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Swiss Confederation

Federal Department of the Environment,  
Transport, Energy and Communications DETEC

**Federal Office for the Environment FOEN**  
Division Hazard Prevention Division

# **Risk Assessment for Industrial accident prevention:**

## **Overview of risk assessment methods and Selected case studies and available software tools**

**COP 12  
30 November Geneva**



# Overview

- Review Seminar on Risk Assessment Methodologies at COP 10 (2018)
- Objectives and elaboration of the two reports
- Highlights of the two reports
- Further actions



# Seminar on Risk Assessment 2018

## Summary report of the Seminar on Risk Assessment Methodologies

Held in the framework of the tenth meeting of the Conference of the Parties to the UNECE Industrial Accidents Convention

4 December 2018



United Nations Economic Commissions for Europe



- Summary report of the Seminar on Risk Assessment Methodologies with key conclusions and recommendations of the seminar.

[Summary Report of the Seminar](#)





# Seminar on Risk Assessment 2018

*Extract from the recommendations*

The seminar highlighted that there is a request to further share and exchange information on risk assessment methodologies, including through the following activities, which could be implemented in the short, medium or long term.



# Seminar on Risk Assessment 2018

*Extract from the recommendations (I)*

- Approach UNECE countries to collect information on:
  - The different risk assessment methodologies that each country uses.
  - Case examples of their experiences in the use and implementation of risk/effect assessment methodologies.
  - Case examples of transboundary risk/effect assessment.
  - List of software tools.



Covered with the two elaborated reports.



# Seminar on Risk Assessment 2018

*Extract from the recommendations (II)*

- Webpage on countries' methodologies and case examples.
- A comparison table of the different risk assessment methodologies and/or risk acceptability criteria used by UNECE countries.
- Guidance categorized by industry.
- Description (mapping) of methodologies / interactive mapping of case examples.
- Organize webinars, possibly to share experiences in the use and implementation of risk assessment methodologies.



# Seminar on Risk Assessment 2018

*Extract from the recommendations (III)*

- Classification of risks and methodologies.
- On-line training.
- Transboundary cooperation: Contribute to the establishment or development of safety culture across the UNECE region through the organization of transboundary exercises, workshops, trainings, etc.
- Assistance / capacity development: Provide support (e.g. assistance activities, capacity development, awareness-raising).
- Review of the location criteria.



# Objectives and elaboration of the report

*Request by COP 11 (2020)*

The Conference of the Parties took note of the progress made and **requested the small group on risk assessment to submit, for review at its twelfth meeting, two reports on risk assessment methodologies for chemical installations in the ECE region**: one providing an introduction to risk assessment methodologies for industrial accident prevention and available software tools, and another one presenting specific case studies on risk assessment methodologies applied at selected industrial facilities in the ECE region.





# Objectives and elaboration of the report

*Small group on risk assessment*

- Martin Merkofer, Switzerland (Lead)
- Raphaël Gonzalez, Switzerland
- Michael Struckl, Austria
- Jasmina Karba, Slovenia
- Evgeny Baranovsky, Belarus
- Suzanna Milutinovic, Serbia
- Laura Vizbule, Latvia
- Sanja Stamenkovic, Serbia
- Claudia Kamke, Secretariat



Thank you very much for the great support!



# Objectives and elaboration of the report

## *Objectives*

- In the context of analysing hazardous activities, provide an overview of risk assessment methodologies in a structured and synthesized manner, including the currently available software tools applied by countries in the UNECE region.
- Share experiences on the use of risk assessment methodologies by countries in the UNECE region.
- Enhance countries' understanding of how different risk assessment methodologies can be applied in different contexts on the basis of case examples, including in a transboundary context.



# Highlights of the two report parts

Part 1,

- Overview of Risk Assessment methods.

Part 2,

- Selected case studies and available software tools.



The report was prepared by Jensen Hughes as contractor, under the guidance of the small group on risk assessment.



