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IMPLEMENTING ART.12 OF THE SEVESO II DIRECTIVE:

Overview of Roadmaps For Land-Use Planning In Selected Member States

Edited by

Claudia Basta [1], Michael Struckl [2] and Michalis Christou [2]

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[1] *Delft University of Technology, Civil Engineer Faculty, Section of Material Science and Sustainable Construction, Stevinweg 1, 5048 GA Delft, The Netherlands*

[2] *Major Accidents Hazards Bureau (MAHB), Traceability Risk and Vulnerability Assessment Unit, Institute for the Protection and Security of the Citizen*

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European Commission
Joint Research Centre
Institute for the Protection and Security of the Citizen

Contact information
Address: via E. Fermi 2749 21027 Ispra (Va), Italy
E-mail: michail.christou@jrc.it
Tel.: +390332789516
Fax: +390332789007

http://ipsc.jrc.ec.europa.eu/
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EXECUTIVE SUMMARY

Implementing Art 12 of Directive Seveso II: summary of findings

Context

The Joint Research Centre of the European Commission is responsible for the coordination of the work of the European Working Group on Land Use Planning (hereinafter: EWGLUP), whose mandate is the development of Guidelines[1] for the implementation of Art 12 of the Seveso II Directive as amended by Directive 2003/105/EC. These Guidelines, developed by the EWGLUP and agreed by the Member States at the 16th meeting of the Committee of Competent Authorities responsible for the implementation of the Seveso Directive (Porvoo, October 2006), were adopted by the European Commission on 7 June 2007[2].

A preliminary research, exploring the state-of art of the implementation of Art 12 within the 25 Member States (MS) was conducted in 2004 by the Major Accident Hazard Bureau of JRC in the form of a questionnaire-based survey. Final results were collected, analysed and finally updated up to spring 2007. A group of MS – the Netherlands, Italy, France, Germany and the United Kingdom – was selected for further analysis and invited to comment and revise the result of the investigation.

Aim

The European Working Group on Land-Use Planning has, in addition to the development of Guidelines for implementation of Article 12 of the Seveso II Directive, as amended by Directive 105/2003/EC, taken part at the development of this document as a supporting tool addressing the issue of LUP in the context of hazardous facilities. The document provides supplementary information material describing in detail "good LUP practices" available within selected Member States and it has a twofold objective. Firstly, it reports the results of the survey concerning "good practice" for LUP in the context of the Seveso II. Secondly, it proposes implementation *Roadmaps* fulfilling Art. 12 requirements. In that context it should be noted that its character is purely *descriptive and informative* and it cannot be used for guidance or normative purposes. At the same time, it is believed that the structured information provided can substantially help the Seveso competent authorities and planning authorities to deal with the land-use planning issue. The document is therefore published in the form of JRC Technical Report.

Key challenges and results

The MAHB survey on which this document is based was used to outline the state-of-art of the implementation of Art 12 of Directive Seveso II within MS practices. Methodological differences and procedural characteristics of decisional processes "bridging the gap" between risk analysis and LUP were considered useful to inform the elaboration of the forthcoming Guidelines for the implementation of Art 12. This document had also the separate aim of delivering "Implementation Roadmaps" fulfilling Art 12 requirements as developed in a selected group of MS. "Roadmaps" stands for the decisional route connecting the different options of risk assessment in land-use planning and procedural phases of decisions, and underlines the profusion of possibilities as developed in MS. In this respect, results of the subsequent comparative analysis different risk regulations led to:

1. the identification of four *different methodological approaches* to cope with the risk-in-LUP issue; methods were developed consistent with national regulatory, geographical, economical and societal backgrounds as well as the specific "accident history" (lessons learnt, multi-risks, national characters, etc) ;

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[1] Land Use Planning Guidelines in the Context of Article 12 of the Seveso II Directive 96/82/EC as amended by Directive 105/2003/EC, in the following text named "LUP Guidance".

[2] Commission Decision C(2007)2371

2. the description of *different procedural routes* connecting actors during decisional processes; in this respect, the assignment of roles and responsibilities lies in the pre-existing institutional engine as well as in national legal and cultural backgrounds (common law vs. civil law, participative processes vs. top-down processes, etc); and

3. the definition of a reference terminology for the issue of risk-in-LUP, with particular regard to the definition of *vulnerability* as a key element of planning evaluations within areas at risk.

A key challenge of the study was the inclusion of environmental vulnerability as an element of the concept. A general overview of methods and approaches was reported, together with the proposal of a set of general indicators assessing both urban and natural vulnerabilities. For the latter assessment being less developed in the European practices further research will be necessary.

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A. INTRODUCTION

I. Background and scope of the recommendations

The Control of Urbanization requirement stated in Article 12 of the "Seveso II" Directive (96/82/EC) and the mandate, for the European Commission, to elaborate by the end of 2006 guidelines for its implementation (1st amendment of the Directive, 2003/105/EC), underlined the need to define a set of guiding principles for "bridging the gap" between two traditionally independent domains: major accident risk assessment and land-use planning (LUP).

The strong inter-disciplinary and inter-sector character of this requirement, combining industrial and socio-environmental risk assessment in ideally one planning[3] intervention, represented a complex policy-formulation problem for Member States and the European Union. As a consequence, monitoring the status of the implementation of the Seveso II Directive within national regulations has been a central task for the Commission.

In the last ten years, due to the independence of Member States with regard to the implementation of Art 12, most MS have developed their own methodological and procedural approach without any reference to common guiding principles. The matter of "risk in land-use planning" has therefore a strictly national character. From the European regulatory perspective, a survey on national practices is, consequently, regarded as a necessary preliminary to any supra-national recommendation. Several surveys and monitoring procedures on the transposition and implementation of the Seveso II were conducted in the period between 1997 and 2004. The official three-yearly monitoring activity, managed by DG ENV, examined the transposition and the implementation of the Directive within national legislation and practices, but to date has not covered land-use planning issues. Based on questionnaires, as required by specific Commission Decisions, it covered the periods of 1997-1999, 2000-2002, and 2003-2005. A Commission summary and the Member States' reports are available online[4]. The summary focuses only on a few key aspects like Emergency Planning, Information to the Public and Inspections, whereas further details on land-use-planning can be found in some national reports.

A recent survey, based on the submission of a new questionnaire to all the 25 national Competent Authorities and focusing on the implementation of the "control of urbanization" requirement in detail, was launched in the first half of 2004 by the Major Hazard Accident Bureau of the Joint Research Centre of the European Commission. The questionnaire was built upon the activities of the European Working Group for Land Use Planning (EWGLUP) coordinated by JRC. This document is based on the collection and elaboration of the results, which were periodically revised by the EWGLUP during sessions parallel to the elaboration of the Guidelines. First results of the survey were collected in the second half of 2004. The investigation comprised both a methodological and a procedural review of the state-of-art of the implementation of Art 12[5]. Besides the developed risk regulation policy, the questionnaire tried to shed light also on the operational "bridge" MS have created between the two banks of risk analysis and planning evaluation. In the last part, the questionnaire addressed also the matter of communication between these institutional players and civil society.

One outcome of this survey, represented by this document, is that of "*Roadmaps*". The term refers to the several possible "implementation routes" complying with the requirement of Article 12 and with the

[3] "Planning" has to be understood in the sense of as defined in Article 12 of the Seveso II Directive which includes "classical planning" as well as all other policies to implement the requirements of this article.
[4] Refer to www.europa.eu.int/comm/environment/seveso/index.htm. Note that the report doesn't refer specifically to Art 12, since it was addressed on the transposition of the text of the Directive within MS legislation.
[5] In this context "methodological" refers to the technical aspects of the risk assessment approach implemented in MS, while and "procedural" refers to the decision-making processes – i.e actors, competences, etc - enforcing its outputs in land-use decisions.

guiding principles as laid down in the LUP Guidance document that forms the basis for the implementation principles. The concept of Roadmaps represents the several routes “from risk to trust” reflecting the interaction among plant managers, risk analysts, planners, decision-makers and stakeholders. It is very important to stress that the use of the plural is to underline that there are several options the development of this route follows, depending on national regulatory and cultural backgrounds.

In the light of the transitional phase which characterises several national risk regulations, the reported analysis has been updated, after the first collection of questionnaires at the end of 2004, up to summer 2007. The Roadmaps, complementary to the LUP Guidance, are therefore one of the tools the Commission will furnish to Member States – with particular regard to new ones - in order to have generally adoptable guiding principles for the matter of risk in land-use planning, as well as a representative overview of the national policies and experiences from which the principles have been derived.

II. Risk in land-use planning: framing Art 12 within European environmental policies

According to several scholars[6], the industrialized nations entered a historical phase known as “risk society”, resulting from the increasing interaction between hazardous man-made activities and vulnerable human and environmental settlements. According to this view, risk is rewarded as an externality of the (western) adopted economical pattern and, consequently, as an intrinsic societal element. The societal response is the increased awareness about new risks: facilitated by the diffusion of media, terms such as risk prevention, industrial safety and, more recently, urban security, became of common use.

Regardless of the lively scientific debate on the applicability of this interpretation to current societal patterns[7], the existence, in industrialised countries, of a number of technological facilities posing some risks to the surrounding environment is evident. Together with the European and extra-European accident history of the last decades, this led to a reflection of policy-formulation. This short paragraph lists some of the more relevant European steps in this direction.

Together with risks related to major accidents (some of the most recent have been the accident in Enschede, in The Netherlands, in 2000; and the accident in Toulouse, France, in 2001), also other kinds of risk are regarded as central in land-use planning. Considering a chemical accident as a sort of “extraordinary” impact of a given industrial activity, also so-called ordinary impacts (like emissions and waste production) would represent, if not carefully regulated, an environmental risk factor. The appropriate separation of establishments, infrastructures and residential settlements in industrial areas is therefore a key prevention factor, which has to be taken into account in planning policies. This interface is, consequently, a relevant part of European environmental regulation. The main pieces of legislation are reported in the following paragraphs[8].

Implicitly concerned with the location of new industrial activities, the IPPC Directive of 1996[9] may be considered as the most relevant European Directive with respect to the Seveso II Directive. Although the main aim of the IPPC Directive is about minimising pollution from various point sources, in Article 3 the Directive requires “…*that installations are operated in such a way that…..the necessary measures*

[6] Refer, in particular, to Ulrich Beck, Risk Society: Towards a new Modernity, Sage Publications, London, 1992. First edition: 1986.

[7] Which have been, historically, always characterized by technological innovation and by the creation of new benefits coupled with risks; refer, among othersin this regard, to Leiss W., 1993.

[8] German observation over the independence of these regulations.

[9] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control, online at http://europa.eu.int/comm/environment/ippc/

are taken to prevent accidents and limit their consequences". All installations covered by *Annex I* of the Directive are required to obtain an authorization from the authorities in EU countries and, unless they have a permit, they are not allowed to operate. The permits must be based on the concept of Best Available Techniques (or BAT), which is defined in Article 2 of the Directive. However, it should be pointed out that the BAT requirements make only limited reference to safety issues, as the focus of the Directive is on pollution.

A second relevant Directive is the Environmental Impact Assessment (EIA) Directive, whose last amended by the Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003. The first version of the Directive dates from 1985. The EIA therefore has a long history, during which, over the last two decades, its development has been enriched, with inputs deriving from the adoption of the precautionary principles (1997) up to the Convention of Aarhus on the access to information and public participation to decision-making processes regarding environmental matters the Community signed in 1998[10]. Basically, the EIA procedure aims at ensuring that the effects (= impacts) of human projects on the environment are identified and assessed before the authorisations to projects are given. The EIA Directive outlines which project categories shall be made subject to an EIA, which procedure shall be followed and the content of the assessments. Obviously, next to the ordinary impacts of industrial activities, also the extraordinary impacts represented by accidents are considered. The EIA requires Member States to conduct case-by-case assessments procedures and/or to adopt thresholds and criteria for the quantification of consequences. One of the selection criteria for projects must be, in this sense, "[…] *the risk of accidents, having regard in particular to substances or technologies used*" (selection criteria 1 referred to Art 2); moreover, the location of projects must be assessed having regard to "[…] *The environmental sensitivity of geographical areas likely to be affected by projects, having regard, in particular, to: — the existing land use, — the relative abundance, quality and regenerative capacity of natural resources in the area, — the absorption capacity of the natural environment*" (selection criterion 2 referred to Art 4). Finally, the characteristics of the effects must be considered having regard, in particular, to "[…] — *the extent of the impact (geographical area and size of the affected population), — the transfrontier nature of the impact, — the magnitude and complexity of the impact, — the probability of the impact, — the duration, frequency and reversibility of the impact*" (selection criterion 3 referred to Art 4). In several countries, the evident overlap between the Seveso II and EIA procedures led to bringing the two regulations together; the documentation required for licensing procedures can be elaborated once. This synergy is precious in terms of timing and transparency of the licensing as well as for the safety management of plants.

