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Innovation



APRU Multi-Hazards Webinar Series: A new Approach for Disaster Risk Management after COVID-19

Understanding & addressing different types of hazards: CHEMICALS

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Introduction

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- Bachelor & Master in Chemistry
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- Indonesian Oil & Gas Independent Safety Team



Outline

- Industrial Chemical Accidents & Disasters
- Lessons Learned
- Chemical Safety vs Security
- Mitigation Strategies
- Industrial Chemical Safety & Security
- Industrial Chemical Management
- Key Points



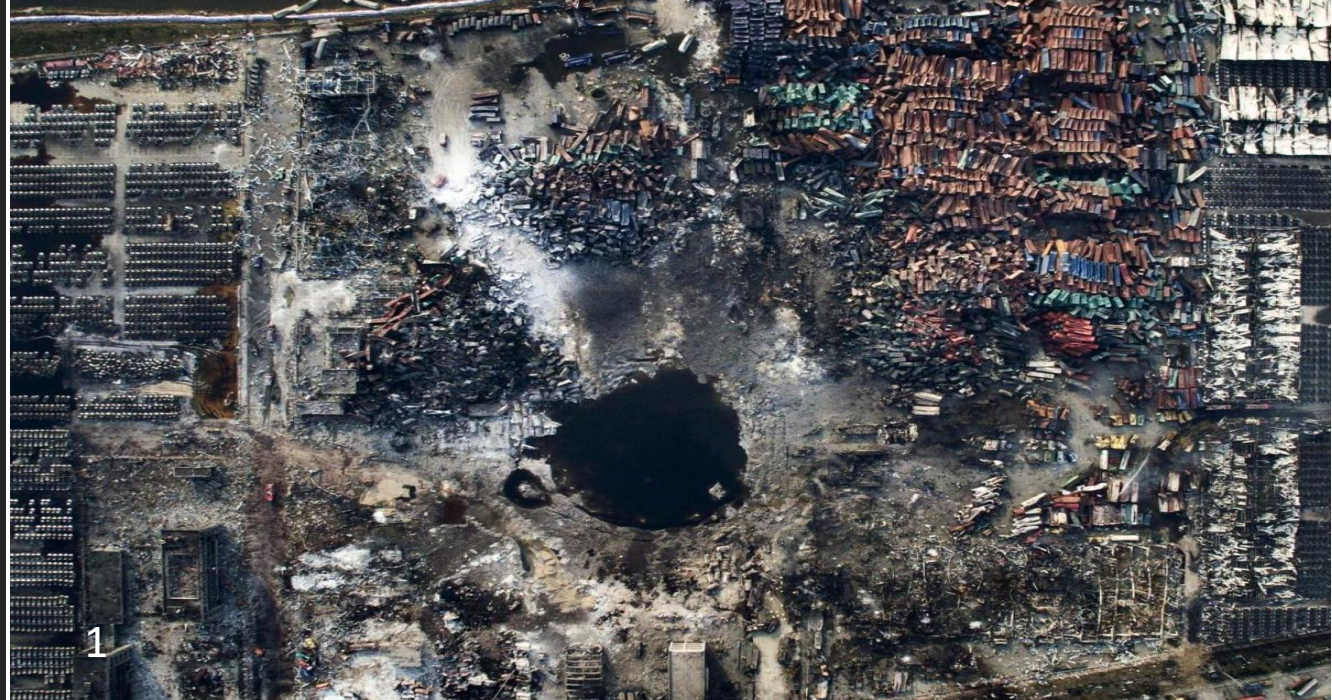
Industrial Chemical Disasters

1. Piper Alpha
2. Bhopal
3. Deepwater Horizon, Gulf Mexico
4. Visakhapatnam gas leak, India (2020) - styrene



Industrial Chemical Accidents

1. Tianjin Explosion, China, 12 August 2015, killed 173 people, injured hundreds of others at a Chemical storage station at the **Port of Tianjin** 800 tonnes of ammonium nitrate (approx. 256 tonnes TNT equivalent)
2. Beirut Explosion, Lebanon, 4 August 2020, a large amount of ammonium nitrate stored at the **Port of the city of Beirut**, exploded, causing at least 200 deaths, 3 people missing, and 6,500 injuries, US\$10–15 billion in property damage, and leaving an estimated 300,000 people homeless. Around 2,750 tonnes of the substance (equivalent to around 1.1 kilotons of TNT) had been stored in a warehouse without proper safety measures for the previous six years



