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SHAPE - RISK

SHARING EXPERIENCE ON RISK MANAGEMENT (HEALTH, SAFETY AND ENVIRONMENT) TO DESIGN FUTURE INDUSTRIAL SYSTEMS

Co-ordination Action

Priority 3: Nano-technologies and nano-sciences, knowledge-based multifunctional materials, and new production processes and devices – "NMP"

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Synthesis document on WP5

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WP5	Management of environmental risks generated by accidents

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Abstract

This document aims to present the results of a survey in area of risk assessment of potential accidents with impacts on the environment with concentration on IPPC and SEVESO classified sources. The Synthesis document is based on *WP5 Discussion document* and the *Proceedings of the WP5 workshop*, which took place in Verneuil-en-Hallate on the 12th of December, 2005 in cooperation with other workpackages (WP4&WP6).

The WP5 Synthesis document presents the output of all the year round work on WP5 delivered to Shape-Risk project's co-ordinator and European Commission.

INERIS quality approval

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- WP deputy: **ISPESL**
- WP contributing members:

MAHB **VTT**

FPMs **UK Environment agency**

→ (Italy, Finland, Belgium, United Kingdom)

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Abbreviations

CA	Competent Authorities
EU	European Union
GIS	Geographical information system
IT	Information technologies
NGO	Non-governmental organisation
WP	Work Package

Note for the reader/Workshop invitation

This is the final document of **WP5 *"Management of environmental risks generated by accidents"*** delivered to Shape-Risk co-ordinator and European Commission as the output of all the year round work on WP5. The WP5 was concentrated on developing working system of sharing experience, technical support and transfer of know-how and good practices on the field of accidents having origin or impact in environment. The objectives of WP5 and the way of their fulfilment are mentioned in the chapter No. II.

The Synthesis document is based on the WP5 *Discussion document*, which was prepared for the purposes of discussion during the Shape-Risk workshop. A one-day workshop held on 12th of December in Verneuil-en-Hallate, France. It was organised by the WP5 team in the cooperation with the project co-ordinator (INERIS) and other WP leaders RISOE (WP4 leader) and JRC-MAHB (WP6 leader). The goal of workshop was to obtain feedback on the WP5 *Discussion document* and collect contributions from the main experts in the field of risk assessment of accidents with impacts in the environment. The results of discussions are included in this WP5 *Synthesis document.*

Target group:

All stakeholders interested in or working in the area of risk assessment of major accidents on the base of SEVESO or IPPC classified sources.

I Introduction of Shape-Risk project

SHAPE-RISK aims at optimising the efficiency of integrated risk management in the context of the sustainable development of the European process industry. The proposal addresses sustainable waste management and hazard reduction in production, storage and manufacturing. **The main deliverable of the SHAPE-RISK process will be recommendations to design future cleaner and safer industrial systems**. These recommendations will be discussed and endorsed by the Industry. As a final part, an agenda of actions, approved by Industry, will be developed.

The main goal is to support safety and the minimisation of accidents, pollution and emissions at industrial installations. In operational terms, SHAPE-RISK aims at structuring a network with the organisations providing technical support to the Public Authorities in charge of the application of the SEVESO II, IPPC and ATEX Directives. This network will interact strongly with industry and other stakeholders at European (international) level, but also at national and local level.

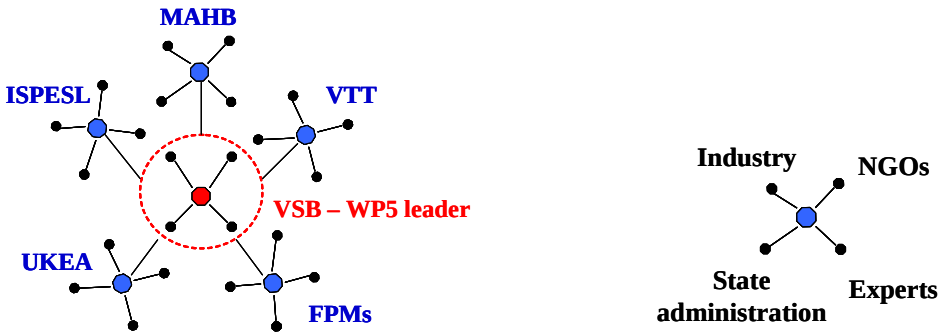
II Objectives of WP5

The SHAPR-RISK Work Package was known as: Policies for the management of environmental risks. The WP5 objectives were concentrated on developing working system of sharing experience, technical support and transfer of know-how and good practices on the field of accidents having origin or impact in environment.. These objectives were fulfilled by WP5 team as follows:

- **Objective 1:** To create the network of sharing of experience of different participants and stakeholders in the policy, prevention and preparedness for environmental accidents

The creation of this network was one of the first important points of WP5. On the base of this proposed network, which is illustrated in the picture below (see Figure No.1), it was formed one common working group of WP5. This common working group consisted of 5 contributing members of WP5 with leader of WP5 as central focal point, who collected the data from all of them. The information flow of WP5 continued both ways, from the leader to contributing members and reversely.

Figure No.1: WP5 network of sharing experience



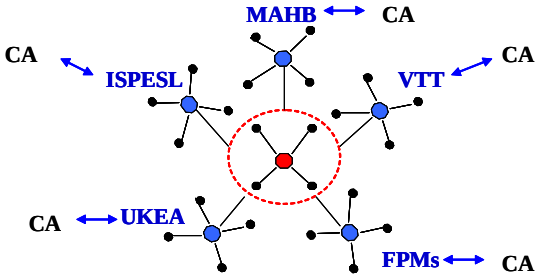
Except this main working group of WP5, every contributing partner formed and described its working group at national and international level consists of IPPC and SEVESO experts and users (industry, authors of documents). The contacts are listed in Annex No. 1.

- **Objective 2:** To develop the structure for providing the technical support of Competent Authorities for management of technological and environmental risks at international level

In this objective was the most important point to spread the working group of WP5 from the "national level" of all us to international level, trans-national co-operation. This international level didn't include only the individual national Competent Authority (and other national authorities), but also included the Competent Authorities or experts from other countries from all over the world. This proposed structure looked like as the illustration below (see

Figure No.2). The exchange of information was higher as the information flow inside the working group shared in WP5 solution.

Figure No.2: Structure of WP5 international network of sharing experience

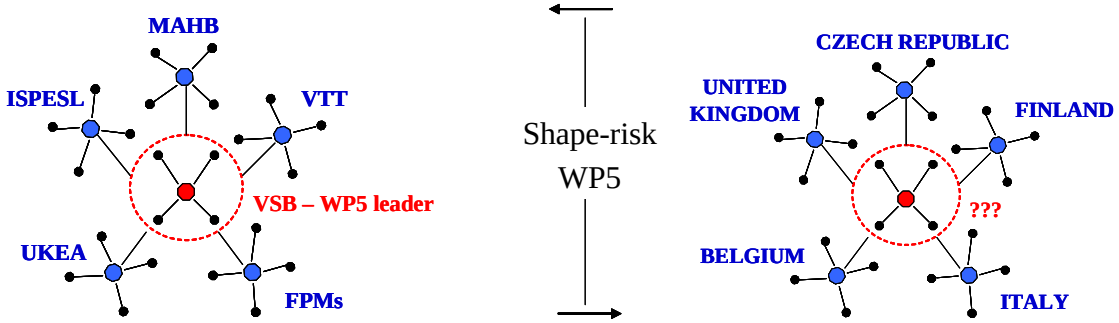


The benefit of this international working group or international network was especially in higher focus on the issue of risk assessment of potential accidents with impacts on the environment thanks to involvement of different participants reaching the "critical mass" of experience. In the future, an useful tool could be the list of contacts (see Annex No. 2).

- **Objective 3:** To propose a system of transfer of know-how and good practises in management of environmental accidents between EU (and pre-accession states)

The third objective of WP5 was written in time, when the candidate countries including Czech Republic (the leader of WP5) was one of the pre-accession states. So the reduction of the scope of this objective was following. The aim of this objective was to propose a system of transfer of know-how and good practices in management of environmental accidents inside of the European Union with the emphasis on the states participated in WP5 solution - Italy, Finland, Belgium, United Kingdom and Czech Republic (see Figure No.3) and open to other countries participant, which will be invited to co-operate.

Figure No.3: System of transfer of know-how and good practises at international proposed by WP5 working group



The result of this proposed structure concerning the system of transfer of know-how and good practises, was the next, new and larger structure involving existing and open to future members of the European Union. But in the meanwhile, this structure was formed on the WP5 partners' basis. The single contacts are listed in Annex No. 3.

- **Objective 4:** To increase the information level and awareness about policy and techniques for environmental accident management for general public and NGOs (together with WP6)

The last objective of WP5 was solved in more details in other parts of project. Among proposed solutions how to increase environmental awareness belonged: company's environmental reports, www-pages, as well as other kinds of public reports, information brochure or information leaflet formed for concrete area (not in general).

The main deliverable of the WP5 was to provide the overview of risk assessment of potential accidents with impacts on the environment at European level with aim at state of the art in different countries of EU, the course and specifities of accidents in the environment and existing methodologies and approaches of environmental risk analysis.

III Description of work WP5

The WP5 was concentrated on developing working system of sharing experience, technical support and transfer of know-how and good practices on the field of accidents having origin or impact in environment. In this context, optimisation of risk (both to people and to the environment) requires combined consideration of:

- frequencies of accidents
- releases of dangerous substances
- consequences of these releases

Whilst the first two mentions refer to and depend on the technology and the management employed in installations, the third one includes the land-use and environment around the installation in order to consider the consequences of potential accidental or routine releases of dangerous substances.

III.I Questionnaire of WP5

The aim of the *Questionnaire of WP5* was to collect the information about the way of implementing the IPPC and SEVESO Directives in certain countries of the EU (legislative requirements) and map the current situation including used methodologies on the field of accidents having origin or impact in environment.

The Questionnaire had 3main parts:

- Legislation: in compliance with IPPC and SEVESO Directives
- Risk assessment of potential accidents in environment
- Risk analysis use

The *Questionnaire of WP5* was structured around these mentioned main areas concerning the issue of accidents in environment. Then the *Questionnaire of WP5* was structured around these mentioned main areas concerning the issue of accidents in environment involved a lot of difficulties connected with the implementation of the IPPC and SEVESO Directives in some countries of the EU, which are almost not solved, but should be.

The WP5 working team addressed with the *Questionnaire of WP5* these stakeholders at national or international level: state administration, competent authorities, industry and NGOs.

From returned *Questionnaires of WP5* pointed out following information or difficulties as non- existence of internationally recognized methods for impact assessment of chemical accident to environment, non defined difference between pollution and accident, the need of deeper IPPC and SEVESO legislation coordination etc. which were involved in *Discussion document* for the purposes of next discussion during the meetings and workshop.

III.II Discussion document on WP5

The aim of the *Discussion document* was to provide the overview of the issue concerning risk assessment of potential accidents with impacts on the environment including description of advantages and difficulties, which will be the base of the discussion during the Shape-Risk meetings and workshop. It was expected that the content of the *Discussion document* will arouse a discussion on this issue and that it will be obtained some useful feedbacks in both

directions (on the side of readers and also on the side of authors of this document), too. The feedbacks from the *Discussion document* together with the WP5 *Proceedings of the workshop* were all used in to compile this *Synthesis document*. The content of the *Discussion document* is illustrated below:

Figure No. 4: The contents of Discussion document

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III.III WP5 workshop

A one-day workshop were organised by the WP5 team in the cooperation with the project co-ordinator and other work packages (WP4&WP6) on 12th of December in Verneuil-en-Hallate, France. The goal of workshop was to obtain feedback on the WP5 *Discussion document* and collect contributions from the main experts (including industry) in the field of risk analysis and management of environmental accidents. The main objectives of the workshop were following:

- To present and discuss the main activities and results achieved within WP5 on management of environmental risks generated by accidents.

- To exchange experiences and solutions concerning major accident impacts on the environment (including their specifities) and used methodologies and approaches for environmental risk assessment.
- To get a feedback from a broader audience participated in workshop on the applicability/feasibility of the WP5 approach to management of environmental risks generated by accidents.
- To form a basis for the next discussion, which encourage in new topics and opinions concerning management of environmental risks generated by accidents.

The topics (WP5 difficulties/advantages), which were discussed during the workshop, resulted in most cases from the WP5 meeting held in Rome on 27th September and are described in chapter No. VII Difficulties and proposed recommendations.

