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Case study example demonstrating application of different EU national approaches

Workshop on Accident Analysis and Risk Assessment

20-22 November 2013, Ispra, Italy

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- 1996: Seveso II Directive with Article 12 on Land-Use Planning
- 1996 – 1999: 1st Technical Working Group
- 1999: 1st Guidance (mainly descriptive)
- 2000 – 2002: Accidents in Toulouse and Enschede, Lille Conference → LUP as relevant factor, differences in EU-wide approaches
- 2002: Re-establishing of LUP – Working Group
- 2003: Amendment Seveso Directive with mandate to establish „database“
- 2006: 2nd Guidance (contains common agreed principles), no agreement on underlying documents (database)
- 2008: Re – start of Working Group
- 2012: Article 13 in Seveso III without database mandate



- Article 12/Article 13 requiring that Member States' LUP policy should take into account:
- Preventing major accidents and limiting the consequences
- The need to establish and maintain appropriate distances between Seveso establishments and residential or sensitive areas
- In case of existing establishments additional technical measures
- LUP considered to be important element in overall Seveso objectives
- Significant differences in approaches
- Any changes face implementation problems for distances already defined and respected ("legacy of the past")
- Need and willingness for coherence?



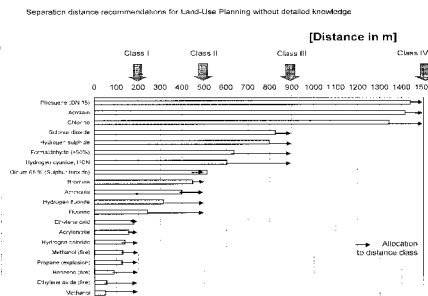
1. Deterministic approach/Generic Format
2. Deterministic approach/ Individual Format
3. Risk-based (or “probabilistic”) approaches
4. Semi-quantitative approaches

Deterministic approach/ Generic Format



Features:

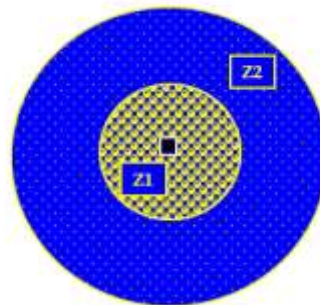
- **Pre-defined** generic separation distances – not to impose risk
- Apply **“state-of-the-art”** technology at the source
- **Typical accident scenarios, consequence assessment (qualitative or quantitative)**
- **“gradual”** land-use zoning system exists, that avoids neighbouring incompatible land uses.



“Classical consequence-based approach”

Features:

- Based on **consequences** of credible accidents
- **No** explicitly quantified likelihood of the event, quantified assessment consequences
- Comparison to agreed consequence thresholds
- Usually two zones are defined:
 - Internal zone – **lethal** effects – no urban development allowed
 - External zone – beginning of **irreversible** effects – no sensitive population

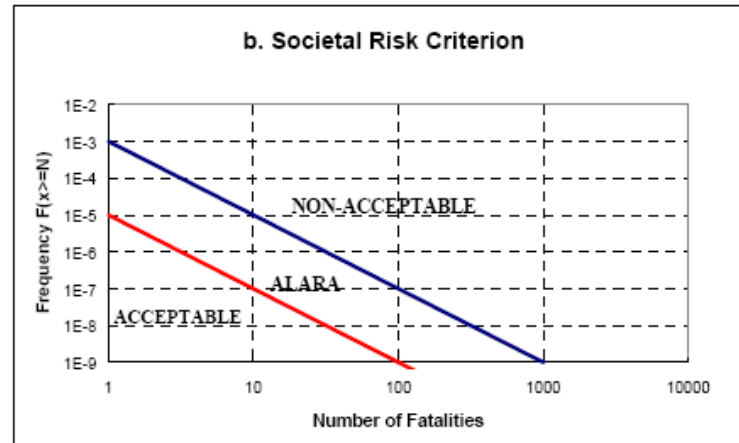
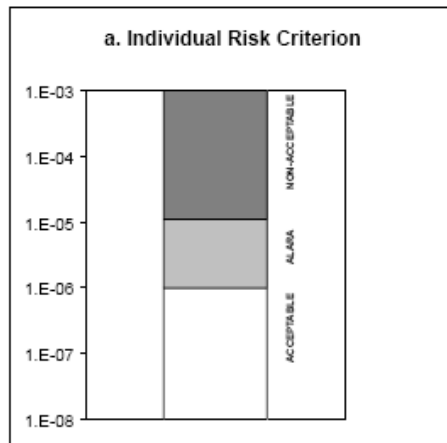


Risk-based approach



The approach consists of 5 parts:

- Identification of hazards
- Calculation of probability of potential accidents
- (Quantitative) Estimation of consequences
- Integration into overall risk (individual and societal)
- Comparison of risk to acceptance criteria
- Zoning dependent on risk levels





Features:

- Specific **subcategory** of the risk-based or the consequence-based methods
- **Composition** of quantitative and qualitative methods
- Result is zoning according to matrix categories

E	D	C	B	A
< 10 ⁻⁶ ev/yr	> 10 ⁻⁵ ev/yr	> 10 ⁻⁴ ev/yr	> 10 ⁻³ ev/yr	> 10 ⁻² ev/yr
Extremely unlikely scenario	Realistic but unlikely scenario	Improbable scenario	Probable scenario	Usual scenario
Possible considering the current knowledge, but never occurred anywhere worldwide	Possible but never occurred in a similar industry	Already occurred in a similar industry worldwide	Already occurred (or supposed to have occurred) during the lifetime of the facility	Already occurred (several times) during the lifetime of the facility

French Risk Acceptability Matrix		Probability				
		E	D	C	B	A
Gravity Level	Disastrous	NO/MMR2	NO	NO	NO	NO
	Catastrophic	MMR1	MMR2	NO	NO	NO
	Major	MMR1	MMR1	MMR2	NO	NO
	Serious			MMR1	MMR2	NO
	Moderate					MMR1

