Session 7: Risk acceptance criteria and land use planning

Workshop on Accident Analysis and Risk Assessment

20-22 November 2013, Ispra, Italy

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Serving society
Stimulating innovation
Supporting legislation

"How safe is safe enough?"

Risk Analysis

1. What can go wrong?
2. How frequent is it?
3. How dangerous is it?

Risk Acceptance

Do the benefits of the industrial activity outweigh the risks?

Risk Acceptance Criteria

What is acceptable depend upon current societal context and values.

- What is tolerable today may not be considered as tolerable tomorrow
- What is tolerable somewhere may not be tolerable somewhere else

Need to balance two conflicting aspects:

- Aspiration to eliminate all possible risks
- Facing reality i.e. impracticability and/or impossibility to eliminate all risks

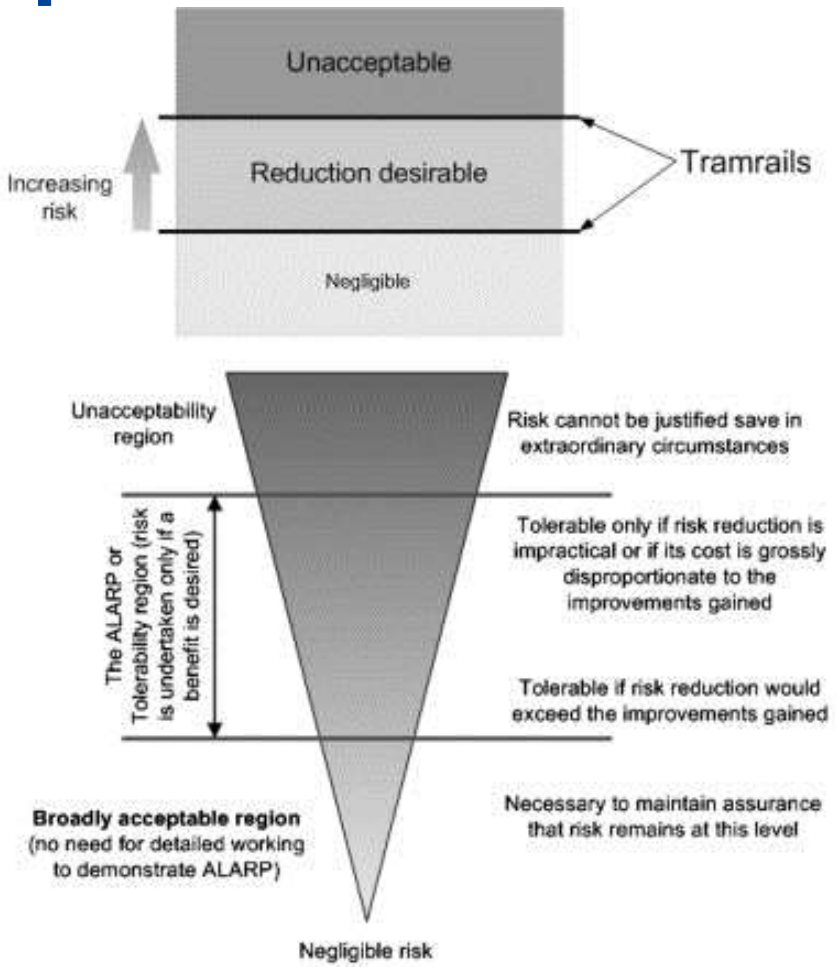
Acceptance Criteria allow defining how much risk we need to reduce before we stop, how we should balance the two conflicting aspects, and how much **residual risk is tolerable**

Factors influencing Risk Acceptance

- Benefits gained from taking the risk
- Degree of control over the risk
- Voluntary vs. involuntary
- Risk aversion
- Time until effects are experienced
- Time since similar accidents have occurred

