SEVESO: HAZID and Major Accident Scenarios

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Seveso Directive – Scope & main obligations

Excluded Sector? (Article 4)

Yes

nuclear, transport, military

No

Seveso does not apply

Lower than lower tier

What is the quantity of dangerous substances? (Annex I)

Quantity above the lower threshold

- Notification
- Major Accident Prevention Policy (MAPP)
- Domino Effects
- Land-use planning
- Inspection

Quantity above the higher threshold

Additionally:

- Safety report (including MAPP and Safety Management System)
- Emergency plans (internal and external)
- Information to the public

Mandatory SEVESO documents/actions (Summary)*	Upper tier	Lower tier
Notification to Competent Authorities	Yes	Yes
Major Accident Prevention Policy (MAPP) & Safety Management System (SMS) to implement it	Yes	Yes
Hazard Identification and Risk Assessment (HAZID)	Yes	Yes
Information to Planning Authorities	Yes	Yes
Consider inter-site domino effects	Yes	Yes
Internal Emergency Plan	Yes	`
Information to Authorities for External Emergency Plan	Yes	`
Safety Report	Yes	`
Information to the Public	Yes	Yes

* Ref. Costa Stanisav

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SEVESO inspections
Member States obligation (art. 20of Seveso III directive)

- MS shall ensure that the competent authorities organize a system of inspections for SEVESO sites.

- MS shall encourage the competent authorities to provide mechanisms and tools for exchanging experience and consolidating knowledge, and to participate in such mechanisms at Union level where appropriate.

- MS shall ensure that operators provide the competent authorities with all necessary assistance to enable those authorities to carry out any inspection and to gather any information necessary for the performance of their duties for the purposes of this Directive, <u>in particular:</u>

  - to allow the authorities to fully assess the possibility of a major accident and
  - to determine the scope of possible increased probability or aggravation of major accidents,
  - to prepare an external emergency plan and
  - to take into account substances which, due to their physical form, particular conditions or location, may require additional consideration.

The main objectives of inspections/control measures

Inspectors have to verify that: (**art 20)**

- (a) the operator can demonstrate that he has taken appropriate measures, in connection with the various activities of the establishment, to prevent major accidents;
- (b) the operator can demonstrate that he has provided appropriate means for limiting the consequences of major accidents, on-site and off-site;
- (c) the data and information contained in the **safety report**, or any other report submitted, adequately reflects the conditions in the establishment;
- (d) information has been supplied to the public

In Summary

Contents of Upper Tier SAFETY REPORTS

Minimum SEVESO requirements for a SR (Upper Tier)

1. Safety Management System of the company as implemented in the establishment incl. MAPP
2. Description of establishment and neighboring environment
3. Dangerous Substances (Quantities vs SEVESO Qualifying quantities)
4. Hazard Analysis (HA) : safety critical equipment/circuits
5. Major Accident Scenarios (Reference Scenarios), Phenomena with consequences outside the establishment Worst Case Scenarios (WCSs)
6. Consequence Zones (Z1, Z2, Z3)
7. Risk Assessment RA (Consequence based or QRA)
8. Domino
9. Measures of Prevention, Control and Intervention (limitation of consequences, internal emergency plan)

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Identification and Accidental Risks Analysis and Prevention Methods

A. detailed description of the possible major-accident scenarios and their probability or the conditions under which they occur, including a summary of the events that may play a role in triggering each of these scenarios, the causes being internal or external to the installation;

B. assessment of the extent and severity of the consequences of identified major accidents, including maps, images or, as appropriate, equivalent descriptions, showing areas that are liable to be affected by those accidents;

C. description of technical parameters and equipment used for the safety of installations.

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Risk assessment

Risk analysis is teamwork

Ideally risk analysis should be done by bringing together experts with different backgrounds:

- chemicals
- human error
- process equipment

Risk assessment is a continuous process!

