

# ICHS

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# Ariane 5

**26 tons liquid  
hydrogen**

**132 tons of liquid  
oxygen**



## Role of hydrogen in launch disasters?

- *28 jan 1986*      *Shuttle*      *failure of an O-ring*
- *4 june 1996*      *Ariane 5*      *software problem*
- *12 dec 2002*      *Ariane 5*      *Liquid pp engine design*

*Process Safety Management*

## FM Global position

- *Our general industry position*
- *Chemical occupancies*
- *Hydrogen*

## FM Global value proposition

- *Our promise is to help protect the value created by our client's business.*
- *Our process is to assess and engineer risk, to help prevent and mitigate loss,*
- *And to provide capital for risk transfer purposes*

# RiRaRi

- *Risk Identification*
- *Risk Assessment*
- *Risk Improvement*

## The process: assessment

- *Quantification: Maximum foreseeable loss (MFL)*
- *Evaluation: Risk quality*

# Chemical risks

- *MFL*
- *Chemical risk evaluation*



# Chemical risk evaluation

- ***Part A: Inherent process hazards***
  - Material factor
  - General hazard factors
    - Exothermic / endothermic
    - Unstable materials
  - Special hazard factors
    - Pressures
    - Temperatures
    - Solvents
    - Indoor / outdoor
    - catalysts

# Chemical risk evaluation

- ***Part B: Risk conditions***
  - Construction
    - Explosion / materials / natural hazards
  - Vapor cloud explosion potential
  - Protection
    - Separation / process safety / drainage
  - Exposure
    - Nat haz / neighbour / ....
  - Management
    - Maintenance / operator auth. / Hazard studies...

## Hydrogen production facilities

- *Chlor-alkali plant : CL<sub>2</sub>, H<sub>2</sub>*                      *30 – 42*
- *Natural gas separation: H<sub>2</sub>, CO<sub>2</sub>*                      *32*

Less hazardous chemical processes

## Hydrogen users

- *Hydrogen cooled generators*
- *Chemical industry*
- *Semiconductor facilities*
- *Food processing*
- *Fuel cells*

– Inherent hazards

To summarise:

- ***We measure the size of the risk: MFL***
  - The presence of hydrogen is obviously a contributing factor.
- ***We measure the quality of the risk***
  - Process safety management iro hydrogen will be important.