

ZRÍNYI MIKLÓS NATIONAL DEFENCE UNIVERSITY

Doctoral Council

Summary

of the doctoral (PhD) dissertation of

GÁBOR CSEH

on

Risk analysis methods applied in the field of controlling major-accident hazards involving dangerous substances

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Discussion of the scientific problem

The research focused on the risk analysis methods applied in the field of controlling major-accident hazards involving dangerous substances. National researches conducted in the matter, namely analysing and comparing techniques used for the purposes of the prevention of major industrial accidents, have mainly had to do with theoretical and practical comparison of the applicability of the different approaches (i.e. the probabilistic and the consequence-based approach, as well as the approach based on generic safety distances) themselves, and the applicability of certain methods generally used for hazard identification at the international level has been dealt with only in this respect. There is a need, however, not only in the everyday work of the operators of a hazardous establishment, but also in the procedures of the competent authorities, for a methodology that provides all the parties involved an assistance in such a way that it supports the decision-making process on the selection of the appropriate methods or combinations of methods (rather than approaches only) for a given technical-safety problem, furthermore it establishes the methodological basis for such a system that is aimed at the inspection and evaluation of the risk management performance of the operator in a coherent and monitored way and on a common basis.

Research objectives

1. To define clear and distinct criteria for the evaluation of the applicability of risk analysis methods accepted in practice for a given problem, and to evaluate the practical applicability of such methods.
2. To develop a methodology suitable for the evaluation of a given risk assessment, a methodology that can be used to support the assessment of the risk analysis from technical-safety aspects on one hand, and the on-site inspections on the other, furthermore contributes to the formation of authoritative opinions in a common way.

Research methods

Tasks originated from research objectives were based on a searching analysis of the relevant technical and legal literature. The data, results and facts from the literature and practice were compared and thoroughly studied, analysis and synthesis were conducted, furthermore those analogies were identified that provide a basis for the description of the common and the

specific elements of the principles, approaches, methods and combination of methods applied in hazard identification and risk analysis in practice.

Studies conducted

In the dissertation it is dealt with those preventive activities qualified for the system of prevention and relief of major accidents involving dangerous substances that fall also within the competence of the organisations for technical-safety surveillance.

This dissertation is also intended to be serve as a summarisation for the evaluation of a given risk assessment, which is one of the determining factors in the task of the implementation of Council directive 96/82/EC on the control of major-accident hazards involving dangerous substances, and in which activities I have been involved from the beginnings.

In line with the research objectives the research topics are discussed in two chapters.

In **Chapter 1** – in relation to objective 1 – the methods generally accepted for hazard identification and technological risk analysis were identified after having studied and compared the relevant literature. Having taken into consideration of the relevant aspects as proposed and found in the literature and also having made use of some practical considerations a set of comparative criteria is proposed. The studies for comparison are also applied in the case of methods and combination of methods used in Hungary, and a proposal is also made for additional criteria to be used in the studies.

In **Chapter 2** – in relation to objective 2 – the relation between risk analysis to be carried out in the field of the prevention of major accident and other activities of risk management is studied from the perspective of technical safety. On the basis of the findings the areas of technical-safety inspection are identified and the assessment criteria are derived which can be used by the assessor when making judgement on the results of a given risk analysis.

Summary of conclusions

Regarding methods applicable to the identification of hazards and analysis of risks of major accidents involving dangerous substances

1. The results of comparing studies on the objectives, the solidity, the level of applicability in the different stages of the lifetime of a hazardous establishment and the comprehensive feature of the methods concerned provided evidence that the set of aspects proposed for comparison is adaptable not only to support decisions on choosing between methods for a given problem in a risk analysis, but also to support evaluations on how systematic, complete and well-founded the use of a certain method (ie. the level of expertise) applied to a given problem was.
2. Further comparing studies are needed on risk analysis methods in order to be able to support the selection or evaluation of methods. Main aspects for comparison are those that provide a basis for the consideration of the possible effects of dependent failures, the influence of the maintenance regime and the distinct management systems.
3. Finding the optimal combination of methods in terms of the comprehensive feature of the approach has proved to be easy as compared to those in terms of the objectives, the solidity and the level of applicability in the different stages of the lifetime of a hazardous establishment, respectively. In terms of those other than the comprehensive one need a complex methodology when conducting a comparison.
4. Based on the results of the comparison of the risk analysis practice of each of the national hazardous establishments it is the consequence analysis or, to be more precise, a concrete form of the consequence analysis that proves to be the most generally applied method. This involves that there isn't a generally applied method at the national hazardous establishments in the field of technological hazard identification.
5. In order to be able to analyse the major-accident risks involving dangerous substances thoroughly a single method cannot be regarded as sufficient, but a structured combination of methods is considered to be indispensable.
6. It is proved that one cannot find a dominant combination of methods in terms of absolute figures when all the hazardous establishments in Hungary is considered, but there are sectors where the use of certain combinations of methods are dominant.