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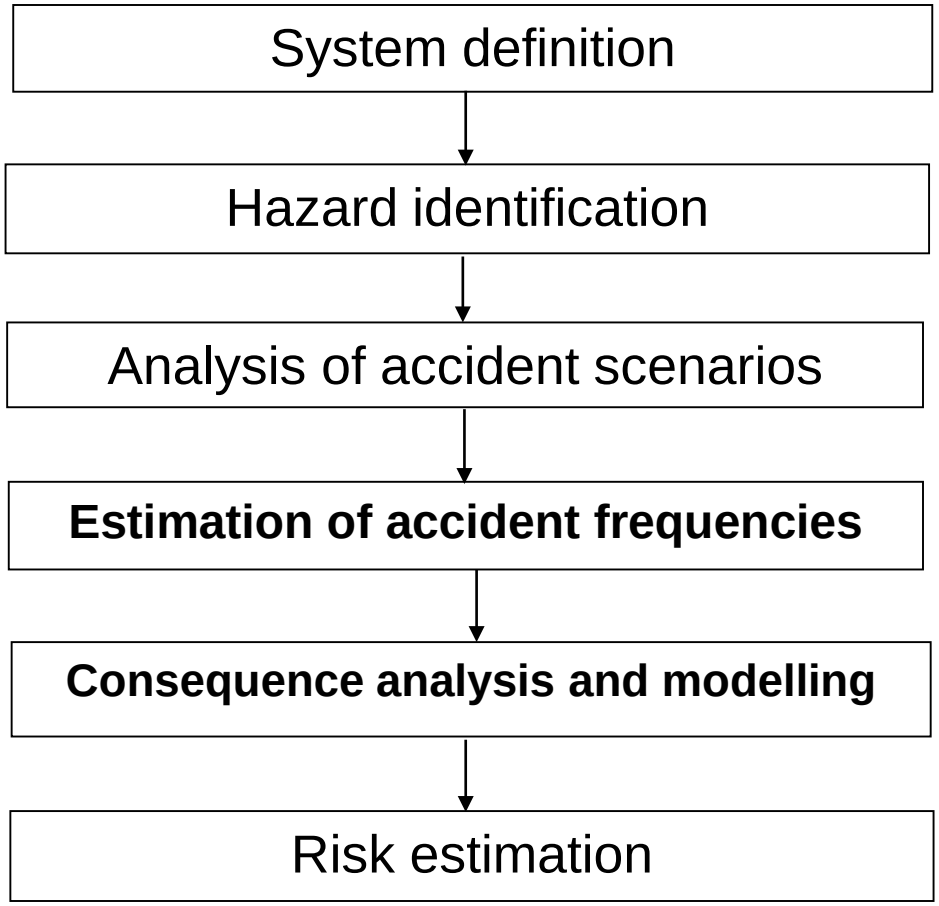
Risk Assessment



- Scheme for qualitative and quantitative assessments
- At all steps, risk reducing measures need to be considered

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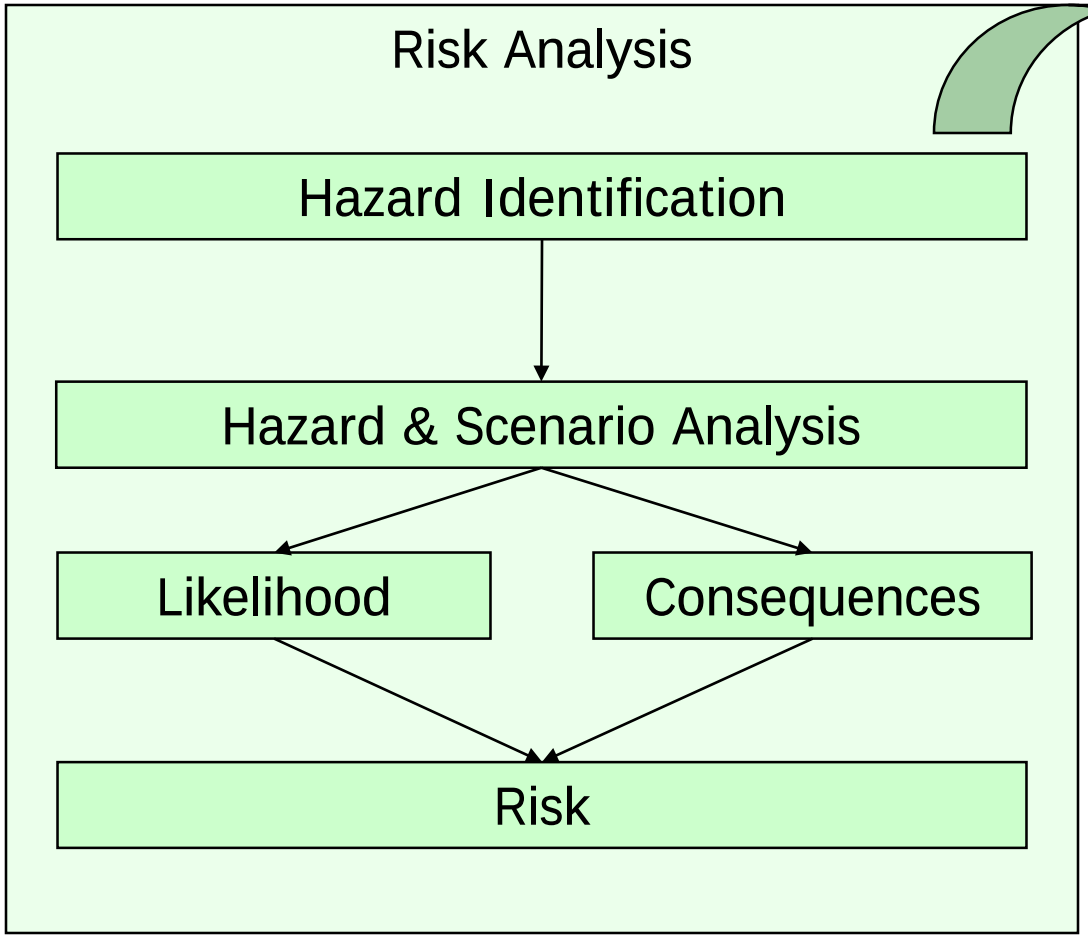
Risk Analysis – Main Steps