A third relevant environmental EU Directive considering the risk as central for land-use planning purposes is the Strategic Environmental Assessment (SEA)[11]. Its aim is to ensure that environmental consequences of certain plans and programmes are identified and assessed during their preparation and before their adoption. The Directive promotes the assessment of the effects on the environment and on human health deriving from the adoption of certain plans and projects in a long-term, inter-generational perspective. A criterion for determining the likely significance of effects referred to in Article 3(5**)** is the preventive assessment of "[…] *the probability, duration, frequency and reversibility of the effects; the cumulative nature of the effects; the transboundary nature of the effects; the risks to human health or the environment (e.g. due to accidents); the magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected); the value and vulnerability of the area likely to be affected due to: - special natural characteristics or cultural heritage, - exceeded environmental quality*

[10] The complete text of the EIA Directive (85/337/EEC and successive versions) can be found at http://europa.eu.int/comm/environment/eia/eia-legalcontext.htm; the text and the comments on the UNECE Convention of Aarhus can be consulted at http://www.unece.org/env/pp/.

[11] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans & programmes on the environment, Journal of the European Community 21.7.2001, refer to: http://europa.eu.int/comm/environment/eia/sea-support.htm

standards or limit values, - intensive land-use; the effects on areas or landscapes which have a recognised national, Community or international protection status". Also here, the typical terminology of risk assessment works as a sub-text. As in the case of the Seveso II Directive, criteria and indicators for risk estimation are to be defined by Member States. This relevant presence of the theme of risk in the SEA led, in some national contexts, to an explicit reference to "technological risks" as a main environmental SEA field-of-action[12].

Finally, a background role refers to the European Spatial Planning Development Perspective (ESPD) adopted in Potsdam on 10-11 May 1999. The joint document defines the objectives of EU spatial development policy as '[…] *to work towards a balanced and sustainable development of the territory of the European Union. In the Ministers' view, what is important is to ensure that the three fundamental goals of European policy are achieved equally in all the regions of the EU: 1) economic and social cohesion; 2) conservation and management of natural resources; 3) the cultural heritage and 4) more balanced competitiveness of the European territory*"[13].Although the document explicitly refers to natural rather than technological disasters, the topic of risk of soil erosion due to land-uses and of the contamination of soil/water by pollutants is generally considered; "risk factors" are also considered as those deriving from human as well as natural pressures. In this respect, the document stresses how "[…] *Knowledge about different risk factors is still insufficient and requires the development of sophisticated methodologies based on a comprehensive concept of risk evaluation*" and recommends, among its policy options, the "[…] *Development of integrated strategies for the protection of cultural heritage which is endangered or decaying, including the development of instruments for assessing risk factors and for managing critical situations".*

III. Requirements of Art 12 Seveso II

The relevant part of the text of Article 12 Seveso II reads as follows:

"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. They shall pursue those objectives through controls on:

(a) the siting of new establishments,

(b) modifications to existing establishments covered by Article 10,

(c) new developments such as transport links, locations frequented by the public and residential areas in the vicinity of existing establishments, where the siting or developments are such as to increase the risk or consequences of a major accident.

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, buildings and areas of public use, major transport routes as far as possible, recreational areas and areas of particular

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[12] This was, inter alia, suggested in the publication of the Italian Ministry of Environment "*Linee Guida per la Valutazione Ambientale Strategica (VAS) – Fondi Strutturali 2000-2006*", L'ambiente Informa n. 9., 1999. [12] Refer, for example, to the Italian Guidelines on the implementation of the SEA procedure, Italian Ministry of Environment, 1999.

[13] *European Spatial Development Perspective – Towards balanced and sustainable development of the territory of the European Union*, Luxembourg, Office for Official Publications of the European Communities, 1999 ISBN 92-828-7658-6. Refer to: http://europa.eu.int/comm/regional_policy/sources/docoffic/official/reports/pdf/sum_en.pdf

natural sensitivity or interest and, in the case of existing establishments, of the need for additional technical measures in accordance with Article 5 so as not to increase the risks to people."

The interpretation and explanation of the requirements are given in the LUP Guidance. The Guidance furthermore defines general and supporting principles for compliance with the Article. In the context of the "roadmaps" this is the basis for the development of more detailed procedural and structural provisions. Reference to the Seveso II LUP principles follows in the chapters on overall recommendations. Below are defined some terms frequently used in this document. For the LUP Guidance a "EWGLUP Glossary"[14] was issued being a complementary part of the LUP Guidance; terms included there are not listed below:

1. Land[15]

Land is defined as the surface of the solid Earth, together with superficial vegetation cover, built features and associated water surfaces, both freshwater and marine.

2. Land Use[16]

Land Use describes the land surface from the social perspective; it is characterised by some identifiable purpose, or purposes, in using it to produce or achieve tangible or intangible products or benefits.

3. Planning

Planning is the exercise of foresight, systematically examining alternative proposals for action to attain specific goals and objectives. It includes the description of the desired future state of affairs and of the actions needed to bring about this state.

4. Land Use Planning (in general)[17]

The systematic assessment of land and water potential, alternative patterns of land use and other physical, social and economic conditions, for the purpose of selecting and adopting land-use options that are most beneficial to land users without degrading the resources or the environment, together with the selection of measures most likely to encourage such land uses. Land-use planning may be at international, national, district or local levels. It includes participation by land users, planners and decision-makers and covers educational, legal, fiscal and financial measures.

5. Land Use Planning (specifically in the Seveso II context)

A range of activities from procedures to administrative or governmental provisions to accomplish a steering of the allocation of land use with the aim to achieve a zoning for the land around a Seveso establishments that complies with the requirements of Article 12.

6. Zoning

In the context of land use planning, it is a term that indicates the regulation of the uses of land by defining certain categories of homogenous (allowed) development within assigned areas, resulting in "zones".

IV. Content and purpose of the initial LUP questionnaire

The MAHB LUP - questionnaire was divided in three parts. Part A, concerning the methodology for LUP in place, comprised 17 questions ranging from the description of the risk assessment procedure to

[14] Refer to http://landuseplanning.jrc.it
[15] EEA Glossary
[16] Own definition, which summarizes the one proposed by the EEA Glossary.
[17] FAO Glossary

the endpoints values in use. Part B concerned the implementation of Art 12 and the legal and procedural instruments enforcing its requirements in all the cases covered by Seveso II. Part C, in which MS were invited to express their opinion concerning the properties of “good practice”, was divided in 2 questions[18].

The Major Hazard Accident Bureau collected the results up until the end of 2004[19]. Cumulative tables, whose scope was presenting a rapid overview of the different implementation of the Seveso II in the Union, were elaborated. At the time that the questionnaire was sent out, the LUP - Guidance was under parallel development and not yet accepted by the representatives of the Member States. The questionnaire therefore could not reflect the Guidance contents, but it summarised the status of the discussions at on the working level at that time. In the following months, results were updated accordingly to the developments of the Guidelines. EWGLUP members (particularly from the countries selected for further investigation) were periodically invited to revise them. The main points of interest with respect to the development of “roadmaps” were:

1. the way the “appropriateness” and the “risk level” are determined (i.e. RA methodology), and
2. the way the technical advice deriving from risk analysis is converted in planning measures[20].

Both aspects were considered relevant to understand the methodological, decisional and spatial dimensions of national practices. The results showed a significant divergence with respect to the methods and approaches in use or the key decision elements. On the other hand, it was possible to spot at least some common fundamentals in those cases where the MAHB received a response. It then was decided to make a second, more in-depth survey for five of the most significant cases of practices of Member States, namely for

- the Netherlands
- France
- Italy
- Germany and
- the United Kingdom.

For these five examples the information provided was extended on the basis of bilateral contacts. The result is given in annex… of this document. So all in all the sources for the definition of “roadmaps” for the implementation of Article 12 of the Seveso II Directive are the following:

- the original LUP questionnaire
- the detailed five national examples (UK, D, IT, F, NL)
- information received within the EWGLUP and related activities, e.g. seminars and workshops such as Lille 2001, Luxemburg 2005, Graz 2005 and Strasbourg 2006
- personal input of the authors, who coordinated the investigation, elaborated the document and updated its content by mean of periodic consultations with the EGLUP members.

[18] The original questionnaire is reported in Annex II.

[19]The French Questionnaire has been collected at the beginning of 2005, while in case of the information from The Netherlands the design of the Roadmap has been supported by VROM - Dutch Ministry of Spatial Planning & Environment in the period comprised between March and April 2005.

[20] For further information concerning the questionnaire and the evaluation of the results, please consult the EWGLUP – Webpage, http://landuseplanning.jrc.it

B. RECOMMENDATIONS FOR ROADMAPS

I. A THEORETICAL FRAMEWORK FOR THE SELECTION OF POLICY OPTIONS

This document is based on the description of selected national procedures complying with the Article 12 requirements of the Seveso II Directive. Procedures are selected on the base of their exemplification of different methods and so-called "decisional routes" fulfilling Art 12. Based on the assumption that the adoption of a methodological approach to land-use planning in risky areas represents a policy-formulation operation, a brief overview of the most recent theoretical development in this disciplinary field is given in the following.

A fundamental ethical principle underlying policy-formulation processes in democratic countries is that of "justice". From the (economic) utilitarian perspective, the operational translation of 'justice' corresponds to the maximization of the collective "utility"[21]. The approach to decision stemming from this equation is that of *utilitarianism*, which basic assumption is that, to satisfy a pre-defined objective, the rational behaviour opts for the best alternative among a set of given alternatives[22]. The "right" policy is therefore the one opting for the alternative maximizing the collective utility. Related objectives usually reflect the axiom of "public interest", as decision-makers are expected to act as a regulatory body whose power is hierarchically superior to private interests.

In recent years, thanks to further contributions of economical and cognitive sciences, the rational-based approach to policy-making has been enriched until the development of proper alternative models. One of interest for the purposes of the present work and relevant to territorial policies is the so-called *advocacy planning*[23] or the *pluralist planning*[24]. Although complementary to the rational model - the bounded rationality is accepted in principle – this planning theory is based on a more complex representation of the reality, and focuses on one key-aspect of policy-making: the distribution of power. In "practical" decisional scenarios in fact, power and liabilities are not equally distributed and policy making is influenced by different interests and values at the stake. Hence, policy options should reflect a "negotiation" activity and policy-makers should focus on the equal representation of each actor's expectations, rather than promoting a solution unilaterally. Notably, in advocacy planning processes there is no a mathematically-generated "best option": the adopted option represents the balance among different interests, or the alternative that, in a given context and in a given time, is considered as the representative solution.

It is very interesting to reflect on what it means, in operational terms, adapting one of these two briefly described approaches within the land-use planning in risky areas field[25]. When allocating a land portion for the edification of a plant, or edifying settlements closed to an existing one, the decisional scenario is

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[21] The proposition is very general and has to be intended as a broad introduction to the main concepts underlying policy-making theories.
[22] The criteria to judge the 'best' among a set of alternatives are obviously crucial and object of continue investigation from the side of social sciences, particularly within the field of decision science. An interesting study in this domain is in Keeney, R.L (2004), "Framing Public Policy Decisions", Int. J. Technology, Policy and Management, Vol. 4, No. 2, pp 95-115.
[23] Davidoff P., "Advocacy and Pluralism in Planning", Journal of the American Institute of Planners,1962;
[24] Peattie L.R, "Reflections on Advocacy Planning", Journal of the American Institute of Planning, 1968; Hague C., "Reflections on Community Planning", in *Critical Reading in Planning Theory*, Pergamon Press, Oxford 1982.
[25] The two examples are hypothetical applications of the two different approaches and are not referring to any real case known to the Authors.

the same for both decision-makers. The objective of *safety* is the primary goal of decisions, but variables are evidently characterized by uncertainty: the maximization of safety by means of unlimited distances of establishments from urban/environmental areas is not achievable due to unsustainable economical repercussions. Hence, policy-makers have "bounded" rationality and limited elements supporting their choice. Also, they have different roles in terms of liability and powers. Theoretically a pure rational policy maker will focus on the primary goal of decision[26] and he will equip himself with a model or tool capable to elaborate the data at his disposal. His approach is generating a set of alternatives, on the basis of quantitative data, and selecting the one maximizing its objective. The second decision-maker instead will accept that the ideal choice is *a-priori* unachievable, and will consider the set of possibilities as limited by the effective distribution of interests, liabilities, capacities and powers of the involved actors. His approach is concerting stakes and powers involved in the case and opening to a negotiation process which best represents the actors' interests (for example, even if acceptable external safety is achievable, he could decide to represent the will of placing the plant in a different context, or to compensate citizens with additional interventions).

It may be observed that while the first approach is based on an idealistic representation of the reality and on a positive perception of the role of science in resolving public-domain problems, the second opts for a contextual and historical-determined representation of problems. In the first case, the "neutrality" of scientific responses is regarded as the fair ground of decisions; in the second case, they are accounted but do not necessarily match the best political alternative.