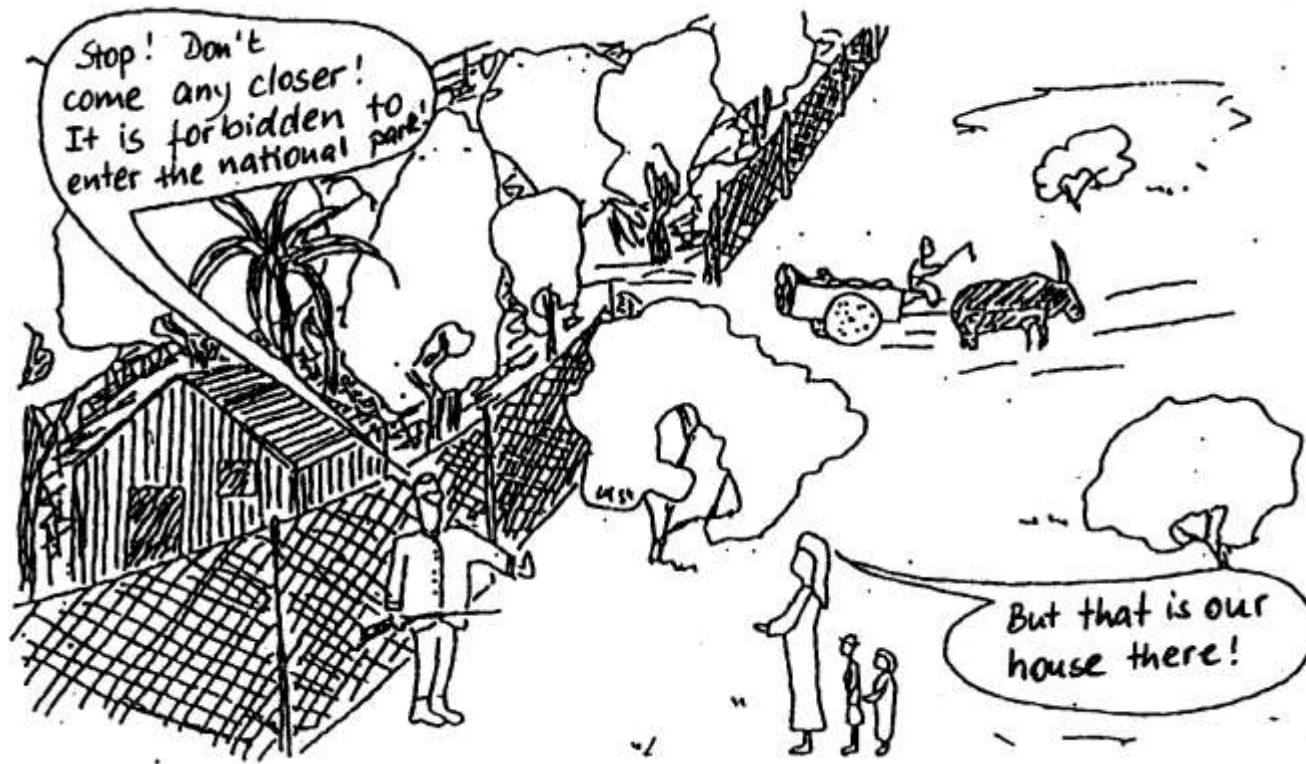


- Operate – if possible – without imposing any risk to the population outside the fence
- Apply “state-of-the-art” at the source
- Define a development restriction by “zoning”
- Use of scenarios
- No absolute “worst case scenarios”
- LUP (as required by Seveso) is a political decision based on technical advise



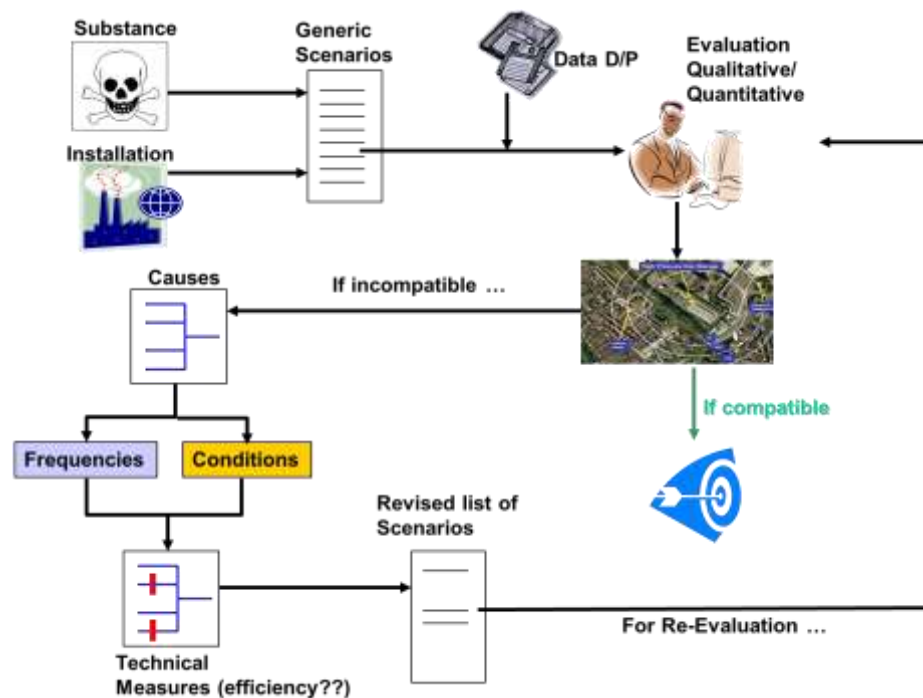
- LUP decision has a connection to, and an implication with safety report.
- LUP decision has no connection to the safety report but is based on separate assumptions.
- LUP decision is made with detailed knowledge of the case.
- LUP decision is made without detailed knowledge of the case but is based on generic assumptions.
- Different understanding of the role of additional safety measures.
- Different values for endpoint thresholds and failure frequencies.
- Different understanding of „state-of-the-art“.
- Implication with other tools like emergency response.

We need to make wise decisions..



