Response Considerations: Flammable and Explosive Substances

Related GSS pictograms and UN Regulation

Example of related case studies:

Cason, 1987, Cape Finisterre, Galicia, Spain; Sodium (1400 barrels) and other hazardous chemicals (flammable/toxic/corrosive products in 5,000 different package forms; 1100 tonnes transported and spilled). Cause of spill: fire on board (reaction of sodium with seawater) and subsequent grounding.

Val Rosandra, 1990, Port of Brindisi, Italy; Propylene (1800 tonnes in bulk, controlled burn, quantity spilled: 0). Cause: fire.

Alessandro Primo, 1991, 30km off Molfetta, Adriatic Sea, Italy. Acrylonitrile (549 tonnes in 594 barrels) and of Dichloroethane (3 013 tonnes); recovery from sunken wreck . Cause: structural damage subsequent storm.

Igloo Moon, 1996, outside Key Biscayne in South, Florida; Butadiene (6589 tonnes, recovery of the cargo, quantity spilled: 0). Cause: grounding.

MF Ytterøyningen, 2019, Norwegian; Ethylene glycol leak (coolant components). Cause: fire and subsequent explosion (failure communication between the EMX -Energy management system- and the battery packs).

Alert and notification in case of a potential leak:

Depending on the location of the accident, MRCC, site emergency services and public emergency services must be alerted. Ships (crew) and population downwind (vapour cloud) and downstream (spill) have also to be warned in order to prevent complications arising.

Applicability and main risks:

For more information and description of flammability and explosivity of substances, refer to chapter 3 on hazardous substances.

Applicability[1]	Risks for human/responders	Risks for environment	Risks for amenities
- leakage of gas from a sealine (subsea pipeline) - leakage of liquefied gas - mixing of reactive chemicals forming gas - evaporation from slicks	- Direct injuries due to fire or explosion - Anoxia, asphyxia, especially in confined space - Depending on	- No major expected chronic impact - Possible indirect impact (e.g. fire residues)	- Windows shattering explosion, - Building destruction

[1] Events leading to a flammable/explosive situation

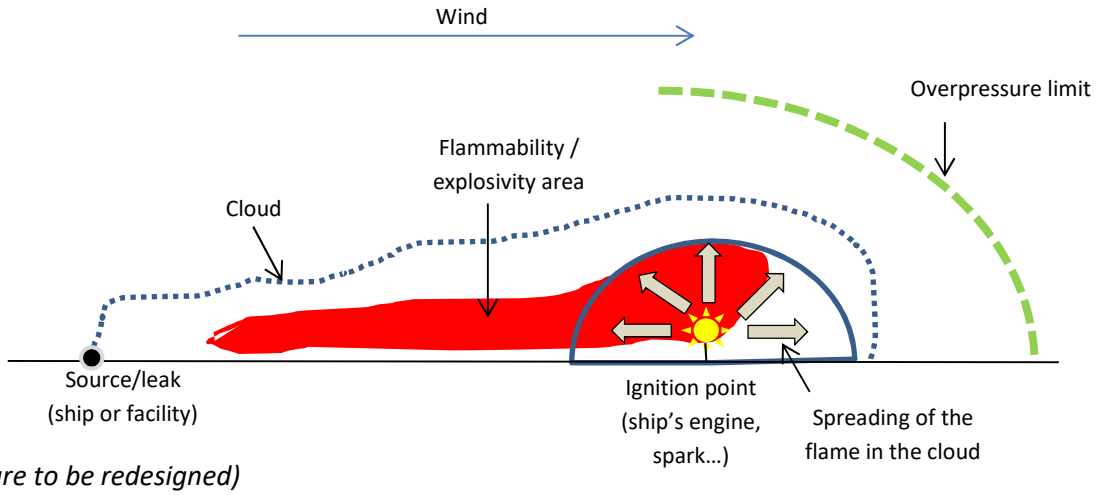
- gas cloud formed after reaction of chemicals	chemicals: toxicity or corrosivity		

Risk Assessment

- Risks of flammability or explosion must be assessed by monitoring LEL/LFL and UEL/UFL values and evolution through time
  - **→Portable gas detectors for first responders**
  - **→ Sampling/Monitoring strategy**

- Forecast of the gas cloud drift must be asked to experts
- If applicable (regarding the characteristics of the chemical and the situation), the risk of toxicity should be assessed (see sheet hazard toxicity), as well as corrosivity
  - **→Response Considerations: Toxic Substances**
  - **→Response Considerations: Corrosive Substances**

- Areas to consider for intervention :



(Figure to be redesigned)

- Consider (and control) aggravating factors:
  - in the event of fire, prevent the risk of BLEVE by cooling tanks in direct contact with heat radiations risk of toxic gas production,

Protective measures (human health, environment & amenities)

- Evacuation:
  - The distressed vessel's crew : the helicopter/rescue ship must approach downwind
  - The population : model has to be used to determine specific area to evacuate or containment measure to implement
- Protection
  - Ventilation of the explosive atmosphere in order to lower LEL/LFL
  - Activation of the existing firefighting systems

- Gas or vapour cloud should be prevented to enter confined or closed area and obstacles must be removed (as possible) to reduce turbulences
- Protection of responders against inhalation of vapours or mist
  →**PPE**

Reminder: a flammable cloud may **become explosive** when the speed of the front flame exceeds several meters per second (due to HNS nature, atmosphere turbulence and obstacles) or in confined space. Keep monitoring LEL/LFL all along intervention.

Response measures

- stop of leakage
  → **Sealing and Plugging**

- elimination of sources of ignition

Behaviour:
→**Response Considerations: Gases and Evaporators**
→**Response Considerations: Floater**
Techniques:
→ **No intervention**
→ **Using Water Curtain**
→ **Using Foam**
→ **Safety Zones**