Risk acceptance principles

- ALARP
- ALARA
- Precautionary Principle

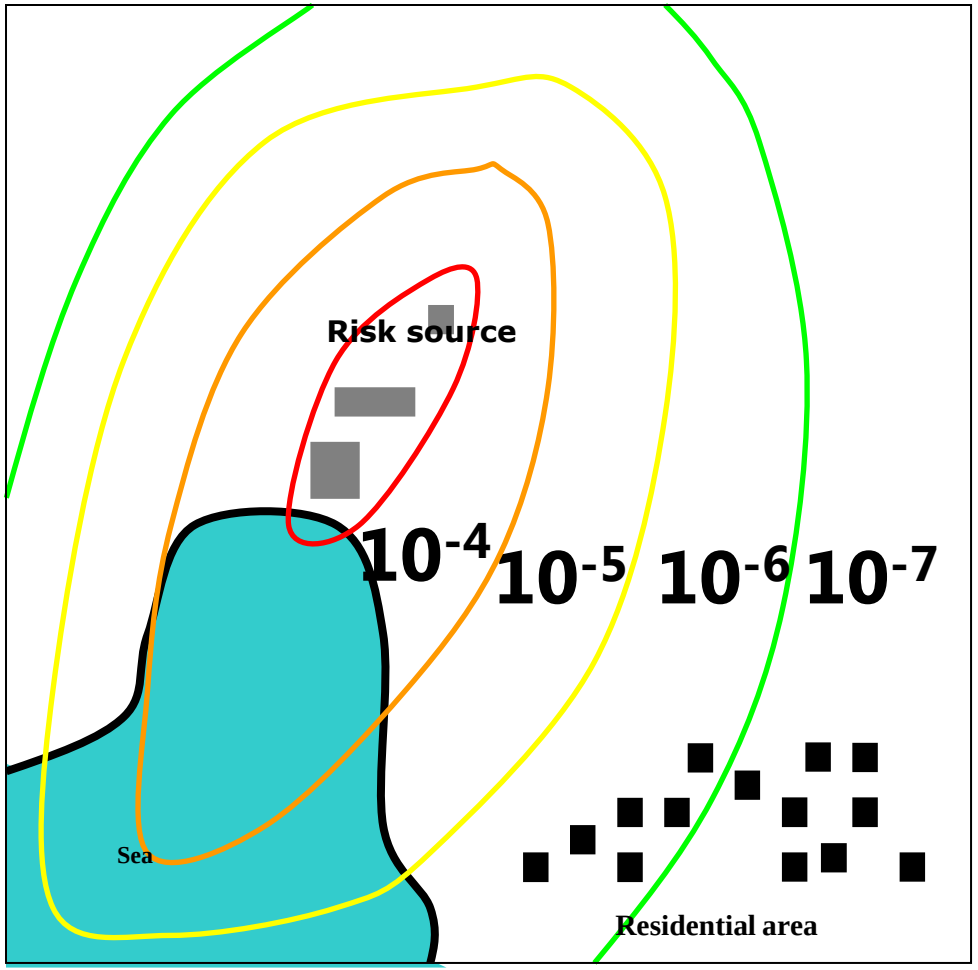


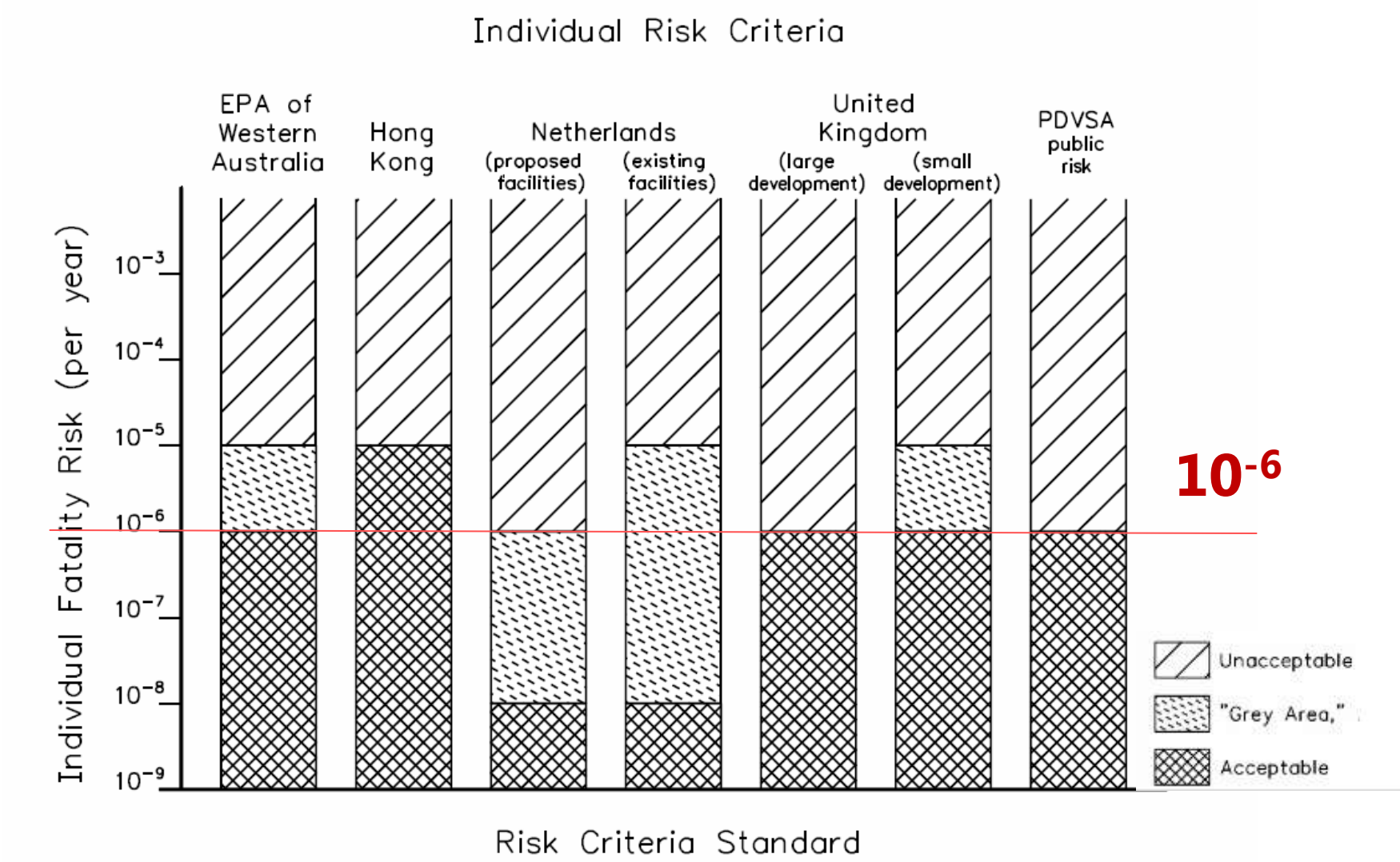
From D.N.D. Hartford
Structural Safety Vol 31, Issue 2, (2009)