7. In order to be able to clarify the relation between the combination of methods applied by the operators and the operators themselves it can be considered useful to analyse influence factors such as the difference between establishments consisting of only one or more hazardous installations, the specifications of technology used in the establishment, the distance of the establishment from the populated areas, the solidity of methods or combination of methods, furthermore the difference between the influence of “sector specific” experts vs. “hazard category” experts.

Regarding assessment and inspection to be conducted in relation to hazard and risk analyses prepared by the operators of hazardous establishments

1. In order to be able to conduct an assessment on the results of a risk analysis for a technological system in a common way, one may consider the following factors as determining:
 - a) the interpretation of risk and hazard, the interrelation of these concepts;
 - b) the method used for the identification of a hazardous establishment or hazardous activity;
 - c) the method for selecting a hazardous installation and deriving the most severe accident(s);
 - d) the method for describing the most severe accident(s);
 - e) the method for the inspection in relation to the given risk analysis.
2. The areas of operator’s activity in relation to hazard identification and risk analysis subject to technical-safety inspection in terms of practical implementation can be identified on the basis of considering the combinations of the processes (technology) (A), the equipment (including those for process safety) (B), operation and handling (C), the state of equipment (D), maintenance and repair activities with appropriate times (E) and the technical-safety tests, inspections and the appropriate times (F) on one hand and on the identification of the hazardous establishment (I), the inventory and quantity of dangerous substances (II), the screening (III) and the frequency/probability on the other.
3. The assessment to be made by the technical safety authority consists of the evaluation of the statements made by the operator in relation to the identification of the hazardous establishment on one hand, and the assessment of the results of the risk analysis performed in terms of the elements and modes of operation of the technological systems

of the hazardous establishment concerned on the other. The assessment procedure involves in this respect assessment tasks in relation to certain elements of the safety management system of the hazardous establishment concerned.

4. In conducting assessment and inspection activities the technical safety authority may expect efficiency when such an assessment regime is applied under which a complete set of criteria for the presentation of the establishment and installation(s), the operation, the management of change, furthermore the identification and analysis of potential major accident is used.

New scientific achievements

1. A common set of aspects was developed for the comparison of methods used in technological hazard identification on the basis of the objectives, the solidity, the level of applicability in the different stages of the lifetime of a hazardous establishment and the comprehensive feature of the methods concerned.
2. In the case of the combinations of methods a comparing study was conducted in terms of the comprehensive feature of the combinations concerned and on the basis of which the set of optimal combinations has been identified.
3. As a result of a comparing study of the practical approaches used by the national companies in risk analysis the relation between the nature of the hazard identification problems and the methods used in practice to solve such problems has been identified and a proposal has been developed for additional aspects to be used in further studies.
4. Having taken into consideration of the results of the comparing study on the applicability of certain methods for the identification of hazards and analysis of risks of major accidents involving dangerous substances, the areas for technical-safety inspection have been identified. Criteria have been developed for the respective areas.

Practical use of the dissertation

1. The conditions developed under which a certain method for risk analysis may be used and the results of a comparing study on such methods may prove to be a handy tool for the training of safety engineers, furthermore may provide help in defining the role of risk analysis in the safety management of a hazardous establishment.

2. The principles and the method developed for the assessment of the results of a risk analysis may prove to be a useful guide for the assessors to be able to evaluate the safety performance of the operator adequately and efficiently on the basis of the operator's principles used for a risk assessment, the identification of major hazards and sequences of hazardous events, the probability of frequency of a major accident, the assessment of the consequences, etc.
3. The dissertation may be put to use as a work-help primarily in the education of disaster-relief professionals and at the Zrínyi Miklós National Defence University.
4. The dissertation may be put to use in the education program of institutions specialized in the further training of experts in safety of chemical processes.
5. The dissertation may provide a basis for a review and revision of legal regulations and other procedures applied in the field of technical safety.

List of the publications of Gabor Cseh

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Curriculum vitae

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| June 2004 onwards | Head of Department in the Hungarian Technical Safety Office |
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October 1997 – December 1999	Executive in charge of industrial accidents in the UN/ECE Regional Co-ordinating Centre for the Prevention of Industrial Accidents
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Foreign languages:

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2000 onwards	Committee of Competent Authorities responsible for the implementation of Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (Seveso II Directive)

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