- ”What if”
- Checklists
- HAZOP
- Task analysis
- Index (Dow, Mond)

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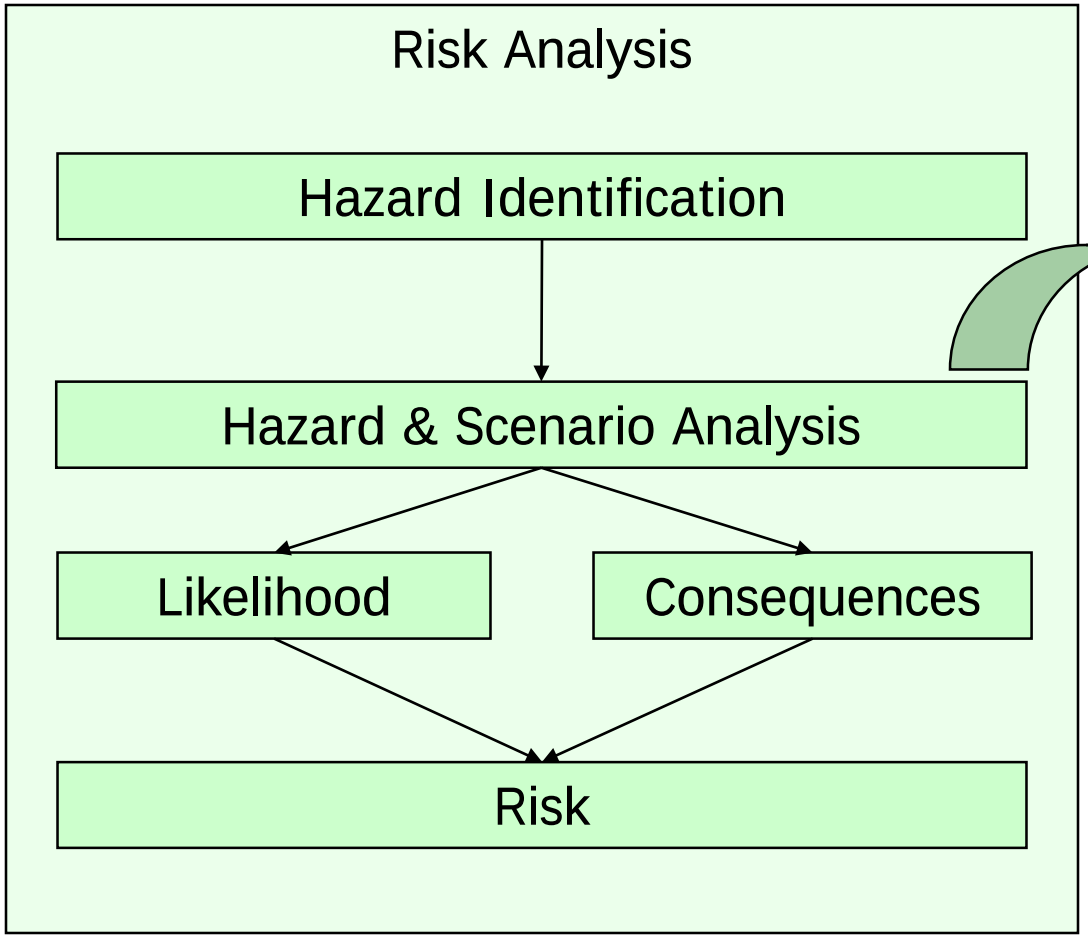
Risk Analysis – Main Steps



