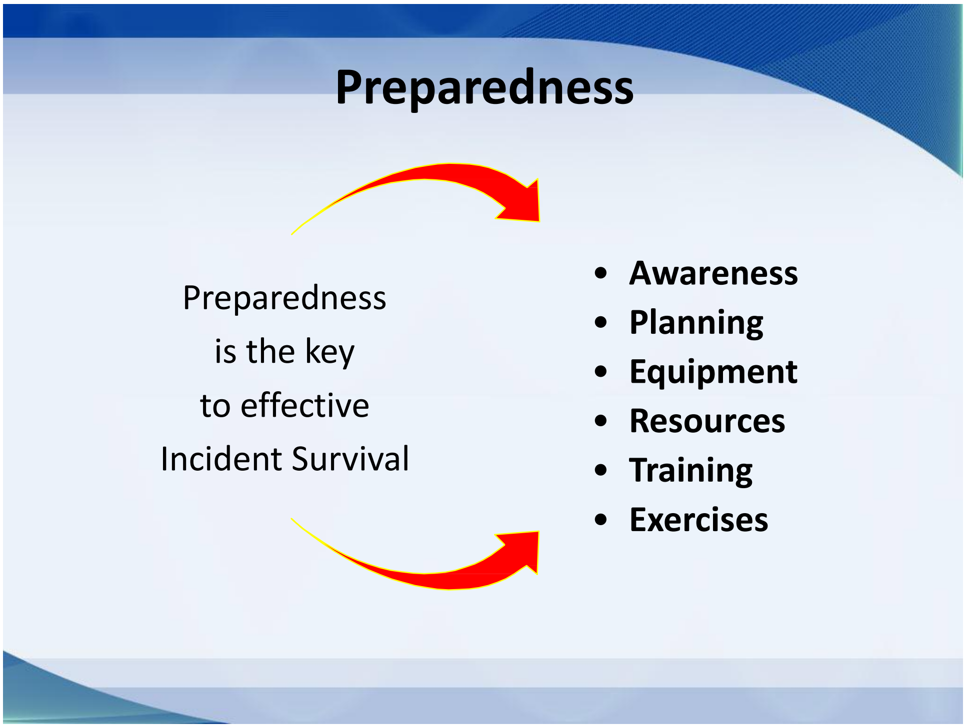
- Embassies/diplomats' residences
- Special events
- Government facilities
- Universities/schools
- Parks
- Sport stadiums/arenas

Oklahoma City Bombing

- At 9:02 a.m. 19 April 1995, rental truck containing approximately 3175 kg of ANFO explosive was detonated in front of the Alfred P. Murrah Federal Building
- 168 people were killed, including 19 children, and over 800 others were injured
- Deadliest terrorist attack on American soil before the September 11 attacks

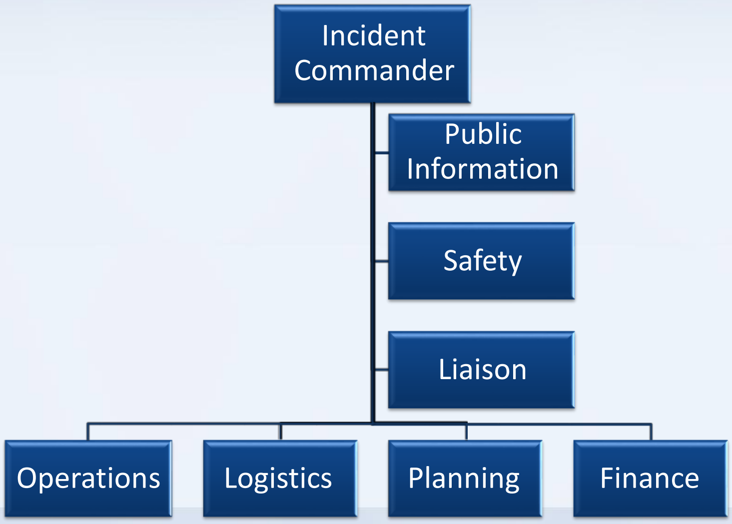
Oklahoma City Lessons Learned

- One effective incident command post
- Perimeter and access control needs to be established early
- Standard & cell phone overload during first 12–18 hours
- Multiple Mobile Command Posts produced fragmented data for Incident Command Post
- Joint Information Center should be established early
- Victim tracking is essential for evidence management


Preparedness
Preparedness is the key to effective Incident Survival
• Awareness
• Planning
• Equipment
• Resources
• Training
• Exercises


How to Manage & Succeed in Weapons of Mass Destruction Incidents
• In order to succeed, you must have:
– A coordinated plan that includes how to deal with
• Mass casualties
• Mass decontamination
• Secondary devices
– A unified training program
– Appropriate equipment and resources

Incident Command/ Unified Command

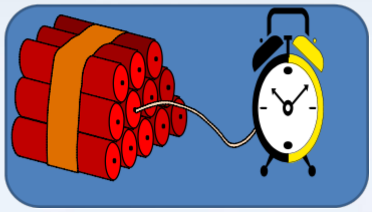


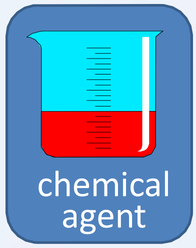
Strategic Command Considerations Overview

- Scene Safety
- Command, Control, Communications
- Decontamination
- Triage, Treatment, Transportation
- Media Management and Information Control
- Resource Management

Secondary Device Tactical Considerations

- Secondary devices may be present
- Establish secondary device plan and procedures
- Be aware that the perpetrator may be at the scene





First Response (1 of 2)

- Discuss each step in the event of a chemical attack:
  - Establish Incident Command
  - Establish communications
  - Secure, isolate, and deny entry to area
  - Establish safety zones
  - Establish water supply, hose lines, and suppression duties

First Response (2 of 2)

- Discuss each step in the event of a chemical attack:
  - Identify if live victims remain in the area of attack
  - Rescue live victims
  - Establish casualty collection points
  - Perform mass decontamination, triage, and treatment of victims
  - Monitor and maintain water runoff

First Response at the Workplace

- When first responders arrive, a person needs to be appointed to work with responders as a liaison
  - Should be trained in advance, not ad hoc
  - Understand and prepare to provide all information available
  - Work closely with first responders and workplace safety officers, emergency management and management

Preparedness

- Begin planning now
- Who might be impacted by a chemical release in your workplace
  - Special medical needs or disabilities
  - Schools
  - Commercial or residential
  - Potential high value targets
- Work with management, local governments and first responders to develop plans, shelter-in-place kits and increase awareness

Emergency Plan

- Make an emergency plan
  - Include steps to protect yourself and co-workers
  - Identify the best room to seal off
  - Develop a Shelter-in-Place kit and have it available
  - Make a checklist of what needs to be done
  - Assign tasks to staff members
  - Keep an updated phone list (doctor, emergency room, fire, police)
  - Note local TV channels and radio stations

Stockpile Resources

- Consider working with government and private entities
- Discuss your shelter-in-place plan with other office building tenants
- With combined resources, it may be possible to stockpile equipment, medications and supplies

Security in the Workplace

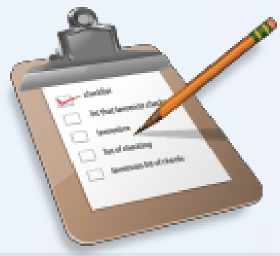
- Implement security measures in your workplace to protect your staff
  - One main entrance to the building
  - Emergency exits are not accessible from the outside
  - Institute a sign-in/sign-out policy for visitors

Source: ttp://www.mysecuritysign.com/img/lg/K/Security-Badges-Must-Worn-Sign-K-1269.gif

  - Have a tracking system for employees (badges)
  - Ensure that the tracking system is available to authorized staff, and that more than one person has access

Conduct Risk Assessments

- Conduct risk assessments of your workplace to identify areas that need to be addressed
- Share best practices with others



Discussion Questions

- What security measures can be implemented easily?
- For those that cannot be implemented easily, what other options exist?
- Do you conduct risk assessments of your facilities?
- What areas did those risk assessments find as potential security concerns?
- Does your workplace need a security officer? Why or why not?

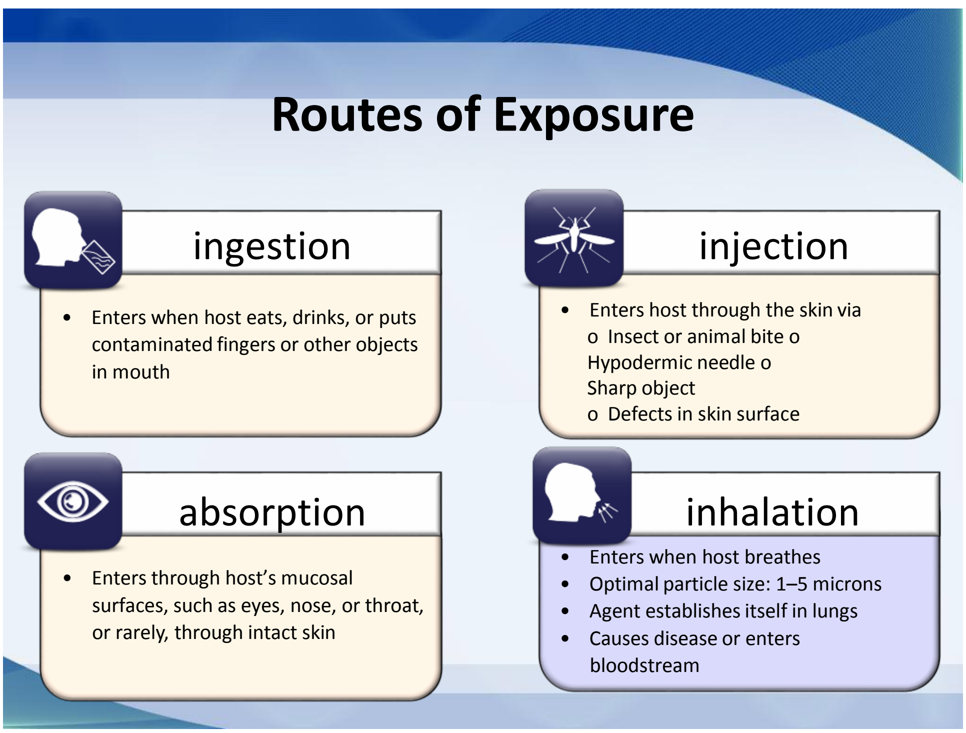
WMD Awareness

Chemical Agents & Explosives Precursors

Enabling Learning Objectives

- Identify chemical agents that may be used by terrorists
- List routes of exposure for chemical agents
- Recognize chemical attack indicators
- Recognize precursors to the production of explosive devices


Categories of Weapons of Mass Destruction
Chemical
Biological
Radiological
Nuclear
Explosive


Routes of Exposure
ingestion
• Enters when host eats, drinks, or puts contaminated fingers or other objects in mouth
injection
• Enters host through the skin via
o Insect or animal bite o
Hypodermic needle o
Sharp object
o Defects in skin surface
absorption
• Enters through host's mucosal surfaces, such as eyes, nose, or throat, or rarely, through intact skin
inhalation
• Enters when host breathes
• Optimal particle size: 1–5 microns
• Agent establishes itself in lungs
• Causes disease or enters bloodstream

Types of Harm

- Thermal
- Radiological
- Asphyxiation
- Chemical
- Etiological
- Mechanical
- Psychological

Chemical Agents

Advantages

- Immediate effect
- Easily spread
- Tie up resources
- Psychological impact

Disadvantages

- Requires large quantities
- Production and deployment hazardous to terrorist
- Less difficult to prepare for

Categories of Chemical Agents

- Nerve
- Blister
- Blood
- Choking
- Irritant


Emergency Response to Terrorism: Law Enforcement Response to WMD Incidents, LSU ACE

Chemical Warfare

- Uses toxic properties of chemical substances as weapons
- Distinct from nuclear warfare and biological warfare
- Considered hazardous material

Source: http://www.defense.gov/multimedia/

Chemical Warfare

- Not conventional weapons
- Does not depend upon explosive force
- Highly dependent upon chemical agent properties

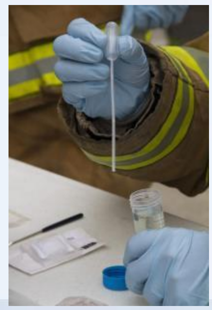
Source: http://www.defense.gov/multimedia/

Chemical Warfare

- Primary effects of chemical weapons can be overcome
- Nations possess vast stockpiles of weaponized agents
- Threat and the perceived threat have become strategic tools

Chemical Weapons Convention

- About 70 different chemicals used or stockpiled as WMD during the 20th century
- Visit http://www.opcw.org for more information



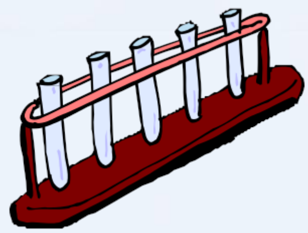
Source: http://www.defense.gov/multimedia/

Chemical Weapon Groups

- Schedule 1
  - Have few, if any, legitimate uses
  - Include nerve agents, ricin, lewisite, mustard gas
  - Production over 100g of these chemicals must be notified
  - A country can have a stockpile of ≤1 ton (0.91 metric ton)

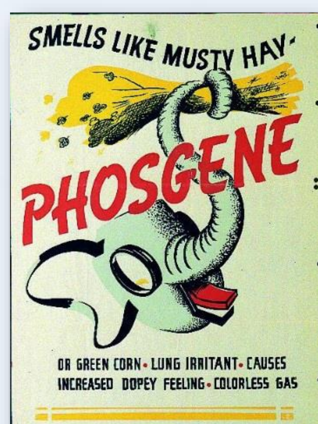
Chemical Weapon Groups

- Schedule 2
  – Have no large-scale industrial uses, but may have legitimate small-scale uses



Chemical Weapon Groups

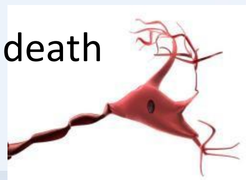
- Schedule 3
  – Have legitimate large-scale industrial uses
  – Must be notified of, and may inspect, any plant producing >27.22 metric tons per year



Source:
http://en.wikipedia.org/wiki/File:Phosgene_poster_ww2.jpg

Nerve Agents

- Disrupt chemical communications through the nervous system
- Leads to an accumulation of acetylcholine at the nerve axon, producing a perpetual excited state (e.g., muscle contraction)
- Leads to respiratory failure and death