# Overview of Risk Assessment methods

## *Content Part 1 (I)*

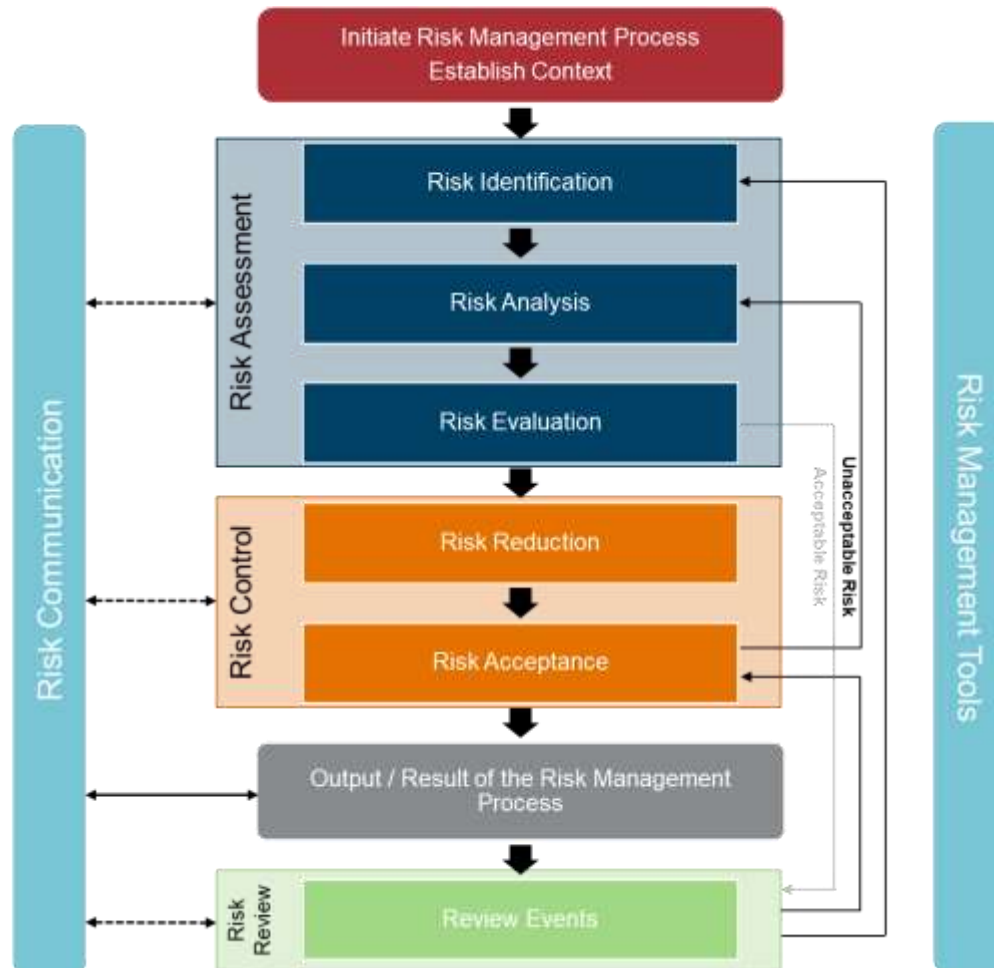
- Glossary of applicable terminology (for example)
  - Risk: The likelihood of a specific effect occurring within a specified period or in specified circumstances.
  - Individual Risk: The risk to a person near a hazard, including the nature of the injury to the individual, the likelihood of the injury occurring, and the time period over which the injury might occur.
  - Societal Risk: A measure of risk to a group of people, often expressed in terms of the frequency distribution of multiple-casualty events.
  - Risk Assessment: Overall process of risk identification, risk analysis, and risk evaluation.