Most LUP approaches include „scenarios“:

- simplified, conceivable descriptions of events to assess consequences
- often specifically defined for LUP
- consider barriers „in broad terms“

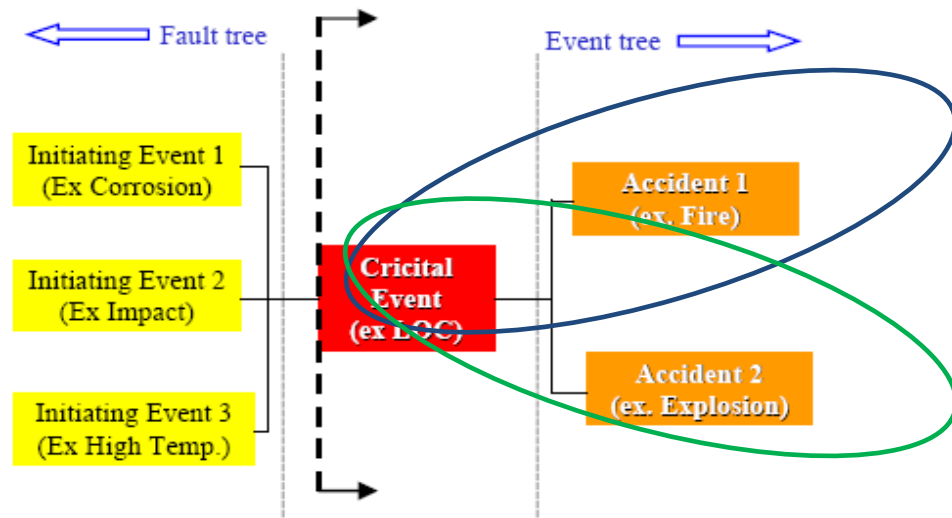


Planned database structure based on scenarios

Which scenarios?



LUP scenarios comprise typically the right-hand side of the bow-tie (consequence – oriented) → focus of further work + mitigation barriers



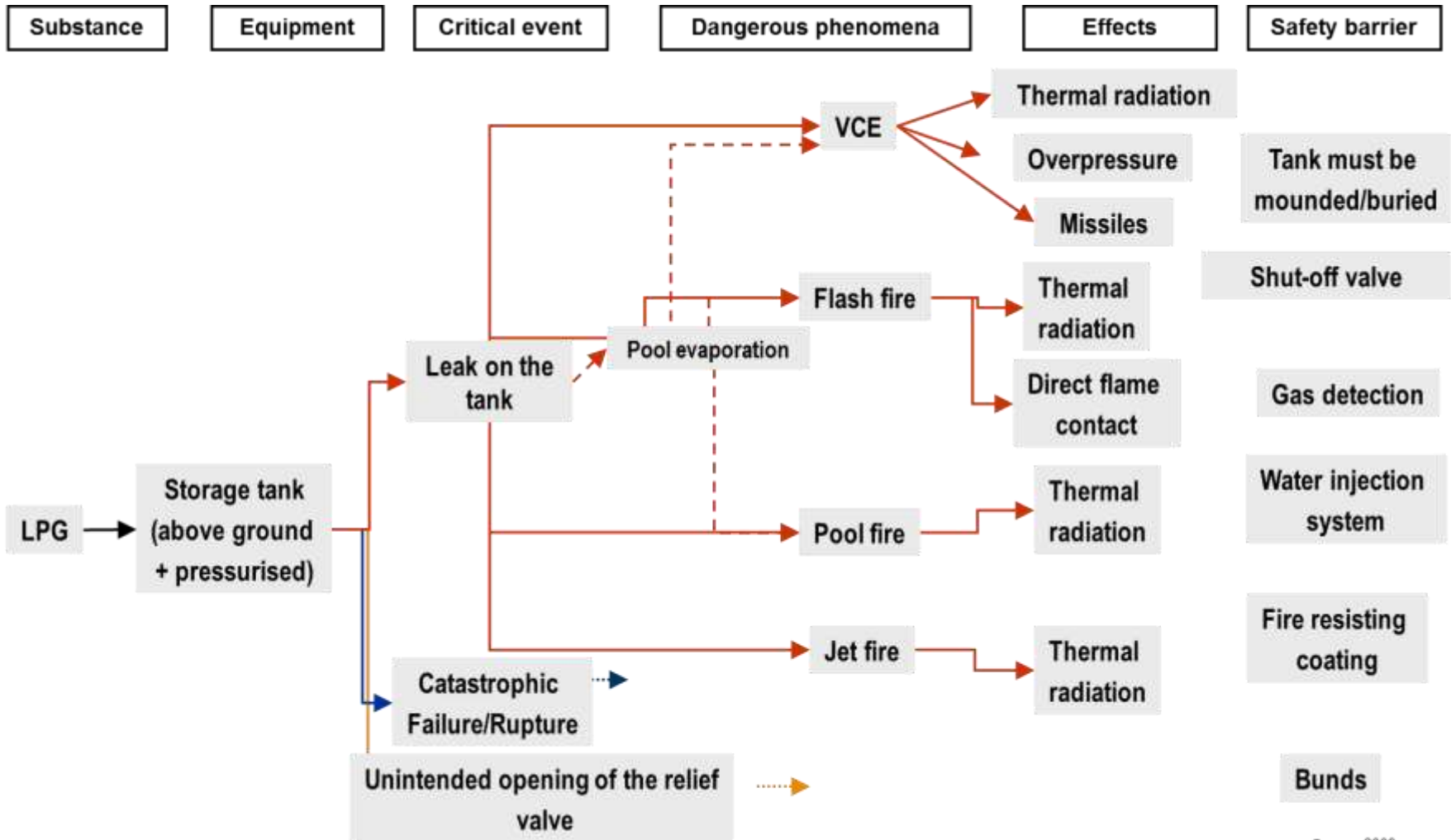
The classic bow-tie diagram (ARAMIS)