Nerve Agent Characteristics

Sarin (GB)

Nonpersistent,
Evaporates rapidly
Boiling point: ~158°C
Vapor density: 4.86
Specific gravity: 1.0887

V Agent (VX)

Persistent, remains for weeks or longer
Boiling point: ~148°C
Vapor density: 9.2
Specific gravity: N/A

Persistency

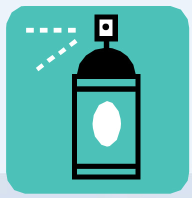
- Measure of length of time a chemical agent remains effective after dissemination
- Classified as persistent or non-persistent
  - Non-persistent lose effectiveness after only a few minutes or hours

Persistent Agents

- Tend to remain in the environment for as long as several weeks, complicating decontamination
- Persistent deployment does not aim at annihilating the enemy but to constrain him
- Defense against persistent agents requires shielding for extended periods of time

Non-Persistent Agents

- Tend to remain in the environment for minutes to hours, evaporating rapidly
- Non-persistent deployment aims to annihilate the enemy without denying access to the area



Nerve Agent Exposure

Routes of Exposure

- Inhalation
- Skin absorption
- Ingestion
- Injection

Signs and Symptoms

- Pinpoint pupils
- Runny nose
- Difficulty breathing
- Loss of consciousness
- Convulsions/seizures
- Sweating
- Nausea/vomiting

Blister Agents (Vesicants)

- Chemical compound that irritates and causes injury to skin
- Also attacks eyes, or any other tissues it contacts
- Vesicants
  - Substances that produce large fluid-filled blisters on skin

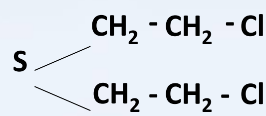
http://en.wikipedia.org/wiki/File:Blister-arm.jpg

Blister Agent Characteristics

- Types
  - Mustard (H)
  - Distilled Mustard (HD)
  - Nitrogen Mustard (HN1, HN3)
  - Lewisite (L)
- Mustard Characteristics
  - Persistent
  - Boiling point: varies
  - Vapor density: varies
  - Specific gravity: varies
- Lewisite Characteristics
  - Persistent
  - Boiling point: 190°C
  - Vapor density: 7.1
  - Specific gravity: 1.88

Mustard (H): An Unusual Chemical

- Oily liquid
- Light yellow to brown



- Vapor heavier than air; persistent
- Persistent liquid; slow to form vapor
- Liquid mustard heavier than water
- Liquid freezes at 14°C (58°F) (marginal vapor hazard in cold weather)

Blister Agent Exposure

Routes of Exposure

- Inhalation
- Skin absorption
- Ingestion

Emergency Response to Terrorism: Law Enforcement Response to WMD Incidents, LSU ACE

Signs and Symptoms

- Reddening of skin
- Convulsions
- Respiratory failure
- Sluggish
- Apathetic
- Lethargic
- Fever

Blood Agents (Cyanide)

Types

- Hydrogen Cyanide (AC)
  - Non-Persistent
  - Boiling Point: 26°C
  - Vapor Density: .099
  - Specific Gravity: .69
- Cyanogen Chloride (CK)
  - Non-Persistent
  - Boiling Point: 13°C
  - Vapor Density: 2.1
  - Specific Gravity: 1.22

Signs & Symptoms

- Increased respirations
- Dizziness
- Headaches
- Cardiac Symptoms
- Odors: burnt almonds or peach kernels

Routes of Exposure

- Inhalation
- Skin Absorption
- Ingestion
- Injection

Choking Agent Exposure

Types

- Chlorine (CL)
  - Non-Persistent
  - Boiling Point: ~-34ºC
  - Vapor Density: 2.5
  - Specific Gravity: 1.46
- Phosgene (CG)
  - Non-Persistent
  - Boiling Point: 7.56ºC
  - Vapor Density: 3.42
  - Specific Gravity: 1.38

Signs & Symptoms

- Coughing
- Choking
- Chest Tightness
- Odors: chlorine, bleach, swimming pools, or newly mown hay or grass

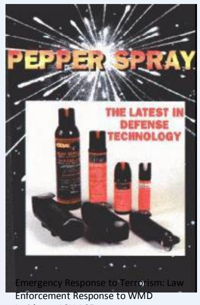
Routes of Exposure

- Inhalation
- Skin Absorption

Irritants

Types

- CS (Tear Gas)
- CR (Tear Gas)
- CN (Mace)
- OC (Pepper Spray)
- **NON-PERSISTENT AND LIGHTER THAN AIR**



Emergency Response to Terrorism: Law Enforcement Response to WMD Incidents, LSU ACE

Signs & Symptoms

- Immediate burning of eyes
- Coughing
- Involuntary eye closure
- Stinging sensation on moist skin
- Odors: hair spray or pepper

Routes of Exposure

- Inhalation
- Skin Absorption

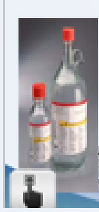
Chemical Attack Indicators

- Dead animals
- Lack of insect life
- Unusual liquid droplets
- Discolored or dead plant life
- Unexplained odors
- Low lying clouds
- Unusual metal debris
- Written or verbal threats

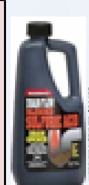
Explosives Precursors

- Acids
  - Commonly used in production of explosives
  - May be mixed to allow for proper chemical reactions

Explosives Precursors



Nitric Acid (HNO_3)	Sulfuric Acid (H_2SO_4)
• Major chemical used in explosive recipes • Forms nitroglycerine when combined with glycerin during nitration	• Most commonly produced chemical in world • Found in home improvement stores



Explosives Precursors

Muriatic Acid

- Chemical name is hydrochloric acid
- Used to balance pH in swimming pools and for cleaning bricks
- Readily available and easily purchased in home improvement stores

Lowe's

Explosives Precursors

Acetone (Dimethyl Ketone)

- Colorless, volatile liquid with sweet smell
- Main ingredient in fingernail polish remover
- Primary use as a solvent
- Used in chemical and drug labs
- Found in home improvement stores

Maxx Beauty

A&M Sales

Explosives Precursors

Hydrogen Peroxide (H_2O_2)

- Common over-the-counter antiseptic
  - 3% concentration
- Found in industry and transported in concentration up to 70%
- Most common industrial strengths: 27.5%, 35%, & 70%

Conney

Explosives Precursors

Hexamine (Hexamethylenetetramine)

- Solid fuel found in tablet form
- Used in making HMTD
- Found at outdoor camping stores
- Instructions for extracting hexamine from tablets found online

Zen Stoves

Explosives Precursors

Ethylene Glycol (Antifreeze)

- Used to make ethylene glycol dinitrate (EGDN)
  - Nitroglycerine-like explosive
  - Generic brands preferred, since they have fewer additives and are easier to distill

Rallye

Explosives Precursors

Toluene (Methylbenzene)

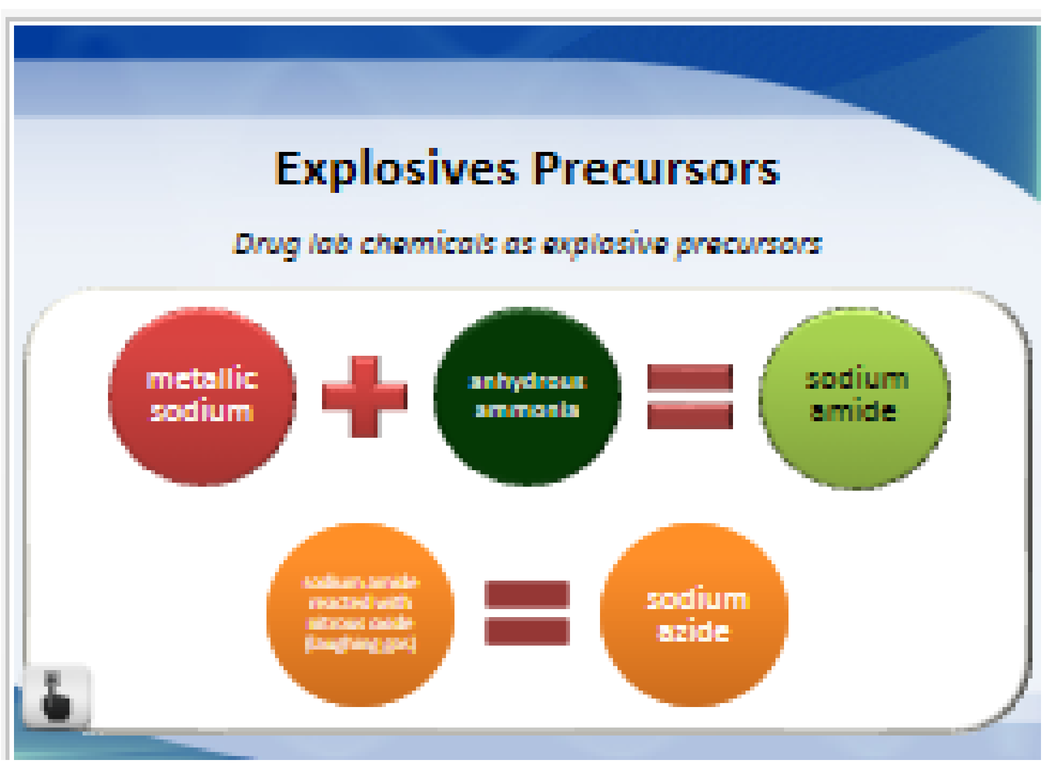
- Clear, sweet-smelling liquid
- Used as a solvent
- Found in paint thinners
- May be purchased at home improvement stores
- May be found in chemical and drug labs