# Overview of Risk Assessment methods

## Content Part 1 (II)

- Overview of risk management process





# Overview of Risk Assessment methods

## Content Part 1 (III)

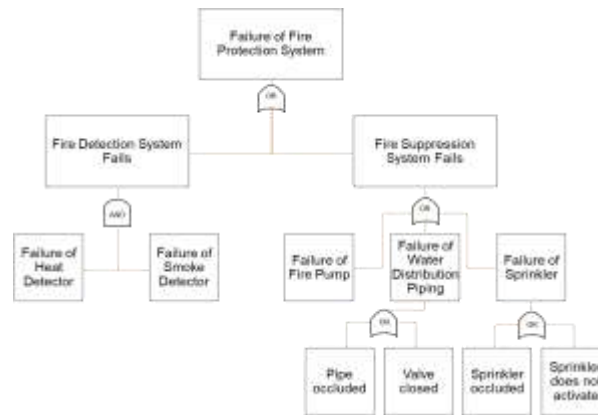
- General introduction to risk assessment methodology

## Risk identification

	Acids (Inorganic)	Acids (Organic)	Acids (Oxidizing)	Alkali (Bases)	Oxidizers	Toxic (Inorganic)	Toxic (Organic)	Water Reactive	Organic Solvent
Acids (Inorganic)		X		X		X	X	X	X
Acids (Organic)	X		X	X	X	X	X	X	
Acids (Oxidizing)		X		X		X	X	X	X
Alkali (Bases)	X	X	X				X	X	X
Oxidizers		X					X	X	X
Toxic (Inorganic)	X	X	X				X	X	X
Toxic (Organic)	X	X	X	X	X	X			
Water Reactive	X	X	X	X	X	X			
Organic Solvent	X		X	X	X	X			

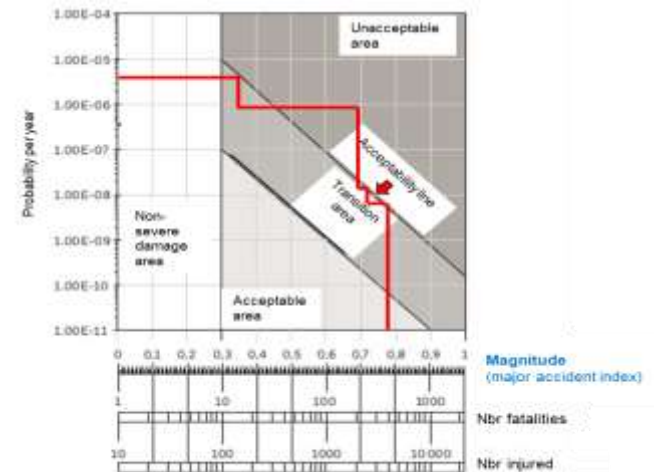
e.g. Chemical interaction matrix

## Risk analysis



e.g. Fault tree method

## Risk evaluation



e.g. Societal risk evaluation criteria



# Overview of Risk Assessment methods

## *Content Part 1 (IV)*

- Benefits of risk assessment (for example)
  - Transboundary considerations
  - Land-use planning
  - Harmonized methods for risk ranking and control
- Challenges of risk assessment and applying risk assessment methodology (for example)
  - Education, experience and expertise
  - Frequency databases
- Conclusions



# Selected case studies and software tools

## *Content Part 2 (I)*

- This report presents selected case studies where a risk assessment methodology was applied to chemical facilities in the United Nations Economic Commission for Europe (ECE) region. These case studies span **five types of facilities**: liquified natural gas (**LNG**) / liquified petroleum gas (**LPG**) **storage tanks**; **ammonia refrigeration facilities**; **oil terminals** (hydrocarbon loading/unloading/storage facilities); **ammonium nitrate storage facilities** and **chlorine facilities**.
- The annex to the report lists key software tools available to support chemical installation risk assessment.