Individual Risk

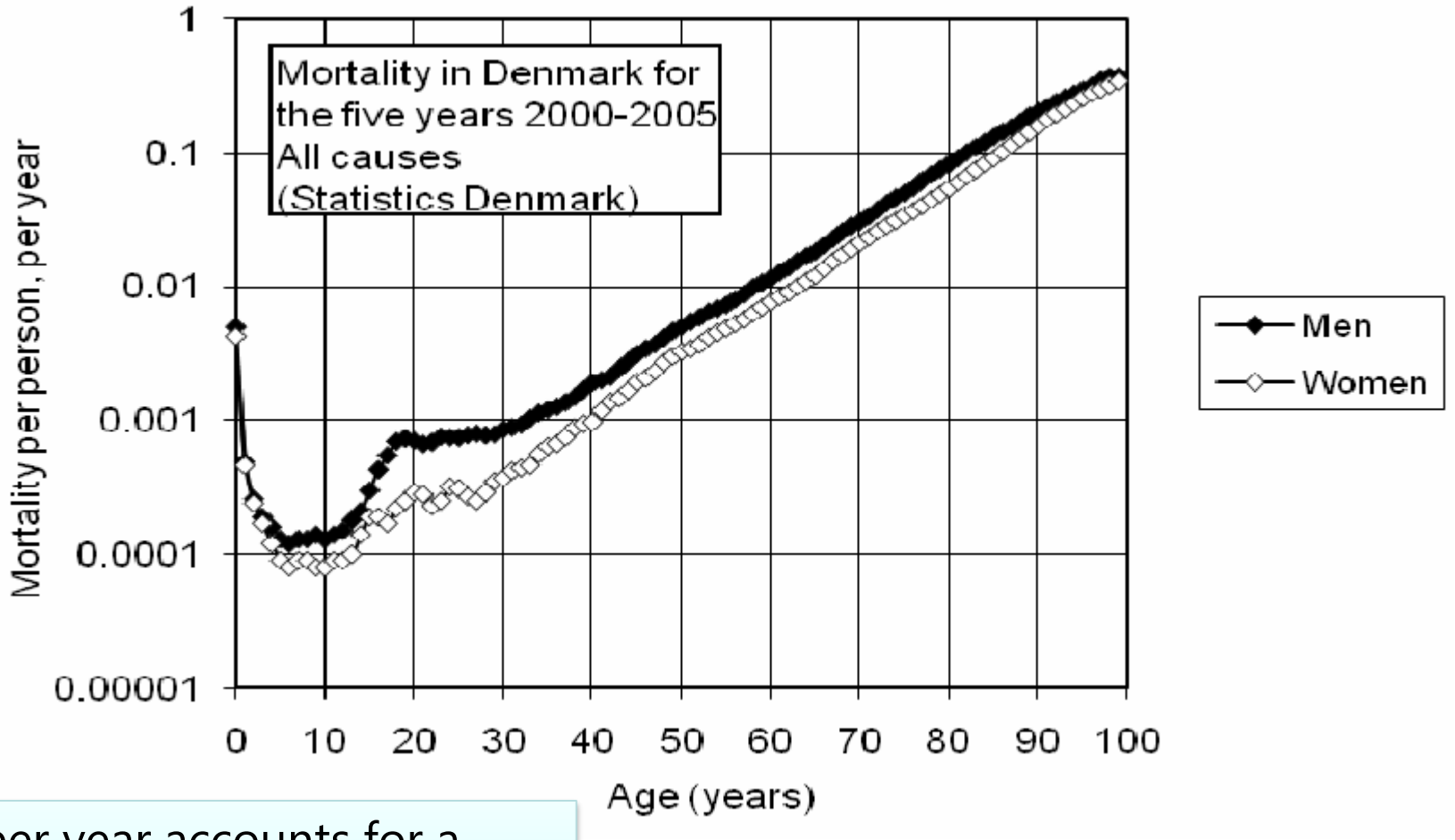
annual frequency of occurrence of the reference damage (e.g., the death), in any point of the geographical area, for a person present

This is a useful figure to characterise the risk in a given location.