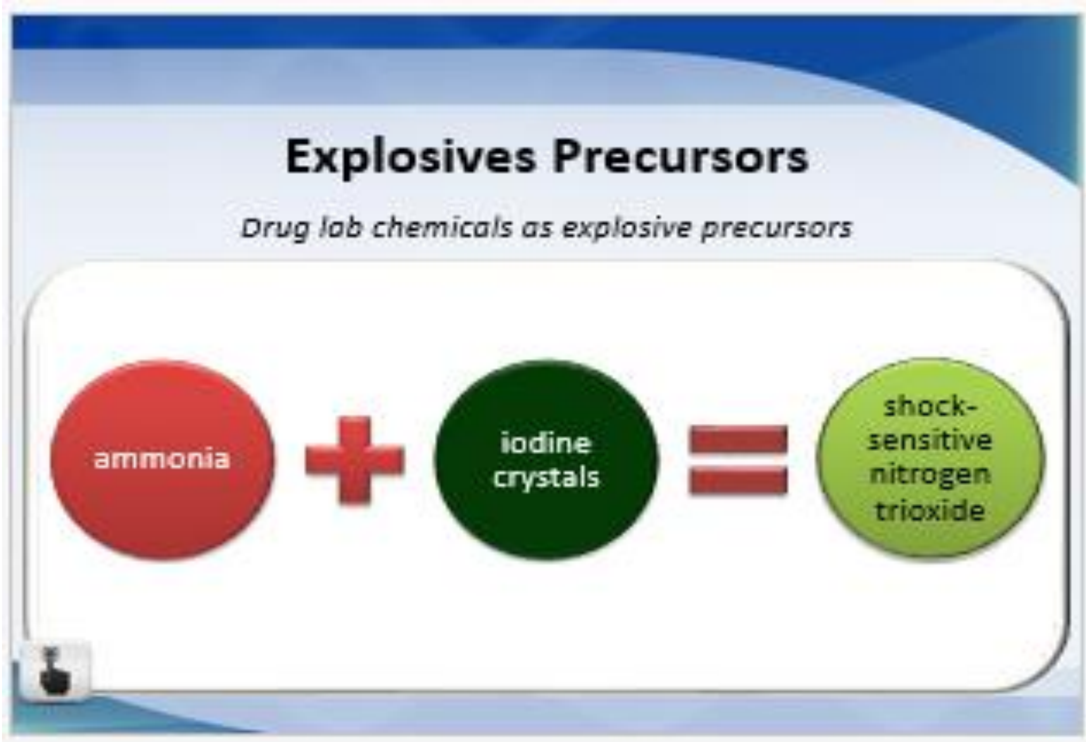
Sherwin-Williams

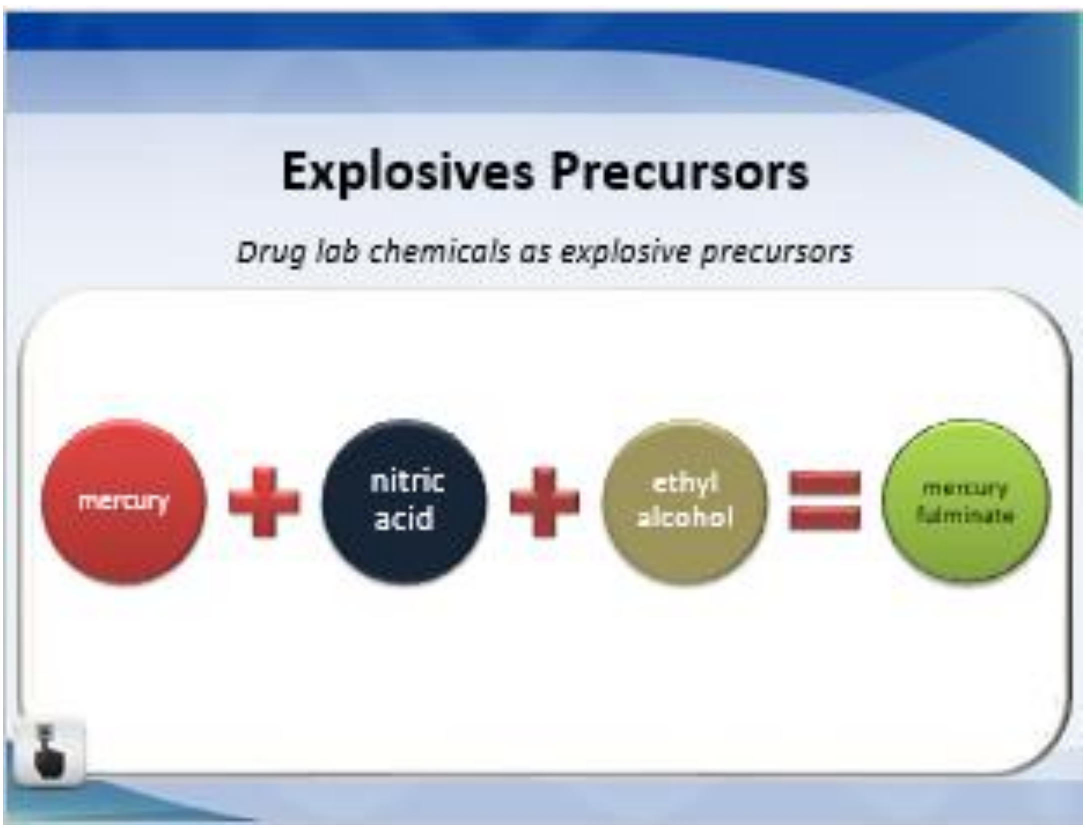
Explosives Precursors

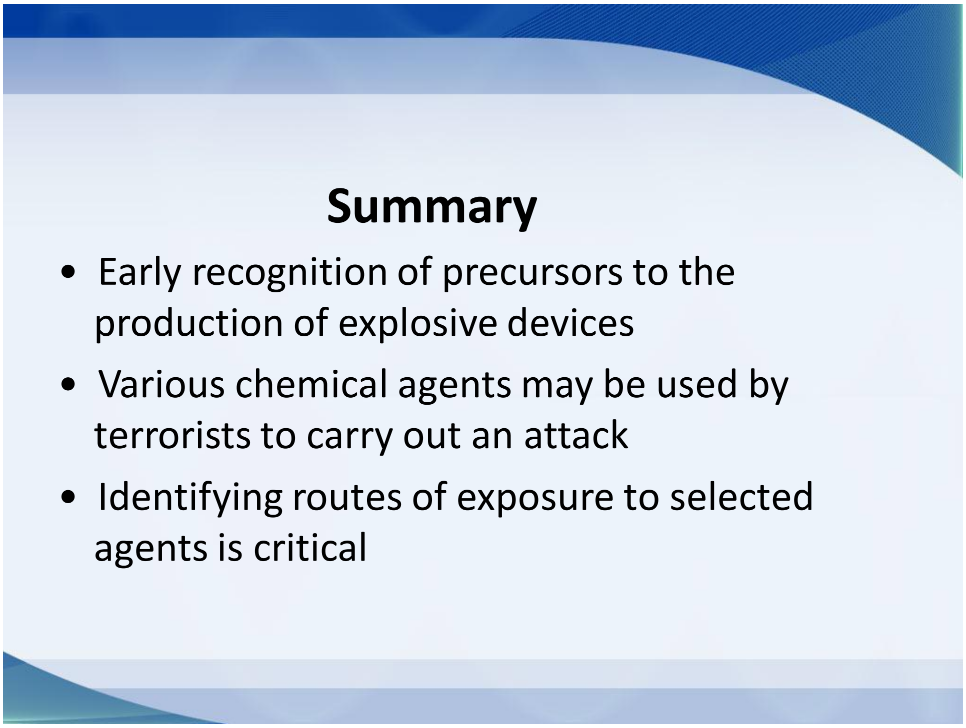
Glycerin

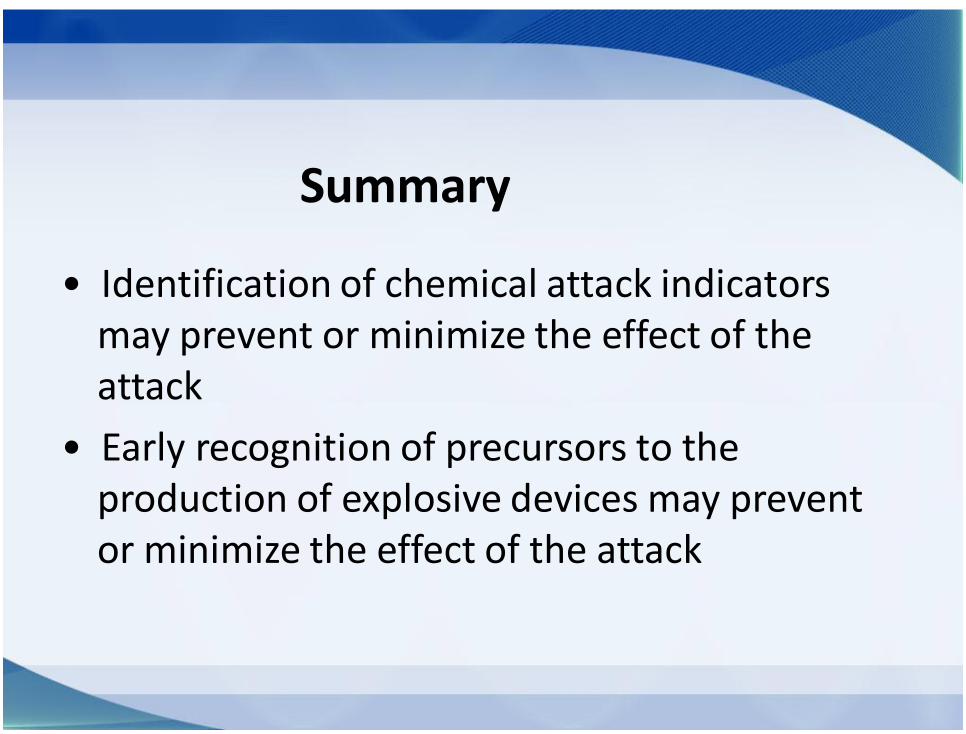
- Colorless, thick liquid
- Used in pharmaceuticals, perfumes, cosmetics, soaps, and antifreeze
- Used to make nitroglycerine and other explosives
- Easily obtainable




Explosives Precursors
Drug lab chemicals as explosive precursors
ammonia
iodine crystals
shock-sensitive nitrogen trioxide


Explosives Precursors
Drug lab chemicals as explosive precursors
mercury
nitric acid
ethyl alcohol
mercury fulminate


Summary
• Early recognition of precursors to the production of explosive devices
• Various chemical agents may be used by terrorists to carry out an attack
• Identifying routes of exposure to selected agents is critical


Summary
• Identification of chemical attack indicators may prevent or minimize the effect of the attack
• Early recognition of precursors to the production of explosive devices may prevent or minimize the effect of the attack

WMD Awareness

Identifying Clandestine Labs

Enabling Learning Objectives

- Describe laboratory classifications
- Identify various laboratory equipment
- List precursors that may indicate the presence of a laboratory
- Describe suspicious items that may indicate potential terrorist attacks

Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) Production Recognition

- Labs differ in size, shape, configuration, level of sophistication, and complexity

NCBRT

Dugway Proving Ground

CBRNE Production Recognition

- Labs combine hazardous materials incidents and crime scenes

LSU/NCBRT

LSU/NCBRT

4

CBRNE Production Recognition

- Do not assume:
  - All chemical, biological, explosive or drug labs look alike
  - A lab is not sophisticated enough to make certain products
  - Lab operators are not technically competent enough to produce a final product
  - Precursors, chemicals, and equipment are unobtainable

5

Activity Phases of Laboratories

1 Pre-Production Phase

- Assemble supplies, chemicals, and other equipment
- Steal, purchase, produce
- Many processes use everyday household chemicals and equipment

AristaTek

Gear Patrol

6

Activity Phases of Laboratories

2 Production Phase

- Produces the final product
- Usually the most hazardous phase

Bryan Wad

7

Activity Phases of Laboratories

3 Post-Production Phase

- Disposal of waste or degradation products

Virginia Department of Emergency Management

Arizona Attorney General

8

Laboratory Classifications

- Operational
  - Lab actively manufacturing product
  - Reactions or processes occurring
  - Containers may be open
  - Chemicals may be out of their original containers
  - Most dangerous type
- Non-Operational
  - Pre-production phase completed
  - Equipment may be set up and in place
  - Chemicals may be out of their original containers
  - No chemical reactions or processes occurring

Laboratory Classifications

- Boxed
  - Chemicals, supplies, and equipment stored or boxed up

- Mobile
  - Moving or "rolling"
  - May be non-operational, operational, or boxed

Clandestine Drug Laboratories

- Range from highly sophisticated to makeshift labs
- Can be found anywhere
- Produce many different types of drugs; primarily methamphetamine
- Are easy to manufacture

Clandestine Chemical Laboratories

- Theft of precursor materials may be an early indicator of a chemical laboratory
- Strange odors
- Strange behavior by persons occupying location
- Illegal disposal of materials
- Dead animals or unusually large amounts of garbage

Chemical Lab Equipment

- Glassware
- Flasks
- Beakers
- Graduated cylinders
- Pipettes
- Funnels
- Tubes
- Weighted stand
- Miscellaneous
- Heaters

Umea University

Chemical Lab Equipment

Sears

Boiling Flask

Enasco

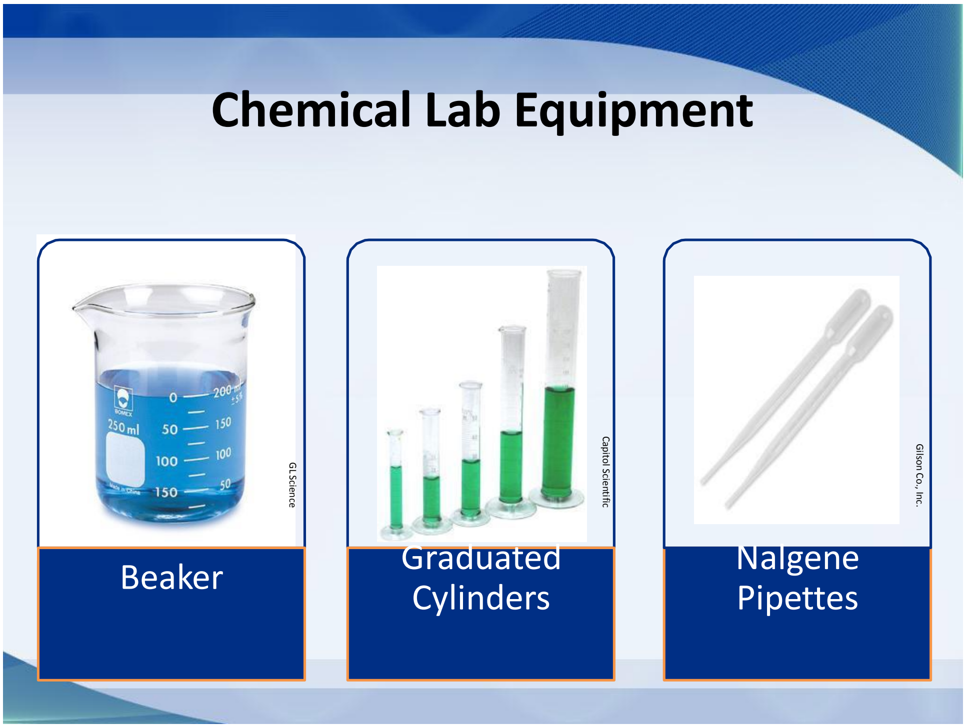
Volumetric Flask

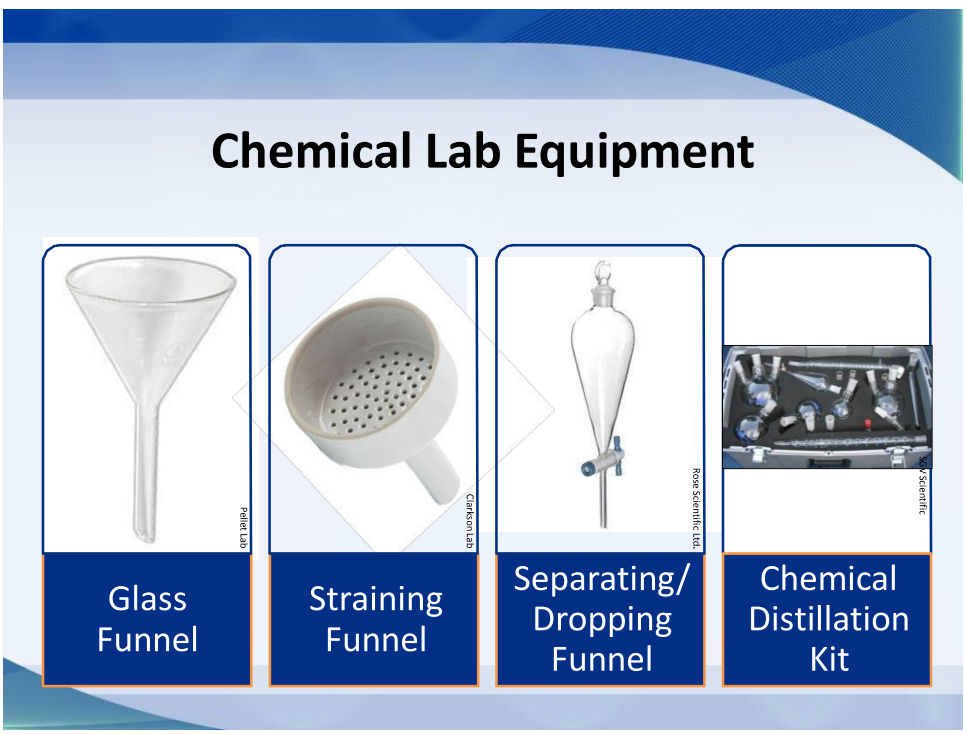
Novatech

Erlenmeyer Flask

Cole-Parmer

Vacuum Flask


Chemical Lab Equipment
GL Science
Beaker
Capitol Scientific
Graduated Cylinders
Gilson Co., Inc.
Nalgene Pipettes


Chemical Lab Equipment
Pellet Lab
Glass Funnel
Clarkson Lab
Straining Funnel
Rose Scientific Ltd.
Separating/ Dropping Funnel
Chemical Distillation Kit


Chemical Lab Equipment
CU Boulder
Watch Glass
American Science Surplus
Vials
Rapid
Evaporating Dish
Science First
Test Tubes


Chemical Lab Equipment
Direct Industry
CU Boulder
Medical Expo
Heaters
Cole-Parmer
Infrared
Heart Best
Digital
Hoskin
Mercury