From the WP5 workshop resulted that the issue of risk assessment of major accident impacts in the environment has a lot of difficulties, which were obtained during all year work on WP5 and Shape-Risk workshop. In the next year of the project will be therefore necessary to focus on limited number of difficulties & practical recommendations.

We are sure, that WP5 of Shape-Risk project is an opening WP to this issue “Impact Assessment in Environment” and we hope, that we will continue in next solution with goal to contribute in process of design future cleaner and safer industrial systems.

IV State of the art

IV.I The general requirements of the IPPC and the SEVESO Directives

The Council of the European Union has adopted the IPPC Directive from number of reasons, among others whereas objectives and principles of the Community's environment policy consist in particular of preventing, reducing and as far as possible eliminating pollution and whereas different approaches to controlling emissions into the air, water or soil separately may encourage the transmission of pollution between the various environmental media rather than protecting the environment as a whole.

One of the reasons why the Council of the European Union has adopted the SEVESO Directive was that it has to be promoted the access to information on the environment. The public should have access to safety reports produced by operators, and persons likely to be affected by a major accident should be given information sufficient to inform them of the correct action to be taken in that event.

IPPC Directive (96/61/EC)

The purpose of IPPC Directive is to achieve integrated prevention and control of pollution arising from the activities listed in Annex I. It lays down measures designed to prevent or, where that is not practicable, to reduce emissions in the air, water and land from the abovementioned activities, including measures concerning waste, in order to achieve a high level of protection of the environment taken as a whole, without prejudice to Directive 85/337/EEC and other relevant Community provisions.

Pollution is defined only in the IPPC Directive and it means the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment.

General principles governing the basic obligations of the operator

Member States shall take the necessary measures to provide that the competent authorities ensure that installations are operated in such a way that:

- all the appropriate preventive measures are taken against pollution, in particular through application of the best available techniques
- no significant pollution is caused
- waste production is avoided in accordance with Council Directive 75/442/EEC of 15 July 1975 on waste; where waste is produced, it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment
- energy is used efficiently
- the necessary measures are taken to prevent accidents and limit their consequences
- the necessary measures are taken upon definitive cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state

Applications for permits

The applications for permits have to contain a description of:

- The sources of emissions from the installation.
- The nature and quantities of foreseeable emissions from the installation into each medium as well as identification of significant effects of the emissions on the environment.
- The proposed technology and other techniques for preventing or, where this not possible, reducing emissions from the installation.
- Where necessary, measures for the prevention and recovery of waste generated by the installation.
- Further measures planned to comply with the general principles of the basic obligations of the operator as provided for in Article 3 ("General principles governing the basic obligations of the operator").
- Measures planned to monitor emissions into the environment.
- If the safety report prepared in accordance with SEVESO Directive fulfils any of the requirements of this Article, that information may be included in, or attached to, the application.
- The permit shall include emission limit values for pollutants, in particular, those listed in Annex III, likely to be emitted from the installation concerned in significant quantities, having regard to their nature and their potential to transfer pollution from one medium to another (water, air and land). If necessary, the permit shall include appropriate requirements ensuring protection of the soil and ground water and measures concerning the management of waste generated by the installation.
- All measures shall be based on the best available techniques.
- The permit shall contain measures relating to conditions other than normal operating conditions. Thus, where there is a risk that the environment may be affected, appropriate provision shall be made for start-up, leaks malfunctions, momentary stoppages and definitive cessation of operations.
- The operator regularly informs the competent authority of the results of the monitoring of releases and without delay of any incident or accident significantly affecting the environment.

SEVESO Directive (96/82/EC)

This Directive is aimed at the prevention of major accidents, which involve dangerous substances, and the limitation of their consequences for man and the environment, with a view to ensuring high levels of protection throughout the Community in a consistent and effective manner.

Major accident is defined only in the SEVESO Directive and it means an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive, and leading to serious danger

to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.

Following information are concerned in general requirements of the SEVESO Directive in relation just to environment.

General obligations of the operator:

Member States shall ensure that the operator is obliged to take all measures necessary to prevent major accidents and to limit their consequences for man and the environment. Member States shall ensure that the operator is required to prove to the competent authority at any time, in particular for the purposes of the inspections and controls that he has taken all the measures necessary as specified in this Directive.

Major-accident prevention policy:

Member States shall require the operator to draw up a document setting out his major-accident prevention policy and to ensure that it is properly implemented. The major-accident prevention policy established by the operator shall be designed to guarantee a high level of protection for man and the environment by appropriate means, structures and management systems.

Safety Report:

The operator shall produce a safety report for purposes of:

- the demonstrating that major-accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences for man and the environment
- the safety report shall contain at least the these data and information listed in Annex II:

  Description of the site and its environment including the geographical location, meteorological, geological, hydrographic conditions and, if necessary, its history.

  Physical, chemical, toxicological characteristics and indication of the hazards, both immediate and delayed for man and the environment.

  Detailed description of the possible major-accident scenarios and their probability or the conditions under which they occur including a summary of the events which may play a role in triggering each of these scenarios, the causes being internal or external to the installation.
- Safety reports, or parts of reports, or any other equivalent reports produced in response to other legislation, may be combined to form a single safety report for the purposes of this Article, where such a format obviates the unnecessary duplication of information and the repetition of work by the operator or competent authority, on condition that all the requirements of this Article (No.9) are complied with.

Emergency plan:

The operator shall produce an internal emergency plan with the objectives of:

- containing and controlling incidents so as to minimize the effects, and to limit damage to man, the environment and property
- implementing the measures necessary to protect man and the environment from the effects of major accidents

- providing for the restoration and clean-up of the environment following a major accident

Land-use planning:

- Member States shall ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in their land use policies and/or other relevant policies.
- Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest, and, in the case of existing establishments, of the need for additional technical measures in accordance with Article 5 (general obligations of the operator) so as not to increase the risks to people.

IV.II The current situation in some countries of the EU

For getting an overview in risk analysis area we formed the *Questionnaire of WP5*, its goal was to bring out the information about the way and scope of implementation IPPC and SEVESO Directive in European Union countries (and also in others selected European countries), map the actual situation including the methods used in accident area having the origin or impact on environment.

We addressed with the *Questionnaire of WP5* following investors on national and international level as state administration, regional offices, industry and NGOs. Among selected states of Europe, which provided the current information about impact assessment to environment belong (more detailed in Annex No. 4):

- Czech Republic
- Finland
- Great Britain
- Italy
- Slovakia, Spain, Sweden, Switzerland

The situation in European Union countries doesn't differ in principle. With the approach in the assessment of chemical accident impacts on environment it's the same. The only evident difference is in the scope of acts and accordant requirements. The requirement of impacts assessment is involved in decrees implementing the IPPC or SEVESO Directives (in case of Finland and Sweden in both decrees). Czech Republic is the exception; this requirement is also involved in some other acts as Water act, Clean air act, Act of environment etc.

Methods for assessment of accident impacts on environment are already produced or are found in the final stage of processing. Some countries don't have their own method, then they take example from the approaches of other countries or they conform to general requirements.

Also in non-EU countries is this issue involved in the legislation. The example is Switzerland, which nevertheless has this accordant decree *Swiss Ordinance on Major Accidents* (OMA).

The different between chemical accident and pollution is not explicit, individual acts interpret them very similar. There are not any specifications (time, quantity, outflow speed, impact form, substance characteristic…) for clear definition of these effects.

In the most of cases, legislation does not give specific way of the assessment of accident impacts on environment.

IV.III The difficulties and opinions from industry

The industry approach to environment issue is very important, because it points out the strategy of environment protection, which industry will realize in practice. In general, the industry approach to environment issue is affected by internal and external factors. From external factors can be considered as basic:

- State environment protection policy
- Science-technical progress level
- Interested person position to environment issue

It's not possible to well enough mention the most important internal factors, because these factors take effect as a whole and loss effect of one factor can be balanced by increasing of the second factor.

On the whole, existing 4 basic types of industry approach to environment protection:

- **Passive**: the oldest approach, which was based on small knowledge about environment issue. However it can't be said, that this approach could be fade in this time.
- **Reactive**: the reaction on legislation progress concerning environment protection.
- **Preventive**: this approach is based on 3 basic principles of prevention, precaution and integration.
- **Proactive**: the principle of this approach is that industry all the time and actively looks up the ways, by which could decrease an impact of its activities on the environment.

Results from responded Questionnaires of WP5

In most of EU states are recommended the methods for impact assessment on the environment for the purposes of safety report/application for integrated permit. There's not an exception, when company has its own methods made especially for company's purposes (e.g. situation modelling of release with the help of Aloha). Then it depends on competent authorities, who approve the safety reports/applications for integrated permits, if they approve using of this method or will ask for completion.

The authorities, who approve risk analysis use for internal (company) emergency plan, were mentioned: regional authorities of each region/regulators within the approving of safety report, operators (generally) or chairmen of the emergency commission (authorities from company).

The information included in safety reports/applications on integrated permit are one of bases for next planning in its region. By the proceeding of change in land-use planning through EIA and SEA is the prevention of major accident used from the point of view of building location in zone of emergency planning, which specified the regional authority on the base risk analysis from the safety document. In case of forming the concept of town development or land-use plan is also watched to risks following from risk analysis.

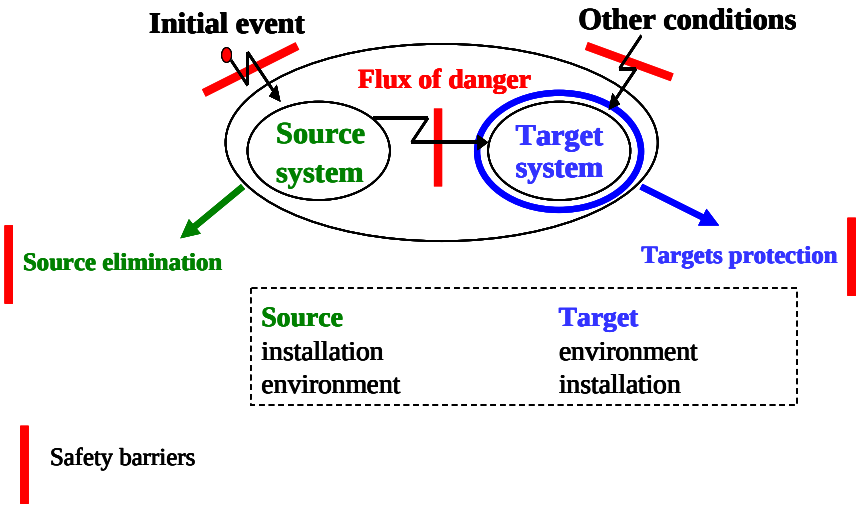
V Major accident impacts on the environment

The current time is characterized by large industrial progress, which brings a various risks. Among others risks also risks of major accidents, well accidents with impact on lives and health of human beings, **environment** and property. Industrial accidents represent one of important sources of real information to prevent similar events.

V.I The course of major accident

The source of danger and target, which will be endangered have to be present to happen the accident. Here existing these target systems: people inside of company (staff), people outside of company, environment and property (financial and material losses). The flux of danger can happen by mass flow, energy flow or information flow. In the reality, only a few of source or target systems and their combination are existed. The example performs following figure (Figure No. 5), when the source of accident can be installation, which can damage the environment (accident will have the impact on environment) or vice-versa, when environment can be the source of accident (e.g. earthquake, floods etc.) and can cause the losses on property (financial or material).

Figure No. 5: The major accident course (the scheme derived from MADS-MOSAR model)



There are three possibilities, how to avoid a flux of danger (to minimize or take out the risks):

1. to take out the source of danger,
2. to put the safety barriers before initial event, which avoid to scenario progress-possibility of initial event,
3. to protect the target system (at this possibility, comes to accident progress, but the target system is protected – small or no damages).

The safety barriers can be technical (precautions in the construction of installation) or organizing (precautions in work organisation, working plan etc.).

V.II Specifities of accidents in the environment

At the accidents with impact on lives and health of human beings it can be consider as the way of dispersion only the air medium. On the other hand, at the analysis with impact on the environment exist except the possibility of air dispersion, also the possibility to spread the contaminant through soil (rock) medium, surface or ground waters. Also the target, which can be endangered by accident, is specific. In the environment doesn't happen to endanger of biota only. By the accident can be also influenced surface waters (including water-significant hydraulic structure), soil medium, soil value and not least the ground water, through which can happen to spread of contaminant and endanger of fresh water resources.

