



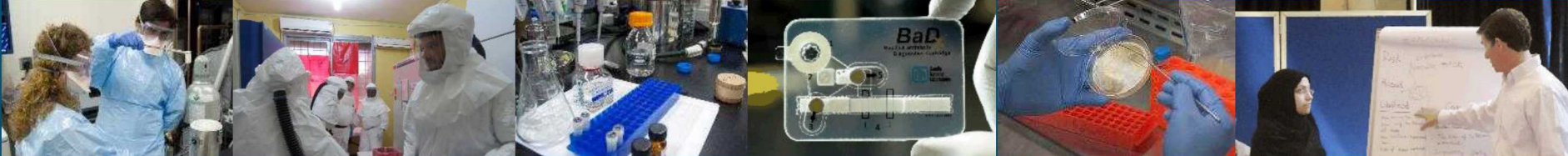
SAND2019-3782PE

# Chemical Transportation Security

Christine M. Straut, Ph.D.



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# Overview

- Overview of Chemical Supply Chain Transportation
- International Laws and Regulations on Chemical Transportation
- Best Practices for Secure Chemical Transport



# Introduction

- What makes chemical transportation security different?
  - Chemicals can have a dual-use purpose
- What are the biggest concerns?
  - Continuously changing environment
  - Adversary controls the environment



# Types of Transportation



Road/Truck



Plane



Ship



Railcar



# Chemical Transportation Security Risks

- In-transit threats
  - Collision, crashes, or accidents
  - Hijacking
  - Theft of materials
  - Sabotage



Photo credit: NTSB  
Pipeline New Mexico, USA

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



# Transportation Threat Examples



Pirates



Hijacking



Ambush



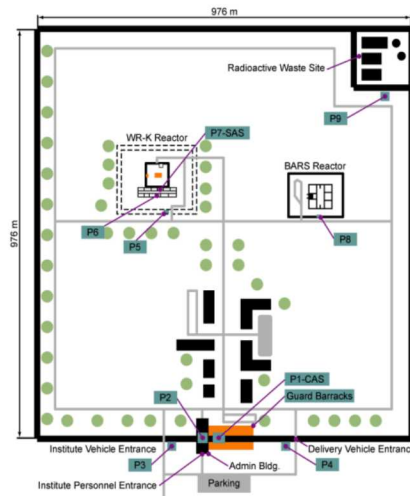
Sabotage



# Differences

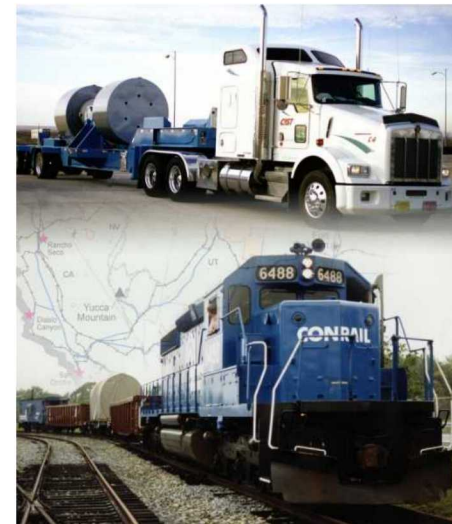
## Fixed-Site

- Fixed Protection Boundary
- Stable Environment
- Control Over Environment
- Operations are Predictable
- Protection System in Place



## Transport

- Moving Boundary
- Continuously Changing
- Uncontrolled Environment
- Variation in Schedule
- Protection System must be Transportable



# Chemicals are targeted during transport

Surat, India (2012): Three drivers were arrested taking out ~240 liters of benzene from transport trucks they were driving



**...and trucks carrying chemicals are involved in accidents**



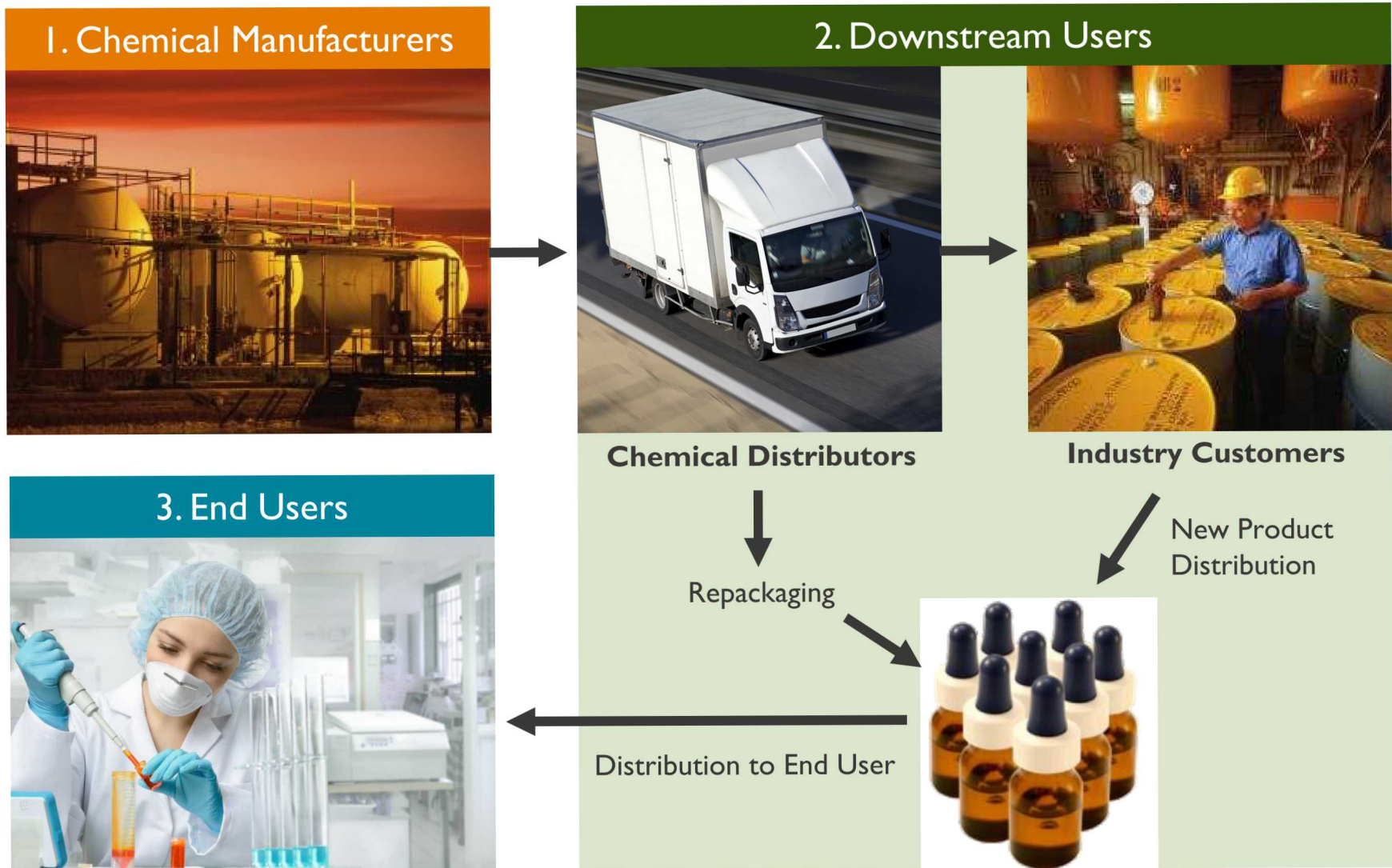
Malaysia (2014): a chemical tanker carrying formaldehyde is hit by a car and overturned, releasing the chemical