Chemical Lab Equipment

You Shang

Ring Stand with Clamps

Direct Industry

Hoses

Science First

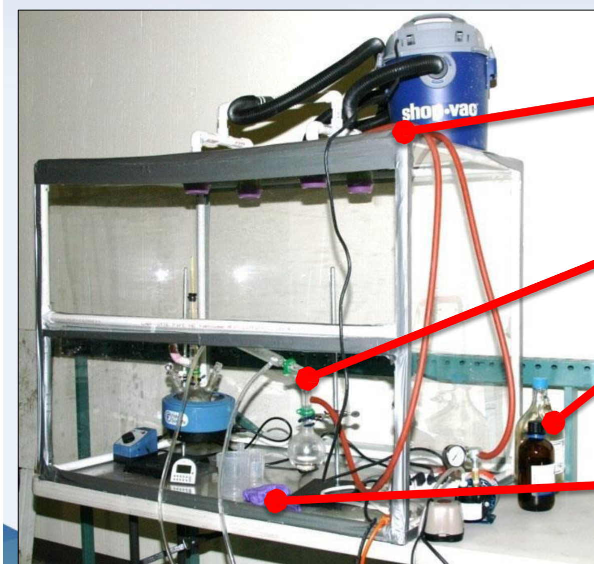
Brushes

Lab Comparison: Equipment

Drug Lab	Chemical Agent Lab
• Coffee pots and 2-liter bottles • Mason jars • Styrofoam coolers and thermos bottles • Maybe mobile and backpacks	• Good quality, clean glassware • Chemicals in original, well-marked containers • PP

Lab Comparison: Chemicals

Drug Lab	Chemical Agent Lab
• Methyl alcohol	• Phosphorus trichloride
• Iodine	• Methyl alcohol
• Acetone	• Phosphorus
• Phosphorus	• Sulfuric acid
• Anhydrous ammonia	• Sodium fluoride
• Lithium	• Acetylene
• Sulfuric acid	• Hydrochloric acid

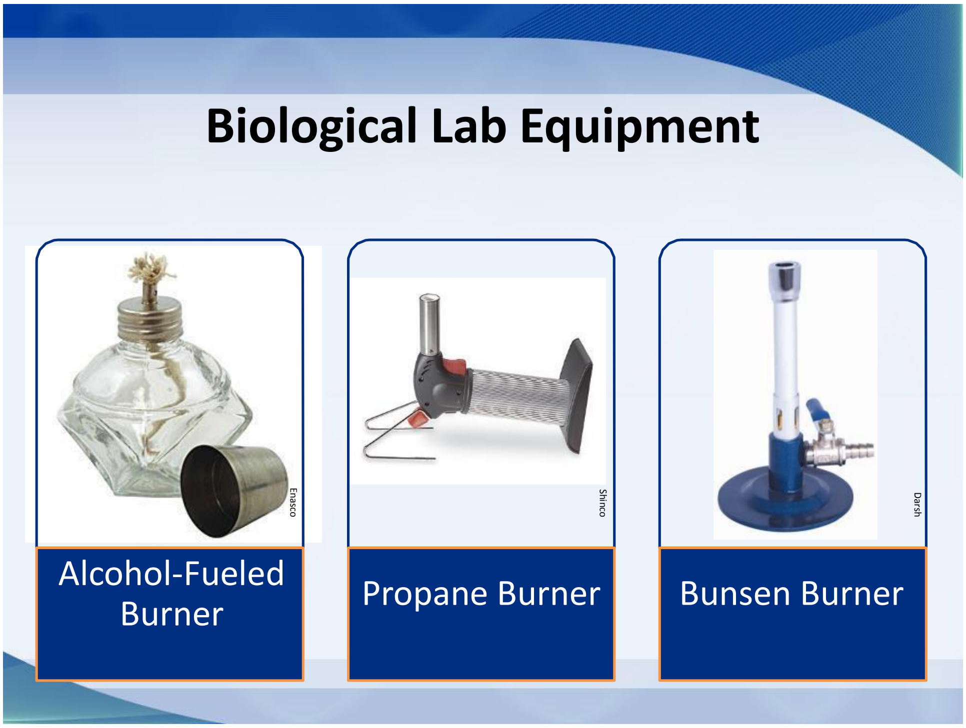


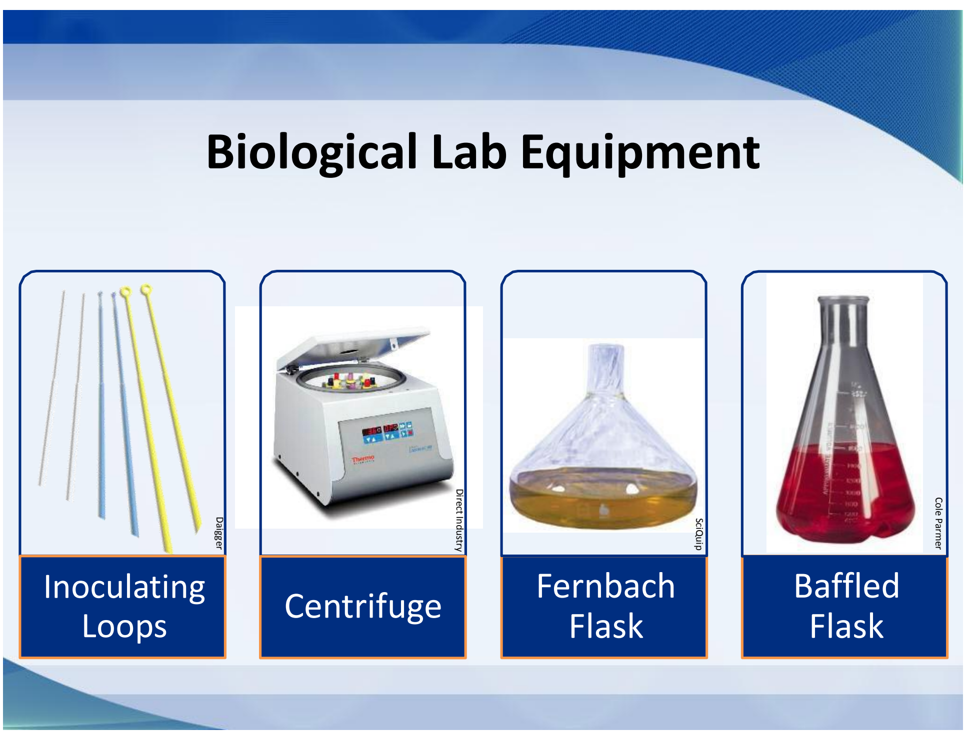
Homemade fume hood using a shop vac and respirator cartridges

Distillation apparatus visible

Chemicals in labeled containers

PPE present


Biological Lab Equipment
Enasco
Alcohol-Fueled Burner
Shinco
Propane Burner
Darsh
Bunsen Burner


Biological Lab Equipment
Dagger
Inoculating Loops
Direct Industry
Centrifuge
SciQuip
Fernbach Flask
Cole Parmer
Baffled Flask

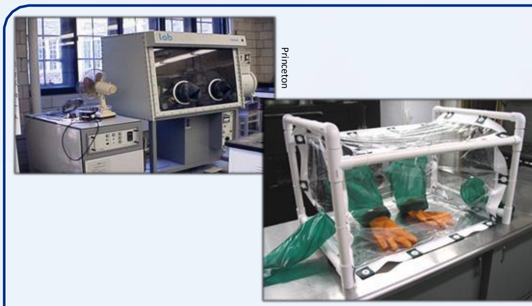
Biological Lab Equipment

Culture Tubes

Petri Dish

Biological Lab Safety Equipment

Biological Safety Cabinet



Glove Boxes

Biological Lab Growth Equipment

CUHK

Seven Bridges

Cornell

Bioreactor Systems

Biological Lab Growth Equipment

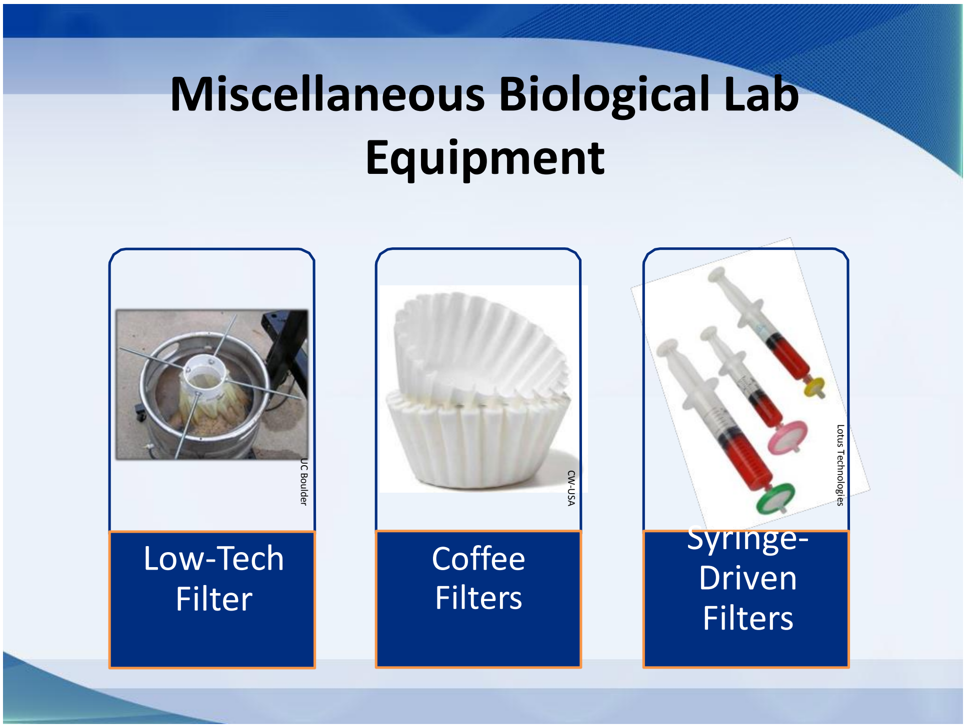
BTS

Instructables

Incubators

University of Calgary

Low-Tech Fermenter


Miscellaneous Biological Lab Equipment
UC Boulder
Low-Tech Filter
CW-USA
Coffee Filters
Lotus Technologies
Syringe-Driven Filters


Miscellaneous Biological Lab Equipment
Cole-Parmer
Vortex Mixer
Pentair
Staining Materials
Dumont
Forceps

Sterilization and Disinfection Equipment

Autoclaves

- Pressurized; designed to heat aqueous solutions above boiling point

Pressure Cooker

- Used as an autoclave in low-tech BTA labs

Chemicals

- Disinfect
- Bleach, Iodine, Alcohol

Bioterrorism Agent Lab Equipment

Household items

- Crock pot (incubator)
- Lamp or heater (constant heat source)
- Modifications to kitchen appliances
- Strange uses for normal appliances

Radiological Dispersal Devices

Law enforcement officers may not be faced with radioactive labs in the traditional sense.

- Be aware of where radioactive sources may be found.
- Crime scenes involving stolen radioactive sources should be thoroughly investigated.

Explosives Laboratories

- Similar to chemical and drug labs in how chemicals are processed and equipment is used:
  - May be difficult to accurately identify
  - Precursors usually different than chemical or drug labs

Explosives Precursors

Nitric Acid (HNO_3)	Sulfuric Acid (H_2SO_4)
• Major chemical used in explosive recipes • Forms nitroglycerine when combined with Glycerin during nitration	• Most commonly produced chemical in world • Found in home improvement stores

Explosives Precursors

- Acetone (Dimethyl Ketone):
  - Colorless, volatile liquid with sweet smell
  - Main ingredient in fingernail polish remover
  - Primary use as a solvent
  - Used in chemical and drug labs
  - Found in home improvement stores

http://images.orgill.com/200x200/8976995.jpg

Explosives Precursors

- Hydrogen peroxide (H2O2):
  - Common over-the-counter antiseptic
    - 3% concentration
  - Found in industry and transported in concentration up to 70%
  - Most common industrial strengths: 27.5%, 35%, & 70%

http://a1468.g.akamai.net/f/1468/580/1d/pics.drugstore.com/prodimg/73864/200.jpg

Explosives Precursors

- Hexamine (Hexamethylenetetramine):
  - Solid fuel found in tablet form
  - Used in making HMTD
  - Found at outdoor camping stores
  - Instructions for extracting hexamine from tablets found online

http://zenstoves.net/SolidFuel/EsbitBox.jpg

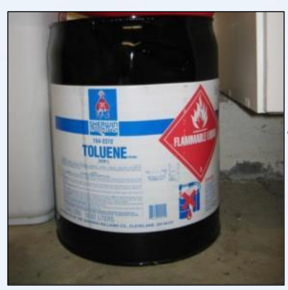
Explosives Precursors

- Ethylene glycol (Antifreeze)
  - Used to make Ethylene glycol dinitrate (EGDN):
    - Nitroglycerine-like explosive
    - Generic brands preferred, since they have less additives and are easier to distill

http://www.recyclemore.com/mimage/bottle-antifreeze.gif

Explosives Precursors

- Toluene (Methylbenzene):
  - Clear, sweet smelling liquid
  - Used as a solvent
  - Found in paint thinners
  - May be purchased at home improvement stores
  - May be found in chemical and drug labs



www.viartis.net/parkinsons.disease/images/Toluene.gif

Explosives Precursors

- Glycerin:
  - Colorless, thick liquid
  - Used in pharmaceuticals, perfumes, cosmetics, soaps, and antifreeze
  - Used to make nitroglycerine and other explosives
  - Easily obtainable

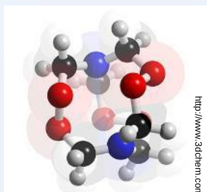
www.valleyvet.com

Explosives Precursors

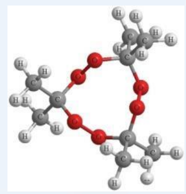
- Drug lab chemicals as explosive precursors:
  - Metallic sodium + Anhydrous ammonia = Sodium amide
    - Sodium amide reacted with Nitrous oxide (laughing gas) = Sodium azide
  - Mercury + Nitric acid + Ethyl alcohol = Mercury fulminate
  - Ammonia + iodine crystals = shock-sensitive Nitrogen trioxide

Peroxide-Based Explosives

- Easy to manufacture
- Chemicals easily obtainable
- Do not require nitric acid
- Cannot be detected by traditional methods



HMTP



TATP

Triacetone Triperoxide (TATP)

- Called the “Mother of Satan”
- Highly unstable
- Precursors:
  - Hydrogen peroxide
  - Sulfuric acid
  - Acetone

Hexamethylene Triperoxide Diamine (HMTD)

- Sensitive to heat, shock, and friction
- Precursors:
  - Hydrogen peroxide
  - Hexamine
  - Dilute sulfuric acid or citric acid

http://www.nctc.gov

Detonators

- Most explosives need an igniter
  - Blasting caps and detonating cords commonly used and frequently stolen
  - May be “homemade”
  - Precursors:
    - Mercury fulminate
    - Lead azide
    - PETN

http://www.oregon.gov/OSP/AES/Blasting_Caps.shtml

Black Powder

- Oldest and most common type of explosives:
  - Recipes are easily obtainable
  - All have same basic ingredients
- Law enforcement officers must be able to quickly recognize black powder labs