Significantly, these two approaches are very useful for the interpretation of the developments of the European risk regulation. In the last two decades, proper 'school of thoughts' emerged and promoted a lively debate over different approaches to *risk governance*, which is increasingly regarded as an autonomous policy field. The engineering-dominated and the psychometric approaches are the two most confronted views. The first responds to the rational model discussed above; the second "imports" into the concept and the analysis of risks also societal elements. The perception of risks from the side of involved parties in given contexts is the most accounted[27]. Therefore, the discrepancy between the two views lies in the approach to the very concept of *risk* (and, but not implicitly, of *uncertainty*)[28] and its operational translation into relevant governance approaches[29]. Although a complete dissertation over the differences among the two visions is not among the purposes of the present work, it is important to stress that their integration into a more comprehensive, integrated approach to risk governance is the

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[26] This corresponds, in this context, to the maximum achievable distance between accident scenarios and targets.

[27] Among the social scientist who stressed the importance of extending the characterization of risks up to the inclusion of their perception from the side of involved actors, Slovic P. in particular demonstrated how, for example, people perceive nuclear power more risky than other activities and technologies and are consequently less willing to accept it. As in many other cases, its perception appears not influenced by the statistic mortality ranking, which estimates nuclear power as dramatically less risky than car driving. Hence, stakeholders act and choose on the base of their perceptions more than scientific data. Refer to Slovic. P, Flynn, J., Mertz C.K, Poumadere M and Mays C (2000), "Nuclear Power and the Public: a Comparative Study of risk perception in France and the United States", in Renn. O and Rohrmann B (eds), *Cross-cultural risk perception – a survey of empirical studies*, Dordrecht, Kluwer Academic Publisher.

[28] In ordinary language the two terms are often associated. In the economical (most accepted) definition they represent instead rather different concepts: *risk* is quantifiable item which can be expressed in terms of a probability distribution, while *uncertainty* refers to unknown and unpredictable scenarios. Refer to Knight, F.H (1921), *Risk, Uncertainty and Profit*, New York: Houghton Mifflin Company, 216-217. Reported in Arcuri A., 2005, Governing the risk of ultra-hazardous activities. Challenge for Contemporary Legal

[29] The implications of the several type of uncertainties in the formulation of governance approaches are discussed in De Marchi B., Funtowicz S. and Ravetz J. (1996): *Seveso: A paradoxical classical disaster*, in Mitchell, J.K (ed.) *The long road to recovery: community responses to industrial disaster*, Tokyo, United Nation University Press.

centre of interest of most of current European research[30]. Bridging the famous "gap"[31] between the engineering-dominated view and the social science perspective through the integration of both contributions in policy-formulation processes appears to be, in fact, the current frontier of risk governance studies[32]. A particularly valuable contribution, which concludes this general overview, is the following:

"Risk management implies a choice among alternatives in the presence of uncertainties. Indeed the results of predictive models and expert judgements are uncertain, especially when they refer to phenomena verifiable only in the long term (e.g. nuclear waste disposal, global climate change and its effects, etc.). The different values, knowledge and interests of the parties involved with respect to expected costs and benefits, parameters to be considered and equity of proposed deliberations represent the second difficult issue. […] recent changes in the paradigms for risk analysis and management show examples of participatory procedures developed for facilitating adoption and implementation of informed decisions, which appear to be promising for achieving consensus at least as far as local and/or national decision making is concerned. [These processes] aimed at the "characterization" of risks through the involvement of different parties and interests in the early stage of the problem-solving, before any formalization of the risk itself. This is not aimed at a reduction of the role of the scientific modelling, but at the elicitation of the values and the perspectives of the involved communities in order to integrate them as part of the analysis and in order to build a mutual trust among the different parties" [33].

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[30] Refer, among others, to the European project *Risk Bridge –Building Robust, Integrative, inter-disciplinary governance models for emerging and existing risks.* The project, coordinated by the National Applied Research Institute TNO (NL) covers 6 risk domains and involves 5 European partners. Online www.riskbridge.eu

[31] Refer to Horlick-Jones T. (1998), "Meaning and contextualisation in risk assessment", Reliability Engineering and System Safety n.59, pp.79-89.

[32] In this respect, a first distinction among different risk domains in terms of their effective *probabilistic* or *uncertain* nature appears to be necessary to adjust the contributions of quantitative and qualitative analysis within decision-making processes. Refer to Renn O. and Graham P. (eds.), *Risk Governance – Towards an Integrative Approach*, White Paper n.1, International Risk Governance Council, 2005, Geneva.

[33] Amendola A., *Gestione dei rischi: dai rischi globali a quelli locali*, Quaderni CRASL, 2002, Italy.

II. WHY "ROADMAPS"?

In the previous chapter the theoretical framework for policy options was described. Within this framework several practical implementation routes a possible or have been developed by various countries. The requirement of Article 12 Seveso II represents a very specific obligation for a planning procedure lively[34]. As is well known, the PP states that if the potential consequences of an action are severe or irreversible, in the absence of full scientific certainty the burden of proof falls on those who would advocate taking the action. Recognizing the differing interpretations of the concept of "full scientific certainty" of outstanding evidence, together with the issue of the incomplete reliability of most of proof stemming from uncertain data, the problem of finding a univocal adaptation of the PP to risk prevention arises. It is not within the purpose of this document to address a discussion about the operational relevance of the PP within this domain; yet it has to be underlined that its relevance in terms of approach to the problem of LUP should be considered. In this context in fact a proper safety distances are a risk tolerability criterion and consequent LUP is a prevention measure minimizing the consequences of accidents. The evaluation of safety distances should, in this respect, opt for the most precautionary measure and LUP should extend the horizon of its validity to the long-term period. Methods and approaches are discussed in the remainder of the document.

The scope of the Roadmaps is to describe different 'decisional routes' bridging the risk analysis to land-use planning as required by Article 12 of Seveso II. Implicitly the assessment of risks and the risk reduction measures taken with land-use planning policies are accounted. Hence, they have a twofold nature: on the one hand, they report methodological differences of the analyzed practices and, on the other hand, they describe different procedural routes; all those being related to different national contexts. These different national contexts may have a number of factors to be relevant for each member state, as reported in the table below.

COUNTRY/REGIONAL VARIABLES	Quantitative variables	Qualitative variables
GEOGRAPHICAL/ DEMOGRAPHICAL	Territorial morphology; Population density.	Territorial specificities (particular agricultural production, water sources, etc); Environmental specificities (rare flora/fauna)
ECONOMICAL	Nr. of Seveso II Plants; National/regional economical capacity (i.e. risk reduction/ additional measures availability);	Relevance of the chemical industry within national economical system and history.
LEGAL	Additional national legal provisions	Legal system (common law vs. civil law).
SOCIETAL	Local communities composition (percentage of elderly, young families, working force, etc)	Local communities' risk perception (deriving from accident history, cultural specificities, etc); Environmental protection culture.

TAB 1 Example of quantitative and qualitative variables influencing European national "*Roadmaps*".

[34] An interesting study about the feasibility and the application of the precautionary principle in the risk prevention domain (applied to the avian flue threat) is in Basili M. and Franzini M. (2005), The Avian Flu Disease: a Case of Precautionary Failure. Quaderni n. 454, Universita' degli studi di Siena (eds.), Dipartimento di Economia Politica, Siena.

Nevertheless the survey of current practices has shown that all systems at least comprise five common elements, namely:

- reference scenarios for the calculation of effects
- occurrence estimates for events of concern (e. g. frequency of “loss of containment”)
- target vulnerability indicators (e.g. effect endpoints)
- separation distances and
- technical measures to replace separation distances with respect to certain principles (feasibility, proportionality etc.)

Consequently concepts of risk assessment and resulting in land-use planning contain:

- hazard/risk assessment methods (sometimes, in the same country, more than one);
- selection of reference scenarios (i.e. selection based on history, substance, worse or most credible scenarios, etc);
- the definition of tolerability thresholds (i.e. qualitative limits and/or endpoints);
- the classification of territorial, urban and environmental targets (i.e. transportation route, buildings, natural elements);
- the outcome of the whole procedure in the form of a restriction of land uses (“zoning”) or in the form of technical solutions (“additional technical measures”).

This configuration leads to a triangle of interdependence among different phases, whose connections are related to specific actors’ responsibilities (safety authority, planning authority, administrative/governmental level):

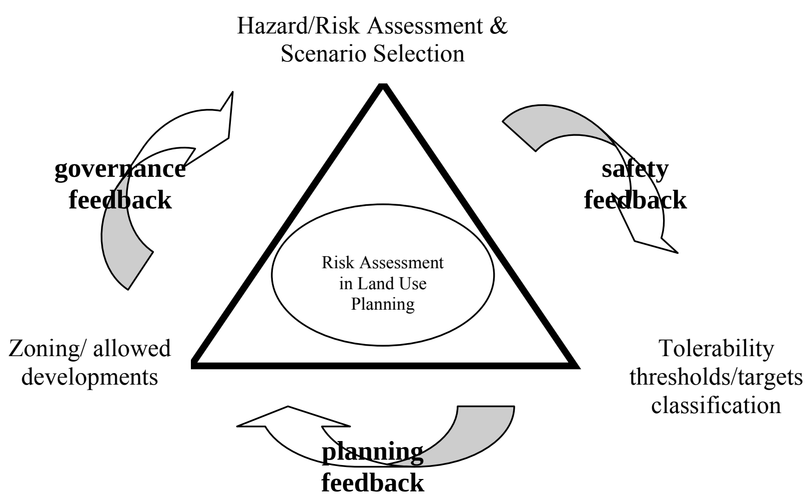

FIG 1: Safety, Planning and governance feedbacks in risk management

Each element of the triangle is described in the following. If reference is made to individual methods or examples this shall not be regarded as a recommendation but has entirely demonstrative character.

III. HAZARD/ RISK ASSESSMENT & SCENARIO SELECTION

1. Hazard/risk assessment method selection: a step-by-step decision

The adoption of a concept for risk analysis in land-use planning comprises two basic decisions about:

- the general category of approaches (deterministic vs. probabilistic);
- the risk assessment method adopted within the category,

being the distinction between "approach" and "method" used in the context of this document:

- "approach": the adopted definition of "risk" and to the way risk is evaluated and compared with a measuring scale;
- "method": the models of hazard identification and assessment compatible with the approach.

As defined in several comparative studies and EU surveys[35], the options for hazard/risk assessment approaches are divided in two categories with a sub-category each. The main difference between the two categories refers to the consideration of the frequencies of accident events as a factor to be accounted within the following evaluations:

a) "risk-oriented"/quantitative approach
b) "risk-oriented"/semi-quantitative approach (limiting pre-conditions are defined)
c) "consequence-oriented"/effects based approach, with implicit consideration of frequencies
d) "consequence-oriented"/general distances approach (use of tables of fixed distances).

It shall be underlined that risk analysis for LUP must be regarded as a specific form of other approaches of that kind where development is still in progress and there exist no standardized options so far.
The options in general are briefly described in the following.
Basically, and as a general explanation for the following descriptions, the distinction between probabilistic and deterministic approach lies in the way how assumptions are made to cope with a real situation. Whereas the probabilistic approach seeks to picture the real situation as much as possible in a more dynamic form, the deterministic approach depicts a homogenous situation which "covers" all deviations (thus adding a safety factor to the statistic results). Hereby the probabilistic approach is the more ambitious one which requires mostly more data input and related efforts (see picture below as example).