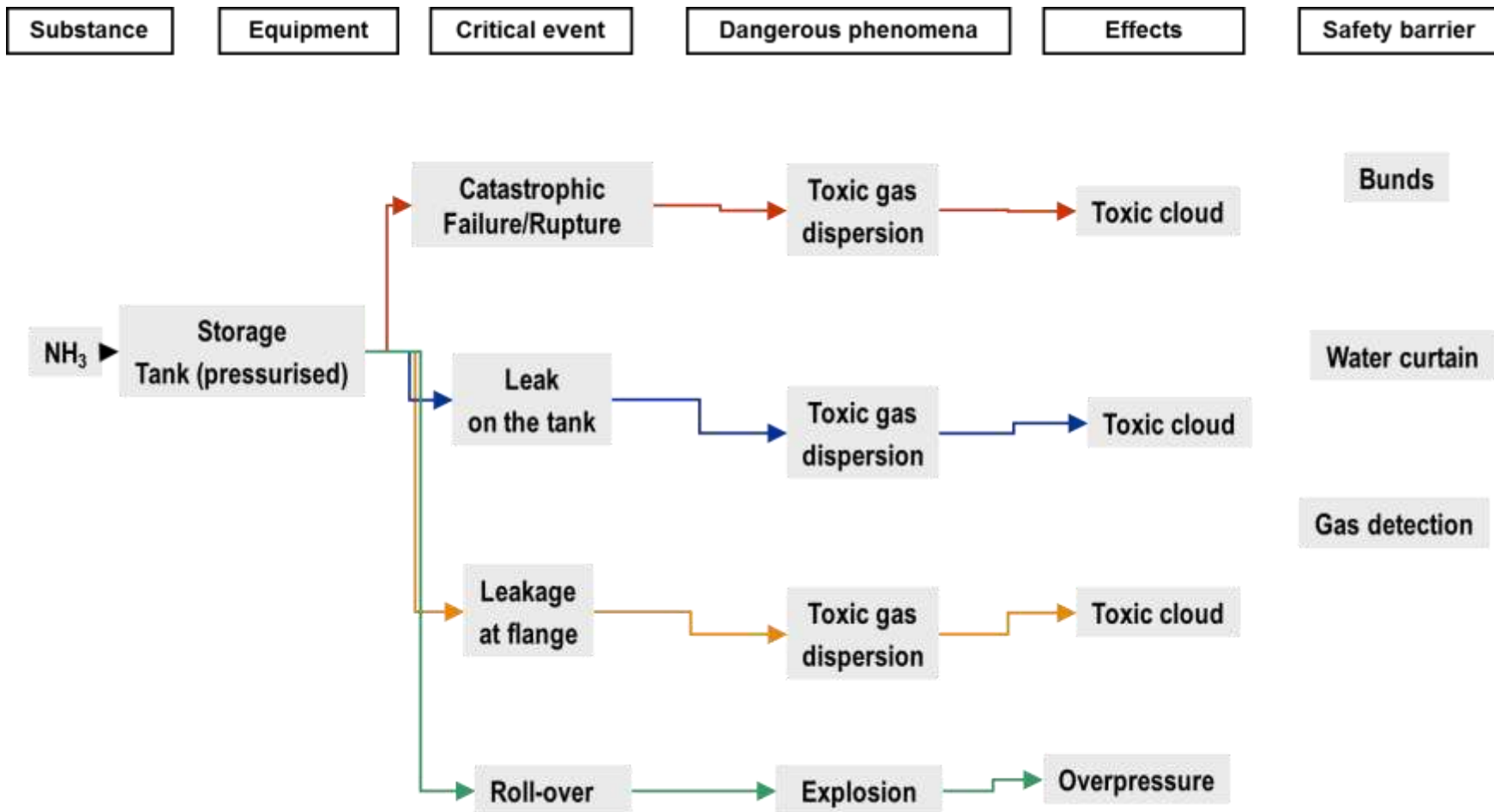
Scenario trees were developed for the main substances and installation types are presented.

The following substances are included:

- LPG;
- Ammonia;
- Chlorine;
- Liquefied Natural Gas;
- Pressurised Natural Gas;
- Flammable liquids;
- Liquid oxygen (LOX).