The scale of consequences of major accident with environmental impacts should looks following:

- lives and health of human beings,
- environment damage/pollution/loss of function,
- domestic animals and agriculture production losses,
- material losses,
- decreasing of people (citizens) well-being (comfort, quality of life).

One of the results from WP5 meeting in Rome was pointing out of well-being of people, which is not implied directly as a part of SEVESO legislation. According to general agreement of partners, the well-being of people should be rather taken into account than domestic animals (mostly bred for people benefit), which are put prior the environment in some scales of consequences of major accident impacts. The example of impact on people well-being is the evacuation or confinement for longer period, loss (even temporally) of drinking water, energy or communication network etc.

V.III Take advantage of IT

In the area of environment, as well as in other specializations is the most often used the services of up-to-date information technologies (IT). One of the relatively new branches of informatics is geoinformatics and related geographical information systems (GIS). GIS are the most often understand as the computer systems providing geographical data processing and their presentation, mainly in the form of various maps. Digital maps in GIS have a lot of advantages against paper maps. Among these advantages belong for example easy data updating, the possibility of various analysis and simulations and also the possibility of data presentation in variety of ways according to actual need.

These tools can be used also for analysis and assessment of accidents impacts with participation of dangerous substance on environment. Analyses are possible to automatize and thereby to speed up their process and to spread the usability also in large areas. The main advantage is easier and more understandable analysis evaluation and results presentation in form of digital maps. Immediately can be seen what size of area can be affected by accident or if in affected area occur some objects endangered by contamination (water flows, water areas, ground sources of fresh water, specially protected areas and others).

VI Methodologies and approaches of environmental accident risk analysis

In the current time exist a lot of methods for assessment of accidents with impacts on human health or property (e.g. IAEA-TECDOC-727, Dow's F&EI, Purple Book, RMP EPA Guide or ETA a FTA). By these methods can be assess the impact of dangerous substances effects, probability of potential accident or the number of endangered or killed people or property damages.

The situation in the area of assessment of accident impacts on the environment is wholly different. Methods, which provide to assess the impacts of accidents on the environment, exist just a few. Although as well as the requirement on assessment of accident impacts on human health and property is the requirement on assessment of accident impacts on environment involved in SEVESO Directive.

Among the most used methods in EU, by which can be assess the accident impacts on environment belong: Czech method *H&V index*, Spanish method *Guideline for the performance of environmental risk assessment*, Finnish method *Sara risk analysis for accidental releases* and *H1 Guidance*.

It is difficult to start impact assessment to environment before, than the set of representative scenarios (for comparative results) will be set up and proper selection made. For the own assessment of environmental impacts is used from the risk analysis these outputs:

- Dangerous properties of substance
- Estimation of quantity involved in accident
- Mobility of substance in environment
- Accident probability
- Local environment vulnerability

VI.I Methodology for analysis of accidental impacts with participation of dangerous substance in environment „*H&V index*"

By this methodology can be assessed a consequence of accidents for environment through Czech Act No. 353/1999 (Directive Seveso II), on the prevention of the major accidents. Also it can be used for the assessment and prioritisation of risks in areas into the size of district, assessment for larger land-use areas should take the advantage of GIS.

Assessment of accidental impacts with participation of dangerous substance can't be realized without the knowledge of outputs of risk analysis of the major accident. Methodology links up to detail risk assessment of the major accident according to Czech Act on the prevention of the major accidents (see Progressive diagram no. 1). It takes advantage of count extents of effects, probability and quantity of released substance. The own analysis of accidental impacts with participation of dangerous substance in environment proceeds in 3 basic steps:

- identification of the dangerousness of substance
- identification of the vulnerability of environment in certain location
- assessment of the consequence of accident

The first step is appreciation of toxic and physic-chemical characteristics for single compartments of the environment. The result is the index of toxic dangerousness of substance for biotic compartment, index of toxic dangerousness of substance for soil environment, index of toxic dangerousness for water environment and index of danger of substance flammability with impact on biotic compartment.

In case the substance has the dangerousness for some of the environment compartments, then is analysed the vulnerability of environment in certain location. In this part the environment compartments are assessed individually:

- surface water
- ground water
- soil environment
- biotic compartments of environment

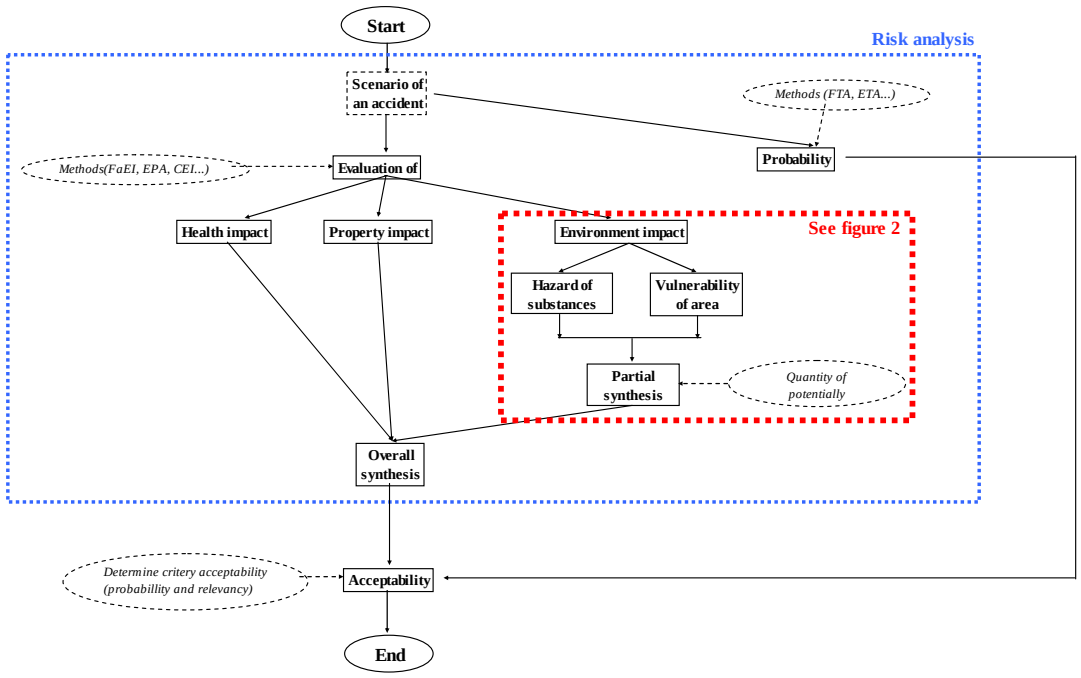
The result of this part is the assessment of index of vulnerability of surface water, index of vulnerability of ground water, index of vulnerability of soil environment and index of vulnerability of biotic environment compartments.

Before the assessment of accidental consequence is done the synthesis of indexes (see

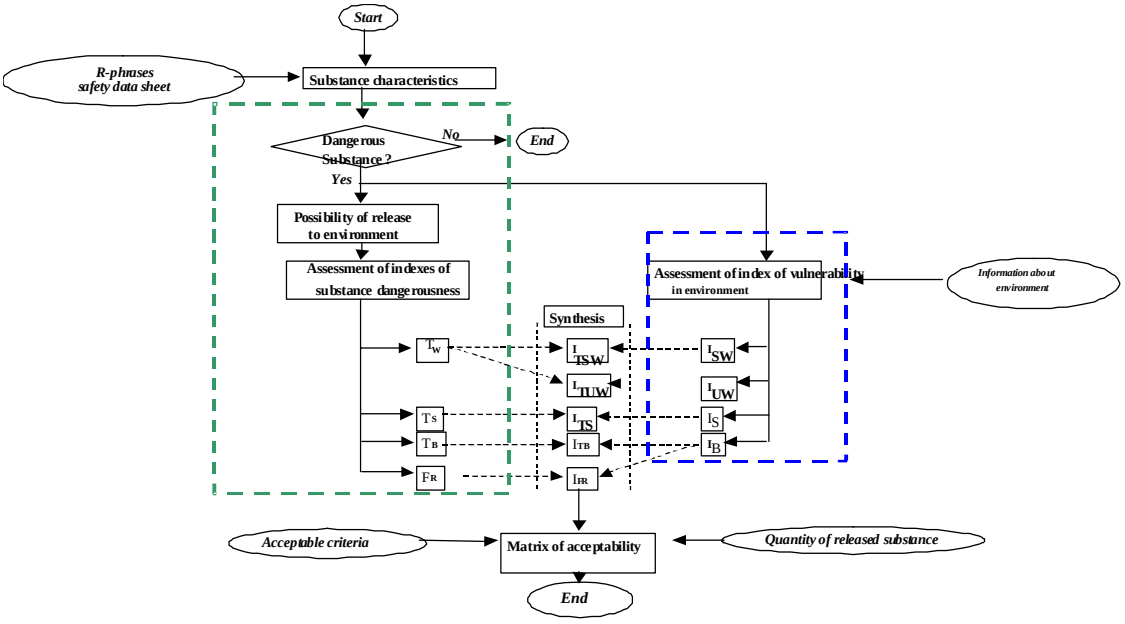
Progressive diagram No. 2).

By synthesis of indexes of dangerousness and vulnerability and in combination with quantity of released substance is assessed the consequence of accident. This count consequence is possible to get into matrix (consequence/probability) and determine the category of risk acceptability of accidental impacts on environment.

Progressive diagram no. 1: Assessment acceptability of consequential accident



Progressive diagram No. 2 Course of evaluation impacts of accidents on environment

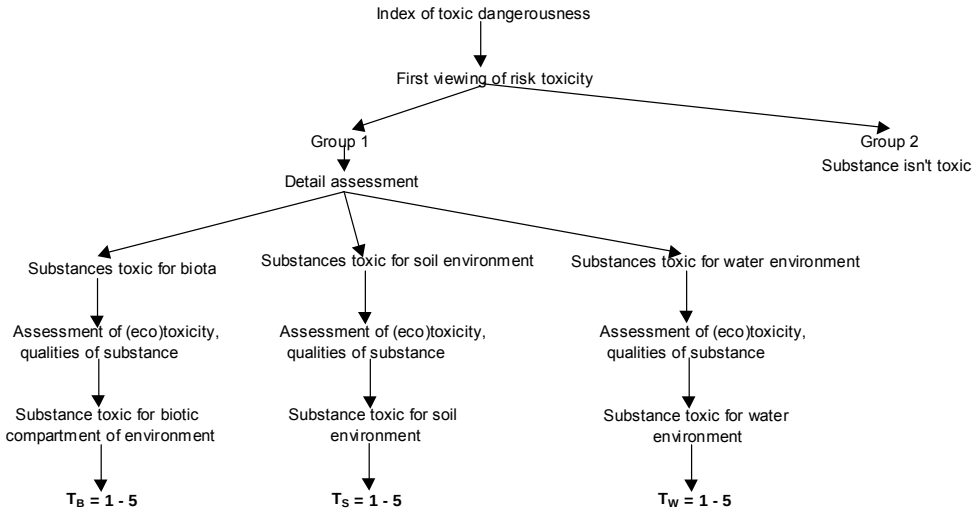


T_W - index of toxic dangerousness of substance for water environment, $\mathbf{T_S}$ – index of toxic dangerousness of substance for soil environment, $\mathbf{T_B}$ - index of toxic dangerousness of substance for biotic compartment, $\mathbf{F_R}$ – index of danger substance flammability, $\mathbf{I_{SW}}$ –index of vulnerability for surface water, $\mathbf{I_{UW}}$ – index of vulnerability for groundwater, $\mathbf{I_S}$ –index of vulnerability for soil environment, $\mathbf{I_B}$ – index of vulnerability for biotic compartment, $\mathbf{I_{TSW}}$ - index of substance toxicity for surface water, $\mathbf{I_{TUW}}$ – index of substance toxicity for groundwater, $\mathbf{I_{TS}}$ – index of substance toxicity for soil environment, $\mathbf{I_{TB}}$ –index of substance toxicity for biotic compartment, $\mathbf{I_{FR}}$ –index of impacts of substance flammability for biotic compartment.

