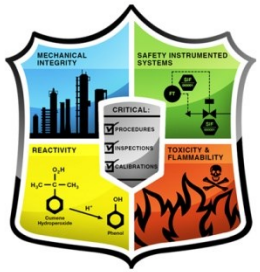


Process Safety
Risk Management

Human Resources Management (by Process Safety)

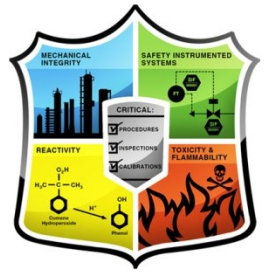
Doug McKnight

Responsible Care Leader

Dow Benelux

Process Safety
Risk Management

Dow site in Terneuzen



Process Safety
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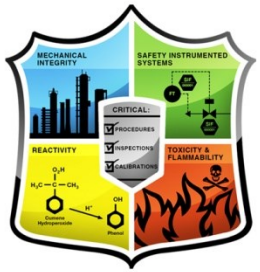
Dow site in Terneuzen

18 plants producing millions of tonnes of products per year like ethylene, polyethylenes, polyurethanes and amines.

85 percent of the total production is exported. Product transport goes over water (38 %), via pipelines (33 %), by road (24 %) and by rail (5 %).

International departments for Research & Development (R&D), purchasing, IT and Accounting

Total surface area is 560 hectare, of which 440 hectare is in use.



Process Safety
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The Human Element

- 1.700 employees and 600 contractors are working at Dow in Terneuzen originating from 30 different countries.

- No plant runs without: operators, maintenance people, engineers, cleaners, planners, ...

Process Safety
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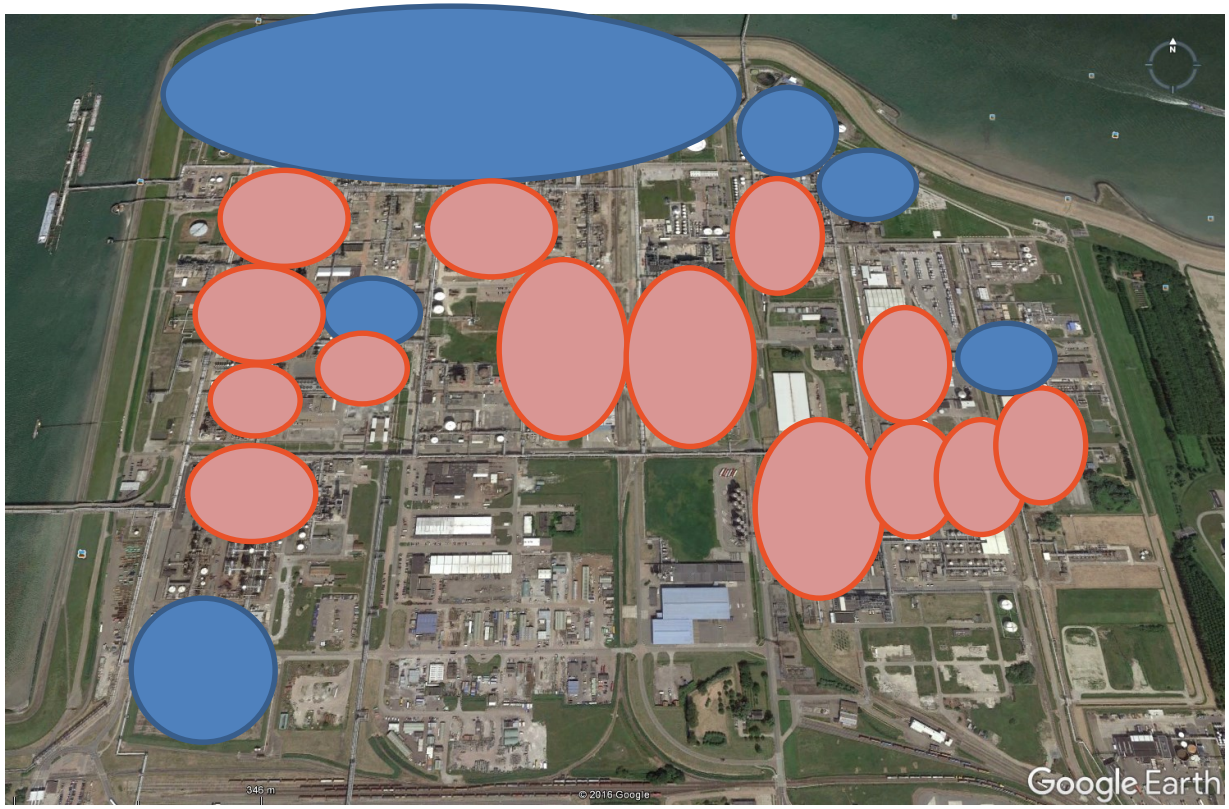
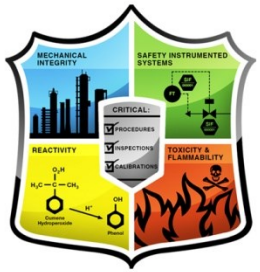
Process Hazards