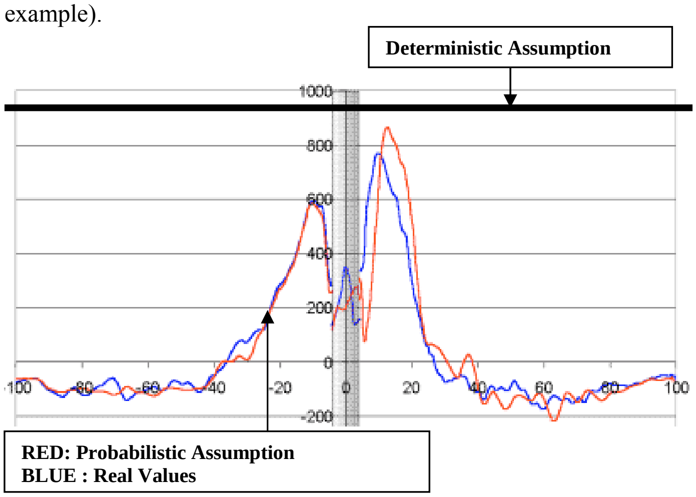

FIG 2: Approach Characteristics

[35] Refer, among others, to Christou D. M, Amendola A., Smeder M. (2000) "The control of major accidents hazards: the land-use planning issue", appeared in the Journal of Hazardous Materials devoted to the Seveso II Directive; to Cozzani V., Bandini, C. Basta, M. Christou (2006), Application of land-use planning criteria for the control of major accident hazards: a case-study, J. Hazard. Mater. 136 170–180ence…..

a) Risk-oriented (or risk-based) quantitative approach

The “risk oriented” quantitative approach is characterized by a final decision based on a numerical risk figure. For reasons of practicability the form of a single figure is preferred, although a strictly mathematical calculation would require a measure of uncertainty (variance) of the final number. The underlying approach is probabilistic, i.e. based on a definition of risk as a numerical definition of effects and frequencies of accident events. In this kind of approach, essential steps of the decision-making are listed in the following:

- The fundamental decision to perform a risk-oriented method must be followed by the conclusion either to use a “full probabilistic” method or a probabilistic method with certain pre-selected assumptions (the “full probabilistic” requiring a huge amount of data and preparation which may not be justified and is thus relatively rare).
- In the latter case the decision must comprise and define the limiting conditions of the pre-selection
- The next decision step concerns the exact methodology of the chosen options
- The “risk-oriented quantitative approach” then requires the availability of reliable and/or agreed failure frequency data
- Depending on the hazard assessment methodology decision a set of scenarios has to be defined
- The scenarios are the source for a modelling of consequences
- For the modelling relevant population and environmental data are required
- The consequence assessment requires effect endpoints
- The final result is expressed in numerical risk values and compared with predetermined risk figures which are set by the responsible authority
- The status of the endpoints and the risk values must be clarified

b) Semi-quantitative approach

The semi-quantitative approach splits the main elements (likelihood of occurrence, consequences) into two different options of description, qualitative or quantitative. The first assessment result is a list of pre-selected scenarios (a “full-probabilistic” part usually is not carried out in this approach). The risk-oriented part, if quantitative, requires a database for failure frequencies or consequences in numerical terms. The assessment outcome may be expressed in the form of an effect calculation. This may entail also the necessary input of population and environmental data and the decision on the status of the effect endpoints. The other form of measure could be a qualitative one for the severity of the consequences, thus combining a quantitative occurrence axis with a qualitative consequence measure.
Besides the splitting up in the first step of the decision scheme the requirements are the same as in the case of the other methods.

c) and d) Consequence-oriented / fixed distances approach

The “fixed distances” comprise a subcategory of the “consequence-based” approach, so they are described together. Differing from the probabilistic case, the consequence-oriented approach requires a limited number of decisions. First of all, a different definition of risk underlines the assessment, i.e. “risk” comparable with the concept of “danger”: the evaluation of frequencies of events is not explicit, i.e. is not a numerical factor but an orienting criterion for the selection of scenarios. Step-by-step decisions for the adoption of this approach are, consequently:

- at first, the definition of pre-selected scenarios and the underlying conditions for the pre-selection (usually, a qualitative likelihood determination based on historical failures, best practice prevention, control and mitigation measures or a purely conventional one);

- based on these scenarios, a modelling of consequences, for which
- the definition of agreed effect endpoints, i.e. a "tolerability" threshold, is necessary;
- the status of the endpoints target or legally binding- must be also defined
- the measure for the tolerability of the calculated consequences/effects could be a qualitative severity ranking or a comparison with threshold figures.
- For the "fixed distance" approach, the concept is broadly similar and comprises a preliminary step on the categories of application and a conclusion on the status of the generic distances calculated by the categorized consequence assessment.

2. Linking risk analysis and LUP: overview of methods and underlying concepts

Usually, the risk analysis carried out for LUP purposes is linked with the one carried out for plant safety. Thus, identified safety-relevant scenarios are also used for specific LUP purposes, or there is a connection between the two stages (i.e. the data provided in the safety report/studies are the same as those used by planning/environmental authorities to assess the compatibility of land-use decisions). Concerning the LUP activity, depending on the complexity of the case and on the available resources, opting for a qualitative or a quantitative approach results in a relevant difference in terms of procedures and necessary information; as a result the complexity of the assessment differs. In this regard, it should be stressed that, in the majority of analyzed cases, the authorities responsible for the implementation of the LUP requirements of the Seveso II are mostly planners and municipalities' officials. One of the often mentioned "gaps" therefore consists of the difficulty to translate, for instance, the "boundary" of a given effect area with a certain frequency into a geographical land-use limitation, since the two assessments are carried out by different responsible persons. It can be easily observed that the engineering-dominated side of risk analysts may find difficulty in communicating the more social and political mentality of planners, and vice versa[36]. Here, besides two different disciplinary domains, also the related professional mentalities are confronted: it can be easily observed that the engineering-dominated side of risk analysts may find difficult to dialogue with the more social and political dominated side of planners, and vice versa.
However, an efficient cooperation between the two sectors is necessary.
One of the crucial elements which would assist facilitating their dialogue is the creation of a common terminology, resolving the problem of misuses of terms This means gaining agreement on decision processes should take place in advance. One typical example of the variety of terms which are used as equivalent although a rigorous distinction exists is:

- hazard identification,
- hazard evaluation,
- risk analysis,
- risk assessment, etc.

The identification of the specific hazard, which is completed with the evaluation of the magnitude of a set of scenarios, is the preliminary step of every risk reduction strategy.
The CCPS[37] guidelines list 12 types of hazard evaluation methods:

- Safety Review
- Checklists

[36] Jones. H-J. (1998) "Meaning and contextualization in risk assessment" Reliability Engineering and System Safety 59 (1998) 79-89.
[37] Center for Chemical Process Safety (1999**),** Guidelines for Chemical Process Quantitative Risk Analysis 2nd Edition, Wiley Publisher.

- Relative Ranking (Dow Index, Substance Hazard Index, etc.)
- Preliminary Hazard Analysis (sometimes also Preliminary Consequence Analysis)
- What – If Analysis
- What – If & Checklist Analysis
- Hazard & Operability Analysis
- Failure Modes and Effects Analysis
- Fault Tree Analysis
- Event Tree Analysis
- Cause – Consequence Analysis
- Human Reliability Analysis

Two other well-acknowledged methods are:

a) the "Layer of Protection Analysis"-method (LOPA) a simplified form of quantified analysis which lies in rigorousness between HAZOP and the more quantitative forms of fault & event tree and
b) ARAMIS[38], which combines various well-proven elements of other methods

It is out of the intended scope of this document to describe the methods in more detail, but it is important to mention that the direct applicability of these methods for LUP purposes is not always feasible. The agreed principles for compliance of Article 12 recommend the use of reference scenarios. On the other hand, some of the hazard assessment methods are entirely aimed at hazard identification and it is not possible to derive directly accident scenarios to be used for LUP. In some other cases, the number of scenarios used for the method may be much higher than required for LUP risk assessment. Expert judgment will normally be the option to derive scenarios from the plant safety risk analysis.

3. Scenario Selection

The LUP Guidance recommends the use of reference scenarios for the purpose of land-use planning in the context of Seveso II. As already explained in the last chapter, there is a coherent link between risk analysis used for plant safety and the one for LUP. Nevertheless is must be pointed out that some differences need to be considered. Reasons for that might be:

- The LUP Guidance recommends a ranking of scenarios: those of greater likelihood shall be taken for plant safety, those of lower likelihood for LUP and those with the lowest (thus those with the most severe consequences) for emergency planning
- Risk analysis for LUP is – in comparison with plant safety judgment – will require a broader form of assessment as the process does not demand results with very high reliability (e.g. it would be impossible to envisage distances which indicate exact "borders of harm")
- In some cases technical details of the establishment of concern will not be known (e. g. planned modifications that need to be taken into account for the predicted effects on the surrounding area)

It would be costly and probably over-ambitious to suggest an assessment based on a large number of scenarios, therefore the more feasible way is to use a small number of representative ones. It is up to the individual MS to enhance the assessment to a more precise form, but from the experience seen so far a limited number of scenarios is sufficient.

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[38] Refer to http://aramis.jrc.it

In the LUP Principles Guidance a "scenario" to be used for LUP risk analysis is defined by:

Scenario = "Top Event" (usually/mostly Loss of Containment) & Dangerous Phenomenon (fire, explosion, toxic cloud)

This definition means that two elements generally analyzed separately are merged in order to simplify the assessment.
Scenarios for LUP derived from the classical bow-tie model are instead reported in the following

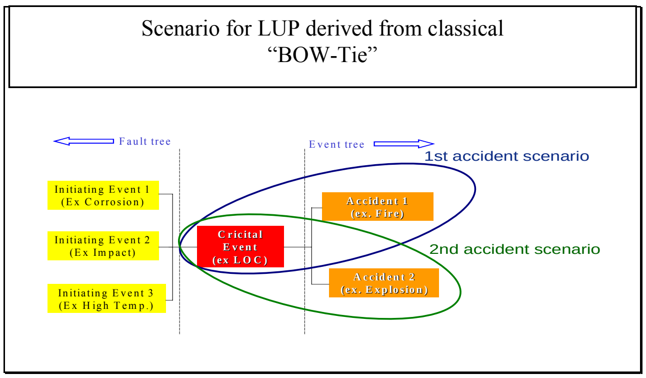

FIG 3 Scenario for LUP derived from "Bow-Tie"

Typical scenario examples therefore could be:

- catastrophic vessel failure & VCE (vapour cloud explosion, see below)
- hole in vessel wall & pool fire (ignition of released flammable liquid, see below)
- pipe leak & toxic release etc.

The Loss-of-Containment part of the scenario may be grouped into the following form:

- vessel rupture
- vessel leak
- vessel roof collapse
- pipe rupture
- pipe leak
- loading connection release (leak or rupture)

The "dangerous phenomena" may be grouped as follows:

- pool fire
- tank fire
- fireball
- vapour cloud explosion
- flashfire
- jetfire
- toxic or flammable cloud release.

The characteristics of these scenarios are:

Poolfire: the combustion (ignition) of a layer of liquid (a pool) formed after the failure of the containment of the substance; the effect is a thermal radiation front.

Tankfire: the ignition of the gaseous phase in a vessel containing a flammable liquid inside the vessel walls; the effect is again a thermal radiation front.

Fireball: a fireball occurs when a vessel containing a flammable substance fails catastrophically after being superheated; it may concern pressurized liquefied gas or pressurized liquid. The consequences are twofold: first there is a blast effect because of the vapour expansion, and then the air-substance mixture ignites immediately and produces a rapidly moving flamefront. This phenomenon is often called BLEVE (acronym for Boiling Liquid Expanding Vapour Explosion).

Vapour Cloud Explosion and Flashfire: The leakage of the containment of a flammable substance may lead to a gaseous release and the formation of a cloud which ignites if the concentration is within the flammability limits; depending on the speed of the resulting flame-front the phenomenon is called Vapour Cloud Explosion (VCE) or Flashfire. The first additionally causes a pressure wave.

Jetfire: the leakage of a vessel containing a flammable liquid or gas can lead to a jet flame with high radiant energy (greater intensity than for pool fires).

Cloud Release: the release of any substance of concern with different properties, toxic or flammable; the effect of the formed cloud mixed and spread in the ambient air depends on these properties, the weather conditions, topography and in the case of flammable materials, the presence of ignition sources.

Precondition of the scenarios relevant for LUP is a massive release of a hazardous substance (the self-decomposition of solids is an exceptional case and is not treated in detail) due to a loss of containment (= leakage) and a subsequent dangerous phenomenon. The properties of the substance lead to one of the scenarios described:

- A toxic substance, especially with higher vapour pressure, forms a cloud with mainly hazards by inhalation or dermal intake, in some cases also oral intake
- A flammable substance forms a pool and from there a cloud or directly a cloud; both (cloud and pool) may develop to a scenario with thermal and pressure hazards in case of ignition

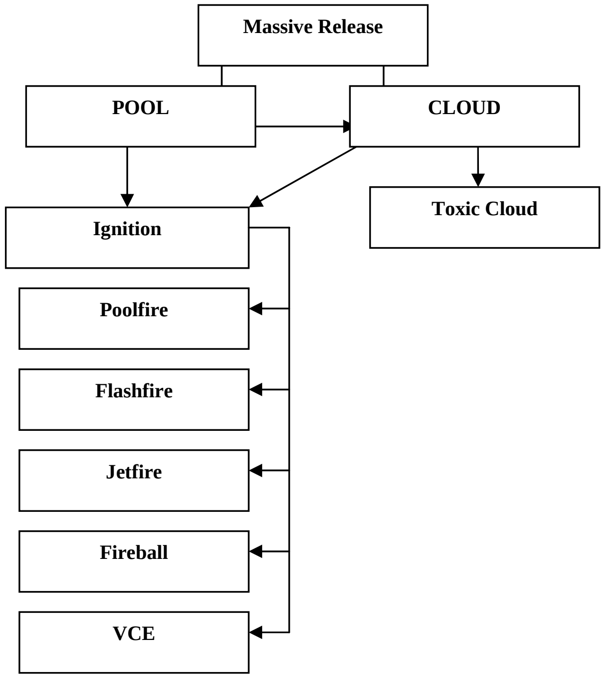

FIG 4 Interface of various types of scenarios

One decisive element of the process is the approach how the scenario is selected, basically offering a

a) quantitative or
b) qualitative alternative.

a) Quantitative Decision

If the decision about LUP measures is made on the base of the quantitative calculation of risks, sufficient data about the likelihood of plant' system failures are necessary. The frequency data may refer to the so-called "top event" (e. g. LOC – Loss of Containment) or to the causes (or "initiating events") for this top event or to the performance of any preventive measures or barriers. These may be obtained

- (preferably) from the establishment (operator's) validated records,
- on the basis of frequencies of causes in a fault tree analysis or
- from literature in the form of generic values (default option).

