

Major Industrial Accidents prevention in European union and in Slovak Republic context

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Abstract: - 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 and Major Accident Hazards Bureau as well as selected institutions of the EU member states and belongs to one of the public security research. For carrying out these regulations and rules which adapt the area of the major industrial accident prevention in the individual EU states, the SEVESO directive was issued in 1982 and it has been amended for several times since then (1996 and 2003). Due to the changes during the first five years the responsible bodies in this area decided about amending this directive also in 2012 and a new directive SEVESO III was adopted. In the same way the Slovak Republic fulfils the requirements stated by this directive and transposes the necessary changes to the legal environment and industrial practice. University of Žilina in Žilina has been solving this problem in project called MOPORI – Complex model of Risk Assessment in Industrial processes which is mentioned also in this article.

Key-Words: MOPORI, risk assessment, industrial accidents prevention, Seveso establishment, Seveso II, Seveso III

1 Introduction

Prevention represents one of the basic pillars of preventing the crisis phenomena in the current society. In the case of the industrial accidents this term achieves still greater and more important dimension due to the possible threats for inhabitants, employees, property or the environment especially from the point of view of the most dangerous industrial enterprises. The area of preventing the major industrial accidents is linked with the European directive Seveso II which endeavours to exercise control over companies disposing of selected hazardous substances and managing their activity with the main goal to limit the possibility of developing any accidents. Every member country transposes the directive into its legal regulations, in the Slovak Republic it is the law No 261/2002 Coll. about preventing major industrial accidents. The method and results of transposition of individual regulations should reflect in the area of prevention and preparedness and reducing the number of industrial accidents.

2 Problem Formulation

The industrial accidents belong among anthropogenic crisis phenomena which became a dangerous phenomenon that threatens the life and health of employees and the general public, which causes material damages and leaves consequences on the environment. On one hand there is the inevitable technical progress which brings a lot of positives, however, on the other hand there is the possible failure of the human factor or the technology used.

2.1 Industrial Accidents prevention in European Union

As it has been mentioned before, this problem is being solved by the EU by creating the databases (MARS and SPIRS) and from this fact resulting lessons learned and corresponding legal environment in the framework of the SEVESO directives.

All major industrial accidents are thus recorded in the database eMARS. This Major Accident Reporting System (MARS) was established to handle the information on 'major accidents' submitted by Member States of the European Union to the European Commission in accordance with the provisions of the 'Seveso Directive'. Currently, MARS holds data on more than 450 major accident events.

The figure 1 shows a ten-year overview according to the classification type of events that has happened in European union and are recorded in eMARS database.

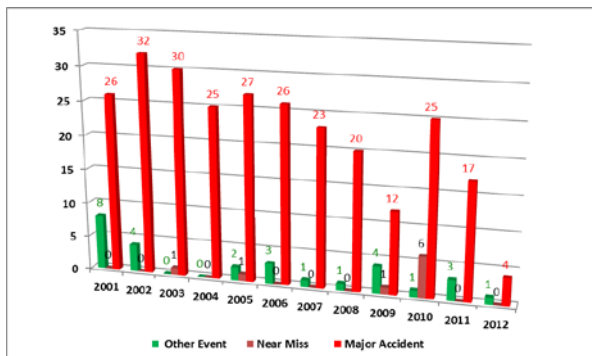


Fig.1 Events types in eMARS 2001-2012 [11]

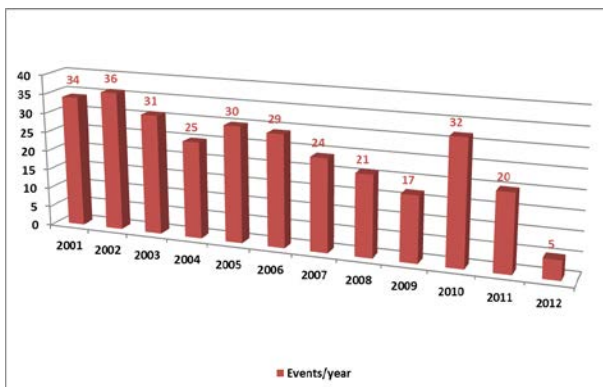


Fig. 2 No. of events 2001- 2012 [11]