Motorists suffered from eye irritation and breathing difficulty

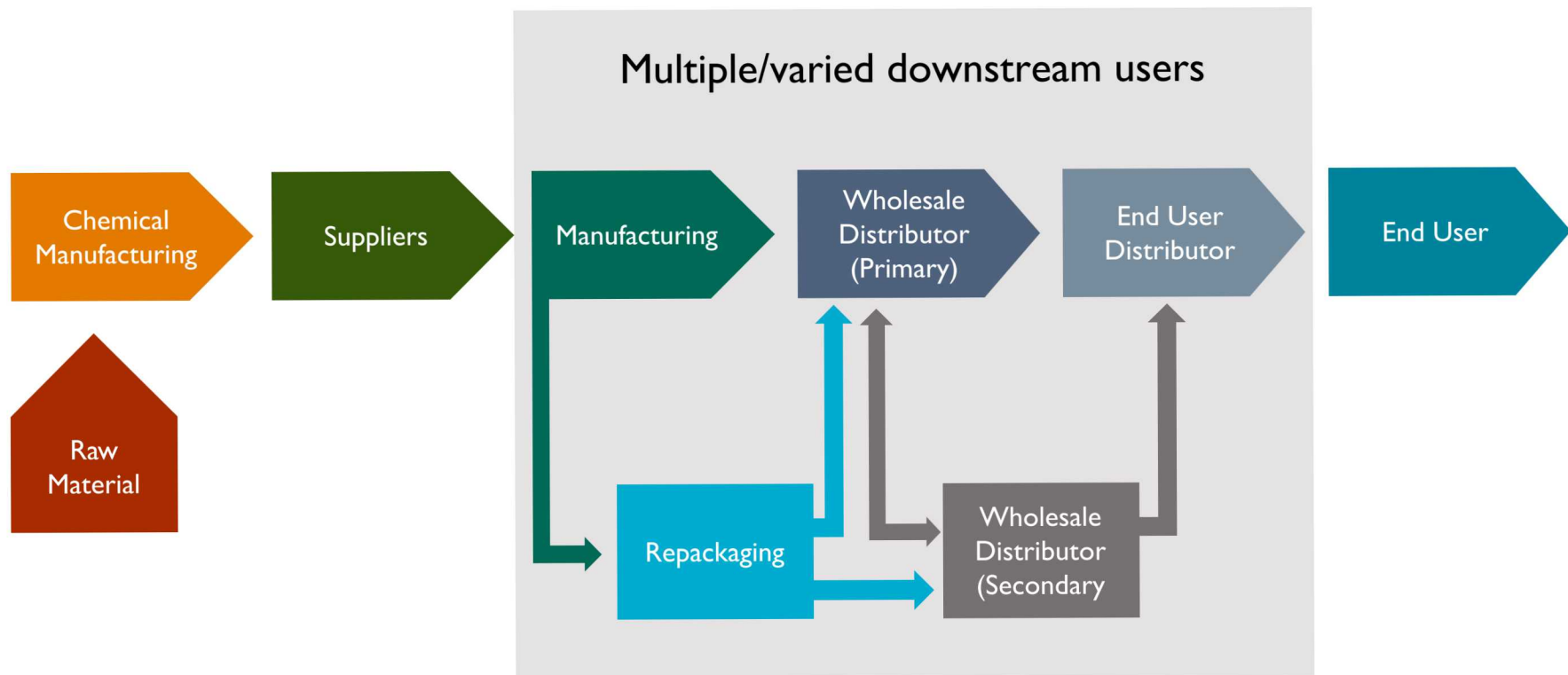
A Hazmat team cleaned up the scene



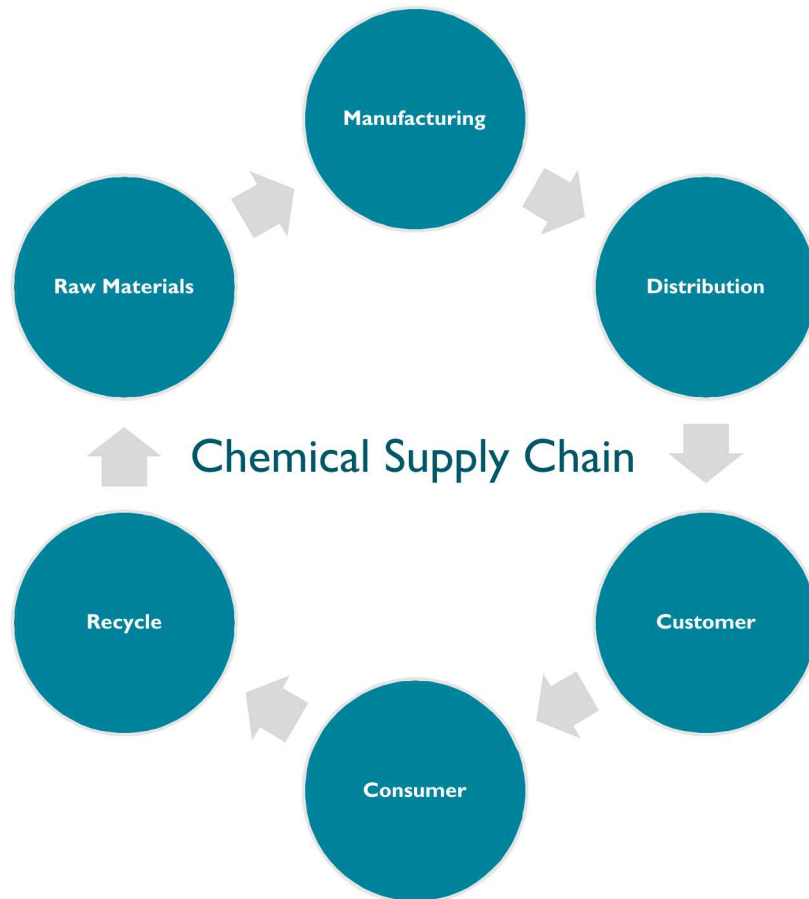
# Simplified Chemical Supply Chain



# Complexity of the Chemical Supply Chain



# Chemical Supply Chain



- The chemical manufacturing industry is supported by a large, diverse, and highly specialized distribution network
- Roles and responsibilities differ for each stakeholder
- Individual activities and actions can impact the risk to the overall **chemical supply chain**



# Chemical Supply Chain

Due to the complexity of many supply chains, chemical risk management is a **shared responsibility**



# Case Study: Sodium Cyanide Theft During Transit



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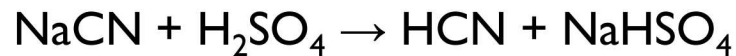
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2016-3784 TR

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# Sodium Cyanide



- White, water-soluble solid
- Used extensively in gold and silver mining due to its affinity for certain metals
- ~1.3 million tons of cyanides (to include sodium) produced each year
- Reaction with a strong acid produces hydrogen cyanide



- NaCN is a potent inhibitor of respiration
- LD50 for humans estimated to be ~3 mg/kg for NaCN
- LC50 for HCN is ~500 ppm at 10 minutes exposure



# What Happened?

- On May 10, 2012, 3 armed thieves stole a truck loaded with 96 blue plastic drums (10 tons) of sodium cyanide off the highway in Pachuca, Mexico
- The truck was in transit from a distribution center to a mining customer
  - The driver admitted to improperly leaving the highway to take a secondary road – a shortcut
  - The driver also admitted to stopping to help men who's car was disabled on the side of the road – these men stole the truck
  - Both of the drivers actions were against regulations
- Initial statements from local police indicated that chances were that the thieves simply wanted the truck (which was a newer model) so they could sell its parts
- The truck was found abandoned on May 16 along a highway about 120 miles southeast of Mexico City – 76 drums of the cyanide were missing



