ICARO

Ministry for the Environment Land and Sea

UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

Workshop on

Training on identification of hazardous activities

Possible scenarios and risk assessment

for activities involving substance that may be released into water paths in case of accidents

Minsk, 21-22 October 2008

Industrial activities

Several industrial activities handle dangerous substances which are generally kept under control inside process equipment.

In case of Loss of containment

Fire, explosion and toxic release in atmosphere

Liquid release in water or in soil

Possible scenarios and risk assessment

Industrial activities

Liquid release in water body

HAZARDS

Release of dangerous substance may cause damage to:

- Animal life
- Sources of potable/industrial waters;
- Fishing activities;
- Bathing activities.

Possible scenarios and risk assessment

Estimate of potential consequences

Liquid release in water body

Consequences of accidental release in water can be calculated as combination of

- Toxicological property of the dangerous substance
- Maximum releasable amount of dangerous substance
- Vulnerability of the territory surrounding the release point

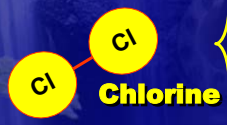
Possible scenarios and risk assessment

Estimate of potential consequences

Toxicological property of the dangerous substance

Main pollutants are classified according to their potential impact on aquatic life.

Effects are evaluated in terms of concentration of dangerous substances in water.



Lethal Concentration LC50aq/1 hr = 0,8 mg/lit

About 0,8 mg/lit of chlorine dissolved into water is capable to cause the death of yellow perch (or other common fishes) after 1 hour of exposure.

Possible scenarios and risk assessment

Estimate of potential consequences

Toxicological property of the dangerous substance

$LC50_{aq}$

- Concentration of dangerous substance leading to death for 50% of a selected aquatic specie for a specified time of exposure.
- Data are produced with laboratory tests.
- Data might be taken from:
  - Material Safety Data Sheet of the substance;
  - Specialised international Data Banks.

Possible scenarios and risk assessment

Estimate of potential consequences

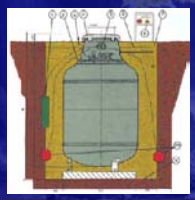
Max releasable amount of the dangerous substance

Large storage tanks

(i.e. oil storage tanks of a refinery)

Oil spill can:

- reach immediately the water body (see picture).
- Reach the sewer network and be subsequently released into the water body.



Underground tanks

(i.e. liquid storage at chemical plant)

Liquid spill can percolate into the soil and reach surface or under ground water.

Possible scenarios and risk assessment

Estimate of potential consequences

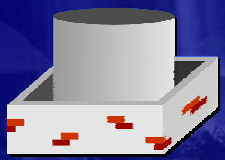
Max releasable amount of the dangerous substance

Maximum Releasable Amount

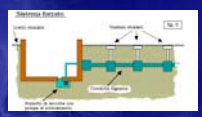
corresponds at least to the entire volume of tank of maximum capacity

Mitigation elements:

Basin for containment



Sewer network



Water treatment plant

Floating strips

Possible scenarios and risk assessment

Estimate of potential consequences

Vulnerability of territory surrounding release point

Industry

Town

Commercial centre

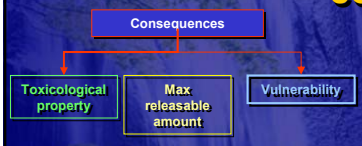
River

Fishery

Possible scenarios and risk assessment

Estimate of potential consequences

Liquid release in water body



Combination of three functions can be very complex and require detailed information:

- Technical data from the site (process, protection systems, etc.);
- Emergency organization of the site;
- Toxicological data of substances;
- Detailed data on water courses (flow rate, variability during year, etc.)
- Detailed data on sensible activities (towns, fisheries, etc.)

The analysis might require a long time to be completed.

Possible scenarios and risk assessment

Simplified approach

Estimate of potential consequences

Liquid release in water body

Gravity of consequences is expressed as **Volume** of water endangered by toxic substance

$$V(m^3) = \frac{Q(g)}{LC_{50}(\frac{mg}{lit})}$$

1 kg of chlorine ⇒ Endangered volume

$$V(m^3) = \frac{1000(g)}{0{,}8(\frac{mg}{lit})} = 1250m^3$$

One bottle of chlorine is sufficient to endanger an entire swimming pool of 25 m of lenght.