<https://qz.com/756872/a-year-after-the-tianjin-blast-public-mourning-and-discussion-about-it-are-still-censored-in-china/>



<https://www.bbc.com/news/53669029>

Industrial Chemical Accidents

1. Fire due to Chemical Theft (Oil & Gas, 2009): 1 deaths, USD7.000.000 – Chemical Security
2. Explosions in Fireworks Factory: 49 deaths – Poor understanding of chemical hazards (2017)
3. Illegal Oil Pipeline Tapping (2014) – 4 deaths, Chemical Security
4. Illegal Oil Drilling (2017) – 2 deaths, 20 severe burns, Chemical Security



Lessons Learned

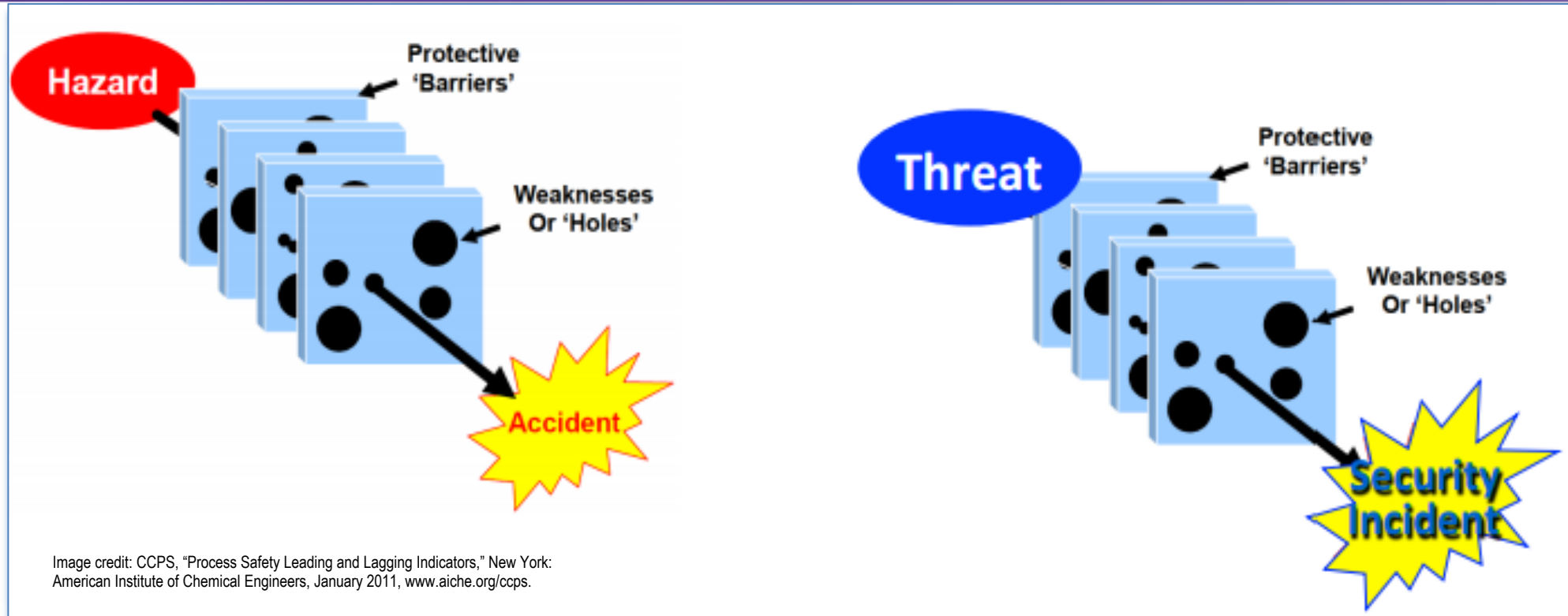
- Inadequate **hazard identification or risk assessment**
- **Lack of understanding** in addressing chemical hazards & threats
- **Low awareness** on Chemical Safety & security
- Inadequate **work standards/procedures**
- Inadequate **supervision**
- Improper decision making or **lack of judgement**
- Inadequate **training/competence**
- Violation unintentional (by individual or group)

Likelihood rating	E	IV	III	II	I	I	I
	D	IV	III	III	II	I	I
	C	V	IV	III	II	II	I
	B	V	IV	III	III	II	I
	A	V	V	IV	III	II	II
		1	2	3	4	5	6
Consequence rating							