<http://news.bbc.co.uk/2/hi/americas/2014935.stm>



# A Security and Safety Concern

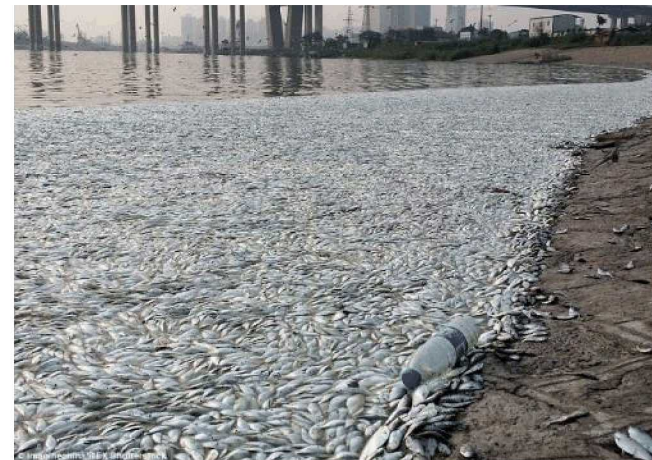
Concern was twofold:

## Security

- The theft raised alarm because several men with suspected ties to the Al Qaeda terrorist network were arrested earlier in the year in Rome: They were carrying a cyanide-based substance and maps showing the U.S. Embassy and the city's water supply system

## Safety

- Also an environmental/safety concern regarding human and wildlife poisoning if the cyanide found its way into the water system



<http://www.dailymail.co.uk/news/peoplesdaily/article-3204797/>



# Response

## Mexico

- Authorities monitored the water supplies in the region and informed the public what the sodium cyanide looked like (white bricks the size of soap)
- The Environmental Ministry urged border agents to take extra precautions against smuggling any of the cyanide out of the country
- Immediate actions were taken once the missing barrels were found
  - Soldiers cordoned off the hilly countryside in the area
  - The highway was blocked off in both directions
  - Water supplies to the local area were cut off as a precaution against contamination

## United States

- The FBI put out an alert to law enforcement agencies to be on the lookout for the truck
- U.S. anti-terrorism officials had alerted Customs and state agencies to watch for the blue drums



<http://pictures.reuters.com/archive/MEXICO-CYANIDE-RP3DRHZQNQAA.html>



## End Result

- The largest number of missing blue drums, about 70, was found dumped in a ditch a few yards off the road about 50 miles northeast of where the truck was stolen
  - At least two of the drums had been opened
  - The remainder of the drums were also found in surrounding areas
- In the end, all of the sodium cyanide was accounted for
- No environmental damage was found
- The thieves were not caught

Through the case, the FBI worked with its Mexican counterparts to try to determine the nature of the crime and to determine where the missing cyanide was



# Thoughts

What could have been done differently to prevent the incident?

Were the actions and responses of the Mexican and U.S. governments appropriate? If not, why not?

Does theft of goods during shipment occur in Chile? Is it a big problem?



## References

<http://www.nytimes.com/2002/05/17/world/mexico-continues-search-for-stolen-cyanide.html>

<http://www.nytimes.com/2002/05/16/world/truck-full-of-cyanide-is-stolen-in-mexico.html>

<http://articles.latimes.com/2002/may/30/world/fg-cyanide30>

<http://www.icis.com/resources/news/2002/05/22/172916/mexican-officials-intensify-search-for-stolen-sodium-cyanide/>

<http://pictures.reuters.com/archive/MEXICO-CYANIDE-RP3DRHZQNQAA.html>

<http://www.foxnews.com/story/2002/05/15/fbi-puts-out-alert-on-stolen-cyanide-truck.html>

<http://news.bbc.co.uk/2/hi/americas/2014935.stm>

<http://articles.latimes.com/2002/may/31/world/fg-briefs31.3>

<http://www.cbsnews.com/news/most-of-stolen-cyanide-found/>



# International Regulations, Voluntary Standards and Codes



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# Chemical Supply Chain: International Regulations, Voluntary Standards and Codes

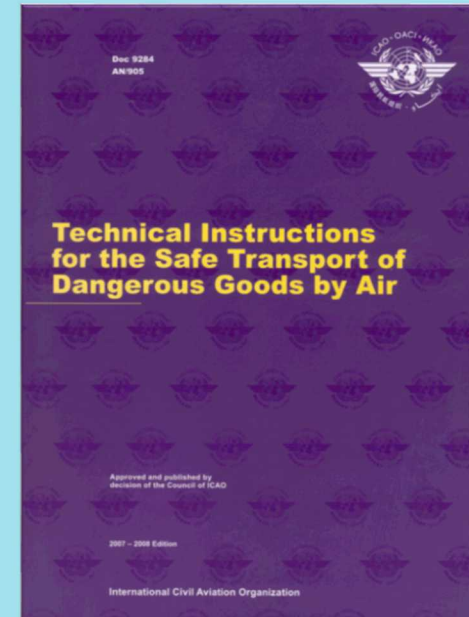
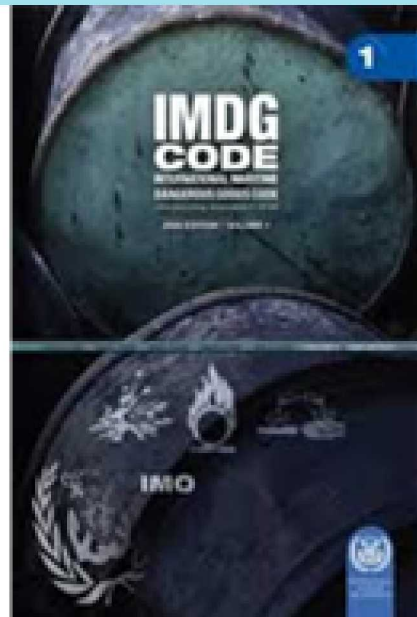
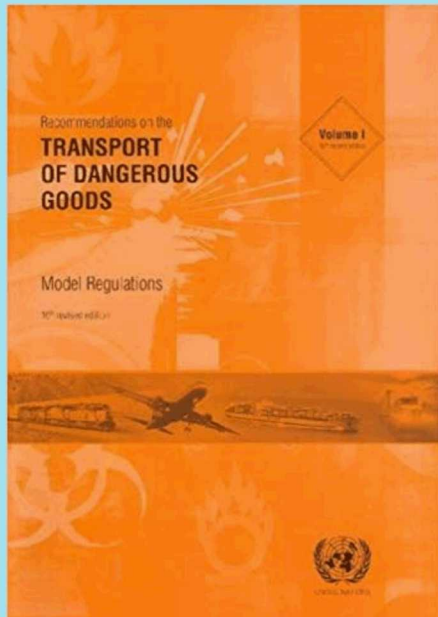
- International and Country Specific
  - Examples: OPCW Chemical Weapons Convention (CWC), UNI 540
- Voluntary Standards and Codes
  - Examples: Responsible Care®
- Import/Export Regulations
  - Examples: Australian Group
- Transportation
  - Examples: IATA, IMDG
- Chemical Safety (labeling/packaging)
  - Examples: Globally Harmonized System (GHS) for labeling chemicals

Ultimate goal: **Safety and Security** for people, community, government, and the environment