Black Powder

- Charcoal powder
- Potassium nitrate or Sodium nitrate
- Sulfur powder
- Alcohols—methyl, ethyl, or isopropyl
- Mortar and pestle


Explosive Manufacturing Equipment
NCBRT
Ice Bath
Science First
Mortar and Pestle
ArteCorpUs
Coffee Grinder
Good Housekeeping
Slow Cooker

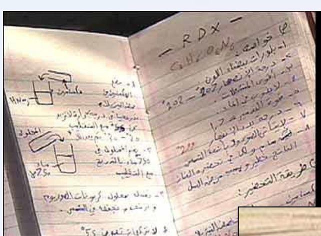

Explosive Manufacturing Equipment
Hot Plate
Funnels
Filters
Glassware

Suspicious Items

- All forms:
  - Books
  - Hand-written notes
  - Computer files
    - May be print-outs of websites
  - Videos
  - Recipes
  - Drawings

http://www.paladin-press.com

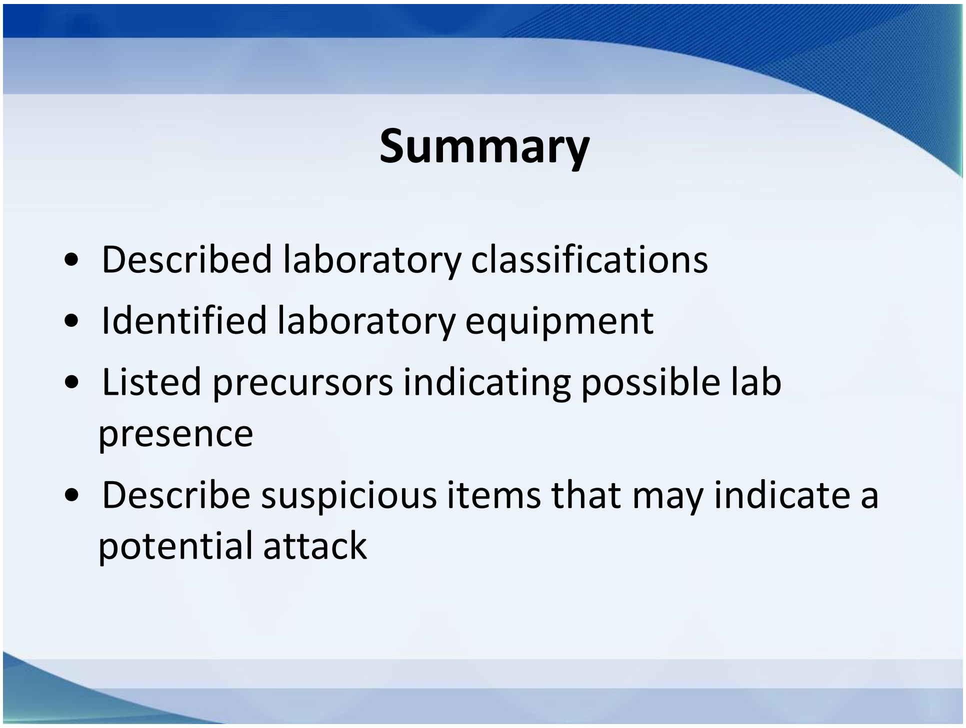
Suspicious Items



http://www.isis-online.org

http://archives.cnn.com/2002/US/01/24/inv.al.qaeda.documents

al Qaeda surveillance sketch (ABC News)


Summary
• Described laboratory classifications
• Identified laboratory equipment
• Listed precursors indicating possible lab presence
• Describe suspicious items that may indicate a potential attack

WMD Awareness-

Dissemination Devices

Enabling Learning Objectives

- Discuss factors affecting dissemination
- List different types of disseminators
- Describe methods of dispersal

Dispersion of WMD Agents

- Environmental factors
  - Wind speed
  - Humidity
  - Temperature
  - Inversions
  - Structures
  - Indoor factors
    - Facility type/size
    - HVAC system
    - Time delays

Chemical Agent Dispersal

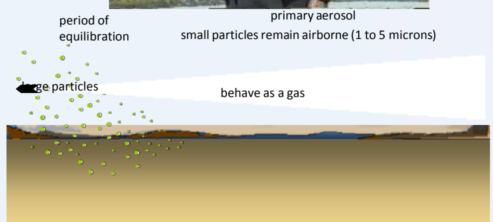
- Agent properties
  - State of matter (solid, liquid, gas)
  - Vapor density
  - Water solubility
- Most important factor—efficiency of delivery
- Weather observations and forecasting are essential

Ammonia Release

Vapor Density = .6
and Water Soluble

Biological Agent Dispersal

- Agent properties
  - Particulate size (1–5 microns)
  - Masking electrostatic charge
  - Hydrophobicity



Aerodynamic Dissemination

- The non-explosive delivery of a chemical agent from an aircraft, allowing aerodynamic stress to disseminate agent
- Removes many limitations of thermal dissemination by eliminating flashing effect and allowing control of particle size

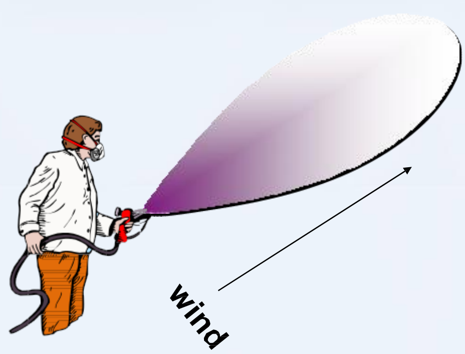
http://www.justice.gov/enrd/ENRD_Assets/pesticides_-_NIH.jpg

Effective Aerosol Dissemination

- Dependent on
  - particle size
  - dispersal device
  - concentration of agent
  - agent form (liquid or powder)
  - environmental conditions such as
    - wind speed and direction
    - UV light
    - temperature inversions

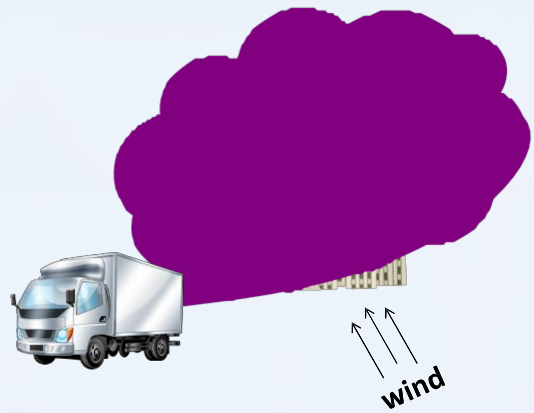
Point Source Delivery

- Single source of dissemination
- Depends on wind direction and speed
- Most likely used on small, discrete targets

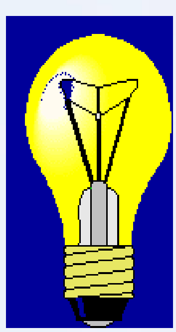


Line Source Delivery

- Product sprayed perpendicularly to wind
- Target can be many kilometers downwind.
- Can be used on much larger targets



Breaking Devices

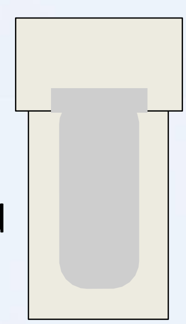


Light Bulb

Point source

Common items

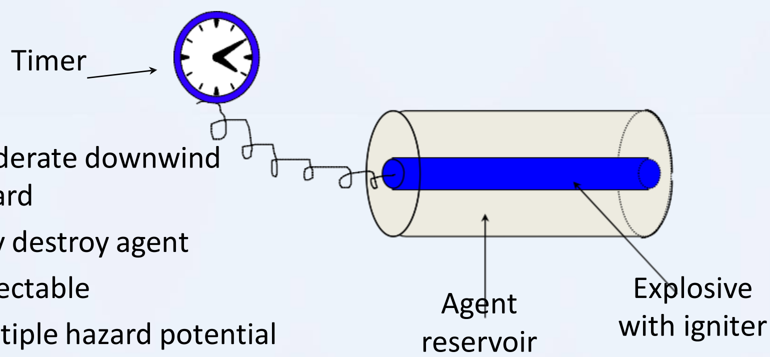
Moderate downwind hazard



Vacuum Bottle

Bursting and Exploding Devices

Point Source



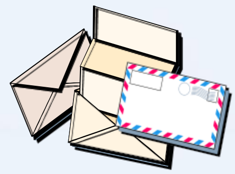
- Moderate downwind hazard
- May destroy agent
- Detectable
- Multiple hazard potential

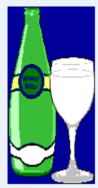
Spraying Devices

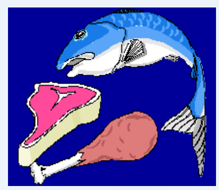
- Line source
  - Moving vehicles
  - Significant downwind hazard
- Point source
  - Aerosol can
  - Garden sprayer
  - Moderate to significant downwind hazard

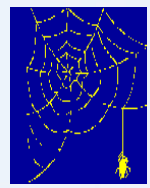
Vectors

- Contaminated clothing
- Contaminated food
- Contaminated water
- Letters, packages
- Insects, animals









Potential Disseminators

Improvised Aerosol Disseminator

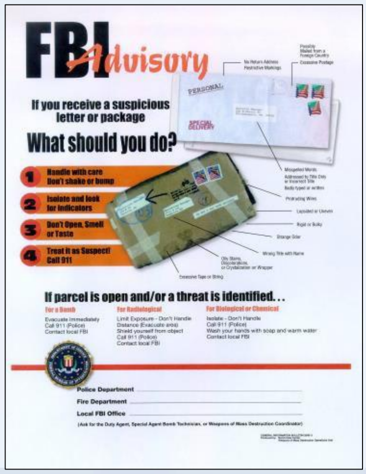
Aerosol Disseminator

Aerosol Disseminator


Potential Disseminators
CHEVROLET

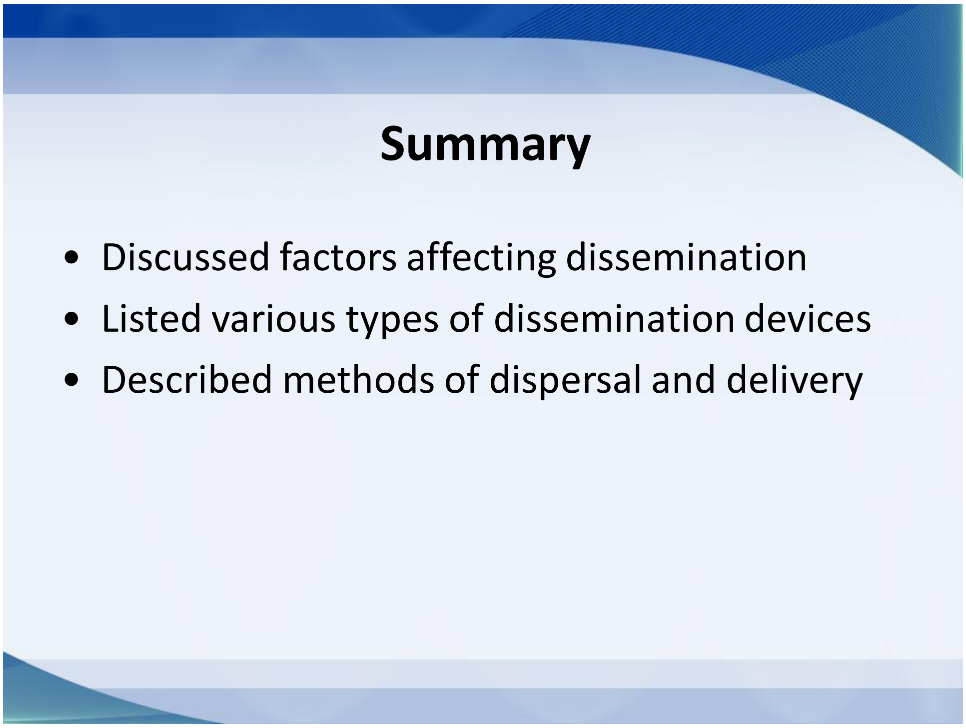

Potential Disseminators
http://www.cumminstools.com
Paint Sprayer
http://www.northerntool.com
Two-Gallon
Garden Sprayer
HUDSON
http://www.acehardware.com
Rose Duster
http://www.agsouthco.com
Trailer Sprayer
http://www.northerntool.com
Backpack
Sprayer

Suspicious Packages



Impact of Dissemination Devices

Device	Downwind Hazard	Most Likely Agent
Breaking	Moderate	Chemical
Bursting	Moderate	All
Explosive	Moderate	Radiological (may also be Chemical or Biological)
Spray	Significant (line source) Moderate/Significant (point source)	Biological or Chemical
Vector	Unpredictable	Biological or Chemical


Summary
• Discussed factors affecting dissemination
• Listed various types of dissemination devices
• Described methods of dispersal and delivery

Personnel Protection Considerations

Goals: (1 of 2)

- Provide greater awareness of vulnerabilities of workplace environments
- Provide methods of detecting an attacker's pre-operation surveillance
- On routes of entry and toxicity of warfare agents, their physical properties, and temporary protective actions

Goals (2 of 2)

- Participants will be given methods of:
  - Chemical exposure mitigation
  - Personal protective equipment
  - Escape
  - Identifying safe areas

Detection

- Detection papers
- Detection tubes
- Detection tickets
- Sticky Polymer Lethal Agent Tag (SPLAT)
- Ion microprobe
- Ion Mobility Spectrometry (IMS)

Isolation Guidance (1 of 2) (from the Centers for Disease Control and Prevention)

- When VX is used as a weapon
  - First isolate in all directions: 200 ft. (60 m)
  - Then protect persons downwind during the day: 0.4 mi (0.7 km)
  - Then protect persons downwind during the night: 0.6 mi (1.0 km)
  - Atmospheric conditions at night allow for more dispersion

Isolation Guidance (2 of 2)

- When sarin is used as a weapon
  - First isolate in all directions: 3000 ft. (1000 m)
  - Then protect persons downwind during the day: 7.0 mi (11.0 km)
  - Then protect persons downwind during the night: 7.0 mi (11.0 km)

Physical Dangers of Sarin and VX

- Vapors are heavier than air
  - Spread along the ground and collect and stay in poorly-ventilated, low-lying, or confined areas (e.g., sewers, basements, and tanks)
  - Hazardous concentrations may develop quickly in enclosed, poorly-ventilated, or low-lying areas. Keep out of these areas
  - Stay upwind