Chemical Safety vs Security

“Swiss cheese model”



Chemical Safety

- ☐ Hazard assessment
- ☐ Consequence assessment
- ☐ Control measures assessment
- ☐ Safety incidents: accidental

Chemical Security

- ☐ Threat assessment
- ☐ Consequence assessment
- ☐ Protective Barriers assessment
- ☐ Security incidents: intentional

Industrial Chemical Safety & Security

Industrial Chemical Safety

- Chemical Safety Risk is a measure of human injury, environmental damage, or economic loss in terms of both the **incident likelihood** and the **magnitude** of the loss or injury
- Protection of **workers** from **chemical hazards**
- Chemical accidents prevention
- Unintentional



Industrial Chemical Security

- Security Risk is an expression of the **likelihood** that a defined **threat** will exploit a specific **vulnerability** of a particular attractive target or combination of targets to cause a given set of **consequences**
- Protection of **chemicals** from **misuse**
- Chemical security incidents prevention
- Intentional

Mitigation Strategies

Industrial Chemical Safety

- Process Safety Management
- Major Hazards Control



Industrial Chemical Security

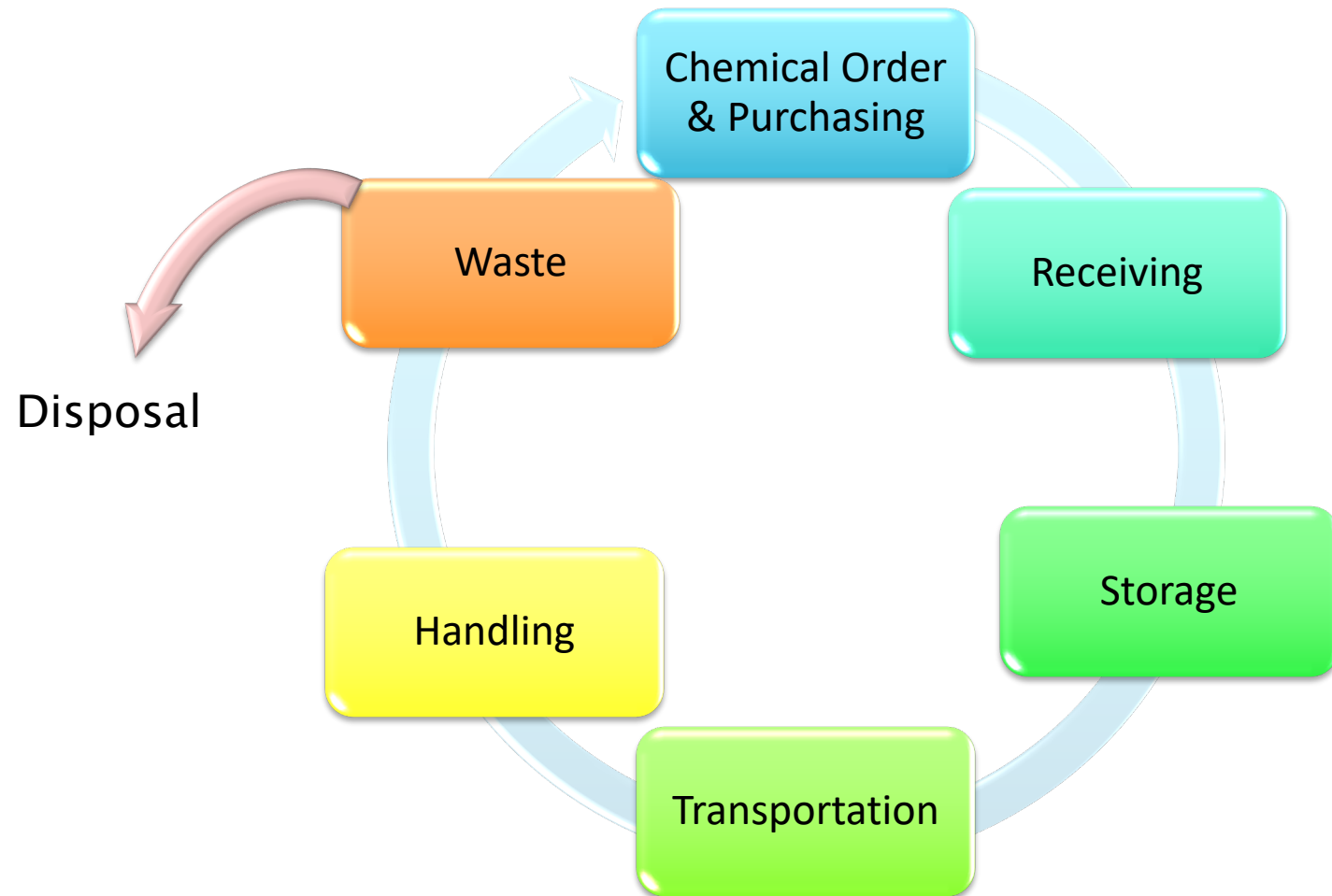
- Security Vulnerability Assessment
- Identify Critical Target
- Assess Threats & Consequences
- Evaluation of Safeguards



