UNIVERSITY OF ŽILINA
Faculty of Security Engineering

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Knowledge FOr Resilient soCiEty

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RISK ASSESSMENT AND TREATMENT IN ACCIDENTS PREVENTION

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https://www.youtube.com/watch?v=FTn9no1i8Vs

Technological development

- Every manufacturing enterprise, service company, or transporter wants to be successful.
- Technological progress brings mankind face to face with sophisticated and dangerous technologies which can be a source of dangerous situations or industrial accidents.
- The manufacturing enterprises working with risk technologies have to deal with systematic and complex risk management.

Seveso Directive

- In Europe, the catastrophic accident in the Italian town of **Seveso in1976** prompted the adoption of legislation on the prevention and control of such accidents.
- The so-called **Seveso-Directive** (Directive 82/501/EEC) was later amended in view of the lessons learned from later accidents such as Bhopal, Toulouse or Enschede resulting into **Seveso-II** (Directive 96/82/EC).
- In 2012 **Seveso-III** (Directive 2012/18/EU) was adopted taking into account, amongst others, the changes in the Union legislation on the classification of chemicals and increased rights for citizens to access information and justice.

Industrial Accidents prevention in European Union

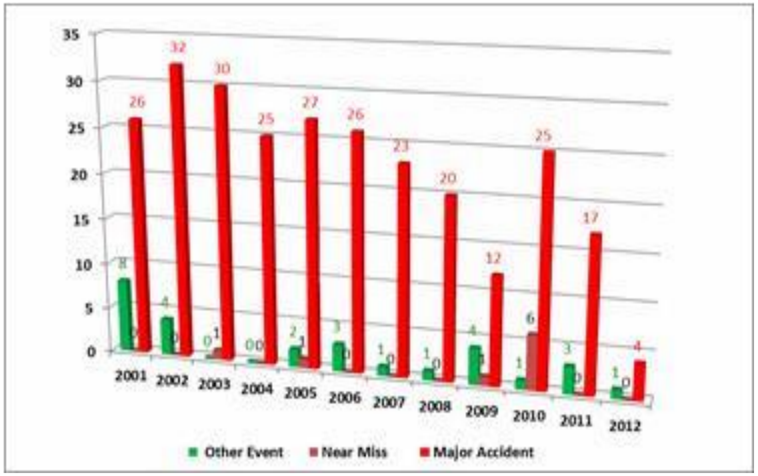
The European Union has been solving the society-wide area of preventing the major industrial accident which can threaten the environment and life, health and the property of the EU citizens through its centres :

- *Join Research Centre* (https://ec.europa.eu/jrc/en)
- *Major Accident Hazards Bureau* (http://actionguide.info/m/orgs/385/).

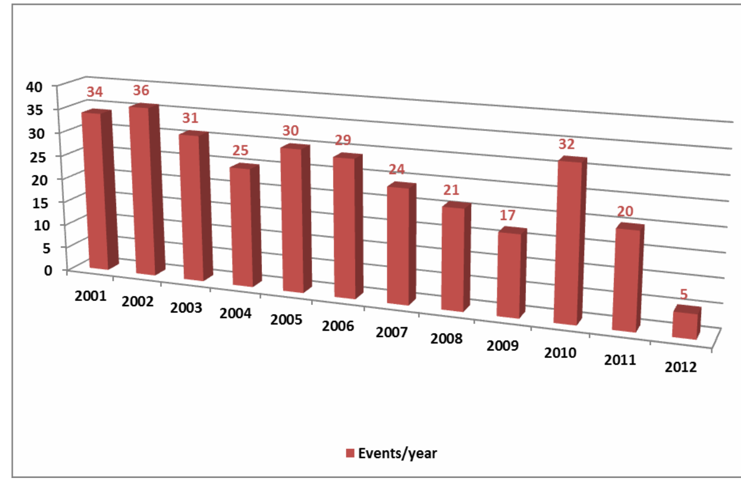
Databases:

- *eMARS* - The purpose of the eMARS is to facilitate exchange of lessons learned from accidents and near misses involving dangerous substances in order to improve chemical accident prevention and mitigation of potential consequences. (https://minerva.jrc.ec.europa.eu/en/emars/accident/search)
- *SPIRS* - (Seveso Plants Information Retrieval System) (https://publications.europa.eu/en/publication-detail/-/publication/919764ca-a426-11e7-9ca9-01aa75ed71a1/language-en/format-PDF)

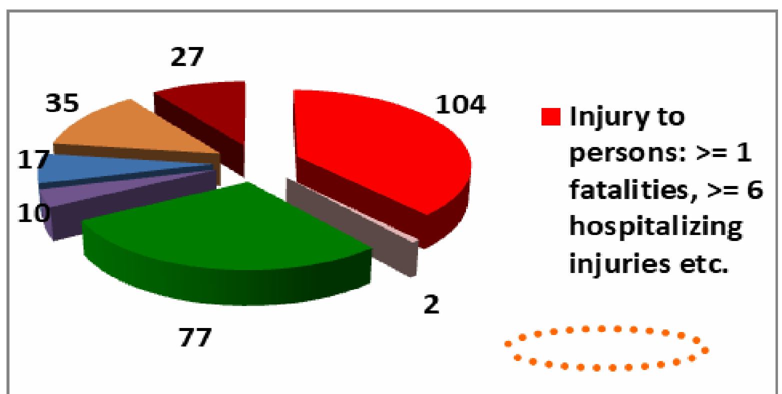
Events in eMARS



Events types in eMARS 2001-2012



No. of events 2001-2012



Reasons for reporting

Lessons learned from eMARS

In spite of the maximal effort exerted for prevention, the major industrial ***accidents still occur***. It is always necessary to take lessons from this accident. As to the system MARS new lessons learned from recent industrial accidents in this database have been as follows:

- explosion in an ammunition dismantling facility (Production and storage of explosives),
- release of toxic substance - mining activities (tailings & physicochemical processes),
- fire at a dry-goods warehouse (Wholesale and retail storage and distribution),
- mobile vacuum tank explosion Petrochemical / Oil Refineries,
- accident in an oil refinery Petrochemical / Oil Refineries.

Industrial Accident in Bhopal

Bhopal Accident

- 2.12.1984
- Union Carbide pesticide plant in Bhopal, India
- highly toxic gas called methyl isocyanate

https://www.youtube.com/watch?v=HZirRB32qzU

https://www.youtube.com/watch?v=IwPSDMU_tNmk

Case study - Industrial Accident in Bhopal

According to video please write down these issues related to Bhopal disaster:

- Causes.
- Consequences on people.
- Consequences on property.
- Consequences on environment.

https://www.youtube.com/watch?v=HZirRB32qzU

https://www.youtube.com/watch?v=IwPSDMUtNmk

Industrial Accident

- accident happened on 15th of March in 2012 in Mining Company in Finland,
- worker died after breathing in hydrogen sulphide while working in the yard,
- worker had not used a gas meter or a gas mask and high concentrations of hydrogen sulphide were detected in the area before and after the accident

RISK ASSESSMENT OF INDUSTRIAL PROCESSES

RISK ASSESSMENT

PREPARATORY PHASE

- stating the goal, extent and object of carrying out the analysis,
- creating a working group for expert estimation of the risk,
- describing the system analysed, object, equipment and defining its specifics,
- selecting qualitative, semi-quantitative or quantitative methods or procedures for stating the risk or creating a combination of several methods,
- stating criteria of the risk seriousness level (and their acceptability).

REALISATION PHASE

- identifying the risk factors/sources of risk/danger,
- selecting risk sources for further analysis,
- stating reasons and creating scenarios/variants of the run of selected risk sources/risk factors of dangers,
- selecting representation scenarios,
- stating probability,
- stating effects,
- expressing the risk.