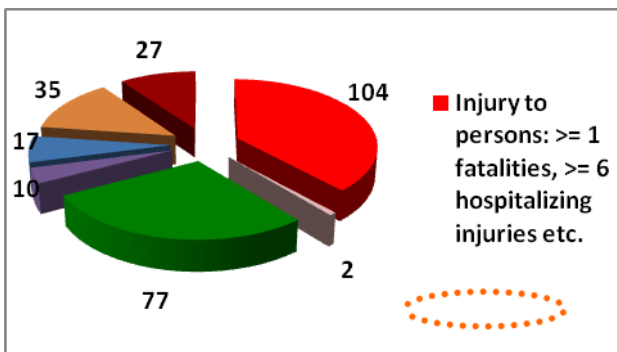


Fig.3 Reasons for reporting [11]

Based on the figures 1, 2 and 3 it is impossible to estimate the development of the rise of major industrial accidents in the next time period. The main reason is especially the fact that the rise of this kind of crisis phenomenon is not easy to foresee especially because the basic cause of the rise of major industrial accidents is the element that is very difficult to anticipate – human factor.

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.

We can mention one example of Fatal Accident 15.3.2012 in Mining Company in Finland: a worker died after breathing in hydrogen sulphide while working in the yard.



Fig. 4 Finland Mining company

This company has ore mining activities and started in October 2008 and is mining nickel, zinc, cobalt and copper. Enrichment method used in this Upper tier establishment is bioheap leaching (first time in use in Finland on this scale). The resulting solution

treated by hydrogen sulphide at the metals recovery plant.

The accident happened in this SEVESO establishment and one worker died when collecting samples. The big problem was that worker had not used a gas meter or a gas mask and high concentrations of hydrogen sulphide (50 – 300 ppm) were detected in the area before and after the accident. There was also established an accident investigation group and realized that the company has had environmental problems okrem iného. During the investigation process there were a huge interest from the media and Tukes had to prohibit the re-starting of the process.

The main causes of the accident including deficiencies in process safety management were:

- Technical reason: A valve in sample collection had been left open,
- Overuse of hydrogen sulphide because they wanted a pure end product,
- Maintenance was not preventative monitoring the use of hydrogen sulphide was difficult because current measurements and automatic valves did not function
- All possible leaking points for hydrogen sulphide were not identified
- Reaction to earlier hazards and high concentrations was not adequate
- Gas sensors were inside even though higher concentrations had been noted outside

European tools

The basic starting point for protecting the interest values of the EU is to ensure the effective prevention in the framework of which the EU creates and utilises:

- The institutional tools,
- The legislative tools.

In the framework of the institutional tools the European Commission created in – house science service called **Joint Research Centre (JRC)** and the part of this centre is **The Major Accident Hazards Bureau (MAHB)**¹ what is a special Unit within the Joint Research Centre's Institute for the Protection and Security of the Citizen, Hazard Assessment Unit, dedicated to scientific and technical support for the actions of the European

Commission in the area of the control of Major Industrial Hazards.

There are several problematic areas in this field. In 2008, The European Virtual Institute for Integrated Risk Management made a questionnaire study, the purpose of which was to obtain information about the transposition requirements of the directive SEVESO II in all the member states. At the same time, it obtained information about and its general advance, practical experience with the use of weaknesses and problems associated with its practical implementation, efficiency of its implementations and its impact on the competitiveness of European industry. Consequently, the member states were asked to react by improving the form of this directive.

The Results of the survey are as follows:

- In some areas, the respondents themselves see the opportunity to elaborate further supporting documents, whereby the point with the highest priority is the area of risk assessment and treatment.
- The area of concern is non-universality of the risk assessment approach, lack of the criteria to quantify the risks and the methods, tools and data used for implementation of the procedures.
- Many companies elaborate qualitative rather than quantitative analysis, which can conceal a higher level of uncertainty of the results.
- An approach to the risk assessment should be synchronized in accordance with the Directive SEVESO II on one hand and the legal norms in the field at particular country on the other.