Despite the fact that specific data referring to the individual case is always the most favourable option, generic data are widely used in order to avoid extensive investigation, which regards also the accuracy of result. Internationally recognized references for these values, with a particular relevance to land use planning, are:

- the Dutch “Purple Book”[39]
- the FRED database of the HSE[40]
- the “Taylor-Study” done under the authority of RIVM[41]
- the “AMINAL-Study”[42].

These sources usually provide LOC – frequency occurrence values; some bibliographic surveys[43] tried to compile the existing values and put them into a coherent form; one of the examples is shown below

Proposition for pipe failure frequencies (occurrence per meter and year)				
	Small leak (effective diameter of 10% of the nominal diameter)	**Leak (effective diameter of 22% of the nominal diameter)**	**Leak (effective diameter of 44% of the nominal diameter) (Large leak)**	**Full bore rupture**
Nominal diameter < 75 mm	$1.18.10^{-5}$	$7.93.10^{-6}$	$3.3.10^{-6}$	$1.22.10^{-6}$
75 mm ≤ nominal diameter ≤ 150 mm	$2.5.10^{-6}$	$1.11.10^{-6}$	$4.62.10^{-7}$	$3.5.10^{-7}$
Nominal diameter > 150 mm	$1.75.10^{-6}$	$6.5.10^{-7}$	$2.7.10^{-7}$	$1.18.10^{-7}$

TAB 2 Example of pipe failure frequencies

The overall occurrence frequency of a scenario then simply combines the LOC failure frequency with the frequency of the additional condition which makes the scenario come into reality, in general the ignition. The ignition probability for highly reactive gases or extremely flammable liquids is almost 1 and is regarded to be close to 1 for other hazardous substances. The real difference in the assessment is the factor of immediate or delayed ignition which usually is determined on a conventional basis by assumptions derived from accident histories and rough estimates.

The interface between the Loss of Containment and various scenario types with ignition of the substance concerned is shown below. The main difference depends on the form of storage or process (if the containing takes place under atmospheric conditions or pressure).

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[39] Committee for the Prevention Disasters (CPR), 1999, "*Guideline for Quantitative Risk Assessment-“Purple Book*” CPR18E, SDU, The Hague

[40] HSE, “*Failure rate and event data for use in risk assessment (FRED)”* , issue 1, Nov 99 (RAS/99/20) – HSE, “New failure rates for land use planning QRA Update” RAS/00/22 - HSE, “*Chapter 6K: Failure rate and event data for use within risk assessments”* 2/09/2003

[41] Taylor, J.R. *“Hazardous materials release and accident frequencies for process plant”*-draft version 2003 – for the time being not free for public use

[42] Handboek Kanscijfers voor het opstellen van een Veiligheidsrapport, 1/10/2004, AMINAL – Afdeling Algemeen Milieu- en Natuurbeleid.

[43] Refer to http://aramis.jrc.it

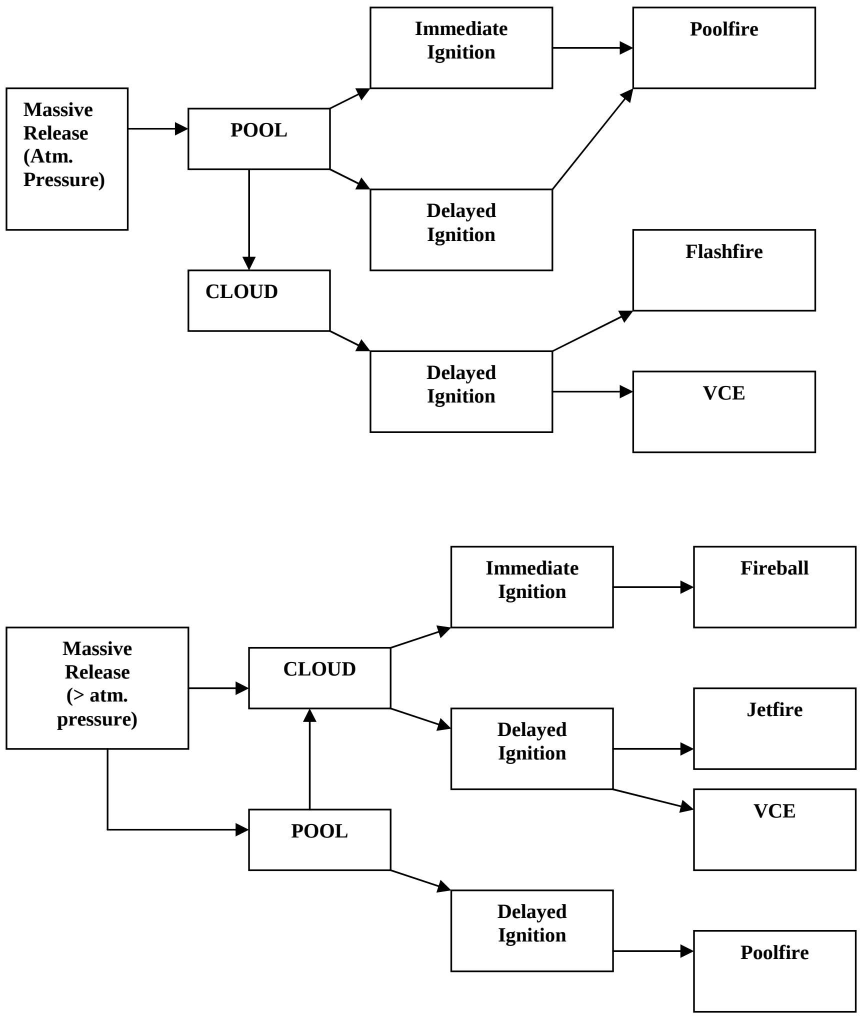

FIG 5 Interface of scenario types with forms of containing and ignition

The likelihood value of the unrestricted final scenario (more precisely the "dangerous phenomenon") depends on the assumptions for the distribution in the event trees shown above; this is based on conventional agreements which themselves are rough estimates of historic data.
Common default values for this calculation are:

- 70 % immediate ignition
- 30 % delayed ignition
- 67 % of delayed ignitions result in a VCE
- 33 % of delayed ignitions result in a flashfire or jetfire.

The second main element of the scenario selection is the assessment of the efficiency of measures. According to the “Guidance LUP” measures may be grouped into the following categories:

- “Avoid Measures”: the scenario will not occur (example: burying a vessel will prevent a BLEVE)
- “Prevention Measures”: the frequency of a scenario is reduced (example: automated systems to prevent overfilling)
- “Control Measures”: the size, severity or extent of the scenario is reduced (example: gas detectors operating block valves)
- “Mitigate Measures”: the size, severity or extent of the effects is reduced (example: firewalls)

The necessary steps at this stage are

- Identification of causes or cause categories related to the scenarios
- Identification of measures
- Allocation of efficiency values to the measures

It is up to the individual user or MS system which types of measures are taken into account and what and how the efficiency is assessed. Some approaches may only consider passive measures (no human intervention or measurement of parameters necessary); some approaches may consider technical measures, some also “behavioural” measures[44].

The same is valid for the efficiency assessment. A common way for the numerical assessment of the performance of measures is the “class of confidence – probability of failure on demand” – approach; see as an example the table below:

Class of confidence	**Probability of Failure on Demand (PFD)**	**Risk Reduction Factor**
4	10^{-5} - 10^{-4}	10.000
3	10^{-4} - 10^{-3}	1.000
2	10^{-3} - 10^{-2}	100
1	10^{-1} - 10^{-1}	10

TAB 3 Example of “class of confidence – probability of failure on demand” approach.

The third necessary element to make the quantitative selection workable is the definition of “cut – off” – criteria; this means, numerical values must be fixed which indicate the borderline to the “negligible area”, the likelihood which may be regarded too low to be taken into account. As already stated in this document, the correct procedure would require the consideration of the uncertainty of values, the “variance”. The problem of uncertainty in the single – value quantitative concept means that the scope for the likelihood of concern is very broad, which leads to the need to include causes and scenarios of comparatively low predicted frequency to be taken into account.
An example for common numerical border values is shown in the picture below [FIG 6]: ….)

[44] More information for this distinction is given in chapter VI

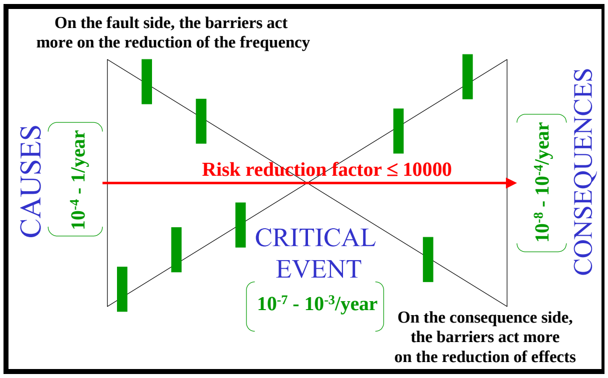

FIG 6 Example of Bow-Tie model to show common numerical values

b) Qualitative Decision:

The selection of scenarios may be based on a qualitative estimate of the consequences only, which means an expert judgment on the expected damage (severe, medium, low etc.). But the main problem is the definition of the scenarios before this step.
Any deterministic safety concept is based on long – term experience with certain processes and technical solutions and gives preference to the use of the precautionary principle. The decision is not targeted at a value expressing the risk but seeks to avoid undesirable incidents as much as possible by process design, operation and prevention measures. The necessary knowledge based is mainly laid down in codes, standards or ordinances, which makes it complicated to identify underlying scenarios as these are usually not defined explicitly. Nevertheless there is a need to reduce the residual risk by land-use planning methods as required by Article 12 of Seveso II, so a possible concept may be to select some representative scenarios according to the exclusion of some measures of lower efficiency or reliability. There are similarities to the quantitative selection, but in this case without assigning values to the various steps, which are

- Deterministic (conventional) assumption of a loss of containment (LOC)
- Assumption of type of LOC and criteria for that (e.g. excluding catastrophic rupture because of failure rate data)
- Identification of measures to avoid the LOC
- Qualitative criteria for the consideration of certain measures

In the figure below the approach is shown in a summarizing form:

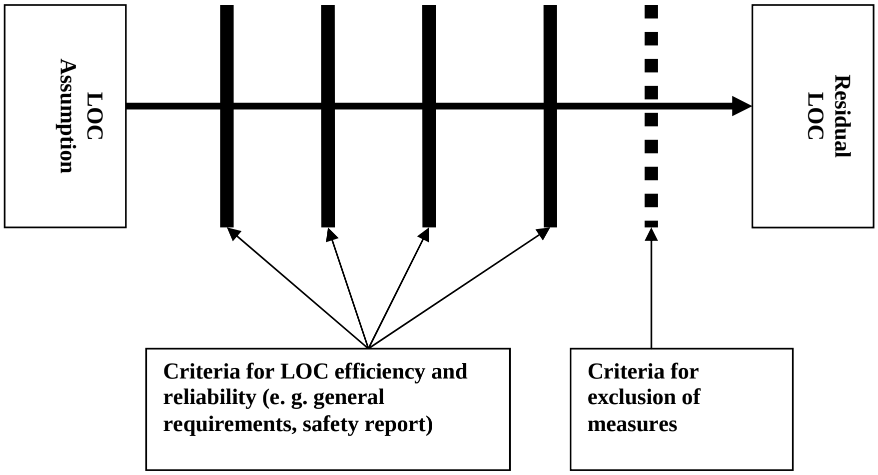

FIG 7 Example of criteria for LOC efficiency and reliability

It is important to understand that the qualitative risk analysis for land – use planning may somehow represent a contradiction to the outcome of a permit process for an establishment and must be communicated in a proper way.