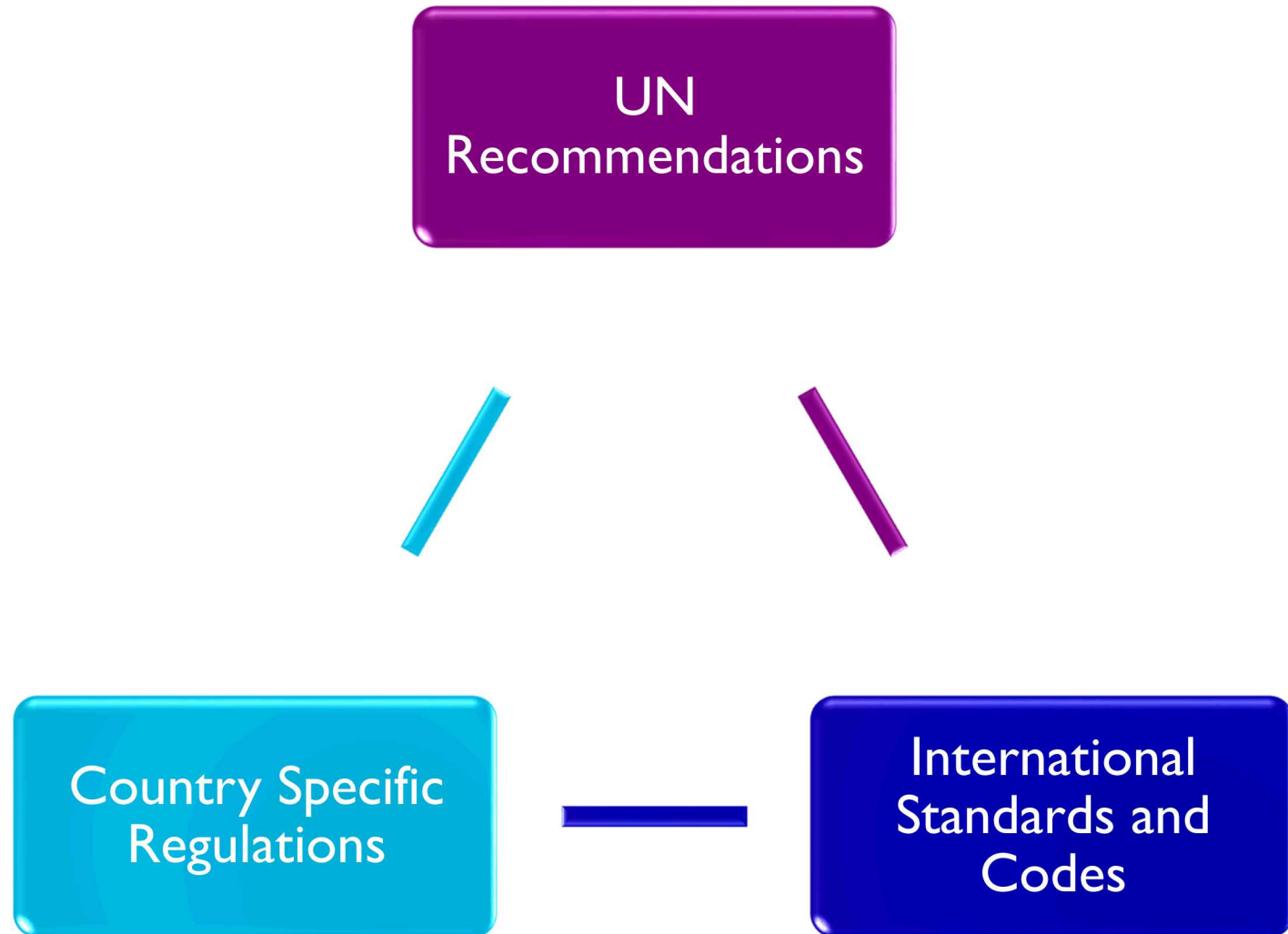


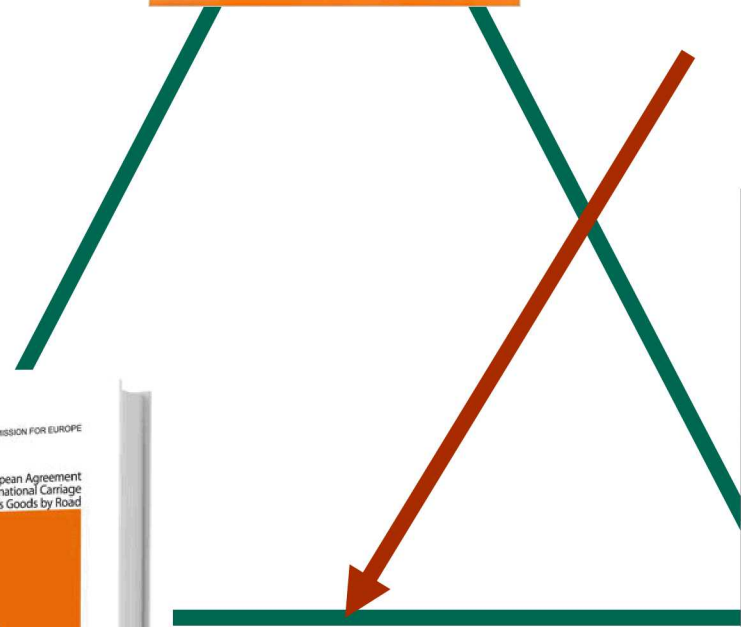
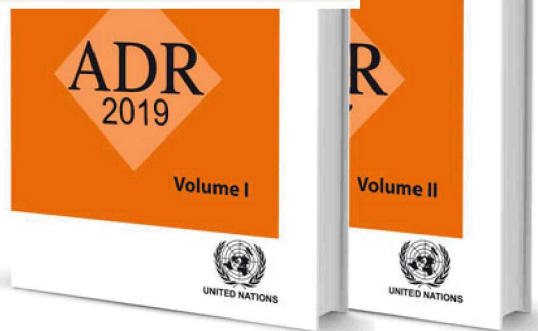
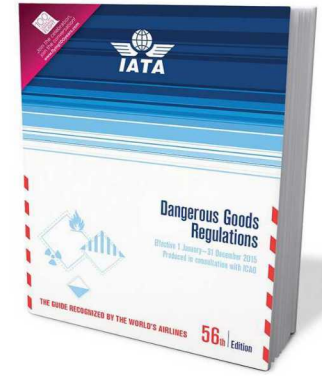
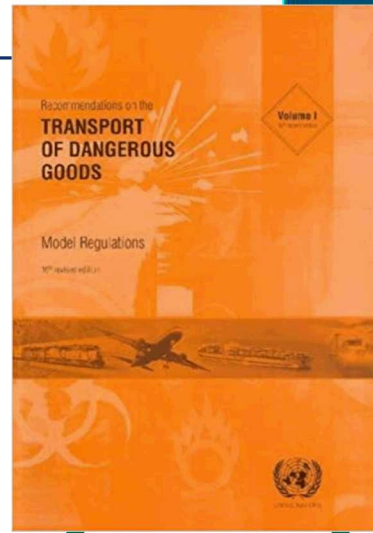
# International Standards and Codes

- “Orange Book” UN Recommendations on the Transport of Dangerous Goods, Model Regulations, Thirteenth revised version, United Nations
- International Maritime Dangerous Goods (IMDG) Code
- International Civil Aviation Organization (ICAO) or International Air Transport Association (IATA)



# Regulatory Framework







# Best Practices for Secure Chemical Transport



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# Best Practices in Secure Chemical Transport