- Fault tree analysis
- Event tree analysis
- Bowties
- Barrier diagrams
- Reliability data
- Human reliability
- Consequence models

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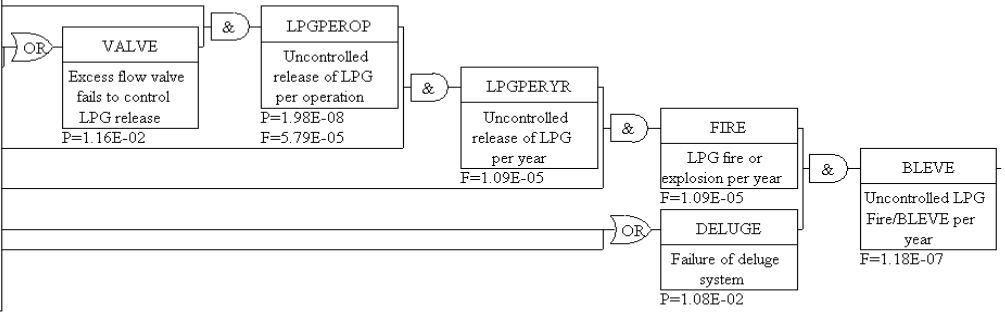
EVENT NAME	DATA REF	DESCRIPTION	FAILURE RATE	Trep/ Ttest	PROB	R/U
HOSEFAIL	CCPS	Failure of hose during unloading	4.99E-03	3.42E-04	1.71E-06	R
OPSFAIL1	Estimate	Operator fails to activate excess flow valve			1.00E-02	-
VLVFAIL	CCPS	Excess flow valve fails to shut when activated			1.61E-03	-
RAILCARS	Butan	Number of railcar unloading operations per year	5.50E+02			-
IGNITION	Estimate	Igntion Source			1.00E+00	-
OPSFAIL2	Estimate	Operator fails to activate deluge system			1.00E-02	-
H20-FAIL	CCPS	Deluge systems fails to operate when activated	8.46E-02	1.92E-02	8.12E-04	U

