Application of « SEVESO II » Directive in France
Land-use Planning around Industrial Facilities

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Introduction

• Land-use planning as tool for disaster mitigation
  • Mapping hazards: past and future (e.g. consequences of CC)
  • Mapping assets + Monitoring / reducing exposure to hazards
  • Guiding vulnerability reduction (e.g.: retrofitting measures)

• A feature of most guidelines for disaster mitigation
  • UN initiatives: IDNDR (1990-2000)+ UN-ISDR; Hyogo Framework…
  • EC Directives (e.g.): 1996 “Seveso II”; 2007 “Floods”; …
  • Guidelines and working groups: MAHB; JRC-Ispra;…

• Land-use encompasses several issues/dimensions
  • Technical / organisational: risk analysis; hazard assessment
  • Institutional: adaptation of national Law is required
  • Governance: land-use planning as constraint to local development; dialogue/negotiation needed
Land-use planning in hazard-prone areas

Map of hazards → Risk Map → Existing buildings → OK? → Maintain, Adapt, Relocate → Plan
Map of assets → Risk Map → Future buildings → Choice of risk level

• **Figure:** *Generic* process for land use planning in hazard-prone areas
• **Sources:** UN agencies (e.g. UNESCO) + IDNDR documents
Industrial Facilities & Land-use Planning in France

- French Law: an early consideration of impacts of industrial activities, yet only progressively focussing on...
  - Well-being of riparian inhabitants: sanitary / noise, smell… (1810)
  - Casting facilities away from cities – « countryside industry »
  - Well-being of workers: focus on process safety within plants (1917)
  - Citizen safety (major accidents; acute/sudden pollution)
    - Safety report as precondition to industrial operation
    - Instructions for land-use planning near plants (two-tier basis)
- + Domestic drivers include:
  - Major accidents (Feyzin 1966; Toulouse 2001)
  - Public opinion / civil society; actual - or perceived - expectations
- + Foreign drivers include:
  - Integration of EC Directives into the French legal framework
  - Sectoral + international good practices for a safer industry
Step 1: Granting an operation permit to industry

• Permit is delivered if the results of the safety report comply with acceptability criteria, as defined in a probability - gravity matrix.

• What is a safety report in France?
  • a summary of an accident risk analysis;
  • a document describing all such risks generated by a facility;
  • a document whereby operators explain/prove that all safety barriers required for minimizing risks have been set up;
  • a decision support tool.

• For what purpose?
  • a basis for setting the risk matrix + permit to operate;
  • a basis for land-use planning process “PPRT”;
  • a tool for State inspection (“competent authorities”);
  • a tool for continuous improvement of safety in facilities.
Definition of an accident scenario / Bow-tie

- Scenarios identified in safety reports are based on risk analysis (HAZOP…)
- Scenario: sequence of events, from initial “root cause” to dangerous phenomenon

- RC: Root cause; CE: Central event; D Ph: Dangerous phenomenon (3)
- EFF: Effects (impacts on assets; severity)
- “Safety barriers”: 2 types + performance criteria
Modelling impact distances of dangerous phenomena

- All physically possible events should be considered, before exclusion (if any)
- Modelling the effects of the worst case scenario (maximum intensity)

CASE 1

Establishment limits

No need for further analysis

CASE 2

Establishment limits

DEVELOPMENT OF BOW-TIE/PROBABILISTIC ASSESSMENT

Option 1: possibility to maintain worst case assessment
Option 2: possibility to refine the assessment
Step 2: Issuing land-use guidelines for municipality

- Land-use planning is defined by the “Plan de prévention des risques technologiques” (PPRT).
- This plan is applicable to both existing buildings and future land-use in the vicinity of SEVESO facilities.
- PPRT guidelines are compulsory (i.e., surpass existing documents).

What is new with the PPRT process:
- Land-use planning is decided once all possible risk reduction measures have been taken at facility level.
- Based on a probability-severity approach.
- Reflects a willingness of the State to involve local authorities (municipality) in the decision process.
- Sets co-funding as a principle for bearing the cost of land-use measures: industry + State + municipality.
Decision tools

Events +/- likely to happen

Political decision for setting rules on...

...which major accidents have to be considered in...

...which dangerous phenomena have to be considered in...

Risk matrix – permit to operate
Is the facility compatible with its environment?

<table>
<thead>
<tr>
<th>G</th>
<th>P</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Désastreux</td>
<td>Non1</td>
<td>Non 1</td>
<td>Non 2</td>
<td>Non 3</td>
<td>Non 4</td>
<td></td>
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<tr>
<td>Catastrophique</td>
<td>MMR 1</td>
<td>MMR 2</td>
<td>Non 1</td>
<td>Non 2</td>
<td>Non 3</td>
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<tr>
<td>Important</td>
<td>MMR 1</td>
<td>MMR 1</td>
<td>MMR 2</td>
<td>Non 1</td>
<td>Non 2</td>
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<tr>
<td>Sérieux</td>
<td></td>
<td>MMR 1</td>
<td>MMR 2</td>
<td>Non 1</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>MMR 1</td>
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</tr>
</tbody>
</table>

« PPRT » - Land use planning
- Considering the residual risk, does land-use require improvements in terms of mitigation?
- Is it relevant to plan further building in the area?
## Risk matrix