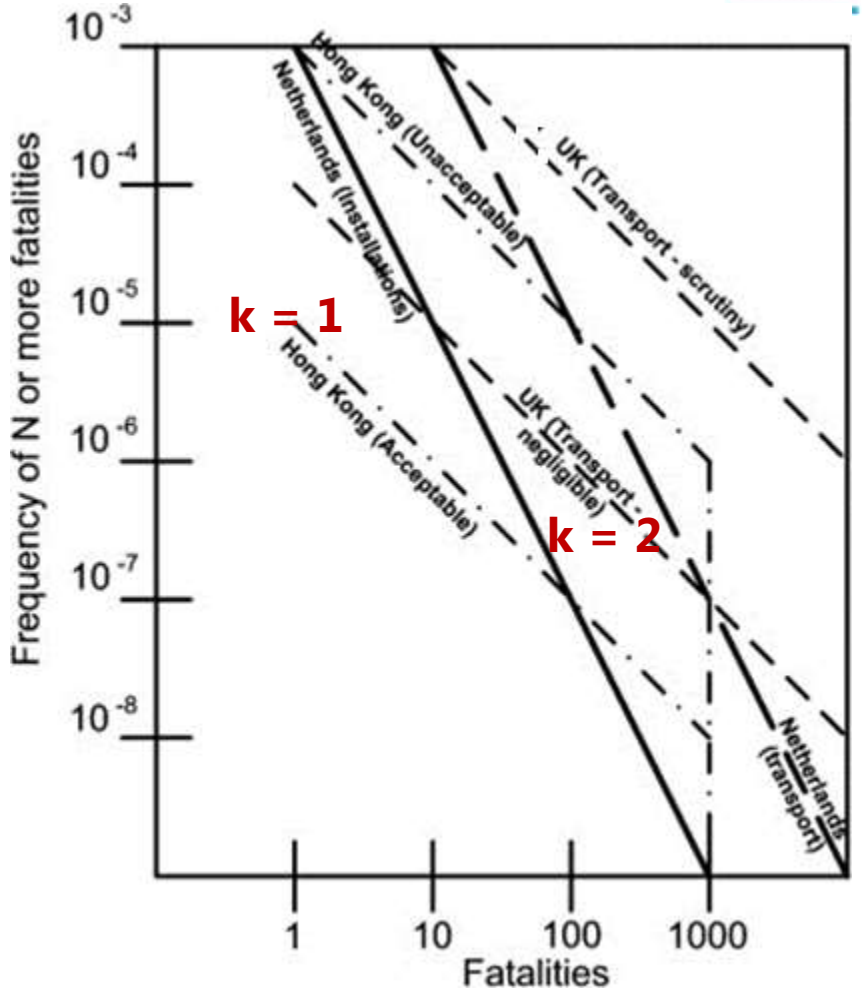


By John B. Cornwell and Mark M. Meyer, II Risk Control Seminar
Petróleos de Venezuela Puerto La Cruz, Venezuela October 13, 1997



10^{-6} per year accounts for a maximum of 1% of the lowest mortality rate

From Nijs Jan Duijmn, Acceptance criteria in Denmark and the EU



$$\text{Risk} = f\, D^{k}$$

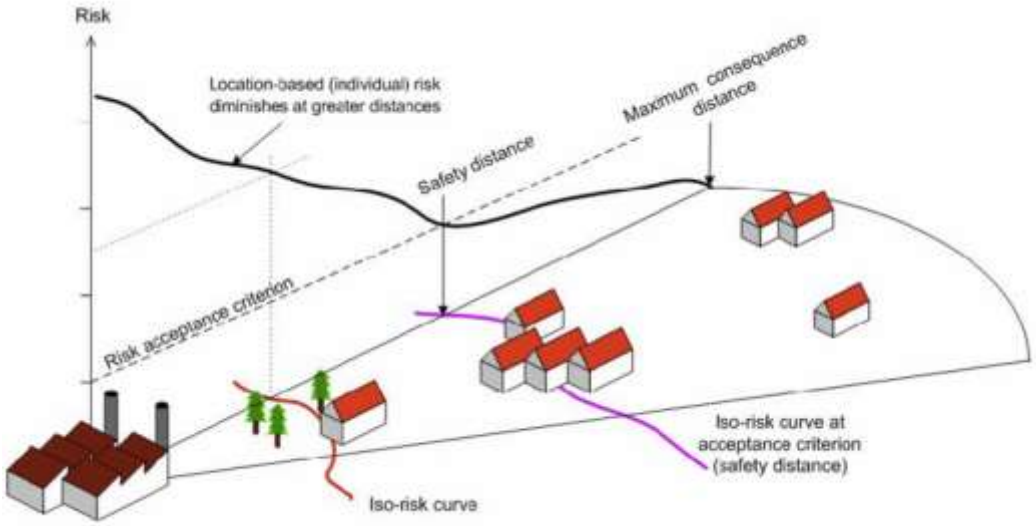
k: risk aversion

Societal risk of certain activities:
$< 10^{-3}/N^2$

From D.N.D. Hartford