Realising the risk assessment requires the presence of at least two persons, i.e. the decision-maker and the analyst. The following questions are to be answered in the phase of planning the analysis:

- What do you want to know (to what questions do you want to get an answer) and why?
- What assumptions (estimations) are acceptable?
- What is the time framework for realising the risk assessment?
- Who will join the process?

Analyst

It is difficult to characterise the person of the analyst who should assess and analyse. Several character properties and professional qualities are introduced in the text which continues. His/her person should fulfil these attributes:

- creative thinking,
- reliability,
- deliberation,
- the ability to communicate,
- partial mathematical thinking,
- a team spirit,
- impartiality.

Results of Risk Assessment

The results could be summarised into a few key areas when we can assume that the analysis will not fulfil the expectations of the decision-maker and analyst:

- if it cannot give answers to all the key questions,
- if too many assumptions (estimations) are in the analysis,
- if not enough data or experts are not available for realising the analysis.

Methods for Risk Assessment

Currently there are several systematic approaches which the experts implement into practice, e.g.:

- Probability approach PRA, PSA,
- Quantitative approach QRA, CPQRA,
- Complex approach MOSAR,
- Complex approach ARAMIS,
- QRA and risk analysis software - Phast and Safeti.

In the framework of the aforementioned approaches the individual steps make use of the principles of the following selected methods:

- FTA,
- ETA,
- Bow-tie diagram,
- HAZOP, HAZAN,
- What if analysis, Ishikaw diagram,
- FMEA,Check-list analysis,
- PHA.

Identifying the risk factors/ the risk source/the danger

This phase consists of identifying the following risk factors:

- the list of selected hazardous substances (SHS) (comparison with reference values),
- identifying dangerous devices.

Stating the causes and creating the scenarios

The identified SHS and devices are subsequently attached to critical events:

- Decomposition,
- Explosion,
- Materials set in motion – entrainment by air,
- Materials set in motion – entrainment by liquid,
- Start of fire,
- Crack of casing in vapour phase,
- Crack of casing in liquid phase,
- Leak from liquid pipe,
- Leak from gas pipe,
- Catastrophic crack,
- Vessel collapse,
- Roof collapse.

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Scenario creation

Bow-tie diagram

Stating the probability

Based on the created bow-ties for the stated critical event it is necessary to determine the probability/frequency of the causalities which are on the FTA side. The partial frequencies/probabilities of causes are written directly into the created software and relations according to the Boolean algebra re-calculate the frequencies which enter other knots. Also the probability/frequency and barriers in every branch are mutually in an interaction.

Stating the consequences and impacts

- In the end, the impacts of an accident are determined (based on the created bow-ties). Before we define them, it is necessary to simulate the development of the crisis phenomenon by appropriate software for us to find out the extent of the hit area. Based on this simulation we subsequently determine the impacts on life, property and environment through the C1 – C4 indicators.
- The impact classification is based on the assessment of the effects on human targets and effects on the environment.

Expressing the risk (stating the risk and determining the risk perception acceptability)

In the end it is necessary to identify if the stated risk value is acceptable or not. In the Slovak Republic we stated these values as the individual and social risks.

- Individual risk - is the annual risk of death or serious injury to which specific individuals are exposed.
- Social risk - which is expressed as the relationship between the probability of a catastrophic incident, expressed as the average frequency with which it can be expected to occur, and its consequences.

Uncertainty

Uncertainty should be divided into three groups:

- the parametric uncertainty,
- the model uncertainty,
- the overall uncertainty.

Practical activity

Please use the method Ishikawa diagram to identify causes for industrial accident related to:

- Human factor.
- Technical issues.
- Environment.

Conclusion

The risk assessment of the technological processes in the industrial environment, i.e. the subject of this educational paper is an area which is highly actual nowadays both from the point of view of the scientific knowledge and the social practice. The technological processes having at disposal hazardous substances are potential threats for the employees, the public, environment and property. Therefore it is inevitable to pay increased attention to their prevention.

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Thank you
for your attention

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