### Effects vs. Level of Effects

<table>
<thead>
<tr>
<th>Effects</th>
<th>Significant lethal effect threshold</th>
<th>Lethal effect threshold</th>
<th>Irreversible effect threshold</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal</td>
<td>8 kW/m² or (1800 kW/m²)²/s.</td>
<td>5 kW/m² or (1000 kW/m²)²/s.</td>
<td>3kW/m² or (600 kW/m²)²/s.</td>
<td>/</td>
</tr>
<tr>
<td>Overpressure</td>
<td>200 mbar</td>
<td>140 mbar</td>
<td>50 mbar</td>
<td>20 mbar</td>
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</tbody>
</table>

### Gravity vs. Significant Lethal Effect

<table>
<thead>
<tr>
<th>Gravity</th>
<th>Significant lethal effect</th>
<th>Lethal effect</th>
<th>Irreversible effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disastrous</td>
<td>&gt;10</td>
<td>&gt;100</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>1 to 10</td>
<td>10 to 100</td>
<td>100 to 1000</td>
</tr>
<tr>
<td>Significant</td>
<td>1</td>
<td>1 to 10</td>
<td>10 to 100</td>
</tr>
<tr>
<td>Serious</td>
<td>0</td>
<td>1</td>
<td>1 to 10</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

### Probability vs. Gravity

#### Probability class

<table>
<thead>
<tr>
<th>Probability class</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of probability</td>
<td>0 to $10^{-5}$</td>
<td>$10^{-5}$ to $10^{-4}$</td>
<td>$10^{-4}$ to $10^{-3}$</td>
<td>$10^{-3}$ to $10^{-2}$</td>
<td>$10^{-2}$ to 1</td>
</tr>
</tbody>
</table>

#### Probability vs. Gravity

<table>
<thead>
<tr>
<th>Probability Gravity</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disastrous</td>
<td></td>
<td></td>
<td>Acceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
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<tr>
<td>Catastrophic</td>
<td></td>
<td></td>
<td>Unacceptable</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Significant</td>
<td></td>
<td>ALARP</td>
<td>ALARP class 2</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Serious</td>
<td></td>
<td>ALARP</td>
<td>ALARP</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td>ALARP</td>
<td>ALARP class 2</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
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<tr>
<td></td>
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<td></td>
<td>ALARP</td>
<td>Unacceptable</td>
<td>Unacceptable</td>
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</table>
PPRT – Hazard mapping phase

Dangerous phenomena list

- Effect distances;
- Probability of occurrence;
- Kinetic

Three hazard maps are drawn:
- Thermal;
- Overpressure;
- Toxic.
Land-use I: Planning for the future

- On the basis of hazard levels, and vulnerability maps, regulation for **new construction** in the vicinity of SEVESO facilities are set.
- These regulations **are defined using a governance process**. However some guidance is available:

<table>
<thead>
<tr>
<th>“Aea levels”</th>
<th>VH+</th>
<th>VH</th>
<th>H+</th>
<th>H</th>
<th>M+</th>
<th>M</th>
<th>Low</th>
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<tbody>
<tr>
<td>Thermal and toxic effects</td>
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<td>Overpressure effects</td>
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</table>

- Ban on new construction but possibility to extend existing industrial buildings and infrastructure if they are protected.
- New construction possible depending on limitations on use or protection measures.
- New construction possible depending on minor limitation on use. Compulsory protection measures for public buildings and industries. No public building hard to evacuate.
- Protection measures on new buildings.
- New construction possible depending on minor limitation on use. Compulsory protection measures for public buildings and industries. No public building hard to evacuate.
Land-use II: Changes to current situation (exist. bldgs)

- Based on hazard levels and vulnerability maps, measures on existing buildings may be taken.

- These decisions are made using a governance process. Available tools are:
  - **Expropriation or relinquishment** in higher risk areas. These measures are paid using an agreement between the State, the operator and the local authorities. Some guidance is available for the definition of these areas:

<table>
<thead>
<tr>
<th>“Aléa levels”</th>
<th>VH+</th>
<th>VH</th>
<th>H+</th>
<th>H</th>
<th>M+</th>
<th>M</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expropriation</td>
<td>Automatic for housing buildings. To be defined for other activities.</td>
<td>To be defined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Relinquishment</td>
<td>Automatic</td>
<td>Automatic for housing buildings. To be defined for other activities.</td>
<td>To be defined</td>
<td></td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

- **Additional risk reduction measures** may be investigated if their cost balances the cost of real-estate measures that is avoided. In this case these measures are paid using an agreement between the State, the operator and the local authorities.

- **Improvements of the population protection** through consolidation of buildings and infrastructures. These measures are paid by owners of buildings and infrastructures. But their cost cannot be above 10% of the value of the goods.
Conclusion

• Ca. 420 PPRT to be done in France; ca. 11 completed so far.
• Involving stakeholders: multiple goals
  • Making the risk management process more understandable
  • Integrating participatory considerations (e.g. Aarhus Convention)
  • Making land-use planning more acceptable + Reducing nr. of claims
  • Integrating accident risk in local development decisions
• Perspectives
  • Not all EU countries follow the same pattern for land-use planning
    • Definition of accident scenarios + Models for impact distances
    • Assessment of severity + Role played by probability
    • Decision capacity granted to local authorities
  • More comparative studies are required (e.g.: SWOT type)
    • Sharing good practice (technical + governance), incl. FP projects
    • Example: F-Seveso survey (8 countries), commissioned by CCA
    • Foster sharing of good practice (e.g. new MS)
Thank you for your attention
Comments welcome