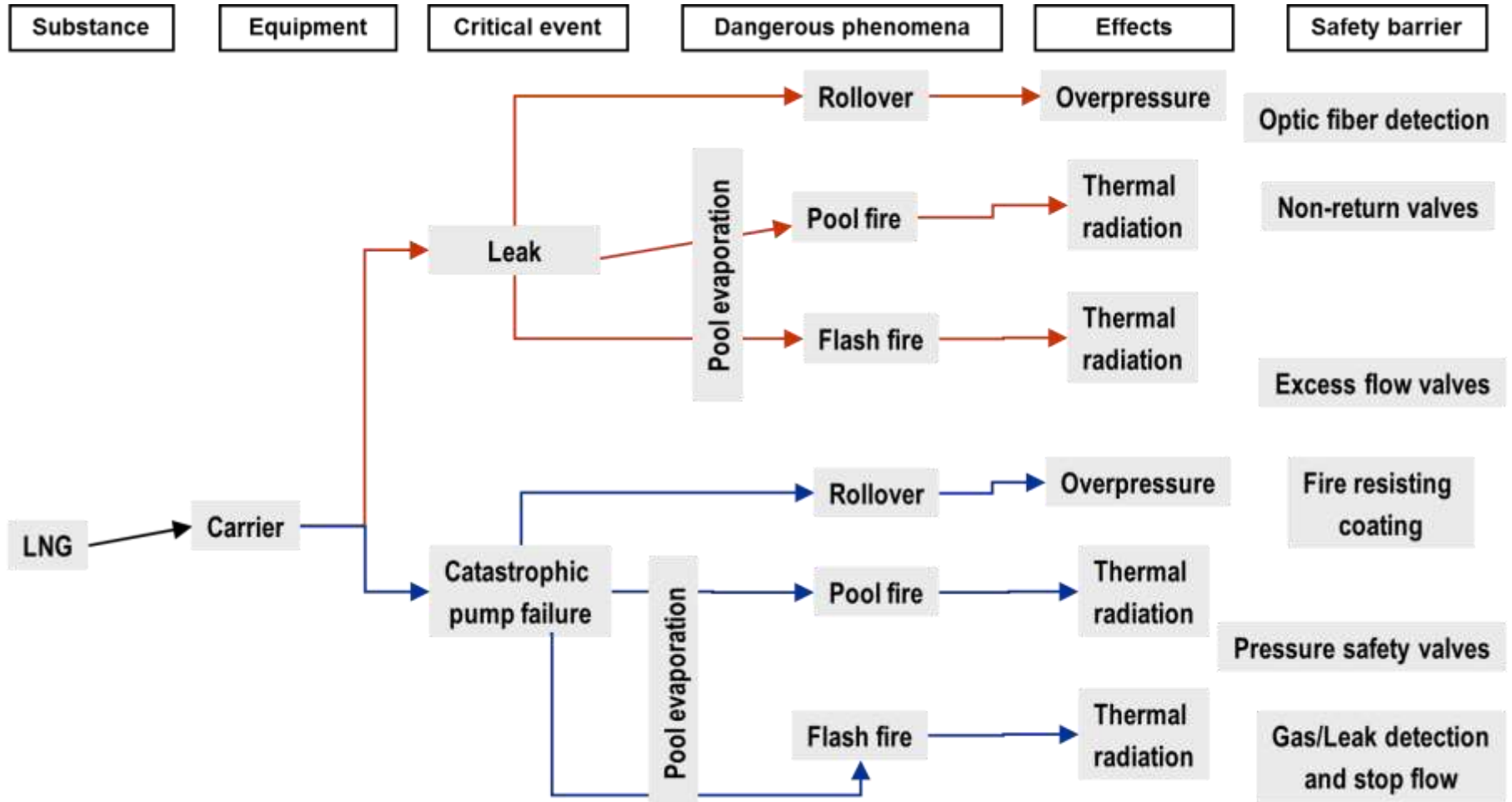


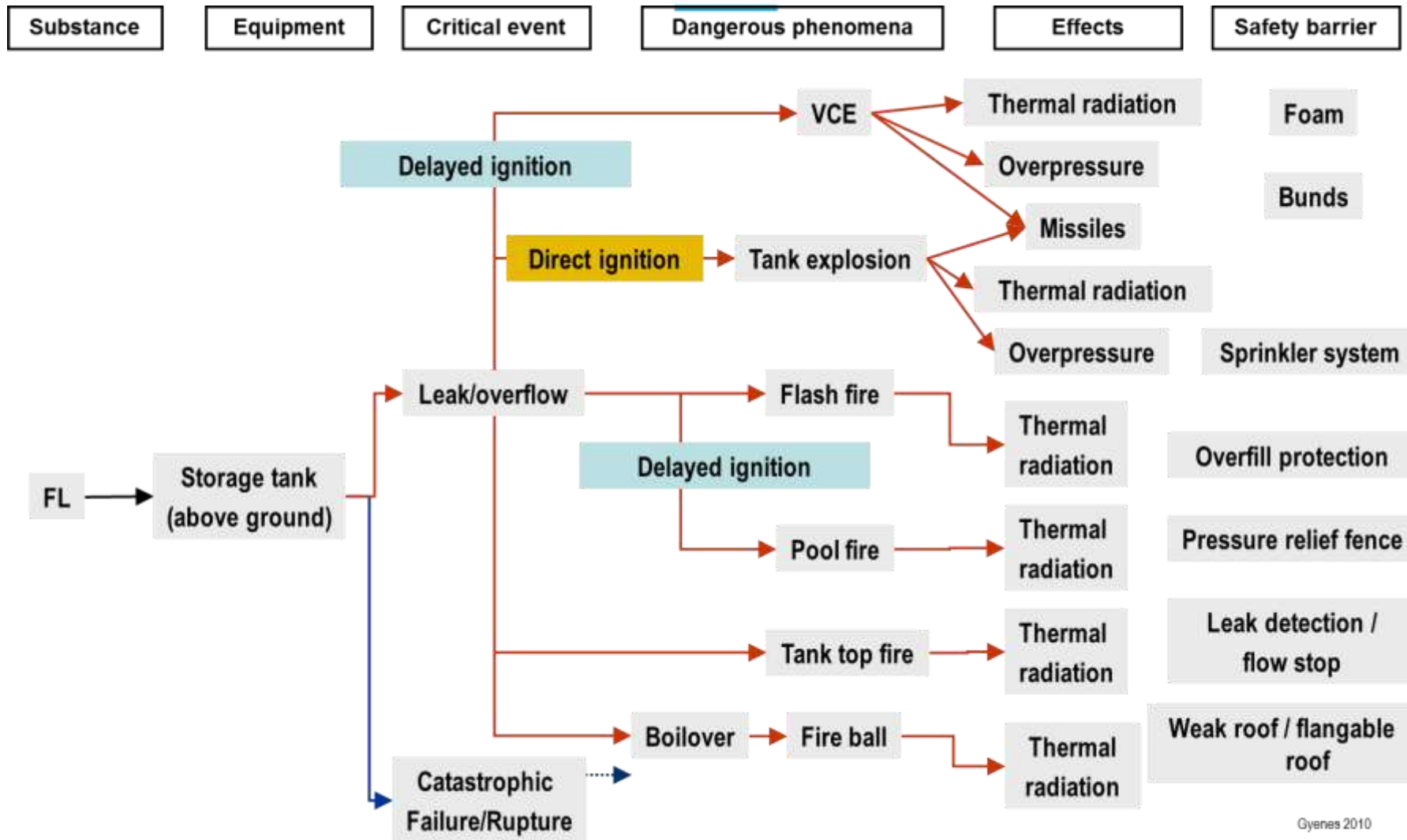
Ammonia

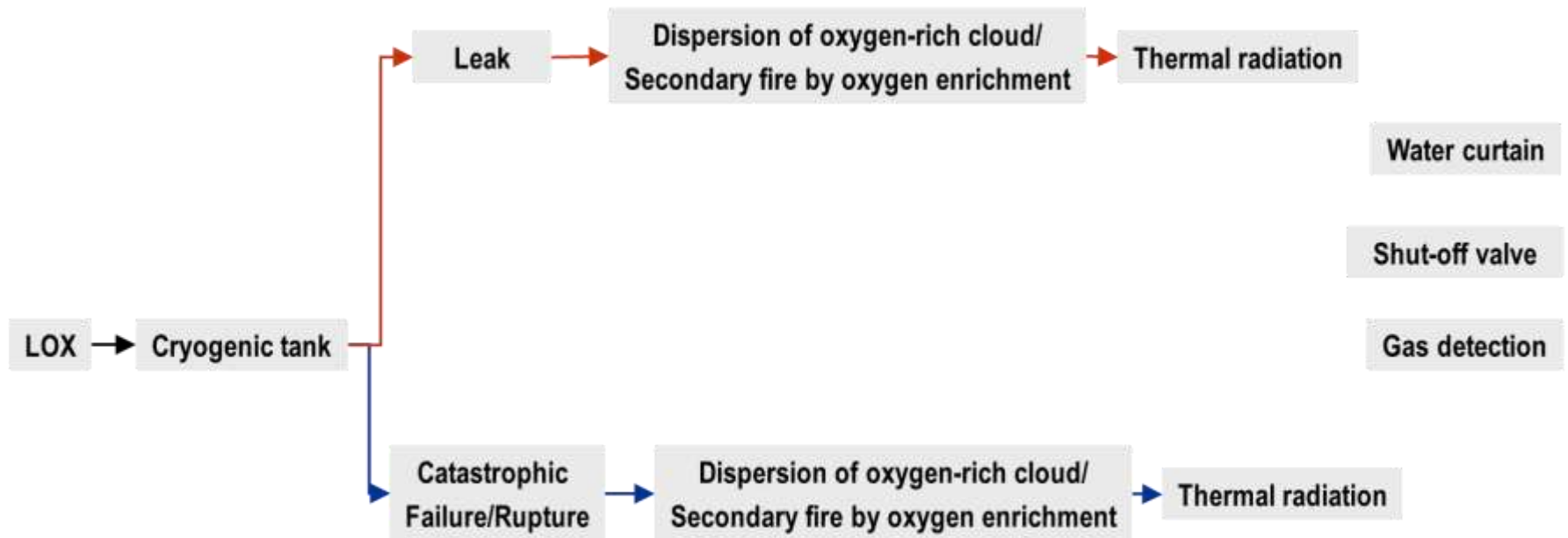
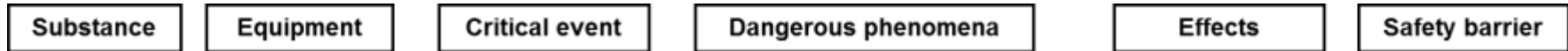


Note: Roll-over for anhydrous ammonia (<0.25% water) is not relevant

Gyenes 2009







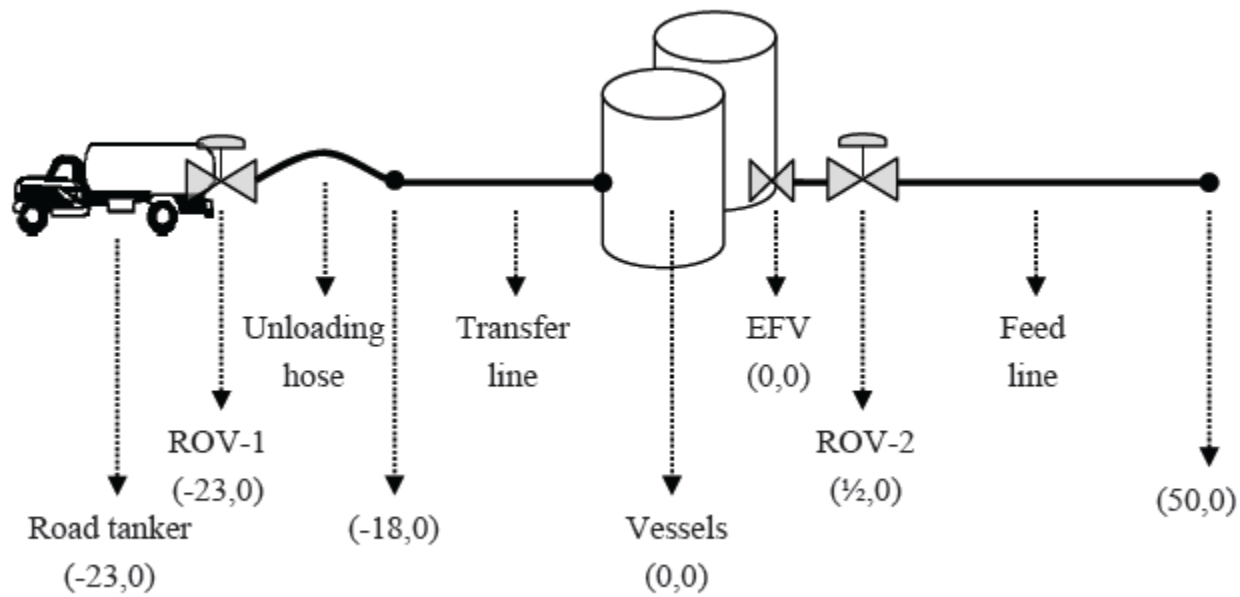
Note: Toxicity level to be considered



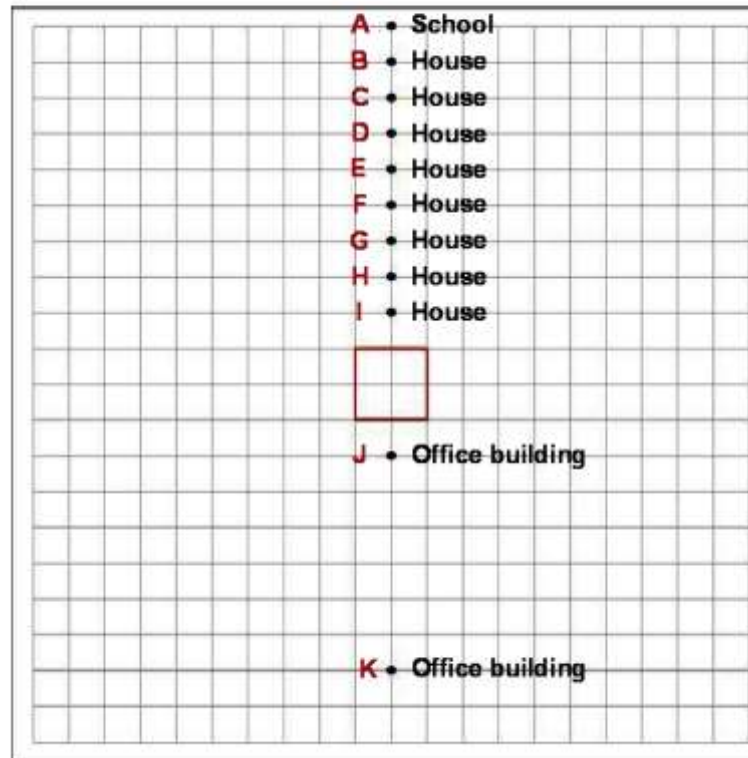
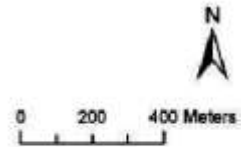
The objectives of the case study were:

- To obtain an in-depth understanding of the LUP approaches within the EU by inviting the MS to conduct an assessment of two the fictitious LUP cases according to their LUP policies;
- To highlight similarities and understand differences among the different MS approaches against the same study case; and
- To evaluate the functionality of the Scenario trees as an inventory of good practices for assessing LUP cases.