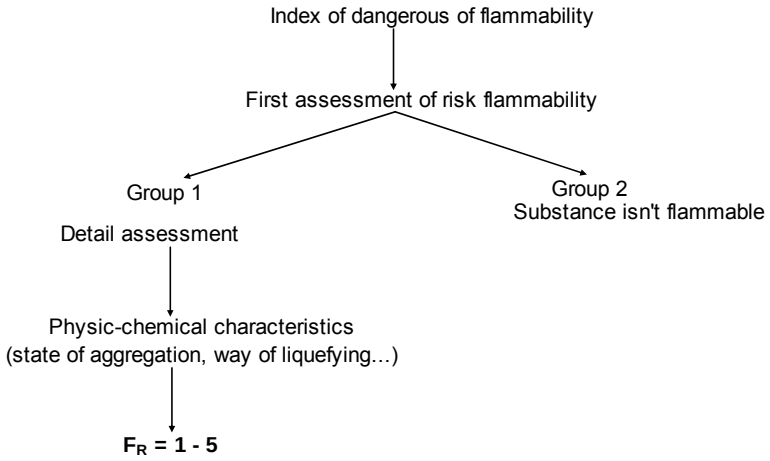
1. Index of dangerousness of substance

This index divides the substances especially according to aims, which can be endangered in environment. On the base of physic-chemical qualities, information about ecotoxicity is divided to categories, which respect their behaviour in environment and their dangerous qualities. The aim of this methodology is a determination of the index of toxic dangerousness of substance and the index of dangerousness of flammable substances.

Progressive diagram No. 3: Assessment of dangerousness of toxic substance



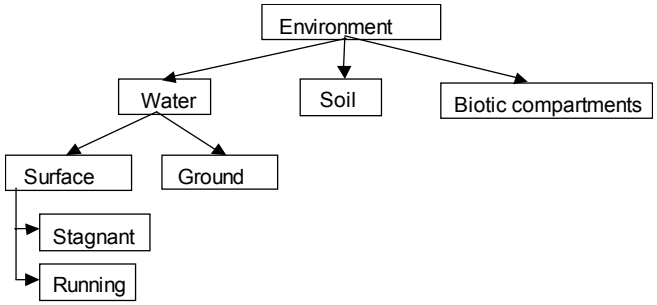
Progressive diagram no. 4: Assessment of dangerousness of flammable substance



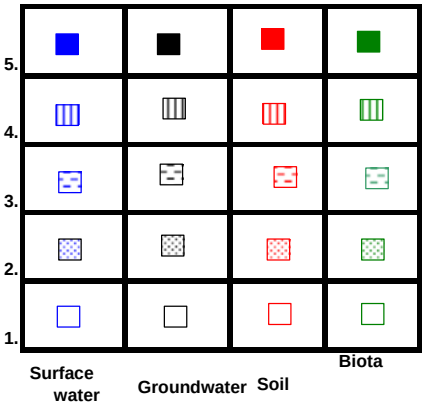
2. Index of vulnerability of the environment

Preliminarily we find out environmental compartments, which can be by accident endangered. This index assesses the select environmental compartments with respect on their possible vulnerability towards effects of dangerous substances, their value-ability and using. Also is taken into consideration a possibility of direct migration of dangerous substance into environment.

Progressive diagram no. 5: Schematic demonstration of analysed environmental compartments



Index in 5-degrees is attached to environmental compartments (surface water, groundwater, soil environment and biotic compartment). Result of assessment can be matrix, which illustrates which environmental compartment has what sort of index of vulnerability (1.–5.)



Evaluative symbols

I_{SW} Index of vulnerability of surface water
I_{UW} Index of vulnerability of groundwater
I_S Index of vulnerability of soil environment
I_B Index of vulnerability of biotic environmental compartment

3. Assessment of accidental consequence in environment

Synthesis of indexes of dangerousness and vulnerability: By interconnection of indexes (vulnerability of environment and dangerousness of substance for environment) are found single indexes (by synthesis), which inform about the dangerousness of concrete substance for assessed location.

X

= **H&V index**

Assessment of accidental consequence in environment: In this part of methodology it will come to estimate of category of accidental consequence on the environment. This estimate is realized for concrete environment and concrete substance in concrete quantity. Separately will be the extents of effects assessed for:

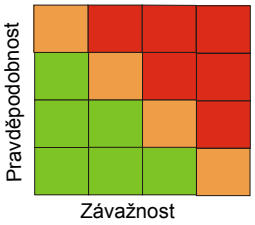
- toxic substance in surface water
- toxic substance in groundwater
- toxic substance in soil environment
- toxic substance for biotic environmental compartment

- flammable substance with impact on biotic environmental compartment

Category of accidental consequence (A – E):

A	inconsiderable impact
B	low impact
C	considerable impact
D	very considerable impact
E	maximal impact

H&V index X **Quantity** ⇨



4. Conclusion

The result of whole process is assessment of category of accidental consequence, otherwise assessment of extent of effects of released dangerous substance for surface water, groundwater, soil environment, biotic environmental compartment (according to chapter No. 3). Categories of consequence (A – E) are in combination with probability put into matrix, from which follows acceptability of impacts of potential accident.

The result of analysis are indexes of consequence of accidental impacts for environmental compartments, which make risk prioritisations and make decision, which from them are so consequence that it is important to do detail analysis. Detail risk analysis of accident with impact on environment is recommended to do in case of result category of accidental consequence is between D – E (with respect to probability of major accident). Detail analysis means mathematical modelling of contaminant effects in compartments of environment. Through mathematical model of contaminant spread we can judge the length of contaminated water flow, contaminated area on the level of stagnant surface water, ground water, eventually the quantity of contaminated soil.

VI.II SARA risk analysis for accidental releases

VTT and the Tampere University of Technology, together with the companies at five forest industry sites, developed a method for the management of accidental releases in the forest industry in a project during 1998-2000.

The aim of this method is to reduce the risk of environmental consequences of accidental releases to biological wastewater treatment plants, the atmosphere, watercourses, the soil and groundwater. According to the method, accidental releases are identified and assessed in group work. The group consists of plant personnel.

The procedure begins with collecting the factual information needed, e.g. the chemicals used, process equipments, maps of the plant area and sewer systems, data from previous accidental releases, previous risk analysis, etc.

The plant is divided into functional parts, e.g. storages, process areas, water treatment, yard, etc. Potential accidental releases are identified separately in each part.

By screening the chemicals such chemicals of the process that are harmless to the environment and to the wastewater treatment plant are identified. At the same time, chemicals that can be classified to be environmentally dangerous are recorded. The screening is based on the information obtained from the Chemical Safety Data Sheets and on the knowledge of the operators and chemists at the plant.

Thirdly, an acitivity and process model of each functional part is created based on a special form (see the activity and process model Figure No. 6). This is done in a group that consists of plant personnel, e.g. plant foreman, operator, instrument man, and maintenance man.

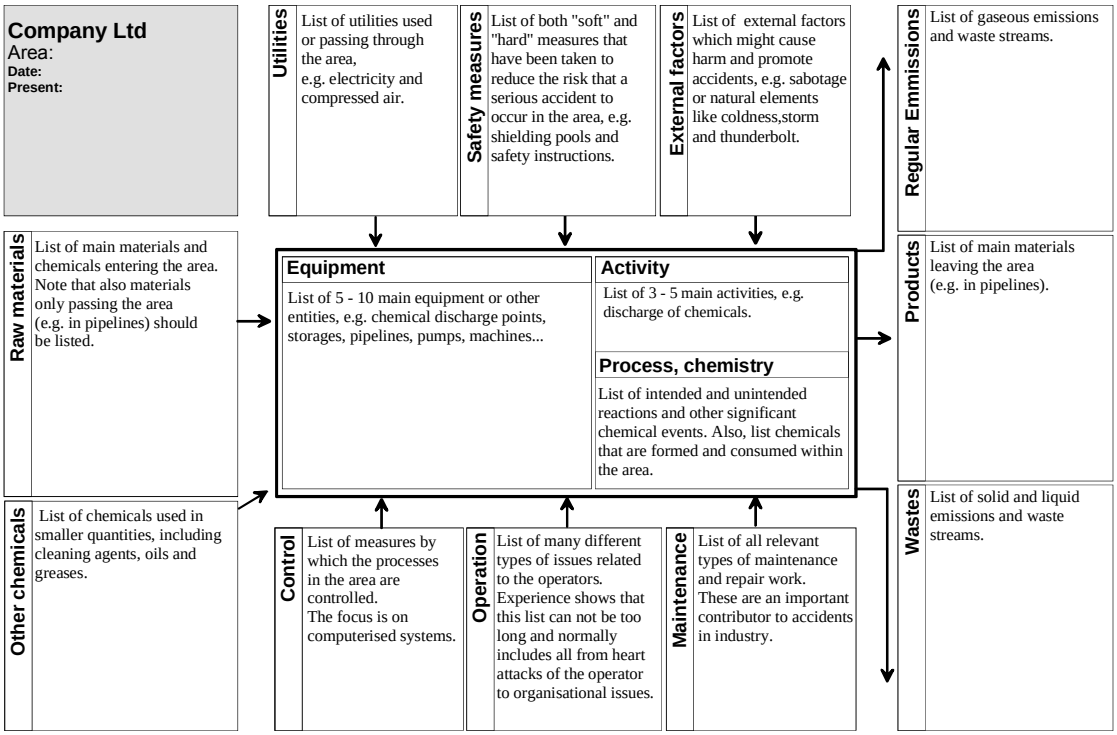


Figure No. 6: An activity and process model

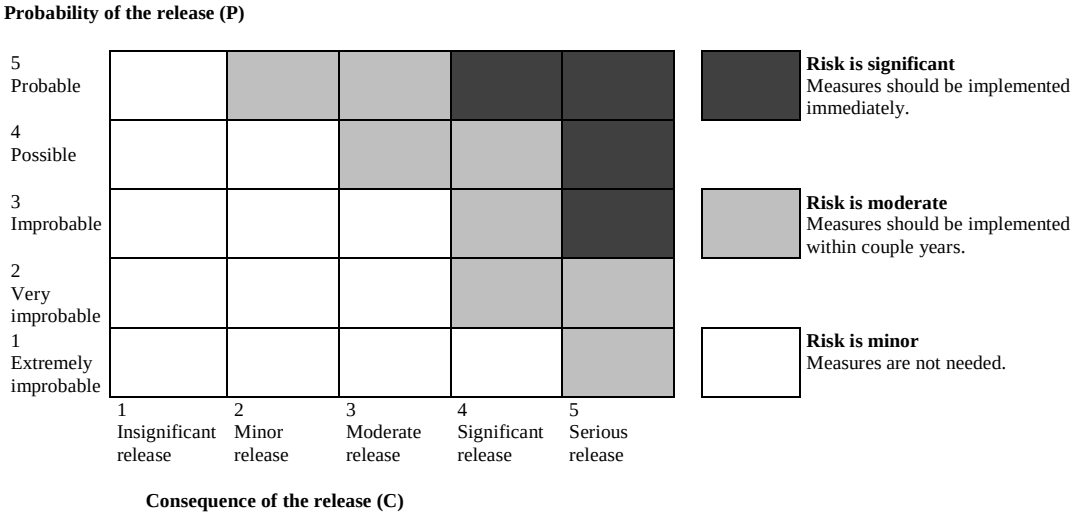
The group identifies potential accidental releases based on the activity and process model. Therefore, this model acts as a checklist for the identification process. Each point is covered by asking, e.g. What might happen? Is there a potential for an accidental release? etc.

Identified potential releases are recorded on a form.

The assessment of the effects of accidental releases is case-specific. Different kinds of consequence analysis and tests can be used, e.g. tests on the activated sludge of a biological wastewater treatment plant. This test gives information concerning the capacity of micro-organisms to treat potential releases.

The identified potential accidental releases are analysed by estimating the probability and consequence of each case. The probability and consequences are given on a scale from 1-5, and the corresponding risks are classified as significant, moderate and minor (Figure No. 7).

Figure No. 7: A risk matrix



At the end of the analysis, proposals for actions to improve safety at the plant are created and a report is written.

VI.III Methodology for the performance of Environmental Risk Assessment

It does not deal with the risk or damage arising from normal operating conditions or from intentional events as a result of which an accident might occur. For example, the guideline does not cover the risk or damage caused by a continuous emission or release resulting from normal operating conditions.

As regards damage arising as a result of a severe accident, the guideline considers the effects of the toxicity inherent to the hazardous substances, or mixtures thereof, released directly during the accident. Also considered are the reaction products into which these substances or mixtures are transformed in the accident scenario.