IV. TOLERABILITY/VULNERABILITY

1. Basic process of measuring compatibility

In a recent study, the interesting difference between the different "wording" used in risk assessment depending on national risk regulations and 'philosophies' was examined[45]. The benchmark between The United Kingdom and The Netherlands outlined how, due to the different legal backgrounds (common law vs. civil law) and to the different interpretation of endpoints as legally binding thresholds, ALARP (*As Low As Reasonably Practicable*) and ALARA (*As Low As Reasonably Achievable*) are not synonymous. The United Kingdom context aims at risk *tolerability*, in the Dutch one aims at risk *acceptability*. These are significantly different, given that the methodological approaches in the two countries are broadly similar and based on at least the partial quantification of risks. The difference is that "[…] whereas the criteria in the Netherlands are the end of the discussion, in the United Kingdom they are the starting point". Hence, even here, the core of decisions is not the application of criteria – but the discussion about their nature and uses.

This premise serves to introduce the unavoidable political nature of every decision related to risk reduction, regardless of the grounds represented by the quantitative outcomes of risk analysis. Yet these outcomes, when carried out LUP purposes, need to be assessed against pre-defined criteria and values. As reported by the mentioned Author, their meanings and roles within practical cases depend on national contexts. In all the analyzed countries, risk criteria and the threshold values are defined in specific regulations and laws. Therefore, regardless the adopted method, the risk analysis informs subsequent planning evaluations (in the form of permission or restriction of given land-use purposes and/or construction) by means of the adopted criteria and the defined endpoints for each criterion. In this respect, the assumption is that a LUP regulatory system exists. A scheme relative to this 'link' between risk analysis and LUP is reported in the following.

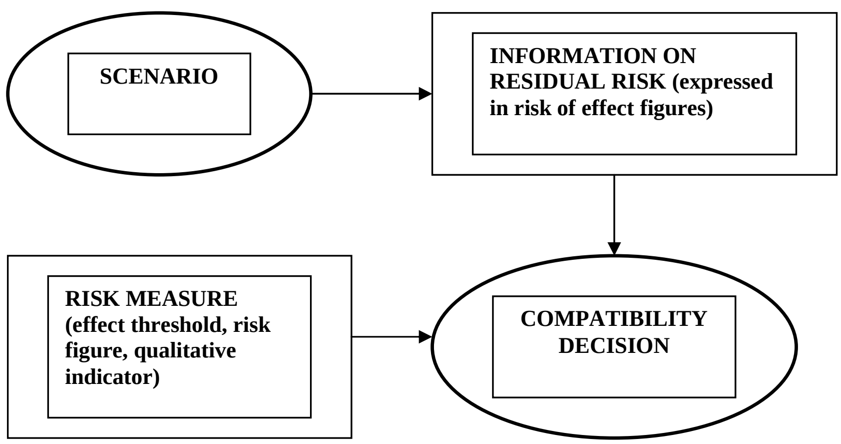

FIG 8 The link between scenarios/risk measures and compatibility decisions

[45] Ale B.J.M. (2005). Tolerable or Acceptable: A comparison of Risk Regulation in The United Kingdom and in The Netherlands. Risk Analysis, Vol.25, No.2, 231-241

2. Compatibility Decision Systematic

a) General Considerations

Usually the compatibility is measured by means of a “risk index” which must be understood in a very broad sense. A risk index is a measure, quantitative or qualitative, oriented to integrating into a numerical value or into a written description, which represent an influence on the hazards or the risk of a system.
A risk index as meant in this respect is not a direct measure of the risk but more some kind of an indicative parameter. Some indexes use a numerical scale to evaluate the “level of risk” of a given system, other indexes do not use numerical values and just qualify the risk as “low”, “medium”, “high”, etc. This type of classification is closer to the usual language and, sometimes, is adequate for the accuracy of the measure (which may not justify a numerical value). Nevertheless, in some cases categories like “low risk” may lead to an acceptance of situations that imply really a significant risk, which could be reduced with additional measures. Both criteria can be used and, in fact, both are used in practice.

Risk indexes can be classified according to different criteria. One possibility is the classification into the following:

- *Risk indexes based on the mathematical definition of risk:* These are indexes are defined according to the general definition Risk = Frequency x Magnitude/Severity.
- *Risk indexes based on the hazards of the substances involved:* In this type of indexes the risks associated to fire, explosion, release, toxic cloud/vapour dispersion, etc. are analyzed.

As for the level of tolerable risk quantitative thresholds are defined, involved targets are usually measured against different categories (for example low, medium and high) for which vulnerability’s indicators are usually given. A general example is shown below.

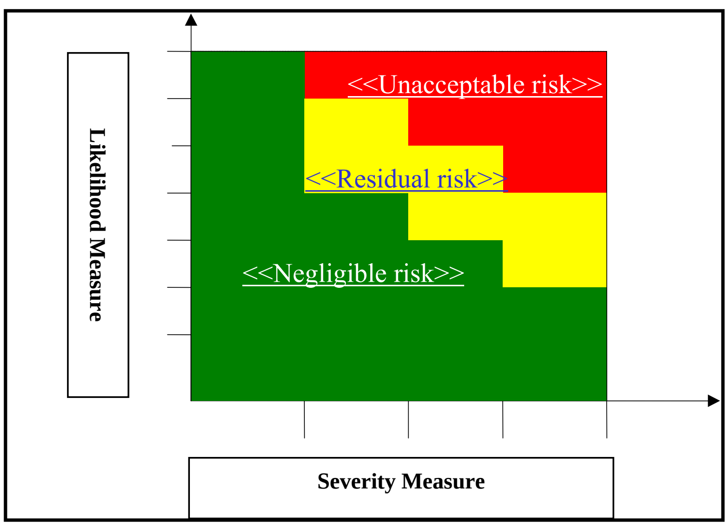

FIG 9 Negligible, residual and unacceptable risk levels

The likelihood measure may be expressed either numerically, e. g. yearly occurrence of an undesirable event in the range of 10^{-3} – 10^{-9}, or qualitatively (e. g. very likely to very unlikely). The severity may be expressed quantitatively by numerical effect "endpoints" or risk figures (individual, societal), qualitatively from "low" to "high". A possible ranking for severity is shown in the table below:

Consequence Classification	
Effects on human targets	**Effects on environment**
No injury or slight injuries without sick leave	No action needed but surveillance
Injuries leading to an hospitalization	Serious effects on the environment inside the establishment, requiring local means of intervention
Irreversible injuries or death inside the establishment, reversible injuries outside the establishment	Reversible effects on the environment outside the establishment; requiring national means
Irreversible injuries or death outside the establishment	Irreversible effects on the environment outside the establishment; requiring national means

TAB 4 Consequence classification for human and environmental targets.

The main tools used in practice linking accident scenarios with targets' vulnerability are reported below:

- Consequence estimation/ modelling
- risk matrix, representing the compatibility between defined level of risk and urban/ environmental development;
- consequence endpoint values, representing the "extension" of the selected scenarios in terms of effects and relative injuries (for example, the representation could be the irreversible damage threshold of a scenario where no residential development is allowed);
- individual risk, associating to effects areas a frequency endpoint (for example, 10^{-6} irreversible damage area where only limited residential developments are allowed);
- societal risk (F/N-curve).

Tolerability Evaluation Tool	**Related RA Method**
Risk Matrix	Qualitative/deterministic Semi-quantitative Quantitative/probabilistic
Consequence endpoint values	Qualitative/deterministic
Individual Risk	Quantitative/probabilistic
Societal Risk (F/N-curve)	Quantitative/probabilistic

TAB 5 The relation between tolerability evaluation tools and risk analysis methods.

b) Endpoints

According to the types of scenarios the following effect types may be distinguished:

Dangerous Phenomenon	Scenario Types		
	Thermal Radiation	Overpressure	Toxic Effects
Fireball	x	x	
Flashfire	x		
Jetfire	x		
Poolfire	x		
VCE	x	x	
Toxic Clouds			x
Solids Fire	x		

TAB 6 Effects related to different kind of scenarios.

Another distinction concerns the duration of the effect, as shown below:

Dangerous Phenomenon	Effect Type		
	Stationary Radiation	Non – stationary Radiation	Overpressure (fixed value)
Fireball		x	x
Flashfire		x	
Jetfire	x		
Poolfire	x		
VCE		x	x
Solids Fire	x		

TAB 7 Stationary, non-stationary and fixed effects.

"Non – stationary" means that the effect is calculated on the basis of an equation that takes into account the actual time of exposure which may be very short in the case of certain scenarios.
Another distinction concerns the basic choice between

- Fixed endpoints or
- Probit endpoints.

"Fixed endpoints" means that the threshold characterizes one specific level of harm for any single recipient. Probit endpoints consider a certain percentage of damage or harm in a number of recipients (= the likelihood that in a given group a certain, predefined percentage will have definite symptoms or "suffer in the same form") and take account of exposure time – probits are calculated by generally accepted and validated equations which are specific to the materials of concern.

For thermal radiation and overpressure the following values may serve as default figures:

Level	Stationary Radiation	Non – stationary Radiation	Overpressure
No effect	1,6 kW/m^2		
Small effects	< 3 – < 5 kW/m^2	< 125 kJ/m^2	< 30 mbar
Reversible effects	< 3 – < 5 kW/m^2	125 – < 200 kJ/m^2	30 - < 50 mbar
Irreversible effects	5 – 7 kW/m^2	200 - 350 kJ/m^2	50 – 140 mbar
Lethality	> 7 kW/m^2	> 350 kJ/m^2	> 140 mbar

TAB 8 Endpoints values for different effects' levels.

Whereas the definition of physical hazards is comparatively easy (the divergence of accepted thresholds is not wide and the main difference lies in the decision which levels of effects should be taken into account), for toxic effects the situation is more complex:

- Countries with existing concepts only agree one threshold, which is the level corresponding to the start of the certain effects (for example irreversible health effect).
- There are various exposure guidelines; the selection of one of them based on scientific expertise is difficult (finding evidence of the effects of a given toxic substance in humans is often unmanageable, so the experimentation is usually done in animals and the values obtained extrapolated to humans).
- Each source guideline (e.g. American Institute of Industrial Hygienists Emergency Response Planning Guidlelines – ERPGs) covers only a limited number of substances.
- The effects of toxic substances on humans are in some cases related to the dose and not to a given concentration.
- The dose may depend not only on the concentration value and the exposure time but also on other parameters which depend on the substance and may be unknown.
- The effects on exposed persons is greatly affected by their health condition, age etc,

Currently three databases for toxic effects are widely used: IDLH, ERPG and AEGL.

- Immediately Dangerous for Life and Health (IDLH):

These values are defined by NIOSH[46] as 30-minute concentrations from which a worker could escape without injury or irreversible health effects in the event of respiratory protection equipment failure and above which "high reliable" respirators are required. These levels were designed for healthy workers in an exposure situation that it is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.

- Emergency Response Planning Guidelines (ERPG)

Are defined by the American Industrial Hygiene Association[47] as concentration ranges where adverse health effects could be observed. The ERPG guidelines do not protect everyone. Hypersensitive individuals would suffer adverse reactions to concentrations far below those suggested in the guidelines. ERPGs are focused on a one hour period of exposure.

[46] National Institute for Occupational Safety and Health, USA. Online: http://www.cdc.gov/niosh
[47] Online: http://www.aiha.org

ERPG-1

Is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG-2

Is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

ERPG3

Is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

- Acute Emergency Guidance Levels (AEGL)

Acute Exposure Guideline Levels are under development by the National Research Council's Committee on Toxicology[48] The committee developed detailed guidelines for developing uniform, meaningful emergency response standards for the general public. The criteria in the guidelines take into account sensitive individuals and are meant to protect nearly all people. The guidelines define three-tiered AEGLs as follows:

AEGL-1

Is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non - sensory effects.

AEGL-2

Is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3

Is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Each of the three levels of AEGL, are developed for each of five exposure periods: 10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours.

It is obvious from the description of the thresholds that they are not originally developed for LUP purposes but serve for emergency response planning; nevertheless they are the only sources for the calculation of distances to be defined for land – use planning with regard to other conditions, as there may be:

- the assumption that an alert system will function and the potentially exposed population will be in a safe location after a given time
- on -site intervention within the emergency response limits the release rate and thus the exposure period and concentration

[48] Information are available online via the (American) Environmental Protection Agency website, http://www.epa.gov/opptintr/aegl/

- regard to the mobility of the exposed population and their expected behavior in an alert situation (e. g. children or elderly persons)

Furthermore it is important to note that, unlike the question of exposure to physical hazards, toxic thresholds differ not only in reference time but also they are a product of several pragmatic considerations and – due to the time of their origin – give different regard to the scientific knowledge. As an example see the next table:

Thresholds for toxic substances (ppm)			
Substance	**IDLH (30 mins)**	**ERPG 3 (1 hr)**	**AEGL 3 (1 hr)**
Ammonia	300	1000	1100
Bromine	3	5	8,5
Chlorine	10	20	20
Hydrogen Chloride	50	100	100
Hydrogen Fluoride	30	50	44
Formaldehyde	20	25	56
Phenol	250	200	Not recommended
Phosgene	2	1	0,75
Sulfur Dioxide	100	15	30
Hydrogen Sulfide	100	100	50

TAB 9 Toxic substance threshold comparison

3. Risk Measure: Target Values

The decision flow after the on the structure of a LUP risk assessment system requires a step to define a definite risk measure. In principle the following options exist (as the existing examples are usually aimed to protect humans, environmental aspects are excluded from this description):

- entirely qualitative measure; in that case no explicit definitions are necessary
- qualitative measure derived from effect thresholds; in that case it is only necessary to define the recipient and the number of exposed persons – in most cases it will be one individual which is the “target of concern”
- quantitative measure: this may consider an individual or a group which might be exposed.