2.2 Industrial Accidents prevention in Slovak Republic

¹ <http://ec.europa.eu/dgs/jrc/index.cfm?id=1450>

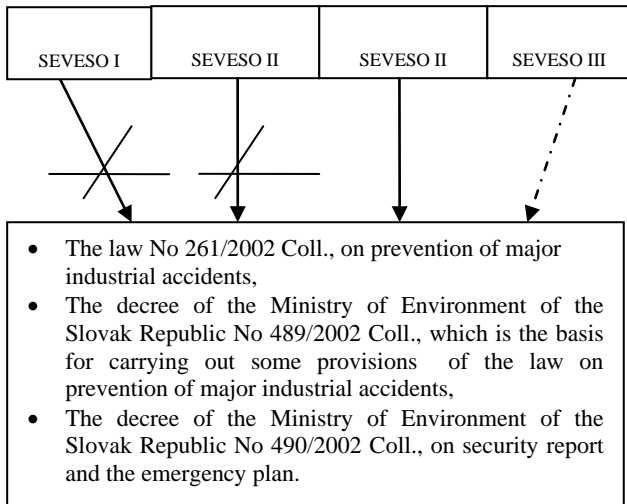


Fig. 5 Implementation of Seveso Directive to legal standards of the Slovak Republic

In Slovakia there are currently 82 SEVESO companies (see the figure 6).

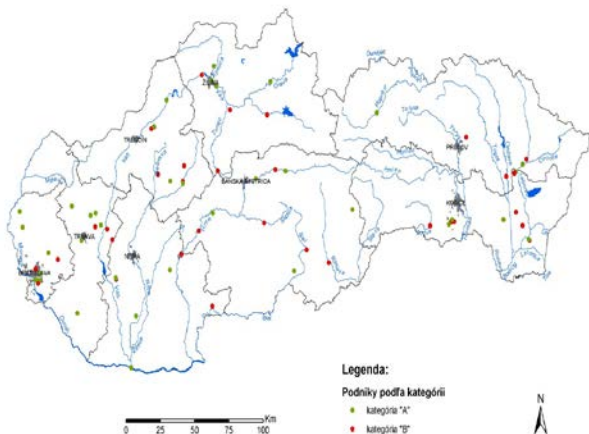


Fig. 6 Layout of SEVESO companies in the Slovak Republic

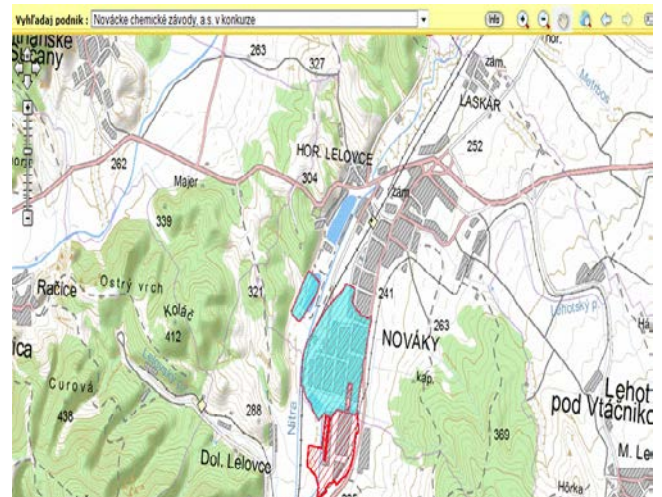


Fig. 7 Localisation of a Seveso company - illustration

Tables 1 and 2 show an overview of serious industrial accidents and near-accidents in Slovakia in the time period of 2003 – 2011.