It focuses on the most immediate effects for natural wealth, the historic heritage and by extension the socio-economic environment that might arise as a result of previous alteration of

the ecosystem. For example, alterations to fishing, landscape or forestry resources as a result of damage to the ecosystem might give rise to a series of repercussions and disturbances on the socio-economic environment of the affected area, translated into a monetary cost to the economic sectors depending directly on the affected resource.

It is not the objective of the present guideline to describe the analytical methods relating to identification of the sources of risk themselves or failures associated with operability, since these are already sufficiently developed and no different characteristics are implied by the fact that we are dealing specifically with environmental risk.

The guideline focuses on the vulnerable recipients, providing a useful tool and methodologies allowing the intensity of the agent causing the risk (normally the concentration of a substance) to be related to environmental damage.

No consideration is given to quantification of environmental risk due to the degree of complexity associated with the process of modelling interactions between the agent(s) of risk and a complex ecosystem. This would make it necessary for so many simplifications and hypotheses in quantification that the practical results would involve a high degree of uncertainty.

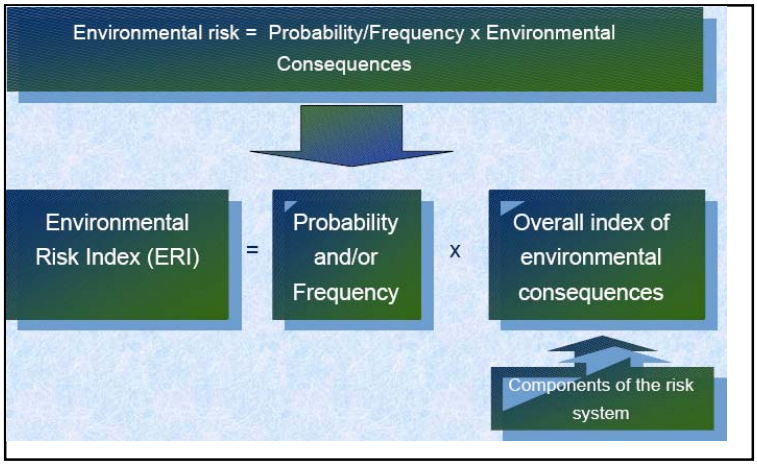
The development of the guideline takes into account the very existence of the information required to carry out the analysis and assessment of environmental risk, the ease with which it is accessed and its degree of detail for an affected industrialist.

It should be possible to estimate the vulnerability of the environment on the basis of the additional information existing and accessible, without the need to request information implying laborious and costly studies for the industry (e.g., inventories of the fauna, studies to determine the existence of endemic species in the area or calculation of the summer flows of surface waters), which although useful for risk analysis would in fact complicate the process.

It is considered that risk analysis should be based on the information existing at the time, making available to the party responsible for the establishment a protocol helping to obtain such information and process and interpret it but not to solve possible existing deficits in this context.

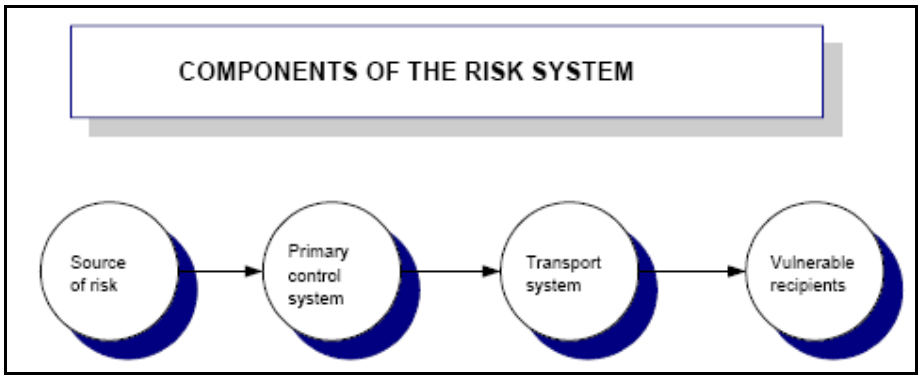
In this respect, the guideline should be a useful and practical tool facilitating and simplifying searches for the affected industrialist.

The Structure of environmental risk:



The methodology is based on the identification, characterisation and systematic assessment of each of the relevant components and factors of the risk system.

The risk system is conceived as comprising four basic components:



Sources of risk

Among other aspects the assessment should contemplate the potential hazard of the substance, the factors conditioning its environmental behaviour and the potential quantity involved.

Primary control systems

The primary control systems are the control equipment or measures implemented by the industrialist in order to maintain a given source of risk under permanent control, such that it does not significantly affect the environment. For each source of risk, the assessment should describe the control systems available and their efficiency, estimating the magnitude of the source of risk that might be reached by the medium and under what conditions.

Transport systems

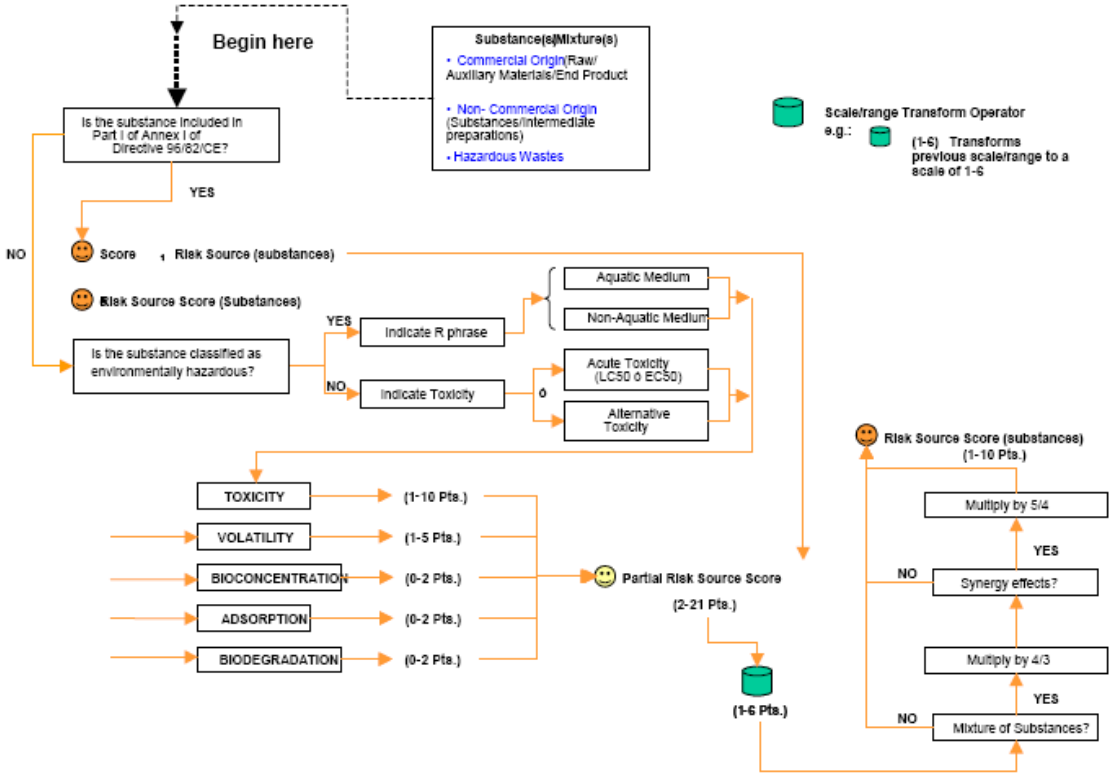
The assessment should describe in which cases the sources of risk might reach the recipient medium and estimate whether transport in this medium (air, surface water or groundwater, soil) might bring the source of risk into contact with the recipient, determining the magnitude of the possible impact.

Vulnerable recipients

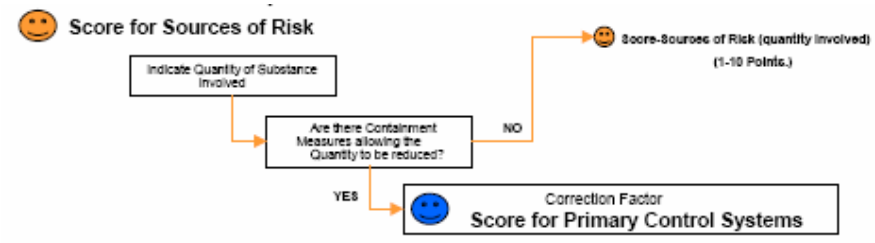
The assessment should include an appraisal of the natural environment, the socio-economic environment and the impact.

1) Sources of risk

Schematic representation of classification via filters for sources of risk-substances

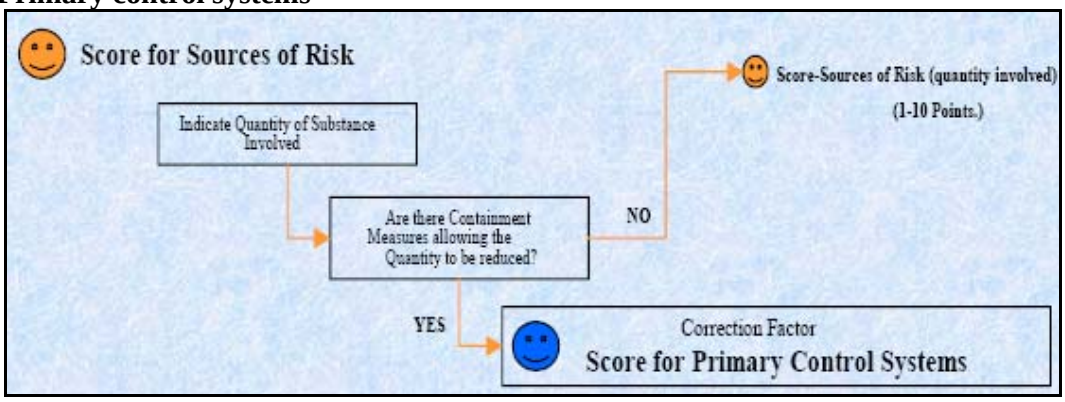


Partial schematic representation of classification via filters for sources of risk-quantity involved



These two scores are consolidated and scaled into final Score for Sources of Risk.

2) Primary control systems

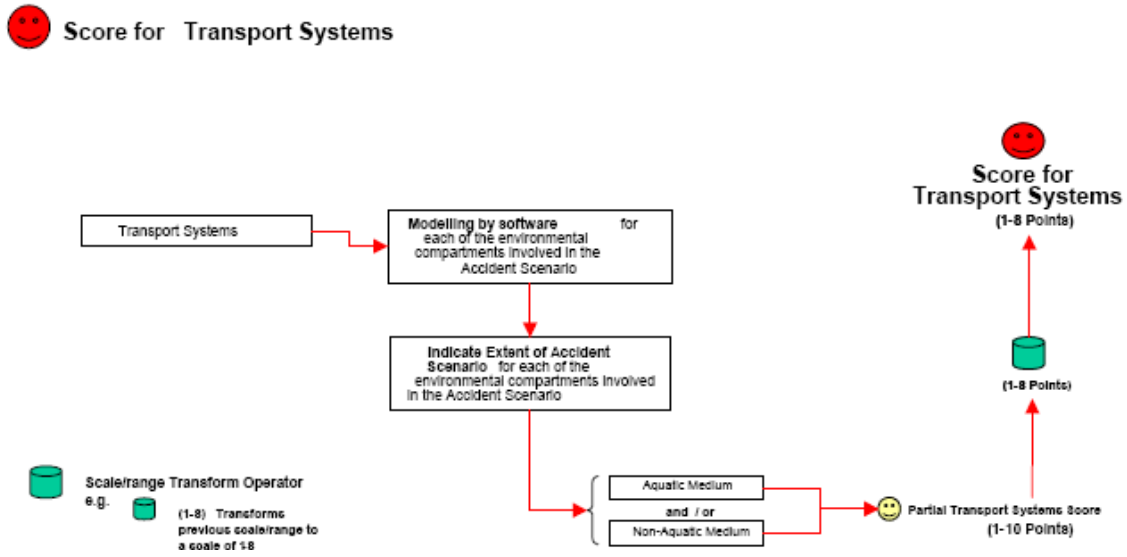


The sources of risk may be controlled by:

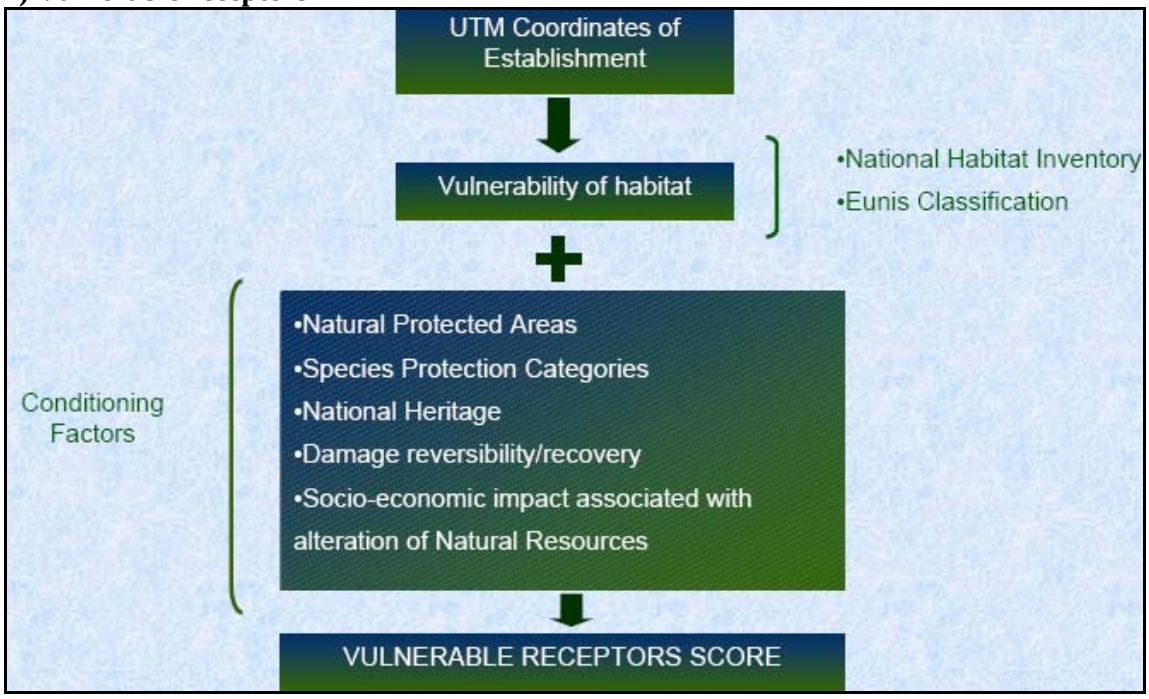
- components
- equipments
- systems

3) Transport systems

Transport systems are the links between sources of risk and vulnerable receptors. Its study through modelling software is essential to determinate magnitude of the possible impact.

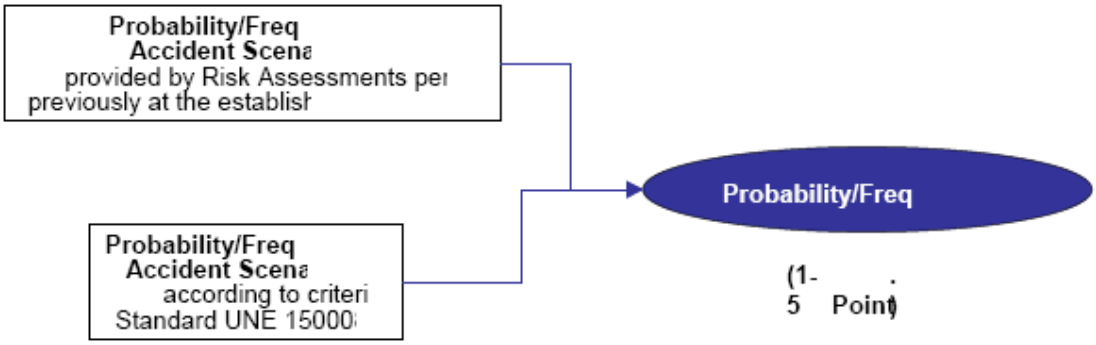


4) Vulnerable receptors



Probability/frequency factor:

Determination of the probability/frequency factor of an accident scenario



Probability/Frequency will be given by:

- Quantitative Risk Assessment (QRA)
- Orientate criteria based on the standard UNE 150008 EX "Environmental Risk Analysis and Assessment"

Evaluation and tolerability of environmental risk:

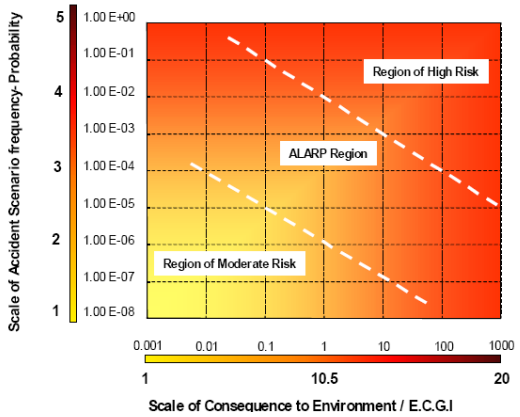
The process ends when each scenario identified has a probability/frequency and an overall index of environmental consequences associated with it, these jointly determining the value or index of environmental risk.

The scales of the graph have been completed with the ranges used by the methodology, with a view to illustrating the different areas or regions of environmental risk in which a given risk index might be located.

<u>The three regions of environmental risk are as follows:</u>

- Region of high risk. In this area risk reduction measures must be implemented regardless of the associated cost.
- Region ALARP (As low as reasonably practicable). The environmental risk bounded by this region, although tolerable, should be reduced to the lowest levels practicable, without incurring in disproportionate costs. The risk will be tolerable only if greater reductions were impracticable or could be achieved only through excessive costs, efforts or time.
- Region of moderate risk. The level of risk in this area is negligible and excessive costs are likely to be incurred to reduce it even further.

Environmental risk tolerability limits



VI.IV H1 Guidance – Environmental assessment and appraisal of BAT

H1 is a screening methodology for environmental impact assessment used in the UK for IPPC Directive. It was produced by UK regulators (including the Environment Agency for England and Wales) following consultation with industry, government departments and non-governmental organisations. It is not mandatory but is widely used.

It has been designed to provide:

- methods for quantifying environmental impacts to all media
- a method for calculating costs of environmental protection techniques
- guidelines on resolving cross media conflicts and making cost / benefit judgements

There are 6 modules in H1 as in table 1 below:

Module	Aim of the Module
1	Define the objective of the assessment and options to be considered
2	Quantify the emissions from each option
3	Quantify the environmental impacts resulting from the emissions
4	Compare options and rank in order of best overall environmental performance
5	Evaluate the costs to implement each option
6	Identify the option that represents the Best Available Technique, by balancing environmental benefits against costs

An Excel spreadsheet software tool accompanies the guidance. This can be used to input most of the data requirements perform calculations and present the environmental impact and cost information.

H1 was designed to consider planned releases not accidents. It uses simple standard transport models to determine the Predicted Environmental Concentrations (PECs) and these are compared against Environmental Assessment Levels (EALs). EALs are a set of defined environmental benchmarks which represent the maximum acceptable level of that substance to a receptor in the receiving medium. EALs for a range of substances have been defined and are generally based on prevention of harm to human and ecological receptors. The EAL is not considered to be a suitable benchmark to define a major accident within the Seveso II context.

H1 includes a sections on accidental releases (as required under the IPPC Directive) but this is limited to a qualitative treatment of the likelihood and impact of accidents. This is designed for option appraisal of new facilities only.

VI.V Guidance on the Environmental Risk Assessment Aspects of COMAH Safety Reports

The Environment Agency of England and Wales produced this guidance for the environmental risk assessment requirements of the Seveso II Directive.

The guidance proposes a similar approach to safety risk assessment. A 32 step methodology is put forward as in the table below:

Table: Proposed List of ERA Aspects

Stage	No.	Environmental Aspect	Requirement
Introduction	1.	Objectives	Adds clarity
	2.	Resources and planning for assessment	Adds clarity
	3.	Background and previous studies	Useful
	4.	Layout and contents of report	Important
Approach	5.	Overall approach and justification	Adds clarity
	6.	Study Scope	Adds clarity
Information for Risk Assessment	7.	Hazardous substances information	Essential
	8.	Site description	Essential
	9.	Environment description	Essential
Accident Initiators	10.	Hazard identification techniques	Essential
	11.	Initiator events/cause analysis	Essential
	12.	Accident phenomena	Essential
	13.	List of potential accident scenarios	Essential
	14.	Screening	Essential
Accident Frequency Analysis	15.	Approach and modelling information	Important
	16.	Frequency estimation techniques	Important
	17.	Onsite pathway analysis	Important
	18.	Accident elimination, prevention and control	Important
	19.	Screening	Important
Accident Consequences	20.	Approach and modelling information	Case-by-case
	21.	Offsite pathways analysis	Case-by-case
	22.	Hazard distances and other results	Case-by-case
	23.	Offsite emergency planning	Case-by-case
	24.	Screening	Case-by-case
Accident Impacts	25.	Approach and criteria	Case-by-case
	26.	Impacts to receptors	Case-by-case
Presentation of analysis/ Risk results	27.	Summary	Case-by-case
	28.	Data presentation	Case-by-case
	29.	Risk Acceptance Criteria	Case-by-case
	30.	Comparison of results with criteria	Case-by-case
	31.	Identification of risk management measures	Case-by-case

Stage	No.	Environmental Aspect	Requirement
	32.	Evaluation of measures	Case-by-case

The guidance recognises that the nature and variability of environmental risks at Seveso II establishments means that it is difficult to provide simple impact assessment levels to determine the potential impact of accidents. The guidance is non-prescriptive and contains descriptions of the principles and likely information requirements, accompanied by qualitative/descriptive criteria for assessing the adequacy of the assessment.

VII Difficulties and proposed recommendations

The workshop of Shape-Risk took place on the 12th of December, and the mid-term assessment on the 13th of December in Verneuil-en-Hallate, France. The co-ordinator's requirements on the questions concerning the WP5 topic, which should be responded during the workshop, were:

1. What are the raised problems?
2. What are the recommendations?
3. How have we disseminated information inside and outside the WP?
4. How are managed environmental accidents in Europe?
5. What are the European methodologies to assess environmental impacts of accidents?
6. What about the future of this WP?

The propositions (difficulties/advantages), which were discussed during the workshop, resulted in most cases from the meeting in Rome, were following:

- **There is at a moment not available really exact method for impact assessment of chemical accident in environment**

In the present time doesn't exist available exact method, which allows to assess the accident impacts in the environment. The problems come already in the choice of method, by which can be best affected all parts of environment, which can be impacted. Also the own process, outputs from risk analysis and their control are not always explicit. The reason is uncertainty of input data, variability of environment conditions and also complexity of environment in different countries of EU.

Some countries of EU don't have their own method, so they accept the approaches from other countries or they conform to general requirements of the SEVESO Directive. Among the most used methods for risk assessment in the environment at European level are:

- **H&V index** (analysis of accidental impacts with participation of dangerous substance) – Czech method
- **SARA risk analysis** (risk analysis for accidental releases) – Finnish method
- **Spanish Guide** (Guidance for process of environmental risk analysis) – Spanish method
- **H1 Guidance** (Guidance for environmental assessment and appraisal of BAT) – UK

Results of discussion/recommendations:

The purpose of WP5 discussion document was to collect and share information and references on existing methodologies for risk assessment of accidents with impact on the environment. The detailed evaluation and comparison of different methodologies was a too ambitious scope for our work; from the other hand, this could be an item to develop during future workshops.

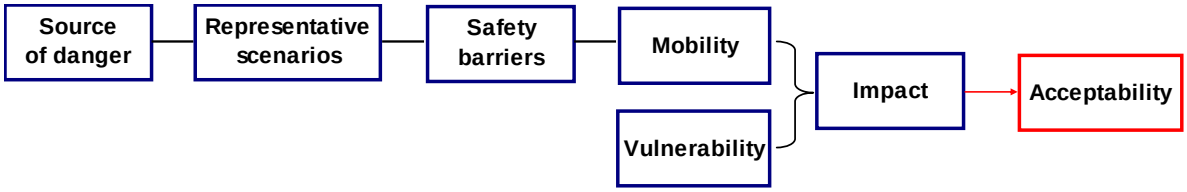
In future more effort could therefore be spent to:

- detailed evaluation and comparison of existing methodologies or the relevant comparative analysis,
- collecting information on the available software models,

- defining general principle of risk assessment methodologies: deterministic and/or probabilistic approach, qualitative/quantitative approach, use of compatibility/risk matrix etc,
- analyzing case-study,
- collecting input from industry concerning methodological approach internally recommended

  or also
- collecting lessons learned from past accident; collecting information on response and post-accident measures or evaluating socio-economic aspects.