For the first option a decision is made within the defined qualitative tolerable or acceptable criteria. In the second case the thresholds defined in the previous chapter are the relevant elements. In the last case, however, an additional decision needs to be made. This comprises three basic elements:

- the decision if the risk goal is one individual or a group of individuals,

- the decision of numeric values for these risks and for comparison -

- the definition of a numeric value for the tolerability/acceptability of the calculated risk.

Definition of the individual risk: “The probability that an individual will experience an adverse effect”[49]; the type of adverse effect needs to be defined additionally, e. g. fatality or the chance to

[49] US-EPA

receive a dangerous dose of a given exposure. The result is usually plotted by iso-risk curves that indicate equal levels of individual risk:

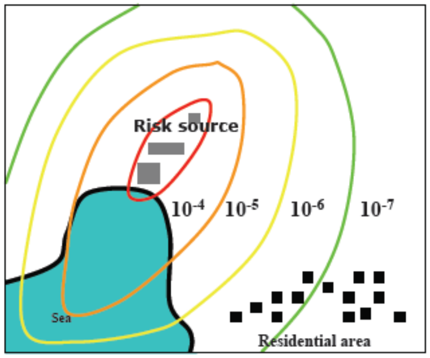

FIG 10 Example of individual iso-risk contours

Definition of the societal risk: "the relation between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards"[50]. The result is usually presented in the form of an F – N – curve[51] which plots the probable frequency of hazardous events against the number of potential adverse effects, e. g. the number of fatalities (see example below).

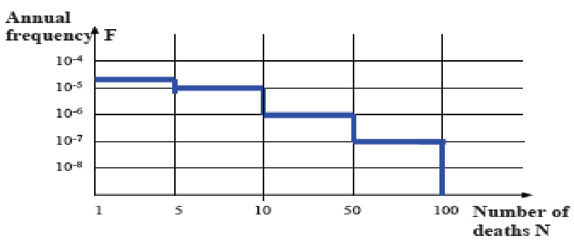

FIG 11 Example of F/N - diagram

The third element within a "full quantitative risk measure" is the comparison against a threshold. The most common terms in this respect are "risk acceptability" and "risk tolerability". Both terms are used as synonyms in many cases, defining them by "the willingness to live with a certain risk in order to secure certain benefits**"[52].** For the use within the technical/land-use planning field the interface as shown below is commonly known.

[50] Defined e. g. by HSE (1989), *Risk criteria for land-use planning in the vicinity of major industrial hazards*, HM Stationery Office.
[51] As proposed by Ale B.,(1996), *Zoning instruments for major accident prevention*, Proc. ESREL/PSIAM, Crete, p.1911.
[52] OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response

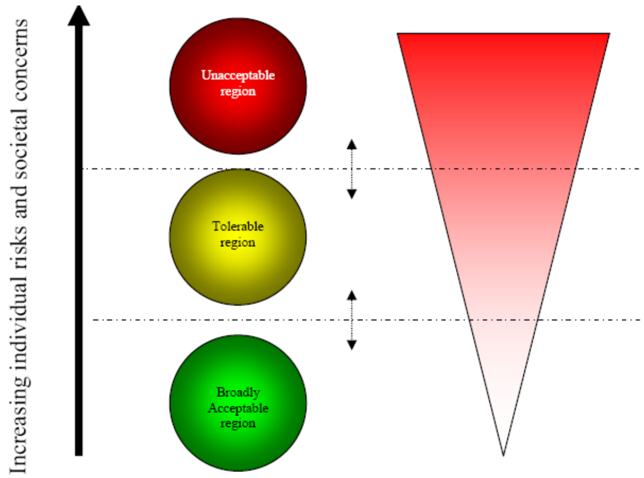

FIG 12 Representation of risk increase and willingness live in its vicinity

Linked with the border areas above, numerical risk criteria would normally be defined; the broadly acceptable region is usually seen as an occurrence with a likelihood < 10-6 per year. The unacceptable region is characterized by occurrences > 10-4 per year whereas the region between these values is subject to consideration of the practicality and reasonableness of measures. In same member states the values may differ, for instance according to factors like the variation between new and existing establishments.

4. Vulnerability aspects in risk assessment: environmental vulnerability/recent developments

Although the vulnerability concept is a core element of several European environmental procedures – like the EIA and the SEA – methods for its evaluation are mostly under development.
What does 'vulnerable' refer to? The EEA Glossary gives the following definition:
'*the degree to which a systems is susceptible to, and unable to cope with, injury damage or harm*"[53].
Hence, in the context of the Seveso II, "vulnerable" is the system which involvement in a given scenario will lead to its injury (human system) or damage (natural and built environment systems). In the context of Seveso II in fact, "vulnerable" refers both to the natural and the built environment. The vulnerability assessment is, in the first case, easier, as it takes advantage of the possibility of evaluating experimentally the capacity of humans to resist to a given toxic, radiation or overpressure exposure. In the second case, being "environment" a general term referring to a complex and site-specific fauna and flora system, the evaluation of its capacity to cope with an accident scenario is less obvious. Consequently, for evaluating environmental risk (with the implicit or explicit consideration of vulnerability), there are few standardized tools. Models to predict the size of polluted areas (e.g. in groundwater, surface water, etc.), given a certain pollution source, are used to assess one particular scenario. In the Netherlands, a model called PROTEUS has been developed to consider and analyse the suitability of transport routes to particularly vulnerable receptors. PROTEUS is an example of the integration of the concept of vulnerability within a quantitative assessment, as it considers the sources of accident pollution and the vulnerable receptors (ecological environment). They may involve following a combination of routes. The output is the assessment of risk reduction measures.

[53] Refer to EEA Glossary, http://glossary.eea.europa.eu/EEAGlossary

Regardless the development of models addressing specific pollution and/or risk matters, the concept of vulnerability of interest for the implementation of Article 12 is that related to the possibility of preserving (human vulnerability) and saving/restoring (environmental vulnerability) the system (in the following: the targets) which is damaged by an accident. In both cases, the definition of indicators may support a ranking of the targets and, consequently, the identification of suitable land-uses. This approach has been developed in several European countries.

In the United Kingdom, a National Population Database mapping the vulnerability on a GIS platform of the population with respect to gender, age, sex, health status and density was recently developed by HSE[54]. In the Netherlands, a mapping of the national territory on the base of vulnerability categories (low, medium and high) that considers a multi-risk situation is developed by RIVM[55] in the Netherlands. In Italy, a set of indicators for assessing the vulnerability of land-uses on the basis among other criteria, of the evacuation capacity of buildings, the capacity of transportation routes and the possibility of restoring damaged natural areas are defined in a specific decree[56].

The last example is one of the few addressing, on a legal basis, the environmental vulnerability indicators issue. The difficulty of defining vulnerability indicators for what lies behind the general concept of "environment" is obvious. Nevertheless, recent studies in the European research framework promote promising perspectives. Estimating the human, environmental and material vulnerabilities[57] has proved useful in characterising Seveso II areas on the basis of a semi-quantitative-multicriteria approach.

Returning to national approaches, in the above mentioned Italian case a tolerability threshold for environmental indicators is also given. This states that any pollution which cannot be restored within 2 years considered as unacceptable. However, this requirement does not specify measures to be taken follows, nor is the meaning of "restoration" itself is defined. This may not always be possible. For example, to recreate original conditions or to assess the time required for this even when possible. The approach seems therefore open to further development.

In Sweden a simplified index accounting the quantity and the properties of the substances (toxicity, biodegradation, bioaccumulation, etc.) was defined. For release of toxic substance into the aquatic environment the equation is:

Hazard Index = K * Toxicity * Amount * (Consistency + solubility/volatility + Bioaccumulation + Biodegradation)

In Spain guidelines for the assessment of environmental risk, based on indexes, were also developed. An index for the amount and the properties of the substance, based on the Swedish equation, is used for assessing the "vector" represented by transport routes (i.e. to assess how easily environmental vulnerable receptors may be reached). The likelihood of the scenario and the existence of vulnerable areas (ecosystems, environmentally sensitive areas) are also assessed. All these indexes are then combined to provide an overall index, which expresses the environmental risk.

An overall list of developed national approaches is not the purpose of this document; but it is useful to mention that experiences and guidelines developed in the United Kingdom and France are opening up promising perspectives. In the following table, a list of possible criteria is given in the table below.

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[54] Smith G., Arnot C., Fairburn J. and Walker G. (2005), A National Population Database for Major Accident Hazard Modelling. HSE Research Report 297.

[55] Refer to www.rivm.nl

[56] DM 9 Maggio 2001, Requisiti minimi di sicurezza in materia di pianificazione urbanistica e territoriale per le zone interessate da stabilimenti a rischio di incidente rilevante, Suppl. GAZZETTA UFFICIALE N. 138/06/01.

[57] Refer to Tixier J. *et* all (2006), Environmental vulnerability assessment in the vicinity of an industrial site in the frame of ARAMIS European project, Journal of Hazardous Material 130, 251-264. In this study, Here, the environment is divided into four sub-systems (agricultural, natural, site-specific and wetlands systems) which sensitivity for overpressure, thermal flux, toxicity and pollution is estimated through an expert-judgment approach. A global vulnerability index, accounting the environmental vulnerability for a 20%, is therefore assessed and mapped on a standard GIS format.

Vulnerable objects	Possible criteria
Residential areas	• Population density; • Building types (fire protection, evacuation facilities).
Buildings and areas of public use	• Customer frequency (shopping malls, sports grounds); • Customer mobility (hospitals, schools etc.); • "Public use" (i.e. equal conditions of access); • Alert problems
Major transport routes	• Transport routes with traffic frequencies (below the following values, they may not be considered as major ones): - roads with less than 10.000 passenger vehicles per 24 hours - railroads with less than 50 passenger trains per 24 hour. • Transport routes with traffic frequencies (above the following values, they shall be accounted as major transport routes): - motorways (speed limit > 100 km/h) with more than 200.000 vehicles per 24 hours or 7000 vehicles per peak hour - other roads (speed limit ≤ 100 km/h) with more than 100.000 vehicles per hour or more than 4000 vehicles per peak hour - railroad lines with more than 250 trains per 24 hours or more than 60 trains per peak hour (both directions together) - Transport routes through vulnerable areas (population or environmental sensitivity)
Recreational areas	• Alert problems (existence of evacuation routes/facilities); • Visitor frequency and hosting capacity
Natural areas and areas of particular sensitivity or interest	• Generic natural areas; • Natural areas comprising surface/underground water; • Natural reserve areas protecting the fauna and flora or landscape falling under national or local legislation; • Areas of specific scientific interest where landowners are obliged to consult conservation bodies prior to a development; • Areas with international wildlife or landscape preserve designations (e.g. EC Fauna-Flora Habitat Directive, "Ramsar - Agreement", UN world heritage sites etc.); • Areas relevant as natural resources to be preserved in their condition
Essential functions (water supply, water purification, sewerage , energy supply)	• Characteristic and positions of supply networks; nr. of people x cut off time (water system, energy system)[58].

TAB 10 Classification of vulnerable elements and criteria for their assessment.

[58] This input is of the Finnish Agency TUKES (Safety Technology Authority, Online: www.tukes.fi).

V. ZONING

LUP is a decision process leading to the destignation of specific uses to land units accordingly to a broader urban planning perspective. Here, the economic, societal and urban development necessities of a given area (usually falling under the same local administration) are considered in terms of the functions to be assigned to private and public land areas. Basically, the vicinity of homogenous land portions leads to the ordinary configuration of the European territory as a mixture of residential, industrial, service, archaeological, historical and natural areas. In this simple description, clearly the complexity of the urban planning discipline does not appear to be as complex as it actually proves to be. Yet this complexity is increasingly confronted with the systemic configuration of modern urban systems, where vital functions – water supply, waste control, transport – are to be combined with a set of elements – residences, services, nature – in an economic and socially sustainable relation. As stated in the European Spatial Development Programme, this objective represents the current challenge of the European territorial development[59]. Facing the problem of allocating land-uses in at-risk areas is part of this challenge.