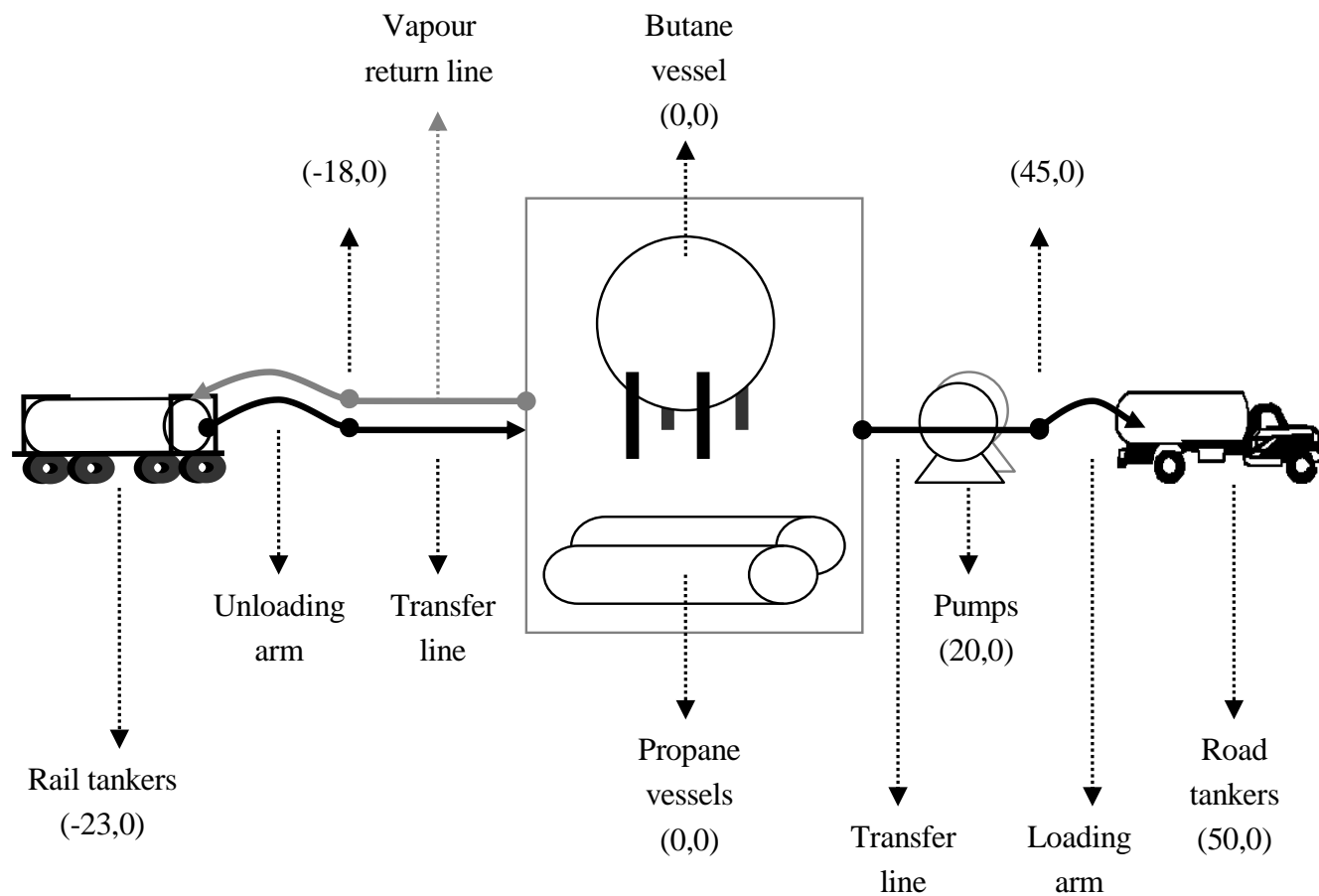
Chlorine facility



- Plant boundary
- Population objects
 - House
 - Office building
 - School



LPG facility





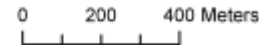
Chlorine

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P1	NO	NO	YES	YES	YES	YES	YES	YES	YES	NO	YES
P2	NO	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO
P3	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	YES
P4	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES
P5	NO	NO	NO	NO	YES	YES	YES	YES	NO	YES	YES
P6	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
P7	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO
P8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Results - Chlorine case



- Plant boundary
- Population objects**
- House
- Office building
- School



8 Participating Teams (P1-P8)

Houses only:

P4: 200m YES
300m YES

P1,P2,P4: 400m YES
500m YES

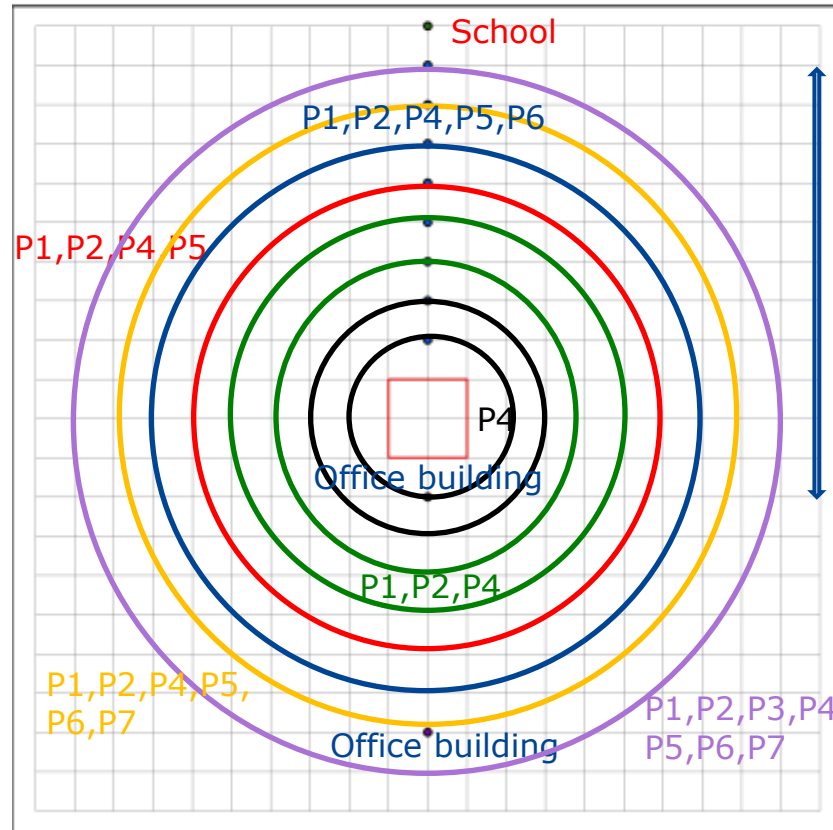
P1,P2,P4,P5: 600m YES

P1,P2,P4,P5,P6: 700m YES

P1,P2,P3,P4,P5,P6: 800m YES

P1,P2,P3,P4,P5,P6,P7: 900m YES

Only the 'P8' country is against development in all distances.



Office building:

P4, : 200m YES

P1,P3,P4,P5: 800m YES

School:

P1,P3,P7: 1000m YES



LPG

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P1	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P2	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P3	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	YES
P4	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P5	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
P6	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
P7	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P8	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES

Note: Some of the participating teams use mixed LUP decision method for specific dangerous substances like LPG, therefore the table is only for indication.

Results – LPG case



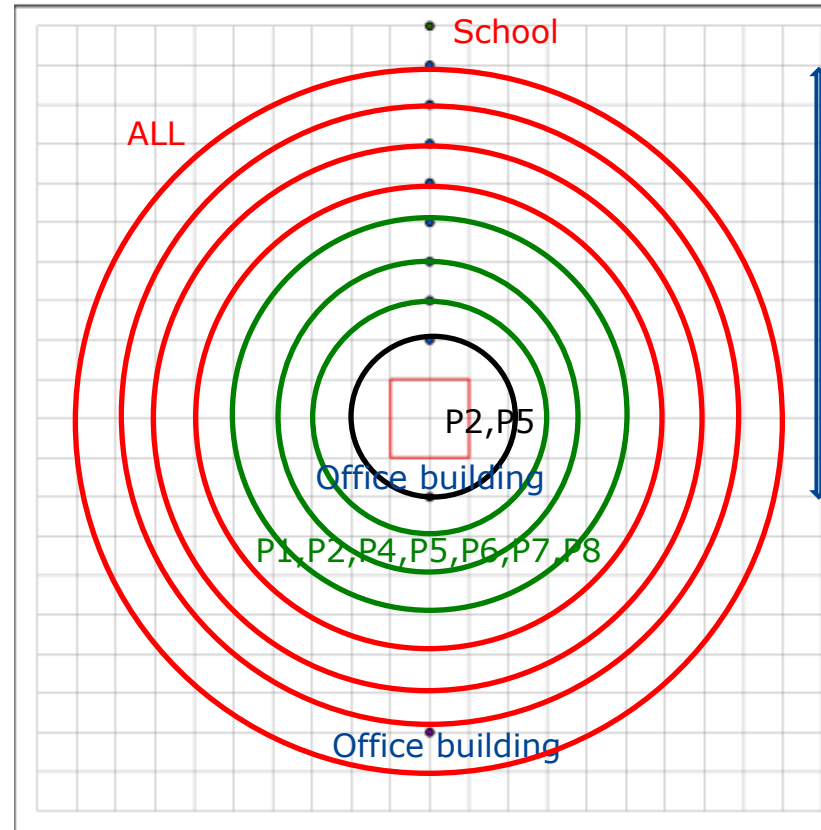
8 Participating Teams (P1-P8)

Houses only:

P2,P5: 200m YES

P1,P2,P4,P5,P6,P7,P8: 300m YES
400m YES
500m YES

ALL: 600m YES
700m YES
800m YES
900m YES



Office building:

P5,P6: 200m YES

ALL: 800m YES

School:

ALL: 1000m YES

Summary

The 6 Participating Teams followed the following approaches:

P1: risk based approach

P2: semi-quantitative approach

P3: risk based approach

P4: risk based approach

P5: risk based approach

P6: risk based approach

P7: risk based approach

P8: semi quantitative approach

Comparison – semi quantitative approach

P2 and P8 - Chlorine case

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P2	NO	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO
P8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

P2 and P8 - LPG case

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P2	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P8	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES

Comparison – risk based approach

P1,P3,P4,P5,P6,P7 - Chlorine case

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P1	NO	NO	YES	YES	YES	YES	YES	YES	YES	NO	YES
P3	NO	NO	NO	NO	NO	NO	YES	YES	YES	NO	YES
P4	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES
P5	NO	NO	NO	NO	YES	YES	YES	YES	NO	YES	YES
P6	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO
P7	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO

P1,P3,P4,P5,P6,P7 - LPG case

Participating Team	[I] 200 m	[H] 300 m	[G] 400 m	[F] 500 m	[E] 600 m	[D] 700 m	[C] 800 m	[B] 900 m	[A] School 1000 m	[J] Office 200 m	[K] Office 800 m
P2	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P3	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	YES
P4	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
P5	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
P6	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
P7	NO	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES



- Introduction –Use of the Scenarios Handbook
- Risk Assessment Methodologies for Land-Use Planning
- Selection of accident scenarios for most relevant substances and types of installations
- Identification of typical causes or initiating events
- Propose values for Generic Failure Frequencies of the scenarios
- For a limited number of configurations calculate distances
- Illustration: Examples of application of scenario trees in two case-studies
- References
- Glossary

THANK YOU FOR YOUR ATTENTION

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