Storage tanks with chemicals

Process units





Process Safety
Risk Management

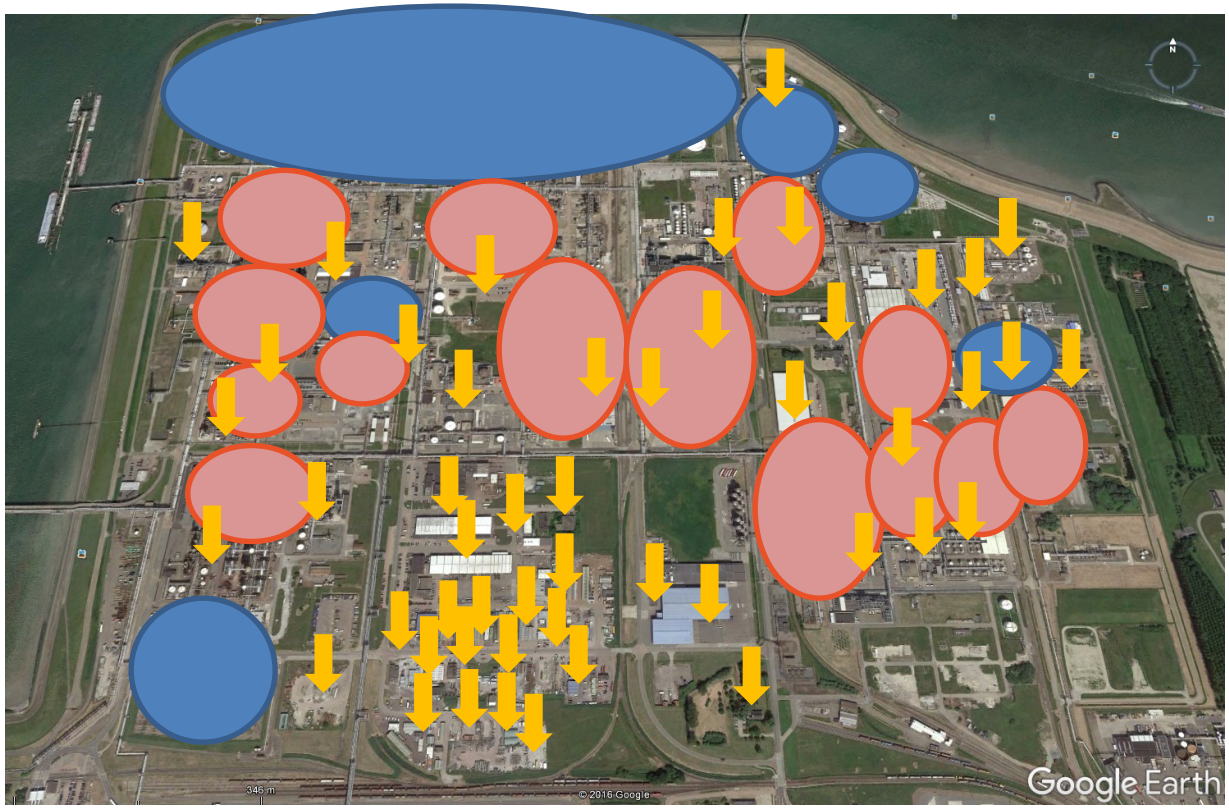
Process Safety

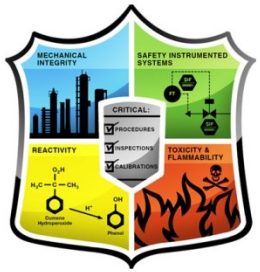
- Those 18 plants have thousands of potential failure scenarios.
- Those hundreds of (very) large and smaller tanks have an equally large number of potential failure scenarios.
- It's the job of Process Safety to prevent that they occur at all: they can impact the people on site.