- Select Chemical Lists
- Documentation and Reporting
- Labeling, Packaging, and Placards
- Security Plan
- Emergency Plan
- Communication





## Chemical Management



# What is Being Transported?

Potentially sensitive materials that are shipped

- Dual-use, CW precursors
- Explosives
- Flammable Gases
- Anhydrous Ammonia
- Toxic Gases
- Flammable Liquids & Solids
- Oxidizers
- Water reactive
- Corrosives
- Radioactive, infectious substances



Take what, where, and how much into account when making hazardous shipments



# Select Chemical List

## Security

- CWC Schedules 1-3 and DOC
- US Department of Homeland Security - Chemicals of Interest (COI)
  - Theft and Sabotage
- Australia Group – Common Control Lists
  - CW precursor control list
- World Customs Organization's Programme Global Shield
  - Explosive precursors


## Safety

- UN Recommendations on the Transport of Dangerous Goods
- European Chemicals Agency (ECHA) - Substance of Very High Concern (SVHC)
- U.S. Occupational Safety and Health Administration (OSHA)
  - Toxic Industrial Chemicals (TICs)



# Material Accountability

## Documentation and Reporting

- Responsibility is on the **Shipper**
- Documentation
  - Transport documentation of shipment
  - Verification documents
    - Customer verification  **Know Your Customer**
    - Transfer responsibility
    - Delivery Receipt
- Licensing and Permitting
- Record Keeping
  - Maintain records of documentation and verification paperwork
- Reporting



# Transportation Documentation

- 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 Contracting Service Providers

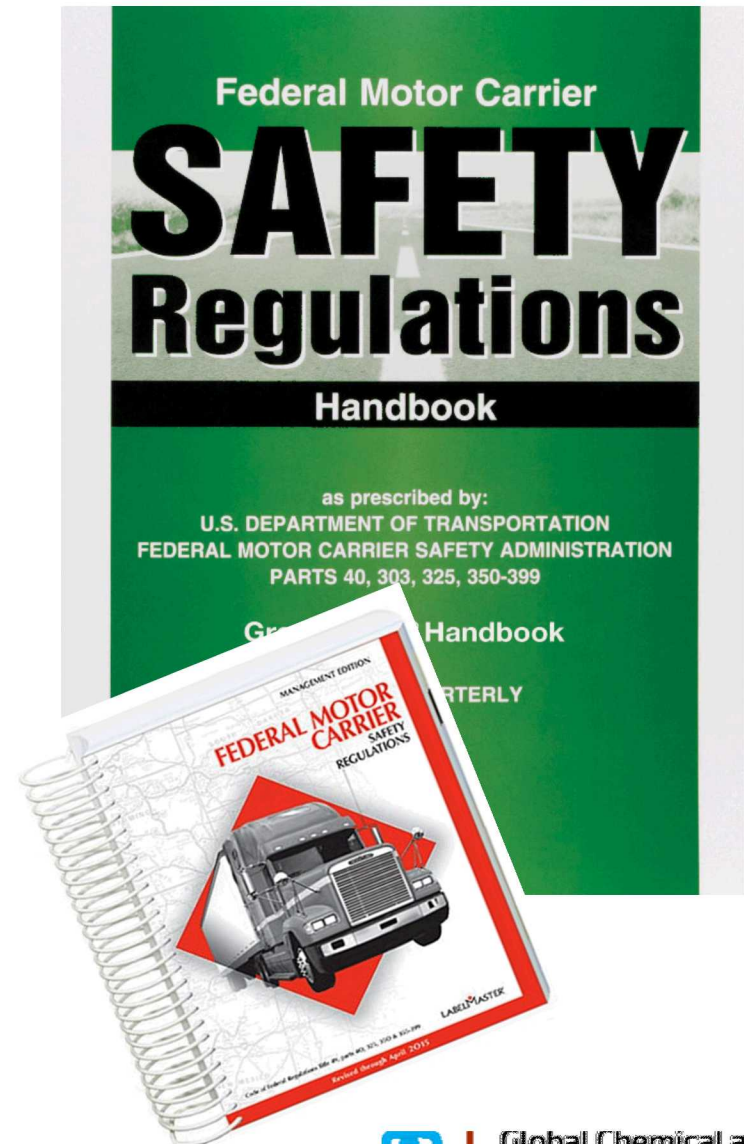
- Certifications/licensing
  - Personnel and Equipment
- Verification of:
  - Evaluation transportation security plans
  - Safety & Security training of personnel
  - Packaging & Labelling certification/inspection
  - Shipping documentation/bill of lading
  - Emergency Plans including posted contact Information



# US Federal Motor Carrier Safety Regulations

The US FMCSA regulates:

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



# Case Study: MGPI Processing, Inc. Toxic Chemical Release



<https://www.csb.gov/mgpi-processing-inc-toxic-chemical-release/>

<https://www.youtube.com/watch?v=Tflm9mttAAI>



# Labels, Packaging, and Placards



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## Labels: Information

- 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

- according to regulations

*Include* emergency information

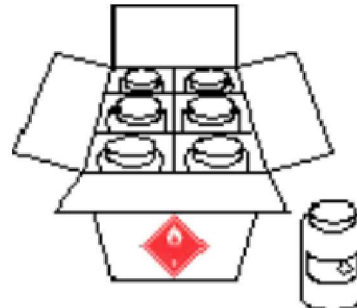
- contact names  
24/7 phone numbers

Language(s)

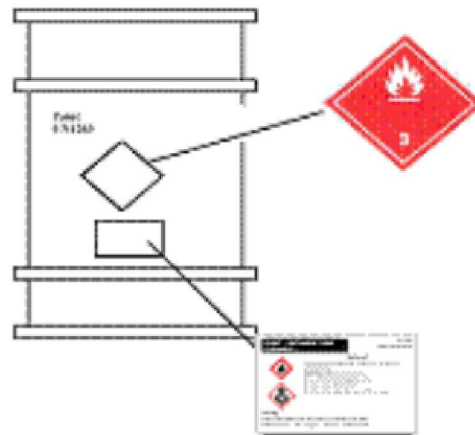
- proper universal symbols



# Package Labels



**Combination Packaging (Outer box with inner bottles)**



**Combination Packaging (Outer box with inner bottles)**



# Labels & Placards

## Hazard Labels

- GHS

## Transportation Labels

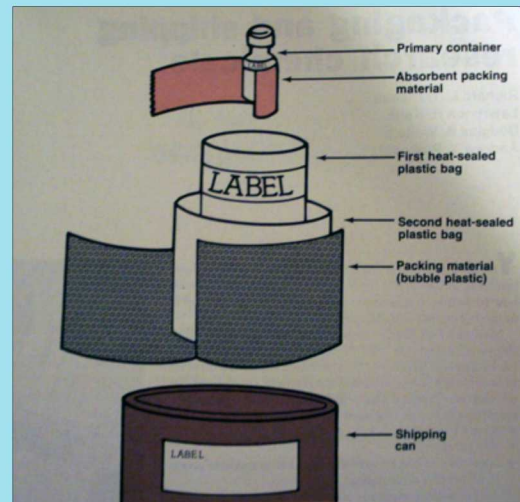
- Transportation pictograms
- Combination labels
- Container label (inner and outer)