Structural Safety Vol 31, Issue 2, March 2009, Pages 118–123

Land Use Planning

Aims at establishing and maintaining **Appropriate Distances** or **Additional Technical Measures** to prevent/mitigate the consequences of an accident off-site



(From Nijs Jan Duijmn, Acceptance criteria in Denmark and the EU)

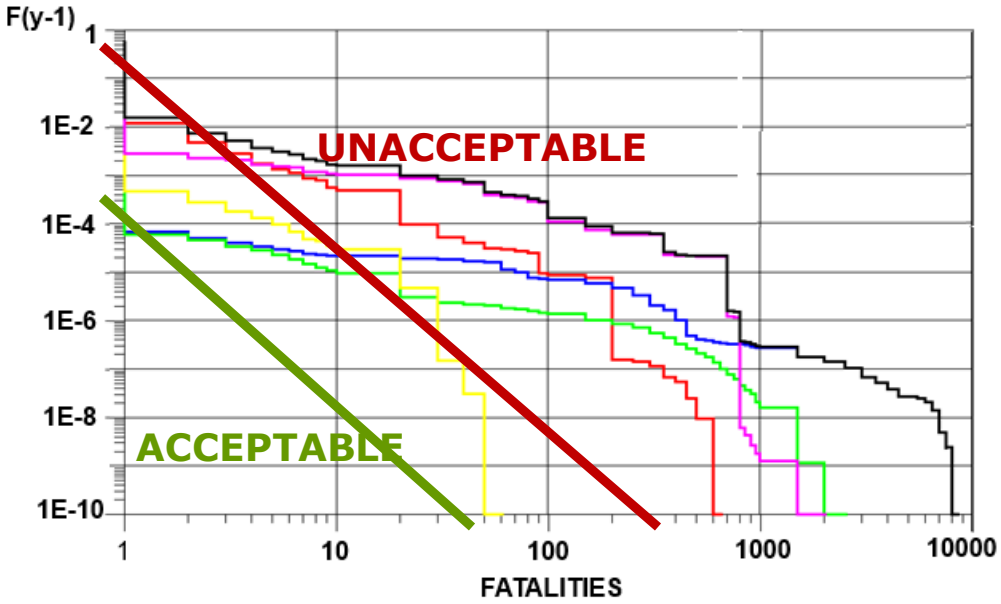
- siting of new establishments
- modifications of existing sites (Art. 10)
- new developments (transport links, locations frequented by the public, residential areas)