Mitigation Strategies

Industrial Chemical Management

PDCA Cycle



Mitigation Strategies

Industrial Chemical Safety

Process Safety Management – 20 element

1. Process Safety Culture
2. Standards, Codes, Regulations, & Laws
3. Process Safety Competency
4. Workforce Involvement
5. Stakeholder Outreach
6. Process Knowledge Management
7. Hazard Identification and Risk Analysis
8. Operating Procedures
9. Safe Work Practices
10. Asset Integrity and Reliability
11. Contractor Management
12. Training and Performance Assurance
13. Management of Change
14. Operational Readiness
15. Conduct of Operations
16. Emergency Management
17. Incident Investigation
18. Measurement and Metrics
19. Auditing
20. Management Review & Continuous Improvement



Major Hazards Control

1. Identification of major hazard installations
2. The role of management
3. The role of authorities
4. The role of workers & workers' organisations
5. Emergency planning
6. Implementation of major hazard control systems
7. Prerequisites for a major control system

Implementation of Industrial Chemical Security

- Security Vulnerability Assessment
 - Identify Target & Critical assets
 - Assess Threats
 - Assess Consequences
- Industrial Chemical Security Risk Reduction
- Evaluation of Safeguards



Target & Critical Assets

Industrial Chemical Security



Identify
Critical
Assets from
your Facility



- People
- Equipment
- Systems
- Chemicals
- Products
- Information



What other possible Target & Critical Assets in your facilities?

Assess Threats

- Pirates
- Theft
- Public Demonstration
- Adversaries
- What other possible threats?



Assess Consequences

- Fire
- Explosion
- Pollution
- Injury
- Acute Toxicity
- Assets damages/loss

Is your organization ready
for this?



Sources: Google image

Chemical Security Risk Reduction

Deter, Detect & Delay
Principles

Physical or Cyber
Protection

Procedures &
Administrative Controls

Inherently Safer Systems

Types of Countermeasures

- Physical security & Barriers
- Detection equipment & Access Control
- Loss prevention, material control & inventory management
- Control Room Security
- Crisis Management & Emergency Response
- Policies & Procedures
- Information/cyber security
- Intelligence



Physical Security & Barriers

- Detection equipment
 - Assessment / response
 - Communication
 - Access Control
 - Material control, accountability & movement control
- Barriers
 - Perimeter Protection
 - Fencing
 - Walls
 - Landscaping



Detection Equipment & Access Control

Detection Equipment

Provides warning of **unauthorized entry** to areas within facilities

- Intrusion detection sensors & systems
- CCTV / video surveillance
- Alarm monitoring consoles