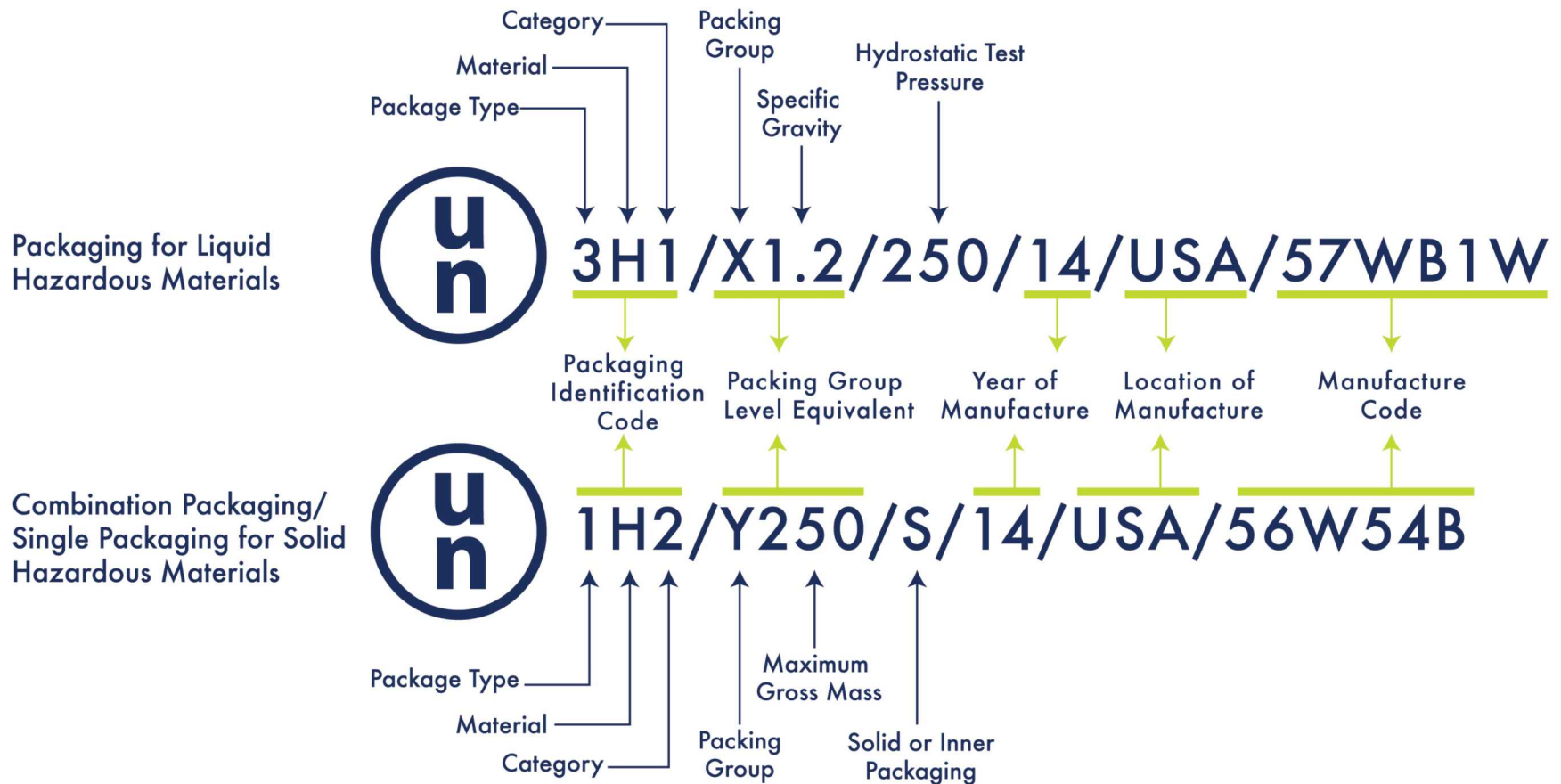
# Packaging

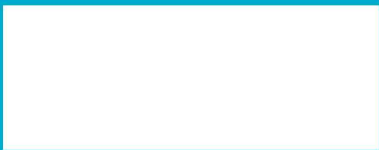
Specific requirements depend on material and other factors

- Container within a container
- UN Standard Packaging



# UN Packing Markings





# Security Plan



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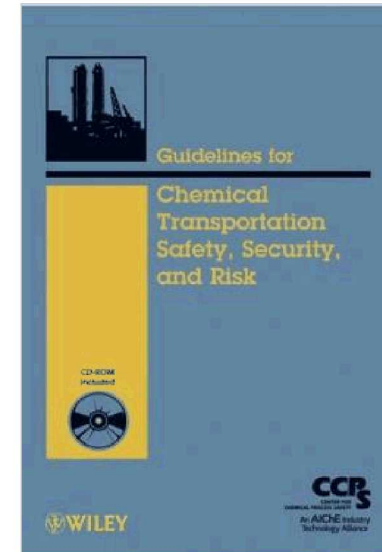
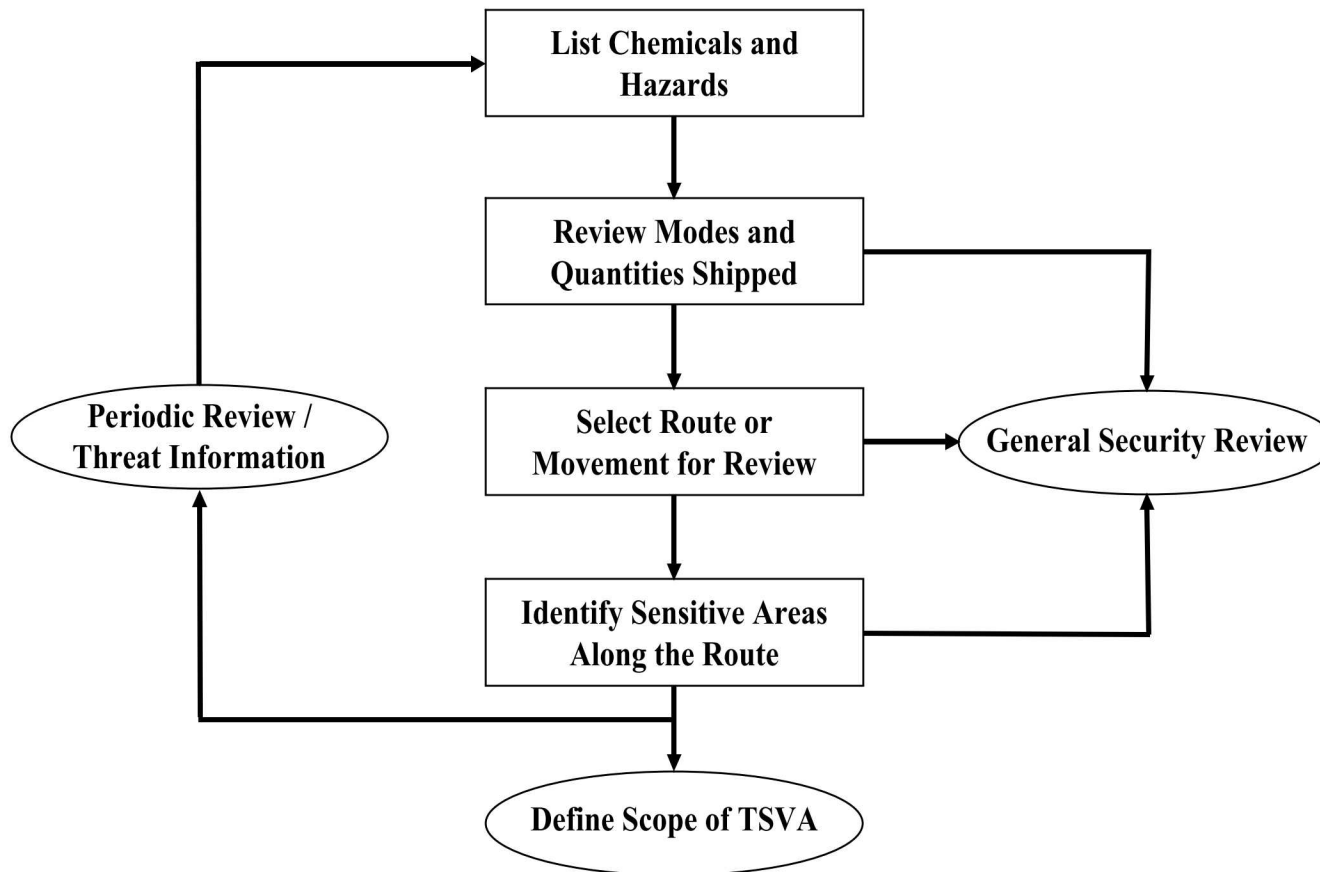
# Chemical Transport Security