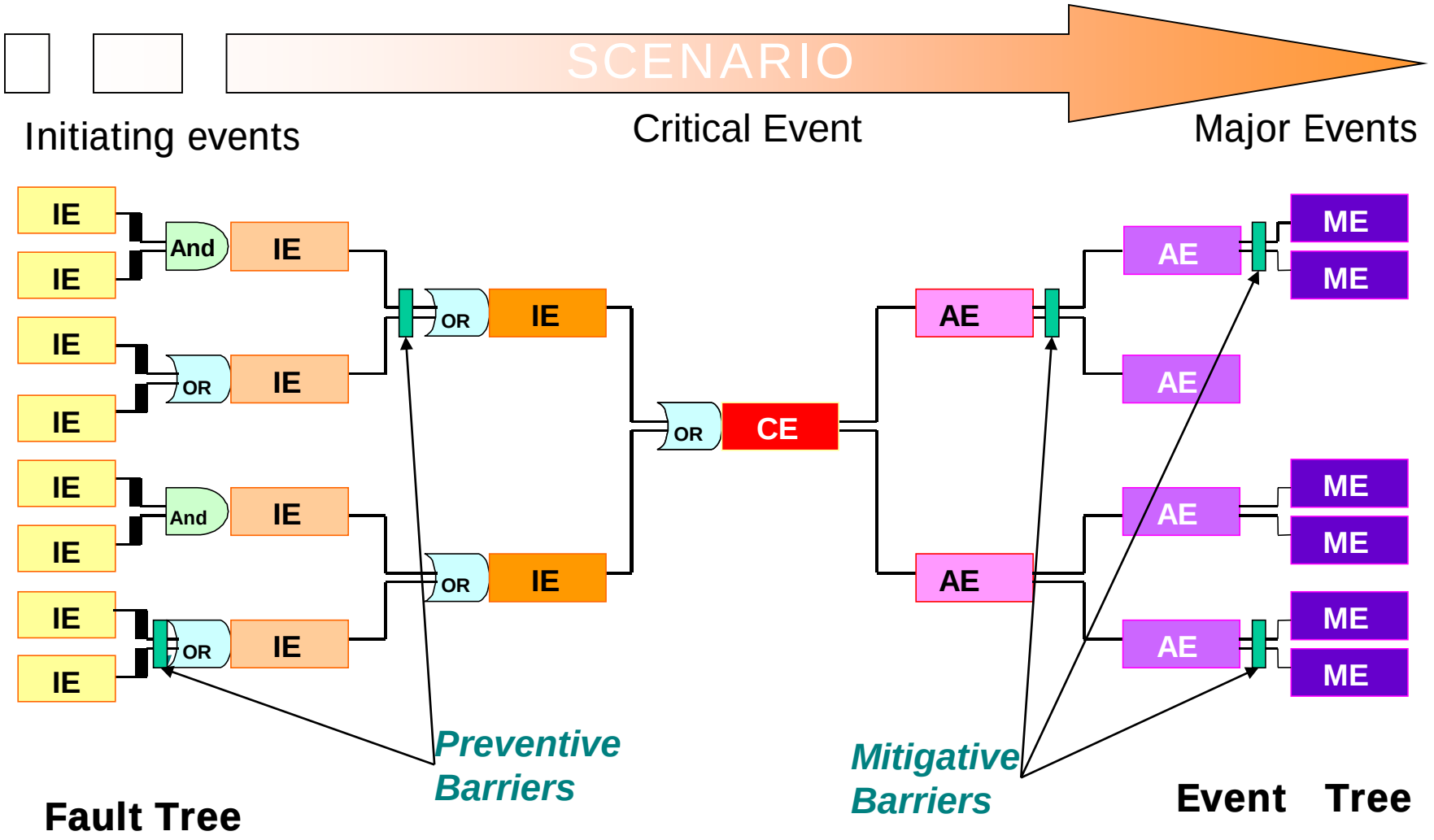


Logan Fault and Event Tree Analysis Version 5.30
Date (dd-mm-yy) :01-11-01 Time: 11.37.45
Fault Tree File :S:\Projects\360006-01\23 Health & Safety\016 Risk Assessment\Fault Trees\LPG Release 1
Cutset Order :6
Proof Tests :Simultaneous

FIGURE 1. FAULT TREE FOR UNCONTROLLED LPG FIRE/BLEVE PER YEAR

Based on historical data and Guidelines for Process Equipment Reliability Data, Centre for Chemical Process Safety (CCPS) of the AIChE, 1989.
Ref. RPS/BKH/PM report REAP 2002