Process Safety
Risk Management

So……Where are the people?

They are all over
The site





Process Safety
Risk Management

Where are the people?

They are in….

- Control rooms
- Work shops
- Office buildings
- Laboratories
- Maintenance buildings
- ….

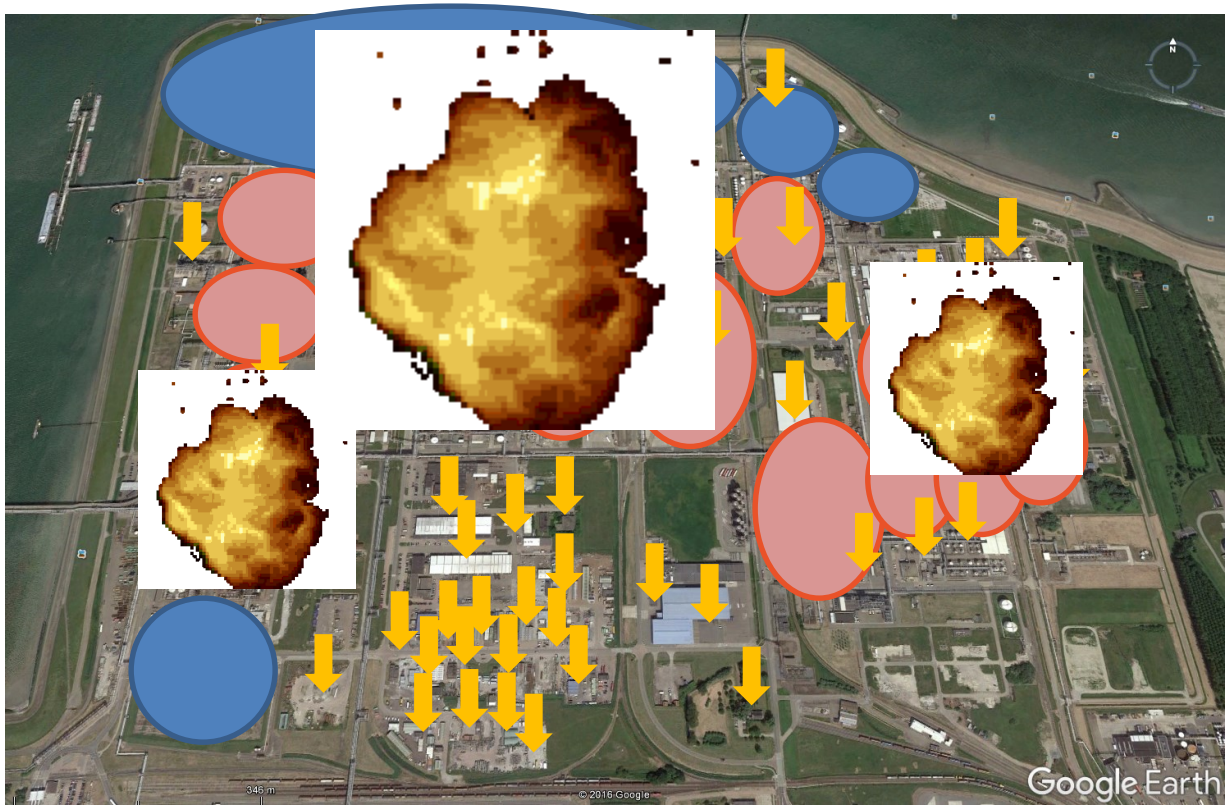
… but also in…

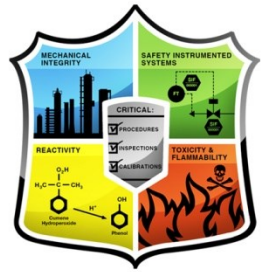
- Cars moving on site
- Temporary buildings
- Sheds
- (turn-around) Tents
- Buses
- On bikes
- ….

Process Safety
Risk Management

They are subject to Process Hazards..

