SUBSTANCES

Safety in Design

protect

BEYER CROP SCIENCE CENTER

- August 28, 2008, **Bayer CropScience** pesticide manufacturing unit explosion that killed two workers and injured eight others
- a runaway chemical reaction inside a residue treater pressure vessel. The vessel ultimately over pressurized and exploded. The vessel careened into the methomyl pesticide manufacturing unit leaving a huge fireball in its wake.
- A different trajectory would have hit a pipe carrying methyl iso cyanate (MIC)

ABBEYSTEAD, UK

May 1984

16 fatalities after a methane gas explosion destroyed a waterworks' valve house

Design didn’t account for methane gas as coal seams 1,200 m below the pipeline

BP TEXAS CITY REFINERY

- The Texas City Refinery explosion occurred on March 23, 2005, when a hydrocarbon vapor cloud was ignited and violently exploded at the ISOM isomerization process unit at BP's Texas City refinery
- 15 killed; 180 injured
- focus on occupational incidents, rather than the more infrequent but much more serious process safety incidents

SUBSTANCES IN LAMINATES / FLOORINGS

HSWA

Duties of designer PCBUs	
Duty to, so far as is reasonably practicable, make sure that structures, plant and substances are without health and safety risk	Make sure, so far as is reasonably practicable, the plant, substance or structure designed is without health and safety risks to people who: ➢ use the plant, substance or structure at a workplace for its designed purpose ➢ handle the substance at a workplace ➢ store the plant or substance at a workplace

OTHER REGULATIONS

HSNO

- All hazardous substances need to be approved under the HSNO Act (Hazardous Substances and New Organisms (HSNO) Act 1996).
- The approvals are given by the Environmental Protection Authority (EPA).
- When a substance is approved, controls to manage any risk that may arise during the substance's lifecycle are applied.

The Health and Safety at Work (Hazardous Substances) Regulations

- controls developed for each class of hazardous substance, and for particular phases of a substance's life cycle.
- These Regulations will come into effect in December 2017 and will replace the workplace controls set under the HSNO Act 1996.

GUIDANCE – SUBSTANCE DESIGN

Designers of substances should consider:

- chemistry principles, toxicology and environmental science
- whether hazardous properties can be removed while still maintaining the functionality and efficacy of the substance
- whether the toxicity or reactivity of the substance can be eliminated or minimised by varying these things:
    - the molecular weight
    - volatility
    - particle size
    - solubility
    - reactivity
    - thermos-reactivity
    - shape
    - molar mass.
- whether the substance's potential for the following things can be eliminated or minimised through good chemical design:
    - bioaccumulation
    - environmental persistence
    - receptor binding.
    - ensuring that there is reliable well tested data for all relevant routes of exposures, no observed adverse effect levels or concentrations (NOAEL/NOAEC) and lowest observed adverse effect levels/concentrations (LOAEL/LOAEC)
    - understanding the process of metabolism or degradation of the substances in the body and in the environment
    - taking a product stewardship approach - making health, safety and environmental protection an integral part of the life cycle of chemical products, in partnership with others involved in the product.

GUIDANCE – STRUCTURE DESIGN

Substances

- Exposure to hazardous substances and materials including insulation and decorative materials
- Exposure to volatile organic compounds and off gassing through the use of composite wood products or paints
- Exposure to irritant dust and fumes
- Storage and use of hazardous chemicals, including cleaning products

GUIDANCE – PLANT DESIGN

Fire and explosion	Certain types of plant hold the risk of fire, explosion or overheating.	A designer should, so far as is reasonably practicable, eliminate or minimise risks posed by the plant itself or by gases, liquids, dusts, vapours or other substances produced or used by the plant or other plant nearby.

Hazardous chemicals	Hazardous chemicals may create health and safety risks for people who handle them.	Plant should be designed and manufactured to eliminate or minimise the release of substances which are hazardous. This includes controlling hazardous waste and airborne substances.

WHAT IS PROCESS SAFETY?

- **Process safety** is a blend of engineering and management skills focused on preventing catastrophic accidents and near misses, particularly structural collapse, explosions, fires and toxic releases associated with loss of containment of energy or dangerous substances such as chemicals and petroleum products.

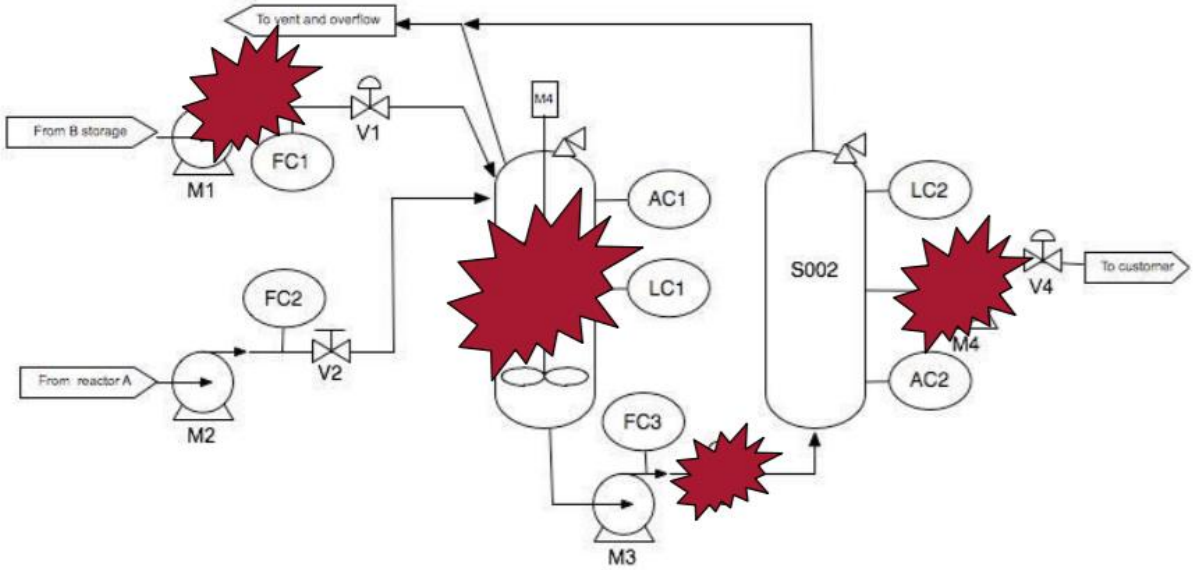
PERSONAL SAFETY

If you're in charge of safety and you think of hazards like this…

You're probably doing "personal safety"

PROCESS SAFETY

If you're in charge of safety and you think of hazards like this…



You're probably doing "process safety"

DIFFERENCES BETWEEN PROCESS SAFETY AND PERSONAL SAFETY

- Process safety deals with major hazards
- Process safety is expensive
- Process safety focuses on changing systems
- Process safety considers humans, the environment and business
- Process safety protects everyone
- Process safety incidents happen at a lower frequency

SUMMARY
TYPES OF SID INVOLVING SUBSTANCES

Plant
- Process safety
- Substances under pressure / transport

Structure
- Substances as a component
- Relational / proximity

Substances
- HSNO


THANK YOU
protect