Bow-tie



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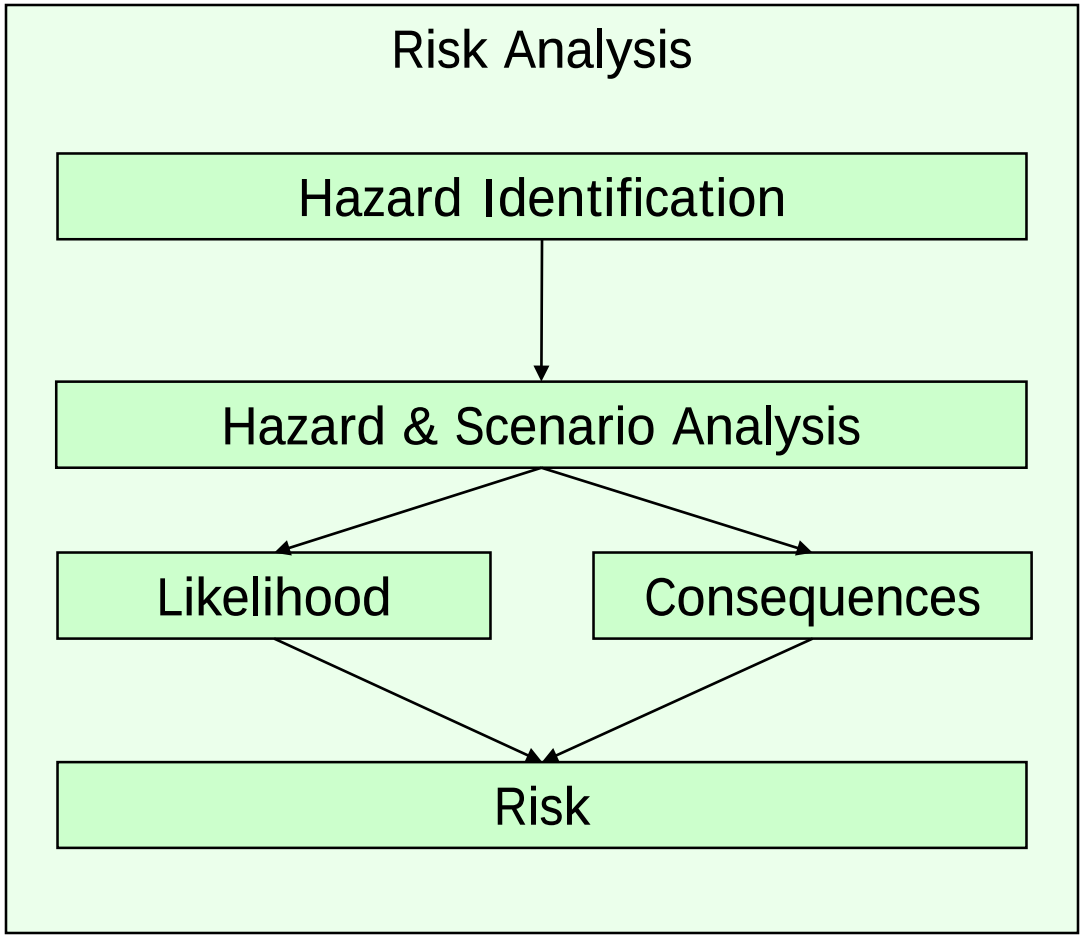
Risk Analysis – Main Steps



Identify Safety Barriers

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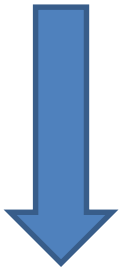
The main elements in any risk analysis process are as follows:

- hazard identification;
- accident scenario selection;
- scenarios' likelihood assessment;
- scenarios' consequence assessment;
- risk ranking;
- reliability and availability of safety systems



With regard to the hazard identification, a range of tools exists for systematic assessments, which are selected depending on the complexity of the individual case.

The identification of hazards is followed by designation of ***reference accident scenarios*** which form the basis for determining whether the safety measures in place or foreseen are appropriate.

A. Description of major-accident scenarios, initiating causes and the conditions under which they occur

A structured approach to scenario selection is a crucial step in the overall analysis. The safety report should, therefore, outline the principles and procedures followed (SMS) to determine the scenarios. In doing so, events which are documented in accident databases, near-miss recording, safety alerts and similar literature must be reviewed when drawing up the list of scenarios and appropriate lessons learnt incorporated.

A major-accident scenario for the purposes of the safety report usually describes the form of the loss of containment specified by its technical type e.g.:

- vessel rupture
- pipe rupture
- vessel leak, etc.

and the triggered event, namely:

- fire
- explosion
- release of hazardous substance(s)

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The following non-exhaustive list provides the most relevant event types that describe the consequences of the top event development (outcome):

- pool fire
- flash fire
- tank fire
- jet fire
- VCE (vapour cloud explosion)
- toxic cloud
- BLEVE (boiling liquid expanding vapour explosion)
- soil/air/water pollution

A point to note is that these events may occur in

- process units
- storage units
- pipe work
- loading/unloading facilities
- on-site transport of hazardous substances.