The proposal of general principle of risk assessment with impacts on the environment. Basic flow chart of steps is presented below:



The prediction of impact of chemical accident to environment is complicated due to the variation of dangerous substances properties (toxicity, ecotoxicity, mobility etc.), actual meteorological and other conditions (climatic, hydrological, hydrogeological etc.) and time-depending vulnerability of individual environmental parts.

The blue-coloured charts present the technical part of assessment. The red/coloured chart, which presents the acceptability of impact on the environment, is the political decision, different in various countries.

Results of discussion/recommendations:

It could be useful analyses more in depth the different kind of safety barriers in use and their efficiency and cost.

From the Italian industry came out a request to clearly define at legislative level the methodologies for the environmental impact assessment.

Also was here suggested a proposal to develop a “simplified instruments”, such as a check-list, to evaluate the impact on the environment of potential accident, in order to support public authorities involved in inspection activity.

In Finland have a national research project YMPÄRI, which is aimed to create a criteria for the environmental risk analysis of accidental emissions at industrial plants. The criterion is a guide which helps industry and consultants to perform a risk analysis, and the authorities to inspect and accept the analysis as a part of the environmental permission procedure. The criteria will be completed by the end of 2005. Within this project, were organised three workshops where authorities, representatives of the industry and consultants have discussed, exchanged opinions, etc. regarding the management of environmental accidents and environmental risk analysis as a tool. These networking workshops provide material for the criterion of environmental risk analysis.

- **No clear algorithm does exist for relation between substance quantity involved in accident and impacts extend**

There is no clear algorithm for calculation of impacts extend on the base of released substance quantity. The main reason is the complexity of environment and variability of conditions (e.g. same environment, same quantity of released substance, but different seasons. The reason is also the current state of the art of science.

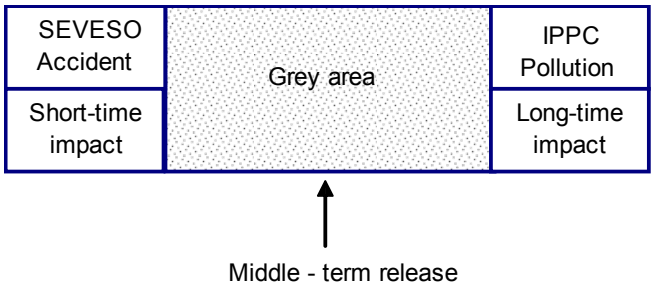
Results of discussion/recommendations:

This is the question of future scientific research, when the multidisciplinary team of experts should participate in the solution.

More effort, at research level, is required to defining the threshold values for each environmental sector potentially affected by accident and to know the behavior of receptors for a given dose of dangerous substances. This is also important in order to establishing acceptability criteria to be adopted for risk assessment.

- **No clear borderline between the short-time accident and long-time pollution**

There is at a moment no clear borderline in the definitions of the short-time accident and long-time pollution in view of duration of accidental release into environment. Also from the point of view of impact assessment (duration of release and impact development) is the situation the same, where IPPC deals with long-time impact and SEVESO deals with the short-time impact.



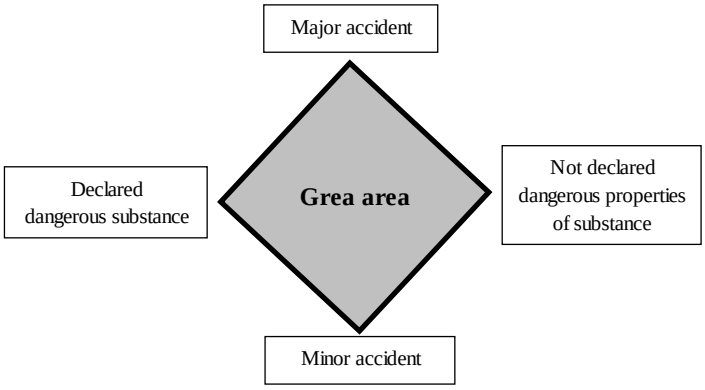
Results of discussion/recommendations:

There is the need to eliminate the grey-coloured area by finding the tools, which would solve this grey area and would be useful for pollutions and accidents too. The grey area has two view-points: the legislative (under which Directive should be included, common management) and research (methods).

- The legislative solution could be supported by results of WP1 discussion on the integration between IPPC and SEVESO Directive both a procedural and content level. Primarily it should be strengthened at national level by cooperation between different authorities involved in the control of industrial sectors under the scope of both Directives.
- IPPC deals mostly with continual planned and certain impacts (i.e non accident) against an acceptability threshold whereas Seveso II deals with accident impacts against a non-acceptable threshold. You can use the same broad methods but need different thinking on acceptability.

- **No clear difference between the SEVESO major accident and all environmental accidents caused by non-SEVESO classified substances.**

Major accident (in the sense of extend of consequences) can cause also non-dangerous substances (no-classified in SEVESO Directive, without corresponding R-phrases). The impact on the environment can be the worse than in case of dangerous substance. The example can be here the fire in Bartoline site from 23rd of May 2003.



Results of discussion/recommendations:

Substances which are not classified as dangerous can cause serious consequences, for example by high BOD and consequent change from aerobic to anaerobic conditions.

One of the approaches for the solution of this problem could be the collection of more data on the lessons learned from past accident; concerning the impact on the environment of different substances. The researchers should take into account the continuous updating of chemical substances classification and its relative implementation in the legislation in force.

Another approach for the solution is to define the limits for not declared dangerous properties of substance. How followed from the discussion, this approach will be not only difficult, but also time-consuming and expensive. There is a need to research, to investigate to the future.

VIII Research and development needs

At present, there is a gap between needs of evaluation of possible impact of chemical accident on environment and lack of functioning tools for it. The most frequent method of evaluation of accidental environmental impact is simple expert judgment, which can be non-coherent and even contradictory when different experts are asked. The basic need is further research of impact of short-time and high-concentration exposure on various environment compartments including lessons learned from chemical accidents including mobility of pollutants in environment.

Although there are existing methods for long period pollution by relatively low concentrations, the understanding of transient part between accidental (acute) exposure and pollution (chronic) exposure is missing and deeper understanding of this transient part is important and demands research.

As shown by various accidents with environmental impact, not only priority pollutants but also other compounds and preparations can cause serious environmental consequences, i.e. by high BOD or by changing pH of water. This topic is so important, that it had been discussed at 14th CCA in Buxton (2005). Also in this domain, research is necessary.

For development, an important is the need of harmonized generally acceptable tool for environmental impacts of chemical accidents, based for example on similar platform as project ARAMIS. An importance of harmonised approach increases in cases where possible transboundary effects are possible.

IX Annex

Annex No. 1: WP5 working groups at national levels

STATE ADMINISTRATION	
Czech Republic	
Ministry of Environment	karel_blaha@env.cz pavel_forint@env.cz
VUBP - Occupational Safety Research Institute (Professional support of state administration in SEVESO)	malyS@vubp-praha.cz prazakova@vubp-praha.cz
Ministry of the Interior	michal.valik@grh.izscr.cz
Czech Environmental Inspection	benes@cizp.cz pazourova@cizp.cz
Cenia – Czech Environmental Information Agency (Professional support of state administration in IPPC)	jan.prasek@cenia.cz
Finland	
Ministry of the environment http://www.ymparisto.fi	miliza.malmelin@ymparisto.fi risto.kuusisto@ymparisto.fi
Finnish environment institute	jyri.seppala@ymparisto.fi pirkko.kekoni@ymparisto.fi
Finnish safety technology authority	mirja.palmen@tukes.fi leena.ahonen@tukes.fi
Ministry of social affairs and health	hannu.alen@stm.vn.fi
Italy	
Italian Ministry of Environment and Protection of Territory ISPESL (Italian Authority for Health and Safety at work) APAT (National Environmental Protection Agency) Italian Ministry of Interior – National Fire Brigade	www.minambiente.it www.ispesl.it www.apat.gov.it www.vigilfuoco.it
England and Wales	
The Environment Agency of England and Wales	andrew.hitchings@environment-agency.gov.uk

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Department of crisis management	rudolf.broulik@kraj-lbc.cz katerina.tokova@kraj-lbc.cz adam.hendrych@cityofprague.cz
Department of prefect office	robert.pekaj@kr-zlinsky.cz
Finland	
Regional environment centre of Pirkanmaa Western Finland permit authority	merja.manninen@ymparisto.fi lea.siivola@ymparisto.fi
Belgium	
Ministère de la Région wallonne – DGRNE – DPA – Cellule RAM Ministère de la Région wallonne – DGRNE – DCE	Em.lheureux@mrc.wallonie.be M.Petitjean@mrw.wallonie.be

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UPM-Kymmene	henrik.diesen@upm-kymmene.com
Italy	
Chemical industries association Oil industries association	www.federchimica.it www.unionepetrolifera.it
Belgium	
Prayon	Mr Geoffroy Verjus 04 273 96 11
UCB	Mr Gildo Aromatorio 02 386 37 68

Annex No. 2: WP5 working groups at international levels

CCA members (actively participating)	
Espana	General Directorate of Emergencies and Civil Protection agarces@procivil.mir.es
Switzerland	Swiss Agency for Environment, Forest and Lanscape bernard.gay@buwal.admin.ch
Italy	APAT (National Environmental Protection Agency) ricchiuti@apat.it ISPESL (Italian Authority for Health and Safety at work) www.ispesl.it Italian Ministry of Environment and Protection of Territory www.minambiente.it Italian Ministry of Interior – National Fire Brigade www.vigilfuoco.it
Slovakia	Ministry of Environment trcka.tomas@enviro.gov.sk
England and Wales	The Environment Agency of England and Wales andrew.hitchings@environment-agency.gov.uk
Sweden	Swedish Rescue Services Agency helena.nasslander@srv.se
Finland	Ministry of the Environment miliza.malmelin@ymparisto.fi Safety Technology Authority leena.ahonen@tukes.fi

Annex No. 3: Members of international network specialized

Members of international network specialized on the transfer of know-how in management of environmental accidents	
Czech Republic	
Ministry of Environment Department of environmental hazards	karel_blaha@env.cz pavel_forint@env.cz
VUBP - Occupational Safety Research Institute (Professional support of state administration in SEVESO) Prevention of major accidents	malyS@vubp-praha.cz prazakova@vubp-praha.cz
Ministry of the Interior Fire rescue company	michal.valik@grh.izscr.cz
Czech Environmental Inspection Department of water prevention	benes@cizp.cz pazourova@cizp.cz
Cenia – Czech Environmental Information Agency (Professional support of state administration in IPPC) Integrated prevention	jan.prasek@cenia.cz
Labrisk Laboratory of Risk Research and Management	labrisk@vsb.cz
Finland	
Ministry of the environment	miliza.malmelin@ymparisto.fi
Safety Technology Authority (TUKES)	leena.ahonen@tukes.fi
Environmental Risk Assessment Centre (ERAC)	kari.paakkonen@gtk.fi
VTT	nina.wessberg@vtt.fi
The Finnish Risk Analysis Society	http://www.vtt.fi/tuo/44/co/riskianalyysiseura/
Tampere University of Technology	http://turva.me.tut.fi/english/indexeng.html
Italy	
Italian Ministry of Environment and Protection of Territory	www.minambiente.it
ISPESL (Italian Authority for Health and Safety at work)	www.ispesl.it

APAT (National Environmental Protection Agency)	www.apat.gov.it
Italian Ministry of Interior – National Fire Brigade	www.vigilfuoco.it
Italian Civil Protection	www.protezionecivile.it
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The Environment Agency of England and Wales	andrew.hitchings@environment-agency.gov.uk

Annex No. 4: The current situation in some countries of the EU

Czech Republic:

The requirements of the IPPC and SEVESO Directives have been implemented in Czech Republic by different regulation:

- IPPC Directive by Czech Act No. 76/2002 of integrated pollution prevention and control, of integrated pollution register and of change some acts (**Act of integrated prevention**).
- SEVESO II Directive by Czech Act No. 353/1999 on the prevention of major accidents caused by selected dangerous chemical substances and chemical preparations (**Act on the prevention of major accidents**).