Table 1 Serious industrial accidents in the territory of Slovakia during 2003 – 2011 (Loveček, 2012)

Company name	Date of event	Type of event	Cause
DUSLO, a.s.	24.7.2010	Administration building (production of ammonia) 1236, Šaľa, Technical failure, explosion, fire	Leakage on the flange of high-pressure distribution pipe for synthesis gas
Novácke chemické závody, a.s.	28.9.2005	Nováky, company premises, ethylhydriene operation. Failure of human factor	Welding and ignition of explosive mixture caused by a point weld. .
U. S. Steel Košice, s. r. o.	28.9.2005	Division plant Energetika, operation Energetické médiá. Technical failure,	Damaging and subsequent breaking the end of the shaft inside of the circular wheel of the

		explosion, fire.	centrifugal pump of the type A-CB 185/4-7,2 No. 1.
U. S. Steel Košice, s. r. o.	16.11.2006	Company premises – technical failure.	Failure of power supply and subsequent failure of technological and safety devices of the company.

			valves of the flexible hose
Slovanft a.s.	9.7.2004		Leakage of the mechanical packing seal caused by impurity
Duslo Šaľa	21.9.2005		Leakage of the flange connection on railway tank, filling valve unlocked
Duslo Šaľa	29.5.2006		Pump failure, leakage – production of inhibitor
Duslo Šaľa, a.s	6.3.2007		Mechanical damage of the pattern and sludge valve, broken weld
Duslo Šaľa, a.s	24.6.2007		Leakage of the saddle of manual valve
Duslo Šaľa, a.s	31.8.2007		Leakage of the flange on the discharge of cooler
Duslo Šaľa, a.s	6.9.2007		Failure of the ball valve control mechanism
US Steel Košice, s.r.o	2.10.2007		Damage of equipment and subsequent leakage of blast-furnace gas
Duslo a.s. odšt.z. Istrochem	30.11.2007		Fire
Duslo a.s, Šaľa	16.7.2008		Unexpected reaction resulting in explosion
Duslo a.s, Šaľa	14.8.		Leakage of the degassing pipeline after filling a 500 kg barrel
Duslo a.s, Šaľa	12.9.2008		Leakage on the flange seal
Slovanft a.s. Vlčie hrdlo	13.8.2008		One-shot short circuit of the cable ending of the input cable to transformer

Table 2 Near-accident in the Slovak Republic - 2003 – 2011

Company name	Date of event	Cause
Slovanft a.s. Vlčie hrdlo	26.3.2003	Erosion caused by the stream of steam condensate
Slovanft a.s. Bratislava	6.8.2003	Self-ignition of flammable waste
Slovanft a.s. Bratislava	13.8.2003	Self-ignition of flammable sludge material of crude oil origin
Slovanft a.s. Bratislava	25.9.2003	Air decomposition
Slovanft a.s.	8.10.2003	Implosion of tank
Slovanft a.s. Bratislava	22.11.2003	Fire due to breaking the sealing of the exchanger and subsequent leakage of pyropetrol
Slovanft a.s. Bratislava	16.3.2004	Realising cutting and welding operations without effective safety measures
Messer Slovanft Bratislava a.s.	3.4.2004	Damaging the hose filling tank, material fatigue
Irganox, ACHIO	2.6.2004	Loosened

Duslo a.s, Šaľa	7.3.2008	Loosening of filter which was not depressurised
Duslo a.s, Šaľa	11.6.2008	Holes on heating spiral of gasifier
Slovenské elektrárne, Vojany	14.4.2009	
Duslo, a.s Šaľa	4.3.2009	Leakage of pipe flange connection
Slovnaft a.s., Vlčie hrdlo	17.1.2010	Fire
Slovnaft a.s., Vlčie hrdlo	9.12.2010	Explosion resulting in fire. Insufficient flushing of the device due to blind spots in the middle part of partition of the space, rests of substance

One of the most serious industrial accidents in Slovakia was the industrial accident in Košice when the European Seveso II Directive was not valid here. It happened in 1995 and arose due to the leakage of the blast-furnace gas, 11 people died and 9 of them were classified as accidental death injury and 2 as deaths of people who came wrongfully to the company premises. The industrial accident developed due to several failures or omitting the human factor and the biggest error was failing to fulfil the safety directives from the side of the executive employees but especially failing to manage the situation from the side of the management. Other shortages assessed after the rise of the industrial accident are as follows:

- the safety documentation which was worked out improperly (incomplete and outdated emergency plan),
- the decisions realised incorrectly and at incorrect time,
- failing to monitor the weather situation after the leakage of the blast-furnace gas (untypical windless conditions and inversion),
- the bad information and communication system,
- the lack of discipline of employees during evacuation,

- the lack of emergency and measuring technique in the company.