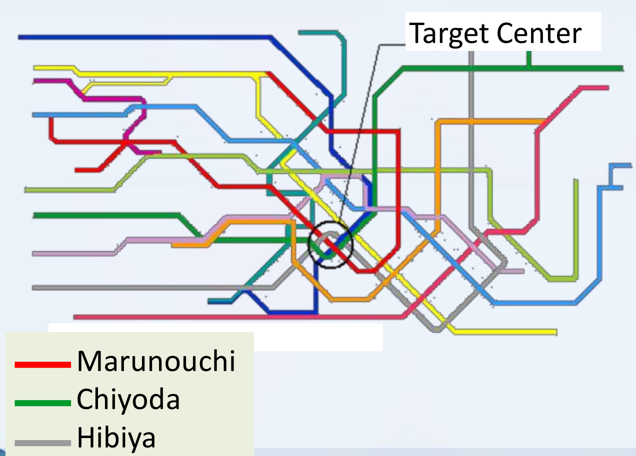
Isolation Guidance

- When Sulfur Mustard used as a weapon
  - First isolate in all directions: 100 ft. (30 m)
  - Then protect persons downwind during the day: 0.1 mi (0.2 km)
  - Then protect persons downwind during the night: 0.2 mi (0.4 km)
  - Atmospheric conditions at night allow for more dispersion

Physical Dangers of Sulfur Mustard

- Mustard gas evaporates slowly
- The vapor hazard of sulfur mustard increases with increasing temperature
- Vapors are heavier than air
- Stay upwind
- Small droplets float on water surfaces and present a hazard in contaminated areas
- Sulfur mustard is more persistent in winter

Case Study-Tokyo Subway Attack



Tokyo Casualties (1 of 2)

- 5 patients in critical condition
- Three successfully resuscitated
  - One did not respond to cardiopulmonary resuscitation and died
  - A second was resuscitated but died on day 28 after the attack due to irreversible brain damage
- 10 other deaths occurred at the attack scene

Tokyo Casualties (2 of 2)

- Initially with 2 mg of intravenous atropine sulfate and 2 g of pralidoxime chloride after the agent was confirmed as sarin
- Intravenous diazepam administered for fasciculation.
- Remaining casualties mainly had eye problems (miosis)
  - Treated with atropine sulfate
  - Released if no other symptoms developed

Tokyo Lessons Learned (1 of 2)

- Although the sarin was not pure, created a mass casualty event.
- Initially, there was no control possible at the scene
- Although Tokyo-area hospitals had emergency and disaster plans, unprepared for a mass casualty incident

Tokyo Lessons Learned (2 of 2)

- Mass psychogenic illness and post traumatic stress
    - Must be considered in the treatment of hazardous material attacks in addition to the treatment of physical symptoms

Improvised Methods of Protection

Dilution

- The first and most important step in treatment is decontamination
- Vapor exposure may not need decontamination

Health and Safety

- Designate a safety officer in advance
  - Train personnel to effectively use emergency kits and know how to don and doff personal protective equipment
  - Identify safety hazards in the workplace
  - Understand response plans
  - If a manufacturing facility, have a trained industrial hygienist

Hazards in the Workplace

- If your workplace is a manufacturing facility, what types of hazards exist?
  - Hazardous waste
  - Moving equipment
  - Electrical hazards
  - Slip, trip and fall
  - Treatment processes
  - Dangerous chemicals
  - Compressed chemicals
  - Others?

Source:
http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/hazardous_waste/hazwastedrumstoragearea2.jpg

Other Hazards

- Farms and agriculture
  - Working outside
  - Limited cover
- Water treatment
  - Storage of large amounts of chemicals
  - Working outside
- High-rise buildings
  - Limited escape routes
  - Lots of people confined within a single building
  - Less control over the ventilation, air handling apparatus
- Others?

Follow-up

- Identify health and safety issues that might be a concern for most businesses
- Include rural as well as urban areas
- What impacts would these workplaces have on their respective countries if they were targeted?
- What can be done now to protect these types of workplaces?
- What procedures can be implemented now that would applicable to most workplaces?

Case Study: Safety and Security in a Hospital Setting (1 of 7)

- Normal hospital security plan requires modification to satisfy requirements of the emergency situation
- Hospital lock-down should be implemented
- Secure the facility to reduce the risk of becoming contaminated and unusable
- Guards need to check people in
- Identification (ID) badges can be issued at the entry control point

Hospital During a Chemical Attack (2 of 7)

What are the hazards here?

maggiesnotebook.com

Case Study (3 of 7)

- Security is necessary at the decontamination point
- Guards need to wear personal protective equipment
- Crowd control, casualty flow, and traffic control are critical
- Vehicles must not linger in the area
- Crowds and media must be kept at a safe distance
- Develop a plan to address any breach of security

Case Study (4 of 7)

- Attacker may plant more than one device
- Investigate and secure the area
- Have a safety plan that addresses specific issues in chemical safety
- An existing safety plan may not include contamination control and casualty decontamination requirements

Case Study (5 of 7)

- Have at least one safety officer who is knowledgeable
- The safety officer has specific responsibility for identifying and evaluating hazards
- The safety officer's primary function is contamination control

Case Study (6 of 7)

- Avoid contaminating treatment areas
- When positioned at a critical location, the safety officer can help prevent the spread of contamination
- Safety officers need to work closely with security staff

Case Study (7 of 7)

- Safety officer can observe workers while they are performing decontamination
- Officer is able to ensure that work and/or rest cycles are implemented and enforced and that personal protective equipment is worn appropriately in hazardous areas
- Safety officers may be appointed as the final approving authority for decontaminated casualties to enter the hospital

Additional Safety and Security

- Safety and security measures outlined for hospitals can be implemented in most workplaces
- It is safest for responders to wear Level A personal protective equipment when entering a situation with an unknown agent
- Once the hazard is identified (for example, sarin) responders can make an informed choice to change personal protective equipment to Level B

Summary

- Chemical warfare agents designed to kill
- Affect people through direct contact, inhalation and ingestion
- Sarin, VX and Sulfur Mustard may be the primary agents in the Syrian arsenal
- Preventing contact with these agents is the only effective way to protect personnel

Additional Information

- The Emergency Response Safety and Health Database
  - Accurate and concise information on high-priority chemical, biological and radiological agents
- http://www.cdc.gov/niosh/ershdb/default.html

Identification of Hazardous Materials During Emergency Responses

1

Course Overview

- Identification Clues
- Contingency Plans
- Transporting Hazardous Materials
  - Highway
  - Railroad
  - Pipelines
- Markings and Placarding
- Shipping Papers
- Senses

2

Objectives (1 of 2)

- List six clues to determine the presence of hazardous materials
- Describe the use of pre-plans in relation to buildings, property, and transportation routes
- List six types of specific containers used in the transport of hazardous materials
- Describe the use of U.S. Department of Transportation placards and labels in the transport of hazardous materials
- Describe the use of the National Fire Protection Association 704M marking system

Objectives (2 of 2)

- List various types of shipping documents used in the transport of hazardous materials by rail, air, water, and highway
- Discuss the use of direct-reading instruments in determining the presence of hazardous materials

Identification Clues

Low risk

- Occupancy and location
- Container shapes
- Markings and colors
- Shipping papers
- Direct-reading instruments
- Senses

High risk

9

Emergency Response Contingency Plan

- Lowest risk to responders
- Required by most government agencies
- "Pre-emergency plans"-former term used by fire departments

Contingency Plan Required Information (1 of 4)

- Facility layout
- Substance list
- Storage location
- Substance profile (MSDS)
- Special handling procedures
- Worst-case scenarios

Contingency Plan Required Information (2 of 4)

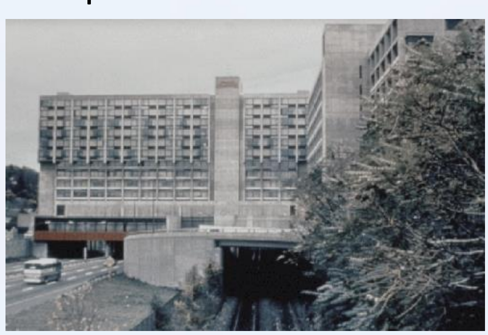
- Emergency recognition/prevention
- Personnel roles
- Lines of authority
- Communication

Contingency Plan Required Information (3 of 4)

- Transportation
- List of substances on board

Contingency Plan Required Information (4 of 4)

- Mitigation techniques
- Evacuation procedures



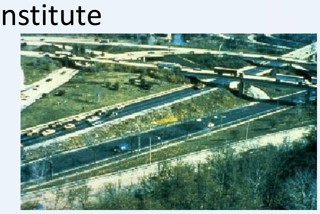
Modes of Transportation





Container Shapes for Transportation

Highway best practices for container design
- U.S. Department of Transportation
- Guidelines
  - American Petroleum Institute
  - American National Standards Institute



Highway Container Features

- Shell construction
- Jacket/un-insulated
- Loading/unloading
- Pressure/low-pressure
- Silhouette
- Type of product

Highway Cargo Tank Types

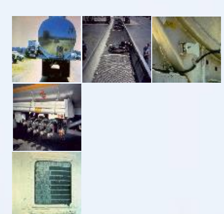
- U.S. Department of Transportation 406, 407, 412
- MC 306, 307, 312, 331, 338
- Compressed gas/tube trailer
- Dry bulk cargo tanker
- Inter-model
- Radioactive “B” cask

Highway Cargo Tanks

- U.S. Department of Transportation 403/MC 306
- Hydrocarbon/fuels
- 0.21 kgf/cm^2
- Aluminum/steel shell

U.S. Department of Transportation 406/MC 306

- Oval shape
- Recessed manholes
- Rollover protection, vapor recovery
- Multiple compartments
- Load and offload/vapor, liquid, and static
- Bulk head baffles, slow surges
- Emergency shutoff, left side
- Manufacturing plate, right side



U.S. Department of Transportation 407-MC 307 (1 of 3)

- "Workhorse"
- Variety of chemicals
- Steel, rubber liner
- Insulated
- Aluminum outer shell

U.S. Department of Transportation 407/MC 307 (2 of 3)

- Horseshoe or small round shape
- Multiple compartments
- Recessed manhole
- Rollover and splash protection
- 1.8 to 3.1 kgf/cm^2
- 23 cubic meters

U.S. Department of Transportation 407/MC 307 (3 of 3)

- Top loading, discharge at bottom mid-ship, or rear
- Bulk head baffles slow surges
- Emergency shutoff at left
- Manufacturing plate right side

U.S. Department of Transportation 412/MC 312 (1 of 2)

- Strong corrosives
- 23 cubic meters
- Steel and stainless steel, or steel and aluminum
- Butyl rubber/polyethylene liner

U.S. Department of Transportation 412/MC 312 (2 of 2)

- Small diameter stiffening rings
- Recessed manhole
- Rollover and splash protection
- 5.3 kgf/cm^2
- Top loading, rear discharge
- Typically coated and corrosive-resistant
- Bulk head baffles slow surges

MC 331 High Pressure Tanker (1 of 2)

- Compressed gases
- 7 to 21 kgf/cm^2
- 43.5 cubic meters
- Dome-shaped ends

MC 331 High Pressure Tanker (2 of 2)

- Single compartment
- Aluminum or steel shell
- Pressure relief valve
- Rear cabinet controls valves for loading and offloading, excess flow shutoff

MC 338 Cryogenic Liquid Tanker (1 of 2)

- Cryogenic gases
- Steel alloy inner shell
- “Thermos Bottle”
- 1.5 kgf/cm^2
- 23 cubic meters

MC 338 Cryogenic Liquid Tanker

(2 of 2)

- Round shape
- Rear cabinet controls
- Pressure relief valve
- Extremely cold liquids
- Vents while moving

Compressed Gas/Tube Trailer

- Compressed gases
- 23 – 122 cm diameter cylinders
- Grouped in 3 – 20 tubes
- Cabinet in rear with controls
- 211 to 352 kgf/cm^2

Dry Bulk Cargo Tanker

- Various solid chemicals
- Aluminum shell
- 28 – 71 cubic meters
- Bottom loading and off-loading valves

Intermodal Containers

- Variety of chemicals
- Steel or aluminum shell
- Single-cage or box
- Mobile for transportation
- Liquid or gases – same design

Radioactive Type "B" Cask

- High level ionizing radiation
- Mounted on trailer
- Crash shield made of steel with lead liner
- Same for rail cars
- Protected from fire and impact

Highway Cargo Semi-Trailers

- Any hazardous materials
- Bulk and non-bulk containers
- Mixed loads
- U.S. Department of Transportation separation required

Highway Semi Trailers

- One cab
- 2 – 3 trailers
- Any type of highway cargo tank

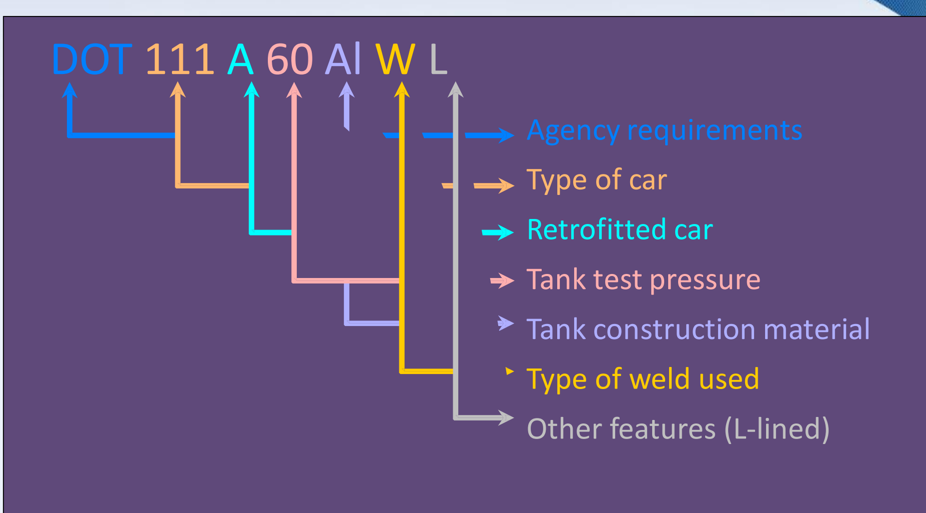
Railroad Tank Cars

- Rail tank car carries 38– 170 cubic meters
- Highway tankers carry 4–34 cubic meters