- Where, how, who opens shipment?
- Is material radioactive, flammable, reactive, explosive, etc.?
- Is monitoring equipment needed?
- Is special storage needed on receipt?



# Transportation Risk Assessment

Risk mitigation measure should be based on a risk assessment AND performance-based



# Security Plan Elements

- Personnel Security
- Unauthorized Access
- En route security
- Must also include:
  - Job title of senior management official responsible for overall development and implementation
  - Security duties for each position/department
  - A plan for training hazmat employees
  - Transportation security risk assessment

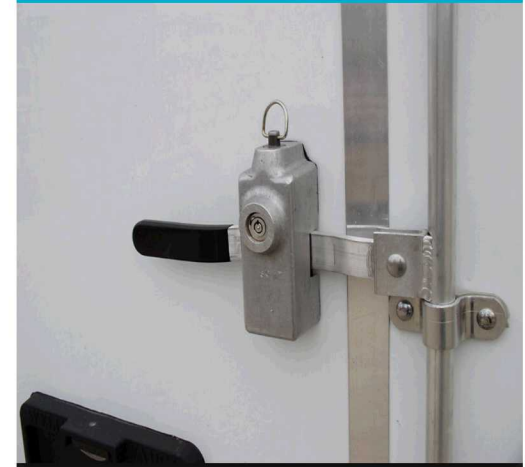


# Unauthorized Access

- Access Control
  - Increase the possibility of delaying an attack
    - Cargo secured to vehicle
    - Immobilize vehicle
    - Hazardous material in vault
    - Locks, barriers, entanglements



Access Control



# En route Security

High risk shipments require *high-level* controls:

Increase possibility of detecting an attack

- Provide for additional security personnel
- Alarm the shipment
- Use communication systems



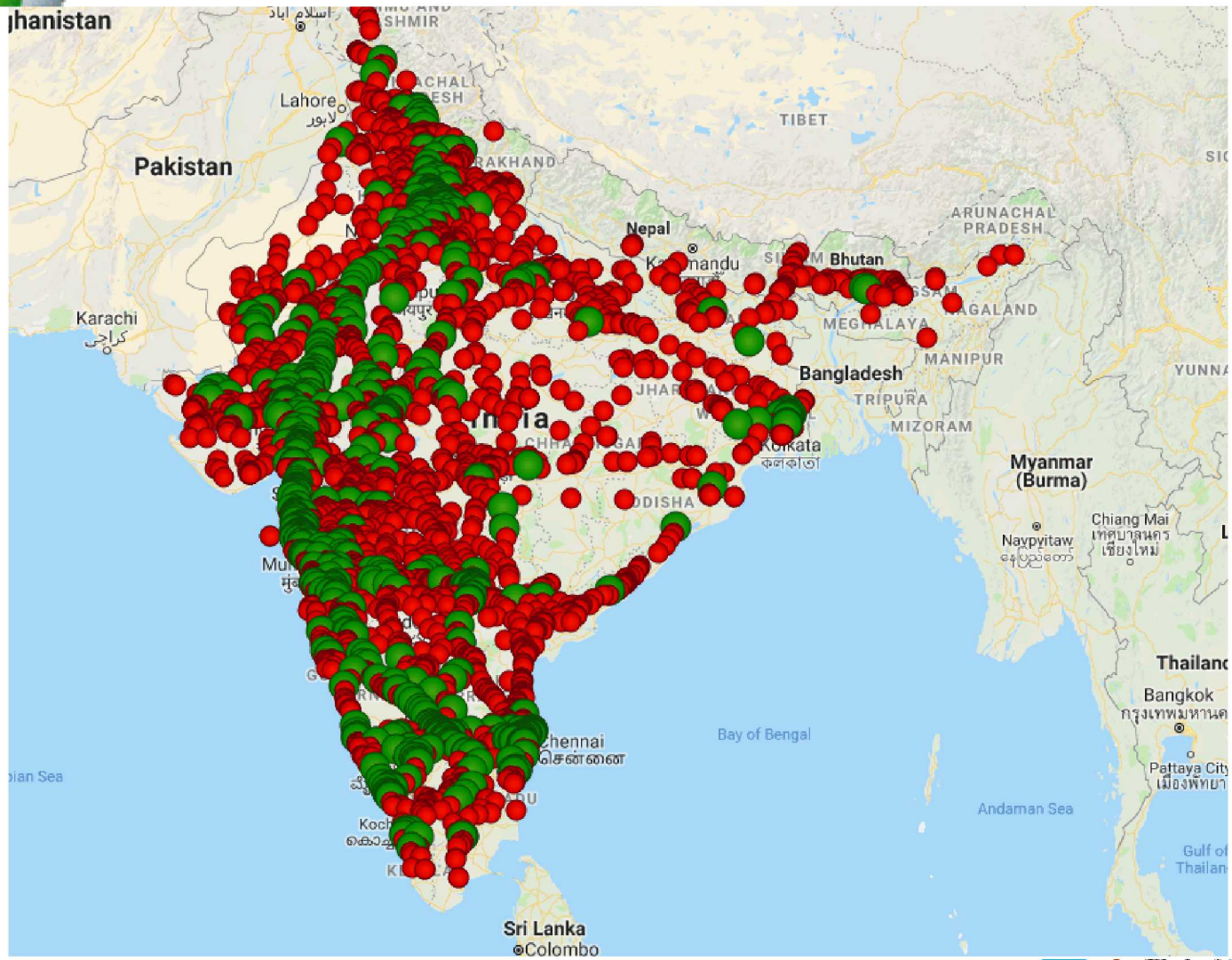
Photo: <http://www.securityguardcompanies.us/>