Possible scenarios and risk assessment

Detailed approach

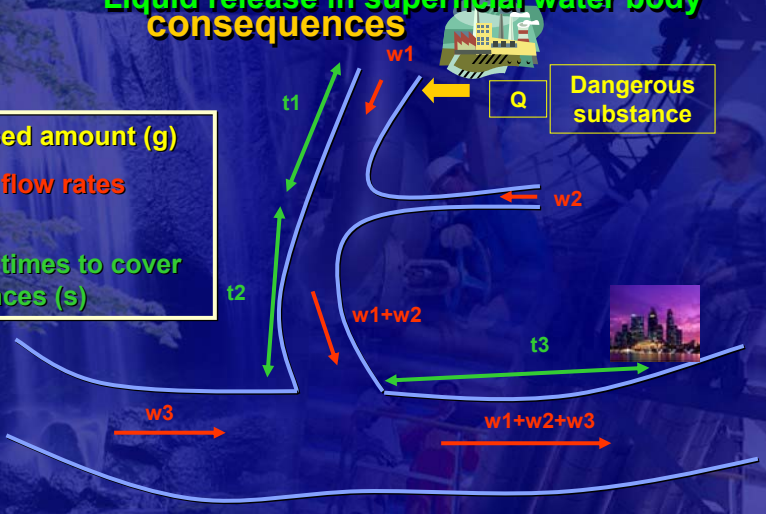
Estimate of potential consequences

Liquid release in superficial water body

Q = released amount (g)

wi = mean flow rates (m^3/s)

Ti = mean times to cover distances (s)



Possible scenarios and risk assessment

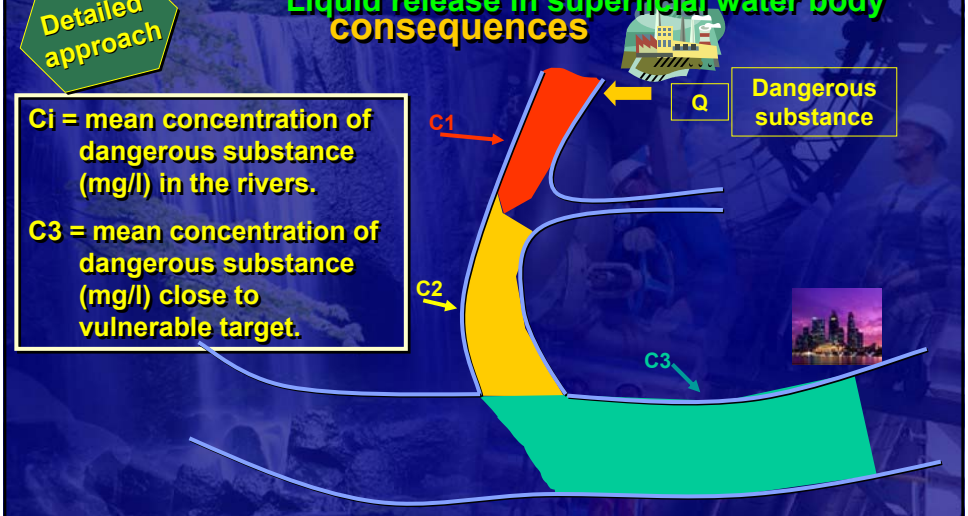
Estimate of potential consequences

Liquid release in superficial water body

Detailed approach

Ci = mean concentration of dangerous substance (mg/l) in the rivers.

C3 = mean concentration of dangerous substance (mg/l) close to vulnerable target.



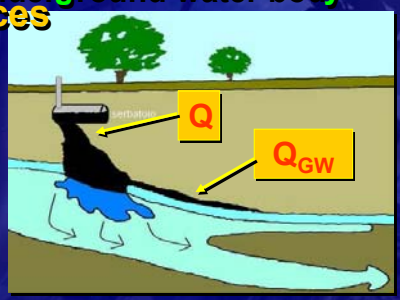
Possible scenarios and risk assessment

Estimate of potential consequences

Liquid release in underground water body

Simplified approach

Main risk associated to a release of dangerous substance in the soil the contamination of Groundwater



Basic Concepts:

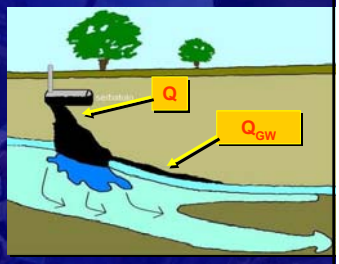
- Of the total released amount (Q) only a fraction (Q_{GW}) reaches groundwater due to soil permeability and reactivity;
- The volume of endangered groundwater (V_{GW}) is directly associated to amount of dangerous substances reaching the water table (Q_{GW}).

Possible scenarios and risk assessment

Simplified approach

Estimate of potential consequences

Liquid release in water body



Gravity of consequences is expressed as **Volume** of water endangered by toxic substance

$$V_{GW}(m^3) = \frac{Q_{GW}(g)}{LC_{50}(\frac{mg}{lit})}$$

THANK YOU !!!

Neil