Commonly used approaches in support to LUP decisions

- **"Risk-based"** - assessment of both the consequences and the likelihood of occurrence for a large number of accident scenarios. Risk tolerability criteria (individual risk / societal risk).
- **"Consequence-based"** - assessment of consequences of the worst – or worst within a number of reference accident scenarios. Consequence zoning criteria ($LC_{1\%}$, IDLH, ERPG, AEGLs).
- **"Generic" safety distances**, for standardised installations, deriving from standard risk/hazard assessment of a typical facility, and used as default or for screening purposes. Depend on the type of activity rather than on a detailed analysis of the specific site.
- **"Hybrid approaches"** – incorporate risk and consequence elements either qualitative or quantitative

Risk-based approach

- 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



Deterministic approach/Individual Format
"Classical consequence-based approach"

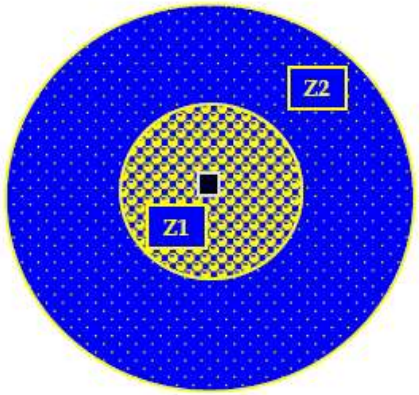
Based on consequences of credible accidents

– 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



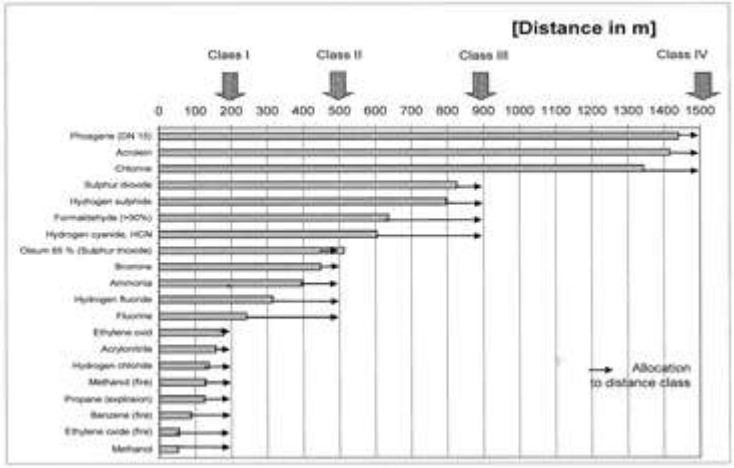
Deterministic approach/Generic Format

"Generic" safety distances

Pre-defined generic separation distances

Typical accident scenarios, consequence assessment (qualitative or quantitative)

"gradual" land-use zoning system exists, that avoids neighbouring incompatible land uses



Joint Research Centre

Hybrid approach

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

Probability class	Consequence category			
	High fatalities	Starting fatalities	Irreversible effects	Reversible effects
< 10^{-6} ev/yr	EF	DEF	CDEF	BCDEF
10^{-4} – 10^{-6} ev/yr	F	EF	DEF	CDEF
10^{-3} – 10^{-4} ev/yr	F	F	EF	DEF
> 10^{-3} ev/yr	F	F	F	EF

Sorce: M.D. 09/05/2001


END