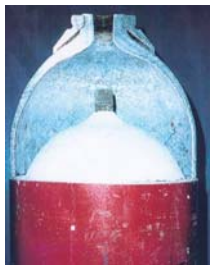
ACETYLENE GAS SAFETY SEMINAR 2009



Asia Industrial Gases Association

Council of Labor Affairs Executive Yuan

Taiwan High Pressure Gas Industrial Association

Safety & Health Technology Center

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ACETYLENE PRODUCTION
Major Hazards & Safeguards

Daniel Tregear

IMPORTANT NOTE

This presentation is intended to show a methodology & examples, not rigorous analysis.

Local regulatory requirements, or internal company standards, may imply more stringent analysis.

Identifying Major Hazards

HAZOP

- Identifies all the hazards in both the design and operation of the process

ID Major hazards

- Highlights the major hazards found in the HAZOP and determines scope of further review

Analysis

- Looking at both onsite and offsite consequence to decide if safeguards are adequate

Information Sources

- European Industrial Gases Association
  - Code of practice Acetylene – IGC Doc 123/04/E [AIGA 022/05]
  - Major hazards (appendix 3 Acetylene Plants) IGC Doc 142/08
  - Guide to lime applications IGC Doc 143/08
- US-National Fire Protection Association (NFPA)
  - NFPA-51A : Standard for Acetylene Cylinder Charging Plants.
  - NFPA-55 : Standard for the Storage, Use & handling of Compressed Gases.
  - NFPA-5000 : Building Construction & safety Code.
- Acetylene Industry best practices.

HAZOP (Hazard and Operability study)

File Edit Format Navigate Project Worksheet Tools Utilities Window Help

Gopeng_Acetylene[1]: Node 3, Parameter Temperature

Session: (1) 03/12/2008
Node: (3) Generator
Drawings: PGG 01
Parameter: Temperature

Revision:
Intention: Generation of acetylene

Intention: 60C water in the generator

GW	DEVIATION	CAUSES	CONSEQUENCES	SAFEGUARDS	S	L	R	REF#	RECOMMENDATION
More	3.4. High Temperature	3.4.1. The cooling system for the recycled water is overloaded but the system continues to draw from recycle rather than fresh	3.4.1.1. See 2.3.2.1 High level of steam in the generator - greater risk of moisture in the screw conveyor and hopper.	3.4.1.1.1. Sizing of the recycled water process (sludge settling tanks) to bring the temperature down to 35C 3.4.1.1.2. Recycled water cooling system becomes more effective as inlet temperature increases (self balancing) 3.4.1.1.3. Ultimate high temperature switch will shutdown the generator					
		3.4.2. Failure of the temperature control loop - either the TC or the water valve	3.4.2.1. See 2.3.2.1	3.4.2.1.1. Hourly visual check of the generator includes check of TI on the generator. 3.4.2.1.2. High temperature loop is part of the critical safety alarms for site				15	During commissioning when o parameters more clearly under TI on the generator with a trans to indicate "not above"
		3.4.3. Hot ambient water supply	3.4.3.1. The generator uses recycled water in preference to fresh water. Recycled water is not used only if too hot or not available/insufficient supply.	3.4.3.1.1. Ambient water temperature specification (<30C) 3.4.3.1.2. TI on fresh water supply - to allow identification of problem.					
Less	3.5. Low Temperature	3.5.1. Low ambient (0degC) Only applicable to high pressure acetylene (25barg)	3.5.1.1. Liquid acetylene - a very dangerous material, prone to explosion etc.	3.5.1.1.1. At low pressures liquid acetylene does NOT form. This risk is only meaningful for the high pressure part of the process. See EIGA Document 123/04 Figure 1. At the lowest pressure value shown	3	0	0		

Severity

Severity	Injury	Environment	Property
0	No injury	No damage	Less than $X'000
1	Minor injury Reversible	Onsite damage	Greater than X
2	Serious injury Reversible.	Offsite damage Reversible	10x X
3	Serious injury Non reversible	Widespread damage No "important" areas	100x to 1000x X
4	Fatality May be >1	Widespread damage Important areas	Massive losses Company impact

Likelihood of occurrence

Likelihood	Events per year	Description
0	$<10^{-71}$	Almost impossible to imagine happening
1	10^{-5} to 10^{-7}	Event requires combination of very rare events
2	10^{-3} to 10^{-5}	Event has occurred somewhere in the world, not necessarily in this equipment or company
3	10^{-1} to 10^{-3}	Event has occurred in this equipment, though not necessarily in this company
4	1 to 10^{-1}	Event has occurred in this company