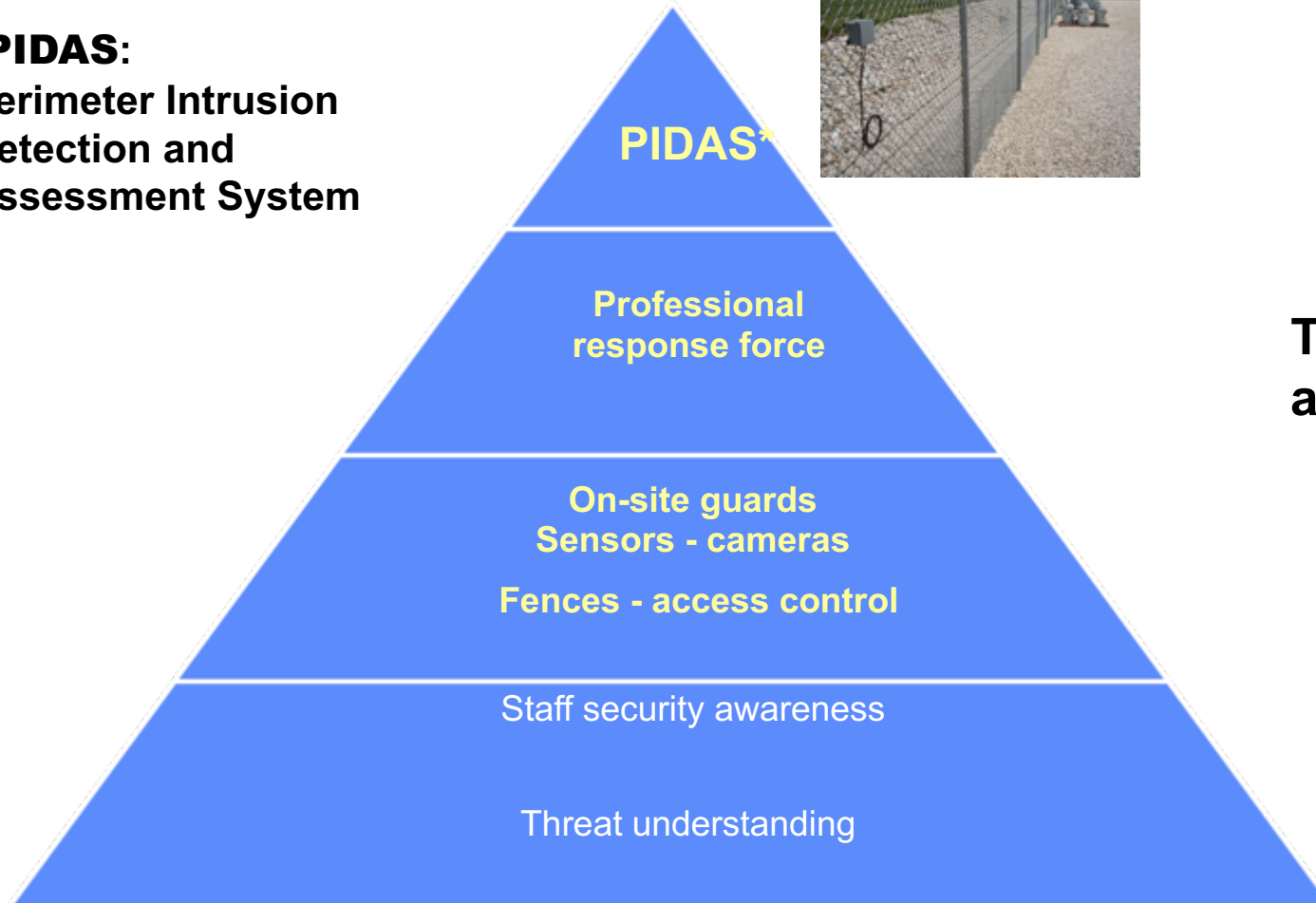
Access Control

- The objective: to establish positive control over whom & what is permitted entry to or exit from the site or critical areas of the site.
- Control over **personnel, property & a vehicle passing** through the site's perimeter
- Access control:
 - Equipment
 - Building
 - Grounds design
 - Security practices



Evaluation of safeguards

***PIDAS:**
Perimeter Intrusion
Detection and
Assessment System



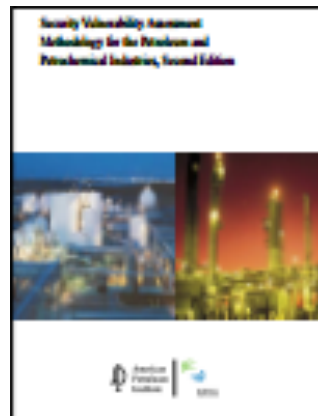
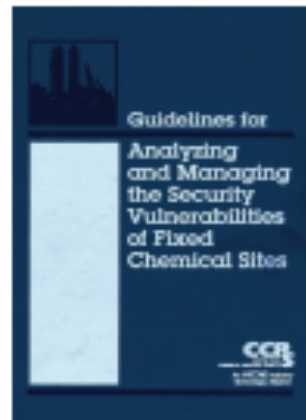
Technology
and/or Cost

Key Points

1. Understanding the **chemical hazards & threats** are very important
2. The urgency need to address **chemical safety & security**
3. Several **mitigation strategies** could be implemented to address **chemical risks**
4. Implementation of **holistic approach to chemical safety, security and management**

References

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- ❑ Picturesources: Google image



Thank You



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