# Selected case studies and software tools

## *Content Part 2 (II)*

- **Several ECE countries were asked to submit case studies** on the five above-mentioned types of installations, providing information **based on a template**. Among the case studies submitted were five transboundary case studies, submitted by three countries; **eighteen out of thirty submitted case studies were selected based on geographic location, facility type and transboundary considerations**. Some countries, including those of Eastern Europe, the Caucasus and Central Asia, did not submit case studies due to the sensitive nature of the information requested.



# Selected case studies from countries

- Estonia
- Finland
- France
- Germany
- Hungary
- Latvia
- Netherlands
- Norway
- Serbia
- Slovenia
- Sweden
- Switzerland



# Selected case studies and software tools

## *Content Part 2 (III)*

- Key information requested with a template:
  - Major incident scenarios
  - Release effects and consequence considerations
  - Likelihood of occurrence
  - Risk presentation
  - Risk acceptability criteria
  - Risk reduction measures implemented



# Selected case studies and software tools

## *Content Part 2 (IV)*

- Annex with available software tools
  - Software tools for hazard analysis
  - Software tools for event tree analysis/fault tree analysis
  - Software tools for quantitative risk analysis
  - Software tools for consequence analysis



# Selected case studies and software tools

## Content Part 2 (V)

- Annex with available software tools (for example)

Name	exploCFD	FLACS-CFD	FLACS-EFFECTS	Fluidyn	FRED
Developer	Advanced Analysis Australia	<a href="#">GexCon</a>	TNO (Owner: <a href="#">GexCon</a> )	<a href="#">Fluidyn</a>	Shell (Owner: <a href="#">GexCon</a> )
Description	Specific to explosion effects. Detailed models available for BLEVE, high explosives and dust clouds.	3D CFD modelling for flammable and toxic releases. Incorporates contributing and mitigating effects, including confinement and congestions due to real geometry, ventilation, and deluge.	<a href="#">Models</a> behaviour of toxic or flammable gases, liquefied gases, and liquids from the moment of release to the resulting physical effects.	CFD modelling platform with multiple modules for specific scenarios.	Consequence modelling tool underpinned by an advanced thermodynamic model which enables extended multi-component fuel representation to be used in nearly all models.
Use	Explosion modelling	CA for detailed 3D scenarios	CA of flammable and toxic releases	CFD models of flammable and toxic releases	CA of flammable releases
Source Terms	Yes	Yes (DIPPR)	Yes (DIPPR)	Manual	Yes (Thermodynamic model consisting of multi-component fuel)
Physical Effects	Explosion	All	All	All	All
Vulnerability	Fire, explosion effects	Explosion overpressure, fire radiation 3D effects	Doses due to dispersion, consequences to human life/lethality	Intensity of fire exposure, toxic gas exposure, explosion pressure contours	Fire, toxic release, and explosion effects
Benefits	Ease of use, no geometry construction required, allows modelling of TNT, AN along with dust and gas explosions.	Geometrical features are considered for fire, explosion, and toxic releases	Considers structural damage	PANFIRE module considers effects of active and passive protection systems. VENTIL module considers confined space effects. FLOWSOL module evaluates liquid-borne environmental effects including groundwater pollution.	Developed and validated through an extensive program of large-scale experiments, substantial investment, joint industry projects and published scientific literature.
Limitations	Limited to fire and explosion applications, no toxic dispersion modelling.	Computationally expensive	Requires significant experience to validate models and results.	No known limitations.	No modelling of toxic releases. Focus on offshore industry.
Availability	Licensed	Licensed	Licensed	Licensed	Licensed



# Further actions

- The Conference of the Parties will be invited to take note of the reports and their planned publication in the next biennium, as envisaged in the workplan for 2023–2024.
- Publication of the Risk assessment reports (overview of risk assessment methods with selected case studies and available software tools) in 3 languages and promotion with focal points and counterparts.
- Lead Party for this activity: Switzerland.



**Thank you very much for your support!**