Major accident hazard table

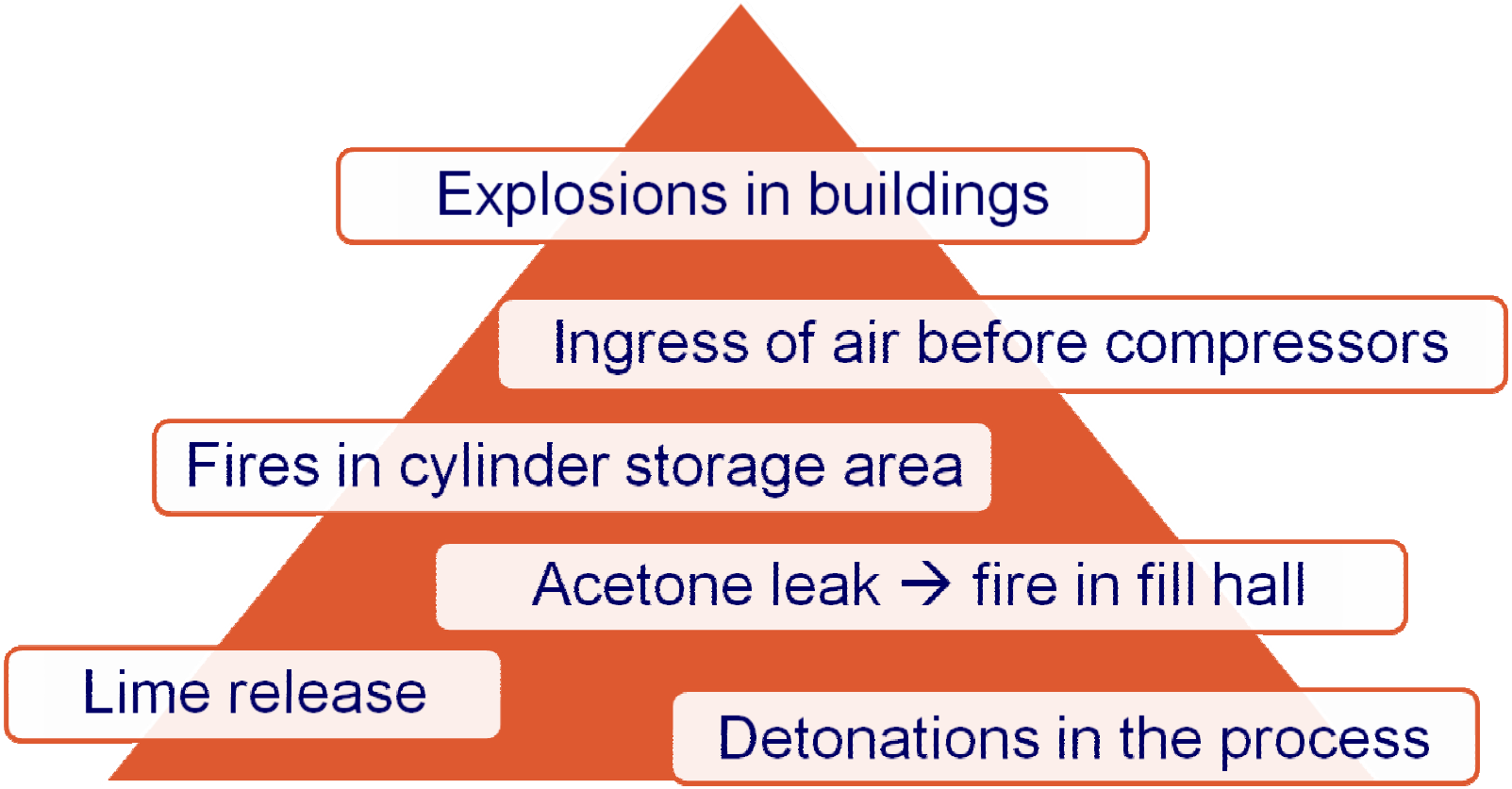
Severity ⇒ Probability ⇓	0	1	2	3	4
4	04	14	24	34	44
3	03	13	23	33	43
2	02	12	22	32	42
1	01	11	21	31	41
0	00	10	20	30	40

Low risk area

Area for which studies to minimize risk must be conducted

Unacceptable risk area

Major Hazards in Acetylene Production



Detonation in the process
Safety Layers

Initiation	• Velocity of process • Electrical earthing
Operation	• Operating Procedures • Maintenance
Mitigation	• Flash back arrestor • Pressure rating of pipe

Lime leak
Safety Layers

Inherent	• No lime storage • No river or water source
Operating	• Procedures and Maintenance • Physical protection
Mitigation	• Ability to close the drainage • Secondary containment