Rail Tank Car Best Practices

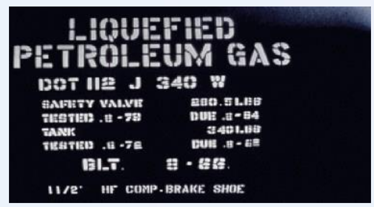
- U.S. Department of Transportation
- Preferred guidance
  - Association of American Railroads
  - Interstate Commerce Commission
  - Canadian Transportation Commission

Rail Car Class Designation



Tank Car Identification (1 of 4)

- Hazardous materials stenciling
- U.S. Department of Transportation and Association of American Railroads
- Right side, both sides, both ends
- 2.5 x 10 cm contrasting
- 49 chemicals
- Safety valve test pressure



Tank Car Identification (2 of 4)

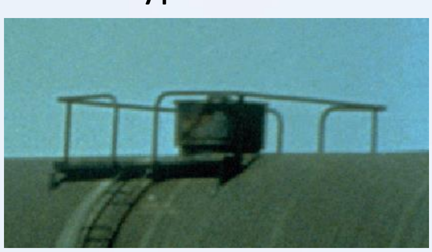
- Unit marking/car identification number
- U.S. Department of Transportation /Association of American Railroads
- Left side, both sides, both ends
- Top of car
- "X" is industry owned
- Last known commodity

Tank Car Identification (3 of 4)

- Placard requirements
- U.S. Department of Transportation Table
- Each side
- Each end
- Any amount

Tank Car Identification (4 of 4)

Two types



Pressurized

Non-pressurized

Pressurized Tank Cars (1 of 3)

- U.S. Department of Transportation 105
- Safety valves
- 5.3 – 32 kgf/cm^2
- Chemicals: ammonia, chlorine, hydrocyanic acid

Pressurized Tank Cars (2 of 3)

- Manway bonnet
- In line liquid
- On side vapor
- Thermometer well
- Test tube
- Gauging device

Pressurized Tank Cars (3 of 3)

- U.S. Department of Transportation 112
- Thermal / head protection
- 38 – 151 cubic meters
- 5.3 – 32 kgf/cm^2
- Chemicals: liquefied petroleum gas, vinyl chloride, sulfur dioxide

Non-Pressurized Tank Cars (1 of 2)

- U.S. Department of Transportation 103
- General service car
- Safety valve 2.5 – 4.2 kgf/cm^2
- 38 – 151 cubic meters

Non-Pressurized Tank Cars (2 of 2)

- Non-insulated rubber liner
- Load/unload top
- Chemicals: benzene, common acid solutions, phosphorous trichloride, hydrogen peroxide, acrylonitrile

Cryogenic Tank Cars

- Low temperature liquefied gases
- U.S. Department of Transportation 113
- 1.1 kgf/cm^2 outer shell, 5.3 kgf/cm^2 tank
- 114 – 151 m^3
- Load and unload side end or midship
- Chemicals: oxygen, nitrogen, CO2

Hopper Cars (1 of 2)

- Bulk commodities
- Top loading
- Bottom discharge
- Cover hopper
- Chemicals: calcium

Hopper Cars (2 of 2)

- Open/closed hopper
- Pneumatic
- Mechanical assistance
- 736 – 1671 m^3
- 1.1 kgf/cm^2
- Safety relief valve
- Products: coal, sand, plastic pellets, fine powders

High Pressure Tube Car

- Compressed gases
- Large cylinders
- 211 – 352 kgf/cm^2
- Rear cabinet/control valves
- Safety relief valve

Container On Flat Car

- Variety of chemicals
- Container types
- Pressure/low-pressure
- Cryogenic tanks
- Tube module
- One-ton cylinders
- Liquid tanks
- Box units

Trailer On Flat Car

- Variety of chemicals
- Semi-trailer, same as on highway

Boxcars

- Variety of chemicals
- General freight
- Military weapons

- Chemicals / non- bulk, intermediate bulk containers
- Refrigerated liquids

Non-Bulk/Intermediate Bulk Containers (1 of 6)

Non-bulk containers

- Up to 208 liters
- Metal, plastic, glass paper, wood

208 liter drum

- Overpack 416 liter drums/lab packs

Open/closed drums

- Open/rings
- Closed bungs

Non-Bulk/Intermediate Bulk Containers (2 of 6)

- Carboys
- Glass or plastic
- Encased in packaging
- >9 kg
- Cylindrical, pressurized
- Beer-keg type
- Cryogenic, insulated
- Pressure relief valve
- Nitrogen, argon
- Very cold liquids

Non-Bulk/Intermediate Bulk Containers (3 of 6)

- One ton cylinders
- Pressure relief valve
- Chlorine
- Pressurized cylinders
- Pressure relief valve
- Compressed gases
- Cylinder color has no meaning
- U.S. Department of Transportation requires collar markings

Non-Bulk/Intermediate Bulk Containers (4 of 6)

- Bottles
  - Glass, plastic, jars or jugs
  - >76 liters

- Bags
  - Flexible cloth, burlap, kraft paper, plastic
  - Glued, heat-sealed, stitched, crimped, metal twist-ties
  - >45 kg

- Outer packaging for transport
  - Styrofoam
  - Fiber board
  - Dark glass for light sensitivity
  - Liquids/solids

Non-Bulk/Intermediate Bulk Containers (5 of 6)

- Metal or plastic
- Encased metal frame
- 1.2m x 1.2m x 1.8 m
- <3,493 kg
- Top loaded, unloaded at side or bottom

Non-Bulk/Intermediate Bulk Containers (6 of 6)

- Type "A" shipping container
- Radioactive material
- Metal container (contains source)
- Cardboard box
- Fiberboard insert

Pipelines and Fixed Facility (1 of 3)

- 2nd largest mode
- Petroleum liquids and gases
- Corrosive liquids
- Pressurized systems

Pipelines and Fixed Facility (2 of 3)

- Marking systems
- Contents
- Operator
- Emergency phone number

Pipelines and Fixed Facility (2 of 3)

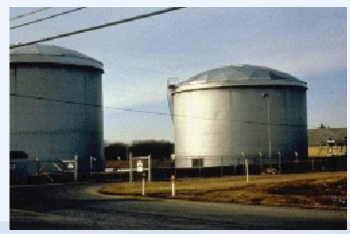
- Various types bulk storage
- Pipeline systems, above or below ground
- Need Emergency Response Contingency Plan
- Secondary containment system required

Pipelines, Fixed Facility Above and Below Ground

- Portable and fixed tanks
- Pipeline systems
- Fuel dispensing systems

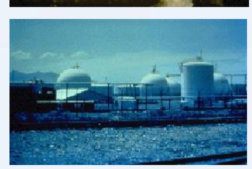
Pipelines, Fixed Facility Some Container Types (1 of 2)

- Open, floating roof
- Flammable liquids $<60^{\circ}\mathrm{C}$
- Covered roof/interior float
- Combustible $>60^{\circ}\mathrm{C} - <93^{\circ}\mathrm{C}$



Pipelines, Fixed Facility Some Container Types (2 of 2)

- Cone roof
- Non-combustible $>93^{\circ}\mathrm{C}$
- Other chemicals
- Spherical
- Pressurized gases
- Horizontal
- Other chemicals



Markings and Colors

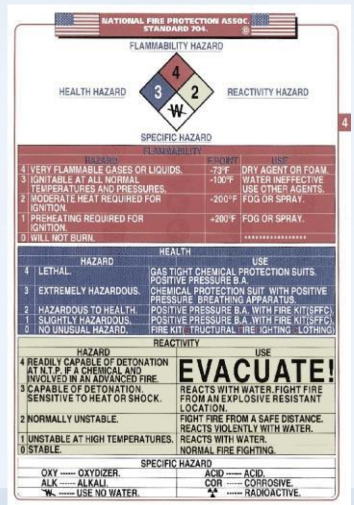
- Used as a means to recognize or identify chemicals
- Type of information
  - Product name(s)
  - Company name and phone number
  - Equipment license plate number
  - Hazard class and identification number
  - Signal words

Markings and Colors
Facility Markings

- National Fire Protection Association 704M system
- System label found on
  - Individual containers
  - Posted on rooms, buildings, fences
  - Not chemical-specific
  - Should not be on transport vehicles

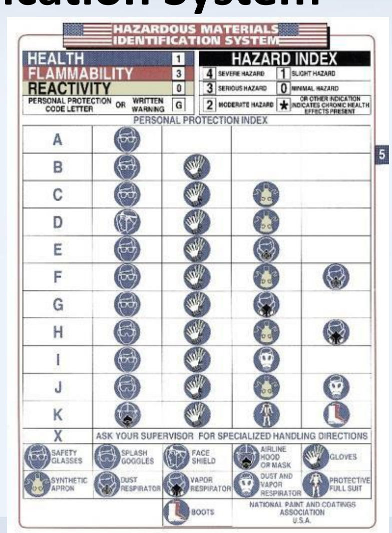
Symbol Seeker National Fire Protection Association 704M

Section 4



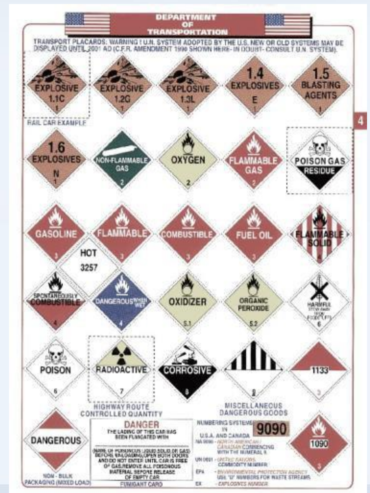
Symbol Seeker Hazardous Materials Identification System

Section 4



Symbol Seeker Placarding

- U.S. Department of Transportation best practices
- Hazardous Materials-181 - international standard
- Both ends and sides
- Table 1 – any amount
- Table 2 – 454 kg or more

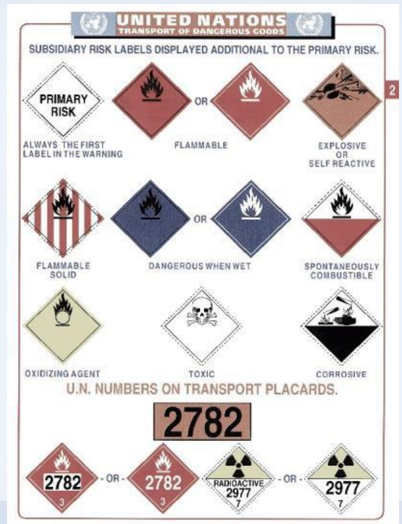


Placarding Five Identifiers

- Color
- Symbol at top
- Hazard Class number at bottom
- Name in center, English and other languages
- Four-digit United Nations/North America Chemical identification number

Symbol Seeker Subsidiary Risk

Section 5



Placarding (1 of 2)

- Two or more hazard classes, total gross weight of 454 kg or more
- Use "Dangerous" placard
- Total gross weight of 1,000 kg or more of one hazard class loaded at one facility
- Use that placard

Placarding (2 of 2)

Four-digit identification number used when

- One container has 450 or more liters
- Center placard/orange panel next to placard

Marking and Colors Labeling System

- Labels 10 cm x 10 cm on containers
- Same design as on placards
- Placard 30 cm x 30 cm

Marking and Colors
Labeling System B Poisons (1 of 2)

- U.S. Environmental Protection Agency Registration Number
- Chemical
- Manufacturer

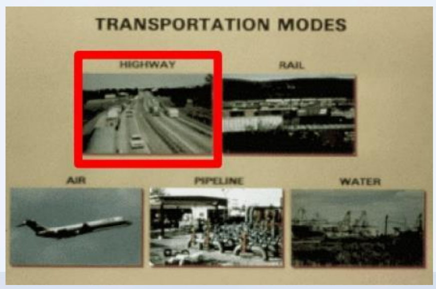
Marking and Colors
Labeling System B Poisons (2 of 2)

3 SIGNAL WORDS

TOXICITY	SIGNAL WORD
High	Danger Poison
Moderate	Warning
Low	Caution

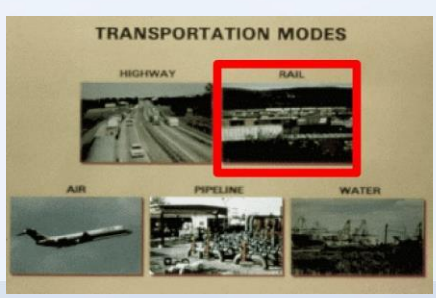
Shipping Papers Highway

- Bill of lading
- Within driver's reach in cab
- On seat or door, when not in cab



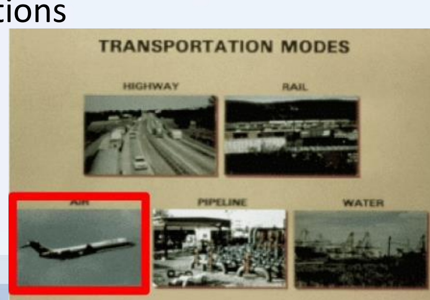
Shipping Papers Railroad

- Consist/wheel report
- Train crew, lead locomotive
- From the locomotive to deadman



Shipping Papers Airline

- Air bill
- Pilot must approve
- Pilot/cockpit
- Must comply with International Civil Aviation Organizations

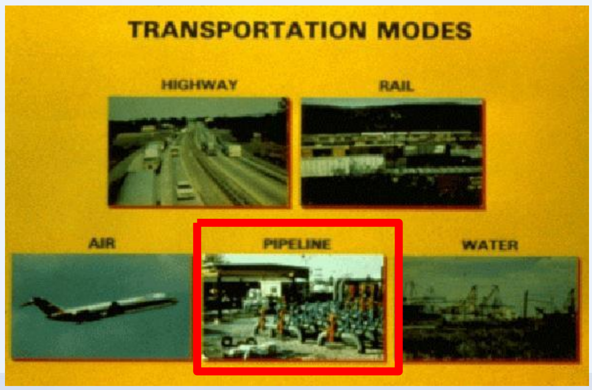


Shipping Papers Waterway

- Dangerous cargo
- Captain/master
- Wheelhouse or bridge, or mailbox on barge/tow
- Must comply with International Maritime Organization

Shipping Papers Pipeline

Information on pipeline markers to call



Direct-Reading Instruments

- Required to monitor at all times
- Provides real time information
- O_2, lower explosive level, toxic, radiation
- Decided in Section 14

Senses (1 of 2)