- Explosions
- Fire hazards
- Gas clouds

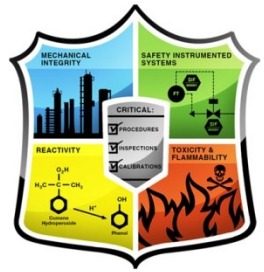




Process Safety Risk Management

Buildings Subject to Process Hazards

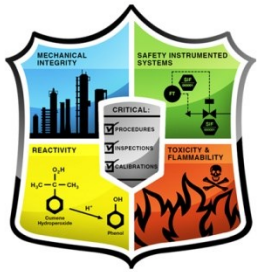
- Subject to overpressure impact
- Subject to Hazardous Window Breakage Impact
- Subject to Fire Impact
- Subject to Flammable Impact
- Subject to Toxic Impact



Process Safety
Risk Management

Managing the Risk of our Workforce

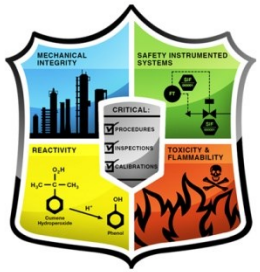
- **Use Dow's Loss Prevention Principles.**
  - Originally developed in 1974 as corporate set of best practices for new plants
  - Grown into a comprehensive set of "rules" based on regulatory requirements, corporate memory (learning from incidents) and RAGAGEP (Recognized and Generally Accepted Good Engineering Practice)
  - LPP 12.2 and 12.8: permanent and temporary buildings subject to process hazards
- **Move people that do not HAVE to be on site off the site.**



Process Safety
Risk Management

Impact of a toxic cloud

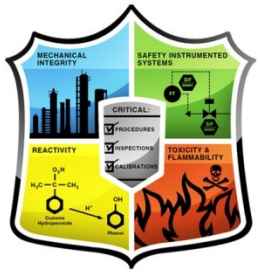
- A toxic cloud is released…. Now what?
- In 2 sentences:
  - If you happen to be outdoors: evacuate.
- But If you happen to be indoors in a building: stay in? Evacuate as well?
- What is safe (enough)? Shelter in Place.



Process Safety
Risk Management

Shelter in Place

- **If people stay indoors during a gas cloud then care must be taken to avoid gas entering the building.**
- **You will need to (have):**
  - A clearly marked and safe room in the building (that is strong enough to survive some form of blast as dangers always comes together!)
  - Ability to shut down ventilation systems from within the safe location.
  - A Shelter in Place kit to seal of doors and windows and other holes.
  - Communications systems inside the safe room to communicate with emergency services.
  - Good procedures that define what to do (for example: what if someone coming from outside knocks on the door?
- **The Shelter in Place needs to keep the people inside safe for 1 hour**
  - Emergency services can evacuate them safely if needed.



Process Safety
Risk Management

Overpressure Impact

- Permanent building generally can handle some (1-2 psi) overpressure (from an explosion)…
  - Not if too close to the process: control rooms are stronger type buildings
  - Windows are a weak point: flying glass is a known people killer.
  - Fittings on walls and ceilings will be flying and injure people.

Process Safety Risk Management

Temporary buildings: modular office

For example during a Turn Around when temporarily more people are needed?

Regular Type **or** **Blast Resistant ?**

Picture from Jan Snel website

Picture from Hunter Buildings website

A regular type building like the above surely can take an 1 or more psi overpressure wave?

In Dow we do **not** want regular modular office buildings in zone where we can expect A blast with more than 0.9 psi overpressure. Why? Well, see next slide(s)

Process Safety
Risk Management

The Picture after a blast test.

People inside a temporary modular office building have a rather high chance of getting Killed by the impact.

Process Safety
Risk Management

Another example: a WC/washroom

Regular Type **or** **Portapotty?**

In case of overpressure wave the left one will look like the modular office in the previous slide and the persons inside have a rather big chance of getting killed.
The right one will simply be blown away (several meters probably) and will leave The person inside covered in …… but otherwise alive!

Process Safety
Risk Management

Keeping people safe…

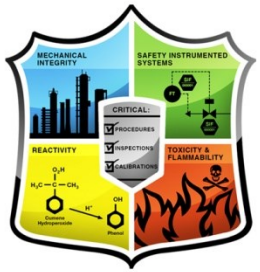
- Be strict in application of Loss Prevention Principles.
- Create good Shelter in Place rooms.
- Use blast resistant temporary buildings.

- Move people off site if possible.

Process Safety
Risk Management

Maintenance Value Park

Outside of all potential overpressure zones



Process Safety
Risk Management

Conclusion

- Presence of people on a site is unavoidable but should be well managed.
- But …keeping them safe from the impact of a process safety incident may cost a significant investment.
- Some think that this money spent on something that is never going to happen and is better spent on other, personal safety related, things.
- But can we afford to take that risk?