The requirement of the assessment of chemical accident impacts on environment is involved in IPPC and SEVESO implementation and in some next Czech decrees too:

- Act No. 100/2001 about risk assessment to environment and about change some acts (**Act of risk assessment to environment**)
- Act No. 254/2001 about water and change some acts (**Act of water**)
- Act No. 86/2002 about the protection of air and about change of some acts (**Act of air protection**)

Act of integrated prevention doesn't define the term accident in environment and it only refers to the Act on the prevention of major accidents where the clear definition of major accident is. This is intend as an extraordinary, partly or completely uncontrollable event that is limited in space and time, for example a major emission, fire, or explosion, that has occurred or whose occurrence is imminent in connection with the use of the establishment or installation, in which the dangerous substance is produced, processed, used, transported or stored, and that leads to serious damage or danger to the lives and health of human beings, domestic animals, or the environment or to property damage that exceeds the limits set forth in Annex No. 3 to this Act.

The others decrees where is the definition lighted are:

- Act of water
- Act of environment (defined only the term of ecological damage)
- Act No. 239/2000 about integrated rescue system and about change of some acts

Difference between pollution and accident is not involved in the acts together:

- Act of integrated prevention defines only pollution of human activity
- Act on the prevention of major accidents defines especially the term of major accident
- Act of air prevention defines the air pollution
- Act of water distinguishes both conceptions
- Act of environment defines the environmental pollution

There isn't concrete way of risk assessment of chemical accidents defined in our legislation. Analysis and risk assessment is done especially for purposes of processing of safety documentations. For this purpose are recommended two methodologies in the Czech

Republic. Then by approving of safety documentations are used methodologies approved or is given the requirement on completion.

The assessing parts of environment are:

- Act of integrated prevention assessed end pollutions to all parts of environment (surface water, groundwater, soil, air, and biota).
- Act on the prevention of major accidents doesn't differentiate single parts of the environment. The difference is then among individual methodologies for risk assessment on the environment.

Legislatively recommended methodologies for risk assessing to environment are:

- H&V index (especially we use this methodology). There are not quantified the impacts in this index method. The result of whole process is assessment of category of accidental consequence (A – E) in combination with probability. They are put into matrix, from which follows acceptability of impacts of potential accident.
- ENVITech03

The requirements on outputs of analysis are: scenario of accidents, risk acceptability and the extent of insurance. The most often are using mathematic methods in combination with expert judgement.

The obligations for qualified realization of risk analysis:

- IPPC: it is necessary to have a certification. The Ministry of environment ensures the expert assistance through the allowance organization, which is under control of Ministry. The allowance organization regards as competent person.
- SEVESO: it isn't necessary to have a certification.
- Act of risk assessment to environment
- Act of water
- Act of atmosphere prevention

necessary to have authorization licence

The control of risk analysis is submitted according to *Act of integrated prevention* to Regional authority, which gives the decision of approving the integrated permission. According to Act on the prevention of major accidents is risk analysis controlled in process of approving safety document. The authorities, who concretely control the risk analysis, are: Occupational Safety Research Institute as professional support of Ministry of the environment, regional authorities (they give the decision of approving the safety document) and state bodies, who going for integrated controls according to this Act.

Approving authority for using of risk analysis is in each region. Regional authority has the competence according to Act on the prevention of major accidents to approve the safety document, where one of the important parts is risk analysis. When is the safety document approved, then becomes the risk analysis acceptable for next other use.

The way of risk analysis use for crisis management of enterprise and area is for internal and external emergency plans.

Finland:

The requirements of the IPPC and SEVESO Directives have been implemented in Finland by different regulation:

- IPPC Directive by Environmental Protection Act 86/2000 and Environmental Protection Decree 169/2000
- SEVESO II Directive by Decree 59/1999 (only in Finnish: "Asetus vaarallisten kemikaalien teollisesta kasittelysta ja varastoinnista", a new version of the Decree is under preparation in the Finnish Safety Technology Authority, the preparation will be finished during 2005)

The requirement of the assessment of chemical accident impacts on environment is involved in both legislatives:

- IPPC: in general the environmental permission application shall include an assessment of the risk of the action, actions concerning the prevention of accidents, and actions under disturbance situations. In the permission the authority can ask the enterprise to do more detailed environmental risk assessment or analysis. The criteria of such an assessment or analysis are currently being prepared in a project led by VTT. The criteria of environmental risk assessment or analysis will be finished by the end of 2005.
- SEVESO: in the Major Accident Prevention Policy (MAPP) and in the Safety Report it is required to assess the consequences of identified potential accidents (extent and severity).

There is not clear the difference between pollution and accident in the legislation. Only a major accident is defined. And no recommended the concrete way of risk assessment of chemical accident in environment too.

Assessed parts of environment:

- surface water
- groundwater
- wastewater to water treatment systems (biological treatment)
- soil
- air
- biota

Using methodologies for assessing:

- **IPPC**: Potential Problem Analysis (PPA)

  Reaction Matrix

  SARA (a risk analysis method based on action modelling)

  SME Risk Management Tool Kit

  Consequence analysis and modelling

- **SEVESO**: HAZOP

  Action Error Analysis (AEA)

  HAZSCAN (Hazard Scenario Analysis)

  Consequence analysis and modelling

The assessing is mostly semi-quantitative (qualitative disturbance and accident description, probability and consequence classification), consequence analysis might be quantitative.

The output of analysis is mostly judgement of expert teams. Methods based on calculations are used in consequence analysis.

In light of IPPC and SEVESO, there is not necessary to have a certification for qualified realisation of risk analysis. The Finnish Risk Analysis Society is currently discussing who would be best possible and perhaps authorised risk analysis leader – by whom it would be acceptable to perform any risk analyses.

The risk analyses are approved and controlled:

- IPPC: by Environmental Authority (Permit Authorities and Regional Environment Centres)
- SEVESO: Safety Technology Authority (TUKES)
- OTHER: unofficially, for instance, VTT discusses about the quality of risk analysis with the authorities. On a more general level, e.g. the Finnish Risk Analysis Society promotes the development and use of risk analysis methods.

The way of risk analysis use for land-use planning is none at the moment, but new version of the Decree 59 (in preparation at the Finnish Safety Technology Authority – TUKES, to be finalised during 2005) will define that identified potential accidents should be taken into consideration in land-use planning.

The way of risk analysis use for crisis management of enterprise and area is internal and external emergency plan.

Italy:

The requirements of the IPPC and SEVESO Directives have been implemented in Italy by different regulation:

- IPPC Directive by Legislative Decree n. 59 of 18 February 2005
- SEVESO II Directive 96/82/CE by Legislative Decree n. 334 of 17 august 1999

For the establishments subject to the Lgs. D. 334/99, the IPPC procedures must consider the results of the SEVESO requirements for granting of the permit.

The Decree n. 59 does not provides for any obligations for accidental risk assessment on the environment. Art. 3 of D. n. 59 only require adopting any measures to prevent accidents and to limit their consequences.

The aim of the SEVESO II Directive has been completely transposed in art.1 of Legislative Decree n. 334 and art. 5 introduce an obligation for the operator to take all measures necessary to prevent major accidents and to limit their consequences for man and the

environment. There are some indications concerning impacted area for assessing immediate damage to the environment in case of accident:

Permanent or long term damage to terrestrial habitats:

- 0,5 ha or more of a habitat of environmental or conservation importance protected by legislation;
- 10 or more hectares of more widespread habitat, including agricultural land,

Significant or log-term damage to freshwater and marine habitats

- 10 km or more of river and canal,
- 1 ha or more of a lake or pond,
- 2 ha or more of delta,
- 2 ha or more of a coastline or open sea,

Significant damage to an aquifer or underground water

- 1 ha or more

The difference between pollution and accident is defined in Legislative separately:

- the Legislative Decree n. 59 defines the pollution: the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment
- the Legislative Decree 334 defines the major accident: the uncontrolled development occurring in industrial activities which could determine damage to the environment. As far as the major accident is concerned, the Legislative Decree n. 334 does not include any indications regarding the concrete way of assessing chemical accident in environment.

Assessing parts of environment (limits are previously indicated):

- terrestrial habitat
- freshwater and marine habitat
- aquifer or underground water

Using methodologies for environment assessing:

- APAT – semi-quantitative methodology for liquid hydrocarbons (addressed to the public Authorities in order to identify critical situations for which a deeper analysis or further technical measures are required). This methodology considers the release of R50 and R51/53 dangerous substances with infiltration in the soil. It is still in the validation process assessment at the moment.
- EPA models (HSSM)
- EIA Index

Evaluation of risk analysis (for man and environment) contained in the Safety Report is carried out by a Regional Technical Committee constituted by inspectors coming from

different bodies and authorities, i.e. Fire Brigade, ISPESL, Regional Environmental Protection Agency, Regions, Provinces, Municipalities.

At the end of the safety report assessment the Regional Technical Committee emits a technical advice which is binding for the operator.

The Italian decree on land-use planning, issued pursuant to the provisions of the Lgs. D. 334/99, introduces criteria to evaluate the environmental risk, on the base of which there are two degrees of environmental damage:

- Significant damage (restoration and reclamation take < 2 years)
- Relevant damage (restoration and reclamation take > 2 years)

This decree contains a matrix for the territorial comp atibility evaluation based on event frequencies and indication of typologies of building allowed in four consequences zones bound to four endpoints (high lethality, low lethality, irreversible damage, reversible damage).

Authority approves using of risk analysis is the prefect of the province where the establishment is located (on the basis of the conclusions of Authorities charged of safety reports evaluation). Conclusions must include reference scenarios derived from risk analysis.

England and Wales:

The requirements of the IPPC and SEVESO Directives have been implemented in UK by different regulation:

- IPPC Directive by Decree: The Pollution Prevention and Control (PPC) Act (1999) and the Pollution Prevention and Control (PPC) Regulations (2000)
- SEVESO II Directive by Decree: The Control of Major Accident Hazards Regulations (1999) and the Control of Major Accident Hazard Amendment Regulations (2005)

Pollution is defined in PPC as “emissions as a result of human activity which may be harmful to human health or the quality of the environment, cause offence to human senses, result in damage to material property, or impair or interfere with amentities and other legitimate use of the environment; and

“Pollutant” means any substance, vibration, heat or noise released as a result of such an emission which may have such an effect.

Major accident is defined in COMAH as “as an uncontrolled development involving a dangerous substance leading to serious danger to people or the environment.” Accident is not defined under PPC. A guidance document on Major Accident to the Environment (MATTEs) provided additional qualitative and quantitative information on defining major accidents. This document defines major accidents both in terms of events and impacts on the environment.

PPC requires (for part A installations only) that ‘the necessary measures are taken to prevent accidents and limit their consequences’. Applications for IPPC permits must consider potential accidents. For low risk installations the Competent Authority expects to see adherence to specified Pollution Prevention Guidance Notes but does not necessarily require a detailed site specific risk assessment. For medium risk sites a site specific risk assessment (frequency and impact) is required but this is normally limited to a qualitative approach according to the H1 Guidance document. High risk sites are normally those also subject to the Seveso legislation.

COMAH requires consideration of the environmental impact of accidents. Guidance is provided in Guidance on Environmental Risk Assessment for COMAH. This is non mandatory. Large companies use their own methodologies. Usually the assessment is variable covering all 3 types (quantitative, semi-quantitative, and qualitative). Fully quantified risk assessments are rare and are under-mined because of the paucity of environmental impact data at major accident thresholds. It isn't necessary to have a certification to undertake risk assessments. Risk assessments submitted in Safety Reports are verified by the regulators.

The regulators assess the safety report to ensure suitable emergency planning scenarios are developed. The regulators also inspect internal emergency plans but there is no specific requirement for those plans to be submitted to the regulators and verified as with Safety Reports. Plans are tested at least every 3 years.

Local Authorities draw-up the external emergency plan in consultation with stakeholders. The plan is submitted to the regulators for a simple screen that it contains the necessary information – this is not an assessment as with safety report. The plans are tested every 3 years.

Local authorities produce external emergency plans. They are checked by the regulators to ensure compliance with the requirements of regulations but are not specifically verified.

Using of land-use planning controls is mostly based upon human safety considerations not environmental.