# nicerGlobe®

Responsible Care® Initiative



Global Chemical and  
Biological Security

# Who Requires Training?

- Managers
- Packers
- Handlers
- Loaders
- Drivers
- Mailroom personnel



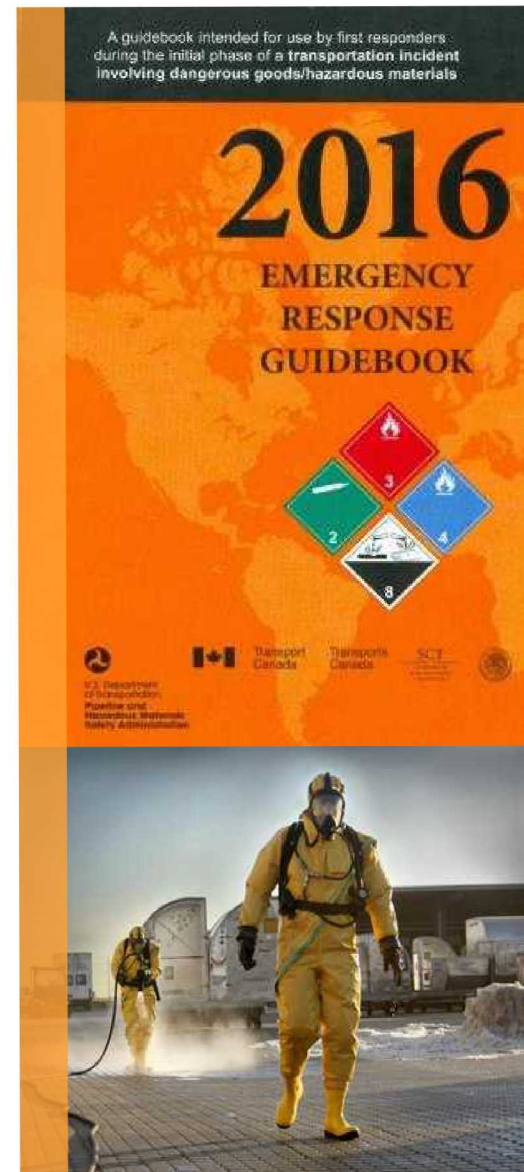
**All shipping and receiving personnel**



# Transportation: Emergencies

- Emergency Plan
- Documentation
- Training
- Contacts

<http://www.phmsa.dot.gov/hazmat/library/erg>



# Resources

## 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>



# Resources

**Transportation Community Awareness and Emergency Response (TRANSCAER®)** - A voluntary national outreach effort that focuses on assisting communities to prepare for and respond to a possible hazardous materials transportation incident.

Resources include:

- Classroom and hands-on training
- Emergency planning assistance
- Support for community drills and exercises
- Technical information, reference, and training materials
- National conferences and workshops for sharing best practices and networking
- <http://www.transcaer.com>



# Balancing Transportation Security with Safety

Issue	Safety	Security
<b>Placards</b>	Commodity information needed by emergency responders to react appropriately to an accident and minimize any impact.	Commodity information could be used by terrorists to target specific chemicals.
<b>Rerouting</b>	May result in more accidents if there are longer transits or the infrastructure along an alternate route may be less well maintained or contain undesirable features (uncontrolled intersections, no shoulders, etc.).	Eliminating a shipment near a specific location (most likely a highly populated or critical area) may inadvertently transfer the risk from one community to another.

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



# Balancing Transportation Security with Safety

Issue	Safety	Security
<b>Working with supply chain partners</b> (implementing security countermeasures)	Technology can be used for both safety and security (e.g., GPS to indicate location en route, emergency response to accident, and monitoring time-sensitive chemicals/materials).	Technologies focused on security should not distract the main function of the carriers (e.g., the safe transport of chemicals from point A to B).
<b>Risk Analysis Methods</b>	<ul style="list-style-type: none"><li>• Rational and structured results lead to recommendations</li><li>• Participation and engagement by individuals with different perspectives, roles, and backgrounds/skill sets for safety, security, and transportation</li><li>• Similar methodology</li><li>• Same decision metrics (guidelines)</li></ul>	



# Tips for Successful Regulations

## Communication

- All Stakeholders
  - Government agencies
  - Community
  - Industry or Industry Association

## Consider:

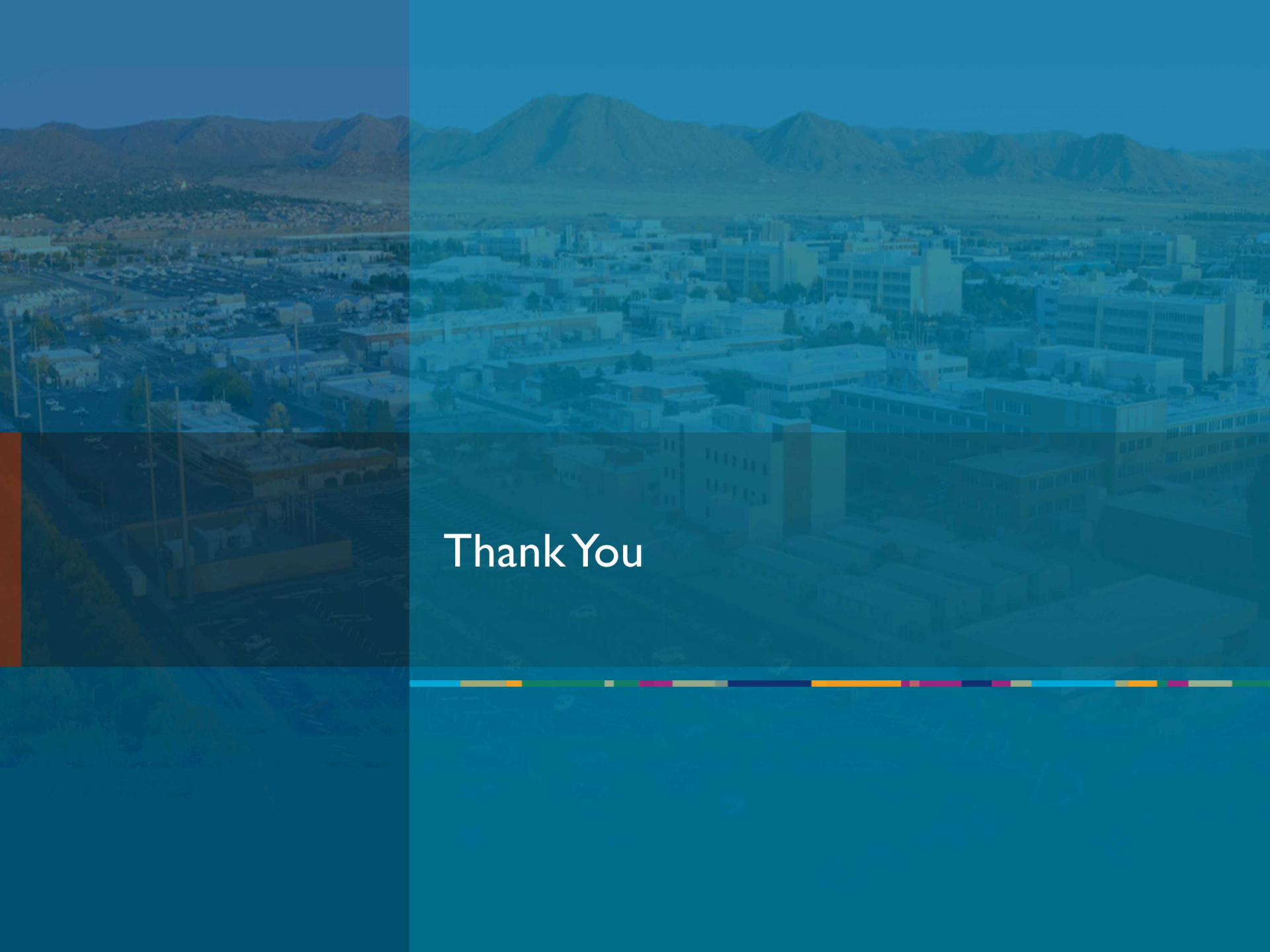
- Economic Impact
- Resource Impact
- Scaled implementation
- Evaluation – exercises to evaluate strengths and gaps in current and future regulations



# Conclusion

- Supply chain & transport security is a shared responsibility
- Overlapping regulations and laws
- Implement security measures based on a thorough transport risk assessment
- Balance safety & security
- Communication is key to successful regulation implementation





Thank You