- Use of senses is very risky in the identification of hazardous materials
- Desensitization of olfactory system could cause exposure to deadly concentrations
- Only safe sense is sight—from a distance, with binoculars

Senses (2 of 2)

- Look for any biological indicators (dead animals or vegetation)
- Look for unusual colored smoke emitted from the scene
- Noises from containers are not normal (containers venting)
- Bulging containers, or those with deep gouges and dents, will rupture

Summary

- Six clues to identify presence of hazardous materials
- Use safest method available to ensure worker safety
- Each incident is different! Though material may be the same, don't be complacent
- Safest approach: Upwind, Uphill, Upstream
- Educated decisions can be made to safely mitigate a situation
- Rely on a variety of clues to collect information

Example Chemical Security Training Agendas

Sample Agenda – Responsible Science for Chemical Professionals

Day 1- Introduction to Chemical Security, Dual-Use, & Information Security

Registration/Coffee

Welcome & Introductions

Course Overview & Learning Objectives

Responsible Science and the Role of Chemical Security

Chemical Safety and Security Overview

Aspects of Chemical Security, Dual-Use Chemicals, and International Controls
- The Chemical Security and Terrorist Threat
- Obligations for Chemical Practitioners in Chemical Security

The Role of Dual-use Expertise and Chemical Security Threats
- The Concept of Information Security
- Information Security as an Element of Chemical Security
- STE Obligations in Knowledge Security
  - Case Study: Nuclear Scientists at the Dawn of the Nuclear Age
  - Case Study: Life Scientists, Genetic Engineering, and Bioethics

Ethics and Responsible Science
- The Spread of Chemical Knowledge for Peaceful and Non-Peaceful Use
  - Case Study: Use of Chemical Weapons in World War I
  - Case Study: From Pesticides to Nerve Agent
  - Criminal Offenders: The U.S. Rose Petal Murder Case
  - Assassination Attempts: Yushchenko Dioxin Poisoning
  - The Rise of Do-It-Yourself Chemistry and the Internet
- Modern Day Adversaries and Threats to Chemical Security

Chemical Security and Nonproliferation Frameworks

Dual-Use Chemistry and Responsible Science

Small group discussion: Multiple Uses of Chemicals

Forms of Expertise and Information Release/Leakage
- Information Extraction Techniques
- Active Elicitation
  - Trainer Role-Play: Elicitation at a Scientific Conference
  - Trainer Role-Play: Responding to Elicitation
- Passive Information Release/Leakage
  - Scenario using Storyboards: “Revenge of the Rejected” (Disgruntled Job Applicant

Day 1- Introduction to Chemical Security, Dual-Use, & Information Security
Information Security Vulnerabilities and Best Practices: The Online Environment
Vulnerabilities and Best Practices in Grant and Proposal Writing

Day 2- Information Security, Scientific Ethics, Safe Laboratory Practices and CATAP
Publications, Collaborations, and Peer Review o Scientific Ethics in Conducting Research o Scientific Ethics in Publication
Small Group Role-Playing o "Misperceptions about Protecting Intellectual Property"
Business Transactions, Intellectual Property, and Patents
Site Visits, Tours, and the Workplace: Best Practices to Protect Sensitive Information
Business Travel, Hotels, and Other Informal Settings o Large Group Discussion Scenario: "The Confidential Consulting Opportunity"
Introduction to Safe Laboratory Practices o Safe Laboratory Practices - Overview and its Importance o STEs' and Chemical Safety and Security Officers' Roles and Responsibilities o Personal Protective Equipment o Engineering and Administrative Controls o Routine vs. Unusual Practices o Safe and Secure Responses to Adverse Events
Chemical Procurement and Storage o Security o Safe Storage and Accountability o Special Cases: Alcohol, Needles, Easily Pilfered Materials, Bomb Making Materials, etc.
Chemical Waste Disposal o General Principles and Practices o Case Studies o Scenario: "Workshop Day 4"
Chemical Anti-Terrorism Awareness Program (CATAP) o Anti-terrorism Awareness Overview

Day 3—Responsible Science Synthesis
Code of Ethics and Responsible Science in Practice o Importance of a Global Chemists' Code of Ethics o Case Studies: Taken from *The Ethical Chemist*, by Jeffrey Kovac o Code of Ethics Toolkit for Your University
Large Group Discussion: Scientists' Perspectives on Code of Ethics Initiative o What factors may help or hinder adoption of a code of ethics in your institution? o What topics discussed in this workshop should be included in the code? o What topics that were not discussed should be included?
Capstone Practical Exercise (Small Groups) o STEs Discussion - How a Code of Ethics may be helpful based on their experiences in their home institutions. What challenges do they foresee?
Synthesis of Key Points o Chemical Security and Safety o Responsible Science and Ethics o Knowledge Security Vulnerabilities and Best Practices o Chemical Anti-Terrorism Awareness and Response
Knowledge Retention: Post-Course Survey and Jeopardy
Round Table o Long-Term Sustainability of Responsible Science and Integration with University Curricula: The Path Forward
Certificates of Participation Awarded: Workshop Conclusion o Trainers will remain available for follow-on discussions with participants as desired

Sample Agenda - Chemical Security Workshop for Industry

Day 1- Overview of Threats/ Chemicals of Concern
Registration/Coffee
Introductions, Invited Leader Introductions
Course Overview *In this module, trainers will provide an overview of the course materials, including the course agenda and a short summary of all modules and their primary focus.*
Chemical Safety and Security Fundamentals and Synergies *This presentation will provide an overview of international best practices related to chemical safety and security, highlighting attributes of each which will be common themes throughout the workshop.*
Chemical Security Culture Overview *This overview will cover definitions, the evolution of chemical security culture, and a strong chemical security model.*
Chemicals of Specific Concern *This session will raise awareness about chemicals of concern to include: chemicals likely targeted for theft or diversion, toxic chemicals, and reactive chemicals.*
Potential Threats to Materials of Interest *This presentation will identify potential threats to chemical facilities, identify chemicals of concern and their risks, discuss adversary characteristic, and discuss the elements of a terrorist attack.*
Wrap-up and Adjourn

Day 2- Security Systems, Planning and Mitigating Risks
Review of Day 1 Material
Graded Approach to Specific Chemicals of Concern *In this discussion, we address the method used to determine where to assign appropriate resources using a risk-based approach.*
Chemical Dual Use Awareness *This session will highlight the international community's resources, laws, rules and norms associated with Dual Use Chemicals. This will cover basic chemistry, export control, and legal approaches to the topic.*
Chemical Hazards and Implementing Systems to Minimize Risks *This presentation focuses on the distinctions between safety and security in terms of awareness of the hazards associated with chemicals. Basic risk assessments will complement the chemical hazard discussion in this session.*

Day 2- Security Systems, Planning and Mitigating Risks
Discussion Based Exercise on Threats in the Chemical Industry *This session will include actual case studies of threats in the chemical environment.*
Mitigating Threats from Perimeter/ Security System Development *This session identifies external threats and strategies to mitigate these threats, i.e. physical protection measures.*
Insider Threat Identification and Mitigation *Here we will define an insider and associated characteristics, identify unique insider issues, discuss insider findings, and address ways to mitigate the insider threat.*
Wrap-up and Adjourn

Day 3 - Security Systems, Planning and Mitigating Risks Continued
Review of Day 2 Material
Physical Protection Systems – Definitions, Concepts, and Infrastructure *This presentation will define and identify the elements of an effective PP system, discuss the principles of security, and introduce specific implementation examples.*
Vulnerability Assessment *The goal of this presentation is to establish a basic understanding of the vulnerability assessment (VA) process, how VA is relevant to chemical facilities, and introduce the VA process.*
Vulnerability Assessment Small Group Exercise
Small Group Exercise Presentations
Security of Materials of Interest Throughout the Supply Chain *The goal of this presentation is to address cradle-to-grave management of chemicals -- procurement, stockpile, Inventory, usage, and waste*
Dow Chemical Case Study *Here an actual case study is discussed with input from the audience.*
Wrap-up and Adjourn

Day 4 - Transportation Security
Transportation Security *This presentation relays the high-level concerns regarding the transport security of chemical materials and identifies elements of a Transportation Security Plan for the secure transport of high consequence chemicals.*
Incident Response to Security Event *This session will focus on international best practices and local requirements when handling an incident of security while chemicals are in transit.*
Continuity of Chemicals *This presentation will focus on the continuity of chemicals while in transit and the requirements for export/re-export by land, sea and air.*
General round-table discussion to highlight potential next steps and future opportunities.
Award of Certificates and Final Comments

Sample Agenda - Chemical Supply Chain Security Workshop

Day 1- Assessing and Mitigating Chemical Supply Chain Risks
Registration/Coffee
Introductions, Invited Leader Introductions
Course Overview *In this module, trainers will provide an overview of the course materials, including the course agenda and a short summary of all modules and their primary focus.*
International Chemical Security Threats and Mitigation Strategies *This will be a presentation largely taken from international documentation, highlighting what threats have been focused on the chemical community as well as successful and unsuccessful prevention measures.*
Chemicals of Specific Concern *This session will raise awareness about chemicals of concern to include: chemicals likely targeted for theft or diversion, toxic chemicals, and reactive chemicals.*
Potential Threats to Materials of Interest *This presentation will identify potential threats to chemical facilities, identify chemicals of concern and their risks, discuss adversary characteristic, and discuss the elements of a terrorist attack.*
Security of Materials of Interest Throughout the Supply Chain *The goal of this presentation is to address cradle-to-grave management of chemicals -- procurement, stockpile, Inventory, usage, and waste.*
Wrap-up and Adjourn

Day 2 – Chemical Supply Chain Security Best Practices and Initiatives
Review of Day 1 Material
The Responsible Care Management System® as it Relates to Chemical Supply Chain Security *This module explores the Responsible Care Management System® as it relates to industry's management of chemicals including the communication of chemical risks throughout the supply chain.* Insider Threat
Identification and Mitigation *Here we will define an insider and associated characteristics, identify unique insider issues, discuss insider findings, and address ways to mitigate the insider threat.*
Discussion of Relevant Case Studies on Supply Chain Vulnerabilities
Wrap-up and Adjourn

Day 3- Transportation Security
Review of Day 2 Material
Transportation Security *This presentation relays the high-level concerns regarding the transport security of chemical materials and identifies elements of a Transportation Security Plan for the secure transport of high consequence chemicals.*
Incident Response to Security Event *This session will focus on international best practices and local requirements when handling an incident of security while chemicals are in transit.*
Continuity of Chemicals *This presentation will focus on the continuity of chemicals while in transit and the requirements for export/re-export by land, sea and air.*
General round-table discussion to highlight potential next steps and future opportunities.
Award of Certificates and Final Comments

Sample Agenda - Prevention and Deterrence of Chemical Incidents for Law Enforcement

Day 1- Overview Protection Measures
Introductions, Invited Leader Introductions
Course Overview *In this module, trainers will provide an overview of the course materials, including the course agenda and a short summary of all modules and their primary focus.*
Importance of Law Enforcement in Combatting the WMD Threat (Case Study) *The overall goal of this module is to demonstrate the effect that law enforcement officers may have in mitigating or preventing terrorist activity simply by carrying out their standard job requirements.*
WMD Agents Overview *This module introduces participants to Weapons of Mass Destruction (WMD) agents; chemical, biological, radiological, nuclear, and explosive (CBRNE), which may be used by terrorists to inflict large-scale destruction. This module will equip participants with the tools needed to identify and respond to a WMD attack quickly and efficiently.*
Self-Protective Measures and PPE Overview *This module discusses in-depth self-protective measures, and builds on the personal protective equipment (PPE) information that was provided in the previous module. Participants will become familiar with routes of exposure and transmission, as well as the primary priorities and principles of response to an attack involving WMD agents*.
Law Enforcement Protective Measures *This module introduces participants to a variety of response considerations based on exposure to different WMD agents. In addition, this module stresses the importance of prior planning and the most applicable methods of response based on WMD agent dispersal in a variety of environments.*
Wrap-up and Adjourn

Day 2- Case Studies and Recognizing WMDs
Potential Use of Improvised WMD Threat (Case Study/TTX) *This module will cover various indicators of the presence of an incendiary weapon of mass destruction (WMD). In addition, the module will discuss the types of modifications to these devices that enable them to effectively disperse harmful agents including chemical, biological, radiological, nuclear (CBRN) and toxic industrial chemical (TIC) materials.*

Recognizing WMDs– Introduction *This module demonstrates the ability of crime scene investigators to readily identify potential WMD agents while carrying out their routine job duties. These hazards may include biological, radiological, nuclear, and high-yield explosive (CBRNE) or toxic industrial chemical (TIC), and may be identified during the course of standard investigative operations.*
Recognizing WMDs – Dissemination Devices *This module focuses primarily on the dispersion of WMD agents and the two primary factors that influence dispersion; the surrounding environmental conditions and properties of a particular agent. Participants will become familiar with key indicators that may provide critical information about particular agents and the preferred method of dispersal.*
Wrap-up and Adjourn

Day 3- Recognizing WMDs
Recognizing WMDs– with Capacity Building Component *This module will allow participants to become familiar with improvised explosive devices (IEDs) that may pose a particularly severe chemical or biological (CB) threat. Participants will learn how to effectively identify IEDs and their dispersal methods in order to mitigate their effects if encountered.*
Recognizing WMDs– Precursors *The ability to readily identify common WMD precursors may enable officials to prevent a potential terrorist attack before it is implemented. Participants will learn about the various materials that are easily obtained and used to produce chemical, biological, radiological, nuclear, and explosive (CBRNE) agents.*
Recognizing WMDs– Signs and Symptoms *Participants will become familiar with nerve agents, vesicants (blister agents), toxins, and other harmful agents. In addition, participants will learn about the hazards and risks associated with commonly used WMD agents.*
Recognizing WMDs– Clandestine Laboratories *While both chemical laboratories and clandestine drug laboratories pose significant threats, participants must be able to distinguish between these two types of labs in order to identify and isolate a particular threat. Participants will become familiar with the three activity phases that correspond to these types of laboratories, including the pre-production phase, production phase, and post-production phase.*
Checkpoint Operations and WMD *Effective checkpoint operations are critical to minimizing or preventing the effects of a WMD attack. This module presents participants with beneficial information regarding gathering information, safe procedures, and key indicators or activities that may mitigate employment or transportation of WMD agents or devices. Participants will become familiar with surveillance tactics to better detect or identify suspicious activity, and recommendations to help enhance checkpoint operations.*
Wrap-up and Adjourn