Acetone leak – fire in fill hall

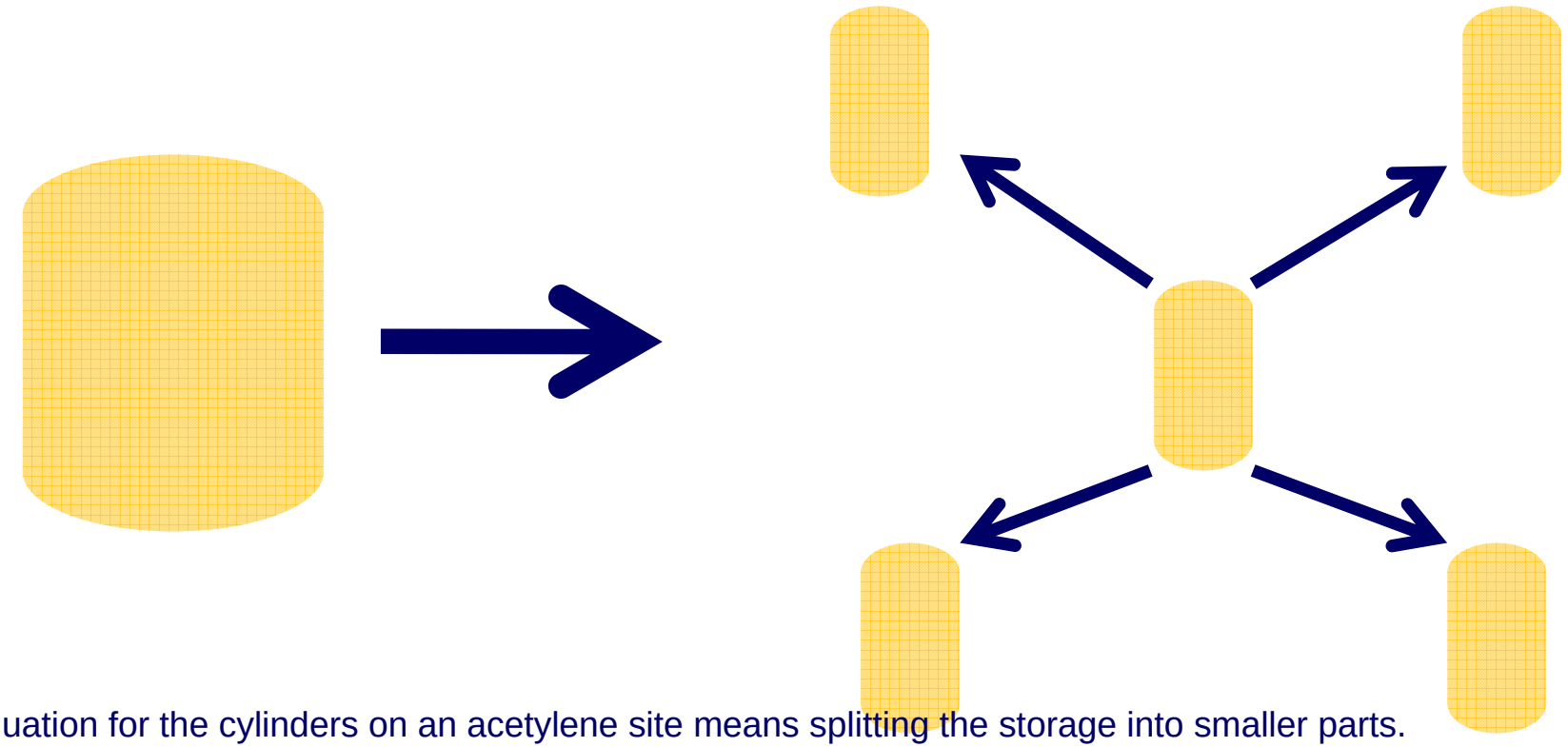
Safety Layers

Initiation	• Away from process • Zone area classification
Reduction	• Limited amount of acetone • Control of supply
Mitigation	• Deluge • Physical separation

Fires involving cylinders
Safety Layers

Initiation	• Away from process • Away from acetone • Clear of combustible materials
Attenuation	• Split into sub groups by fire walls
Mitigation	• Fire fighting measures • Away from major consequence

Attenuation



Attenuation for the cylinders on an acetylene site means splitting the storage into smaller parts. Each part has to be safe from a fire occurring in another part of the storage. That can be achieved by distance or by having a fire wall.

Ingress of air before compressors
Safety Layers

Initiation	• No openings • Low availability of acetylene
Instrument	• Low pressure detection • Gas detection
Mitigation	• Design rating of piping • Flash back arrestors

Explosion of rooms / buildings
Safety Layers

Initiation	• No leaks • Zone area classification
Building design	• Size / Compartmentalised • Ventilation • Gas detection
Mitigation	• Distance to site boundary • Distance to neighbours

Major Hazards in Acetylene Production

Thank you for your attention

Whatever you do – do it safely !