Currently in the general public there still resounds the industrial accident which happened in VOP Nováky on 2nd March 2007. An explosion in the ammunition storage with a huge pressure wave acting in the distance of several tens of kilometres – 8 persons died and several tens of people were injured. The crater which arose and its surroundings were a dangerous zone even after the explosion; the firemen had to cool here the heated ammunition for long hours to prevent another disaster. The shortages assessed after the industrial accident:

- in the company there was more ammunition than there should have been,
- the emergency plan was not worked out according to the regulations of the law about prevention of serious industrial accidents,
- the company did not rank the explosives among the sources of risk,
- informing and gathering the persons was part of another documentation than it should have been,
- the crisis staff was non-functional at the time of the rise of the industrial accident,
- the ammunition of various types was scattered at unsuitable places in the premises,
- the company management at the time of the accident rise was not able to document how many people were in the plant.

In spite of these facts the Slovak Republic is prepared and exerts maximum effort in the area of industrial accident prevention.

One of the main problems of this area is risk assessment and risk treatment what is part of risk management process.

3 Project MOPORI

One of the possible solutions is to solve these problems through a research project. Here the University of Žilina in Žilina – Faculty of Special Engineering works in the “A Complex Model of Risk Assessment in the Industrial Processes” which is in the process of prevention one of the most important actions, however, one of the processes with the most complicated character.

The main objective of the project is the improvement of security in industrial establishments "Seveso establishments" in the Slovak Republic by creating a complex model of the industrial enterprise risk assessment using quantitative methods, its synchronization with standards of the EU and following the application in the conditions of the Slovak Republic. Project target groups:

- „Seveso establishments“ in the Slovak Republic from the industrial accidents point of view (their activities are limited by the law),
- Reviewers/experts (natural persons or legal entity) of major industrial accidents prevention,
- Evaluators/auditors of safety (Ministry of Environment of the Slovak Republic),
- University students of the programmes connected to the industrial safety.

The main project partners are:

- University of Žilina in Žilina,
- Ministry of Environment of Slovak Republic,
- Risk consult (company),
- Slovak Environmental Agency.

