KLM Technology Group

Practical Engineering Guidelines for Processing Plant Solutions

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Process Safety

Part One

a. How I lost my Job Today
b. Process Industry Safety
c. List of Incidents
d. Natural Gas Processing Plant Incident 2003

Part Two

a. Algiers Incident 2005
b. Texas City Incident 2005
c. Safety in Plant Design

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### Process Safety

#### Safety Questions

1. How safe are chemical processing plants?
2. What is the safe distance from a blast?
3. What is the major cause of accidents?
4. Which workers are the most likely to have accidents?
5. What is the first layer of process safety?

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### How I Lost My Job Today

[Image of a container ship accident]

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How I Lost My Job Today

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1. We work in an extremely hazardous environment, but we get blinded by the day to day familiarity of the environment.

2. I worked in a refinery that was built in 1940s. The older workers would point out to the new employees the points in the refinery where people had been accidentally killed.

List of Accidents

- 1921 – BASF Ammonia – Germany – 500+
- 1959 – LPG Plant – Georgia USA – 23
- 1966 - LPG Plant – France - 18
- 1974 - Chemical Plant – Fixborough UK – 28 / 36
- 1980 – Propane Plant – Spain – 51
- 1984 – Propane Plant – Illinois USA – 14
- 1984 - Union Oil Refinery – Illinois – 19
- 1984 - LPG Plant – Mexico – 500 / 5000
- 1988 - Piper Alpha – North Sea – 167
- 1988 - Shell Refinery – Norco La – 7 / 42
- 1989 – LNG Plant – Russia – 645
- 1989 – Polyethylene – Houston USA – 23 / 130
Process Industry Safety

List of Accidents

- 1990 – Ethane Propane – India – 31
- 2001 – Fertilizer Plant – France – 29 / 2500
- 2004 – Refinery – Algiers – 23 / 74
- 2005 – BP Refinery – Texas City USA – 15 / 170
- 2010 - BP Horizon – Gulf of Mexico - 11 / 17
- 2010 - Power Plant – Connecticut – 5 / 27
- 2010 - Chemical Plant – China - 7
- 2012 – Chemical Plant – China – 25 / 46
- 2012 – Chemical Plant – Thailand – 12 / 129

BASF 1921
France 1966 - 18 deaths

Crescent City, IL railroad incident and BLEVE 1970
Nature of fires

- Flash fire
- Pool fire
- Boiling Liquid - Expanding Vapour Explosion (BLEVE)
- Unconfined Vapour Cloud Explosion (UVCE)

Key events – I: Flixborough
Flixborough, UK:
simplified reactor arrangement

Flixborough, UK 1974 - 29 Deaths

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Piper Alpha before 1988 incident
Piper Alpha partway through 1988 incident

Piper Alpha oil rig fire 1988
CP Derailment near Belleville, Ontario
February 2003

Note the tank cars in the right foreground and middle distance

Pasadena, TX Vapour cloud explosion 1989
A 1968 American Insurance Association study of 317 large loss chemical plant explosions and fires in a 20 year period showed the following critical factors.

a. Equipment failures were critical in 31% of the cases.
b. Operational failures were key in 17.2% of the accidents.
c. Weak Safety Programs were an issue in 8% of the cases.
Electrocutions occurring between 1982 and 1994 were studied by the National Institute of Occupational Safety & Health (NIOSH) in 1998.

The NIOSH researchers, Kisner & Casini, analyzed 224 electrocutions which resulted in 244 workplace fatalities.

These fatalities accounted for approximately 7% of all workplace deaths.

The information they learned provides valuable lessons for everyone that works with or around electricity.

- Younger males die most often. Victims ranged in age from 17-70 years, 99% of them were men, 64% died prior to age 35, and 99% of the incidents involved alternating current (AC).

- New hires need to take the most care. 41% of all victims were on the job for under 1 year.

- Construction workers had the highest percentage of electrocutions at 40%. Other predominate industries included: transportation/communication/public utilities (16%); manufacturing (12%); and agriculture/forestry/fishing (11%).
Utility line workers (linemen) typically receive extensive training in electrical safety, yet they had the highest number of fatal injuries.

55% of linemen fatalities were caused by failure to use required Personal Protective Equipment (PPE) such as gloves, sleeves, mats, or blankets.

Laborers, who generally receive little or no electrical training had the next highest fatality rate.

1. Highest Number of Fatalities

Utility line workers (linemen) typically receive extensive training in electrical safety, yet they had the highest number of fatal injuries.

2. Second Highest Number of fatalities

New hires need to take the most care. 41% of all victims were on the job for under 1 year.
Which Group are you?

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