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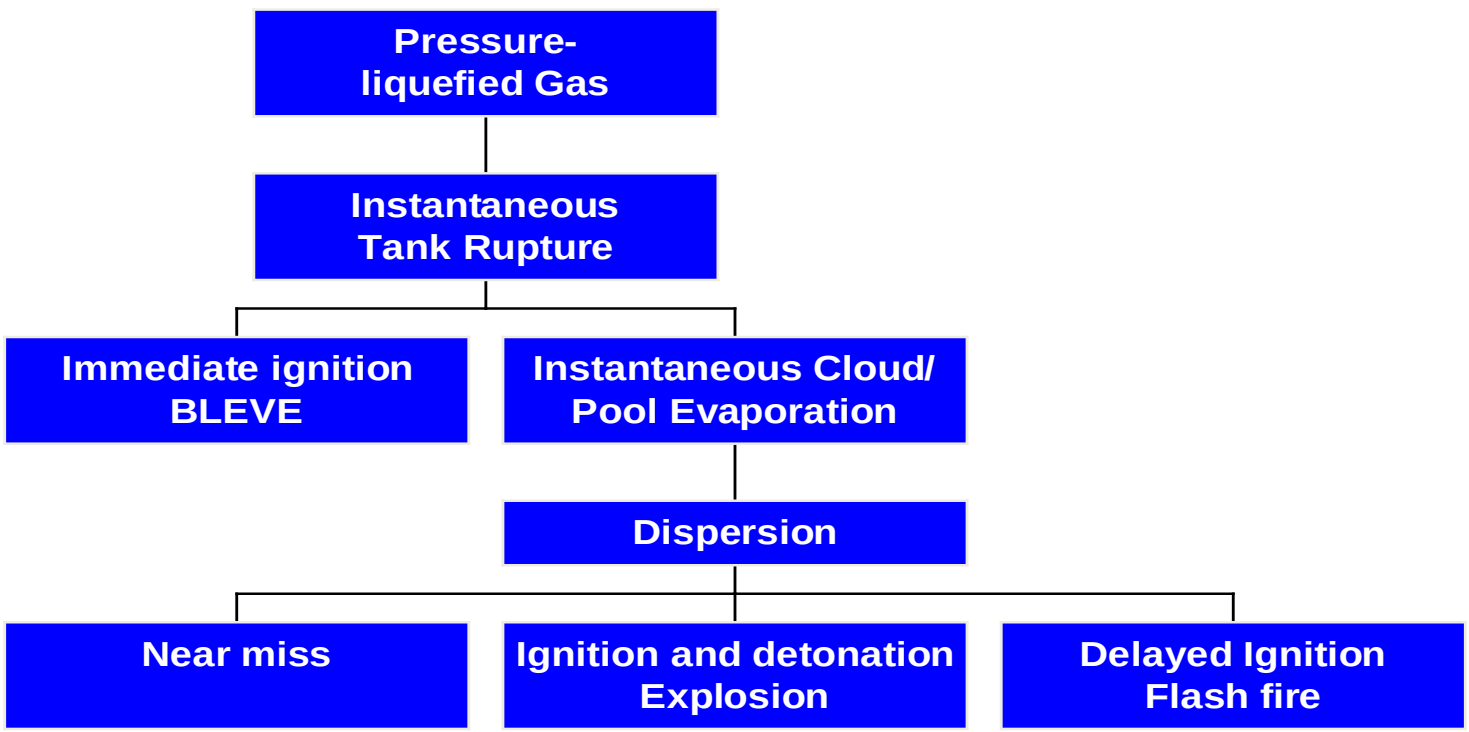
Consequence event tree for a flammable pressure-liquefied gas – instantaneous rupture



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Example BLEVE

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The safety report must demonstrate
that, of these possible scenario elements, the relevant scenarios were chosen.

The selection may follow strategies such as:

- event likelihood
- consequences
- how comprehensive or representative the scenario is.

It is necessary to consider the causes of the potential accident; the most relevant of these are:

Operational causes (malfunctions, technical failures, ignition, kock-on effects etc)

Internal causes may be related to fires, explosions or releases of dangerous substances at installations within the establishment affecting other installations leading to a disruption of normal operation (e.g. the fracture of a water pipe leading to a disruption in the cooling capacity on site).

External causes *(fire, explosions toxic release of neighboring plants –Domino Effects; Natural hazards-NATECH; transportation and transport off site etc.*

Plant security *(intentional acts)*

Other accident causes (related to design, construction and safety Management)

References

COUNCIL DIRECTIVE 96/82/EC
of 9 December 1996 on the control of major-accident hazards involving dangerous substances(OJ L 10, 14.1.1997, p. 13) – consolidated version

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CASE LPG STORAGE FACILITY - Slovenia

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