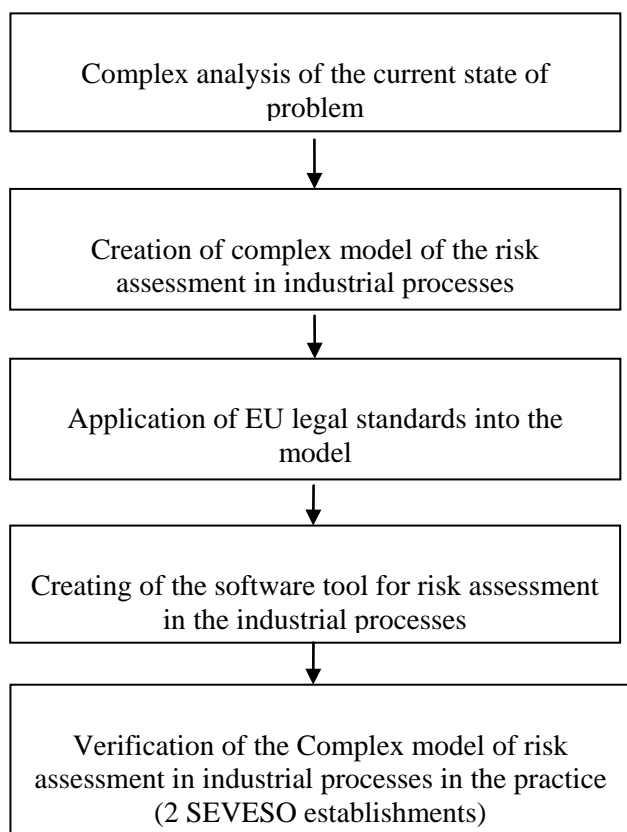


Fig.4 The main project idea

Last year an analysis of the current state in the area of the major industrial accident prevention was carried out and shortages at the level of individual stakeholders, competent authorities, SEVESO establishments, reviewers/experts were identified and possible solutions were proposed. Based on the realised analysis a new university textbook with the title „Prevention of Major Industrial Accidents“ will be issued. It will serve the university students of the University of Žilina in Žilina.

Similarly, an investigation was carried out among the SEVESO companies in the Slovak Republic and the return rate of the questionnaires was 55 % which is the highest return rate of the questionnaires during the whole time period of performing the directive SEVESO II in the Slovak Republic from the SEVESO companies. Based on a survey conducted by the questionnaire method several facts were detected out of which we choose the most important and relevant to the proposed model:

- Inconsistency of the used approaches and methods of risk assessment and treatment of industrial processes whereby there is missing possibility to compare results (different algorithms of the approaches based on the economic potential of the subject)
- Inadequate conditions for the application of the quantitative procedures for the risk assessment and treatment
- The lack of explanatory documents and methodologies for processing of the required source data necessary for the documentation in question
- Inconsistency in an approach to assess risks of the natural character considering the ambiguity of data and criteria for their assessment
- The lack of knowledge on new approaches to the latest technical and technological development in the field of major industrial accident prevention.

Plans for the Future within MOPORI

Considering the continuation of the project, the project team has defined the essential activities and tasks associated with the fulfilment of the defined partial objectives of the project, namely: Based on the established model of risk assessment of industrial processes, an integration of currently valid as well as newly-formed approaches in the project will be implemented to achieve its complexity. Two

representative models will be established, one will have a character of a deterministic approach and the other of a probabilistic approach.

The established model and the application of the currently valid approaches and methods into particular phases and steps will create a prerequisite for its verification in two of the SEVESO establishments. Negotiations are currently underway with several companies. The model will be applied into use by two experts for major industrial accidents prevention from the University of Žilina and two employees of the company Risk Consult who are involved in the project. Due to the use of two different approaches within the model, it will be possible to compare the results of the application not only between the companies but also between the different approaches established. Based on this, new conclusions will be determined and so will, consequently, advantages and disadvantages of the application of the complex model.

The next planned step is to create a software tool for risk assessment in the industrial processes. Following the verification of the model in practice, deficiencies of the complex model will be eliminated and a software tool will be created and recommended for use by the companies in the Slovak Republic.

This project finishes in 2014 and we as a project team hope that the results will help Seveso establishment and also to state administration and private companies.

4 Conclusion

The environment of preventing major industrial accidents is an area which is being solved in all EU member countries through the Seveso II Directive. Regarding to several changes which have arisen due to the new classification of the hazardous substances and other facts which are to be revised in this directive, space for research and necessary modifications in this area not only in the whole EU but also in the legal systems and legal standards and their practical utilisation in individual member countries has developed. The new Seveso III has been adopted and it will be implemented to individual legal systems of individual member states. In the framework of prevention the so called Seveso companies have to fulfil criteria which result from the legal requirements of the given country and

in this way to ensure maximal preparedness for the rise of industrial accidents.

There are other problems arising from this actual problem of industrial accident prevention:

- Seveso companies are checked and what about the below-the-limit ones? Much greater amount of accidents develop just here,
- the companies do not want to belong under the Seveso II directive due to complicated and costly administration,
- the arrival of the law about the critical infrastructure will cause increasing the administration and duties to fulfil them for some companies,
- the enterprises make their work as easy as possible,
- the inspections are not effective and regular.

In spite of all of these problems the European Union is trying to coordinate all of these areas connected to major industrial accident prevention as much reasonably as it is possible. But each member state is different and requires a different approach to the application of these kinds of standards.

5 Acknowledgements

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