The resultant requirement of Article 12 of Seveso II is the definition of "appropriate distances". In some European concepts (particularly, the German one), this corresponds to the "zoning" practice. Generally, "zoning" indicates the practice of dividing the territory in homogenous land units, whose classification respond to their function (industrial, residential, etc). In the context of the Seveso II then, "zoning" stands for the definition of land use restrictions/designations within calculated distances around the establishment. Theoretically, this should result into a precautionary sitting of plants within extra-urban industrial areas, and into a restriction of land - use surrounding non-residential developments.

In other European practices (like the Dutch one) restrictions of land-uses are defined accordingly to vulnerability levels. Allowed land-uses are, consequently, those compatible with estimated risks in terms of their effect on this vulnerability. The latter refers to the type of function (residential vs. industrial), to the density of settlements (low vs. high), etc. The drawing below reports an example[60]:

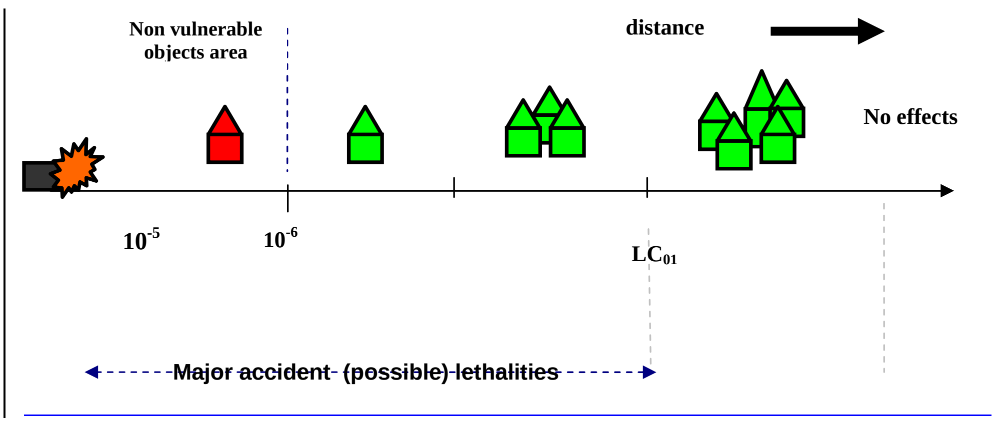

FIG 13 Safety distances and vulnerable objects in the Dutch approach

The difference between the two described approaches is evident in the evaluation of the surroundings of establishments, which is, in the first case, based on land-uses only, while in the second case it accounts a set of criteria leading to a vulnerability estimation of the specific targets. A common denominator is the definition of restrictions for land-uses accordingly to endpoints. In the case of a probabilistic risk regulation, endpoints values will be represented by the frequencies of events, and estimated effects will

[59] Refer to www.espon.eu/

[60] Adapted from Bottelberghs 2005, VROM, The Netherlands

work as “boundaries” for the construction permits of specified installations. In the deterministic case, consequence or effect values will work as limitation for the land-use designations.
A scheme representing a common decision route for a new development in the vicinity of a Seveso establishment is reported in the scheme below:

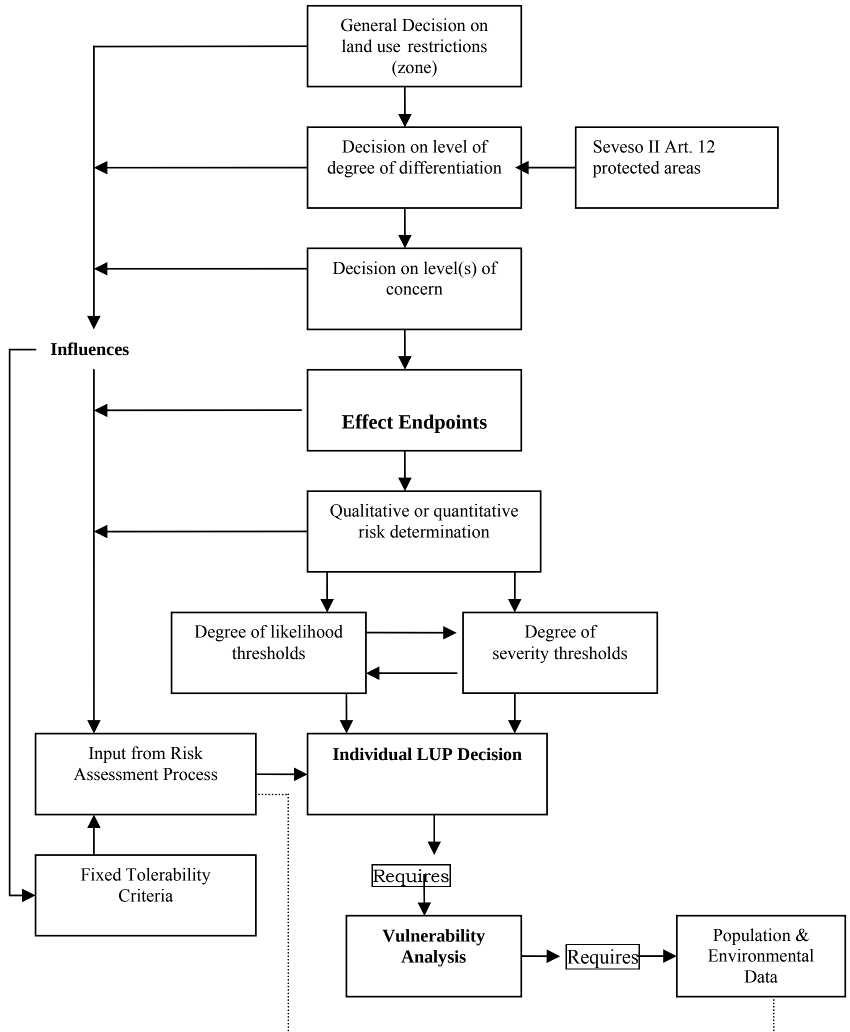

FIG 14 Example of decisional route to evaluate the compatibility of vulnerable objects and Seveso establishments

VI. ADDITIONAL TECHNICAL MEASURES

The definition of additional technical measures as designated in the LUP-Guidance reads:

"Additional Technical Measures (ATM) in the context of Article 12 of the Seveso II – Directive are measures that reduce the likelihood and/or mitigate the consequences of a major accent as effective as the establishing of a distance to the relevant vulnerable recipient; this involves consideration of whether there are measures at or outside the establishment in addition to those already in place"

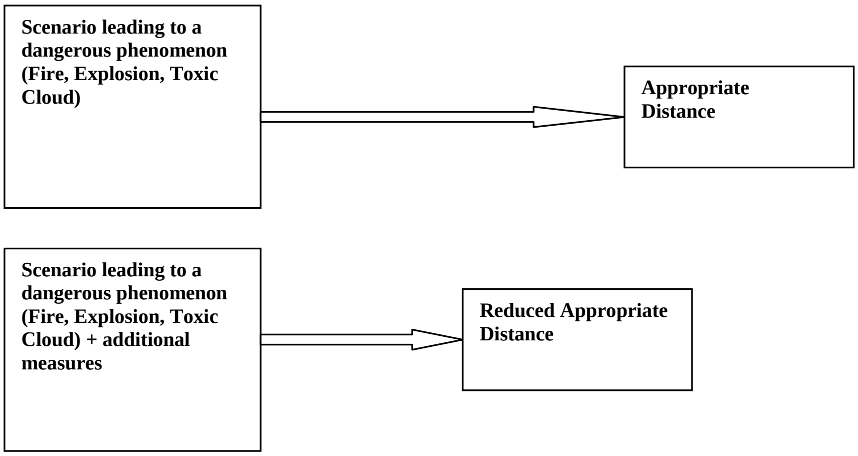

FIG 15 Role of additional technical measures

It is outside the scope of this document to list the particular options for additional technical measures in detail. It should be noted in this respect that the relevant information will usually come from the safety report as required by Article 9 of the Seveso II Directive (or a similar document according to national legislation). This source provides a more generic description of the measures in place or planned. The "Guidance on the Preparation of a Safety Report to meet the requirements of Directive 96/82/EC as mended by Directive 2003/105/EC"[61] recommends for the necessary amount of information:

"The description of measures should be limited to the explanation of their specific objectives and functions. Specific technical details should (only) be provided within the safety report when its necessary to demonstrate that the measures are sufficient".

"The safety report should discuss general criteria assumed (for the description of technical parameters), should give the reason why a method of presentation has been selected over and above other possible options and in particular should describe:

- *The criteria used to decide the degree of redundancy, diversity and separation…*
- *The reliability of components and the efficiency of organizational measures*
- *The functional calculations needed to confirm the capability of the measures to cope with the design-basis accidents*"

The role of technical measures is therefore a more schematic one, giving information on

[61] EUR 22113 EN, European Communities 2005

- function
- efficiency
- position (prevention or mitigation/upstream or downstream of the loss of containment or dangerous phenomena at the centre of the “bow-tie”.

Acknowledged basic concepts to define the typology of technical measures are for example

- the “protection in depth” – concept[62]
- the “protection layer” - concept[63] or
- the “lines of defence” – concept[64].

A schematic example for these concepts is shown below.

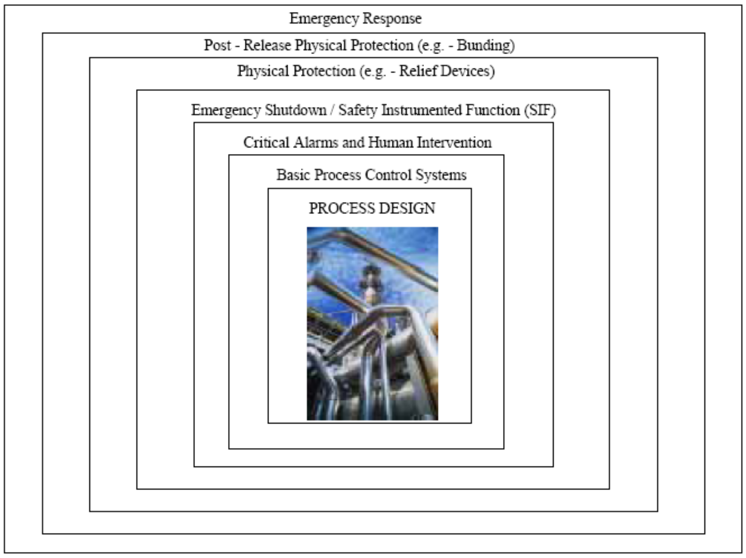

FIG 16 Schematic figures of the relation internal safety – external safety and emergency response

In the scheme above every line represents a “safety - related function”. In the fault tree the purpose of the safety function is to avoid or prevent the occurrence of an event (and thus the dangerous phenomena or critical event) in the left side of the “Bow – Tie” or to limit the size of an event by mitigating its severity effect within the right side.

An overall typology of safety functions may distinguish between measures which are constantly protecting i.e. permanent and independent of the state of the process (all passive measures are permanent), and those activated by the state of the process.

A more detailed classification can be specified as follows:

- A. Passive hardware measures (no actuation mechanism required to fulfil its safety function; e.g., a retention bund round a tank, enclosure with elevated stack) Passive hardware measures have a relatively high level of availability, but in many cases act only to mitigate severity.

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[62] INSAG (International Nuclear Safety Advisory Group), Defence in depth in nuclear safety. International Atomic Energy Agency, Vienna, 1996

[63] CCPS, Engineering Design for Process Safety, American Institute of Chemical Engineers, New York

[64] P.A.M. Uijt de Haag, G.M.H. Laheij, J.G. Post, B.J.M. Ale, L.J. Bellamy, A method to judge the internal risk of establishments with dangerous substances, RIVM, Bilthoven, 2001

- B. Active hardware measures (require external source of energy to fulfil the safety function but operating without or without human intervention, e.g. automatic shutdowns, emergency cooling systems, alarms and emergency shutdown systems).
- C. Passive behavioural measures (behaviour consisting of staying away from defined areas, refraining from contacting or modifying parts of the plant. This behaviour alone constitutes the barrier without any hardware being involved e.g. safety distances, exclusion areas, no smoking area), but normally acts to reduce the frequency of the deviation which starts at the left hand side of the bow tie.
- D. Active behavioural measures (behaviour consists of acting in defined ways whilst interacting with the dangerous part of the plant, and this behaviour alone constitutes the barrier without any hardware being involved, e.g. evacuation in case of toxic or fire alarm, safe working methods when handling chemicals). These generally act as mitigating factors.
- E. Mixed measures, where both hardware and behaviour are involved, and where, in theory, any combination of A and/or B with C and/or D are possible, but where the combination of B with D are the most important, since they interact (e.g. shutdown routines triggered by warnings).

There is no common line among the Member States approaches on which type of measures are taken into account for the selection of scenarios and therefore also no common approach which measures qualify as regarded as "additional technical measures" Almost all Member States take into account passive measures for the definition of scenarios. Some Member States also take account of active hardware or mixed measures, when demonstration is made through safety report of good performance of effectiveness and reliability. This may relate to the legal framework of the individual Member State reflecting which measures are already 'mandatory' or to the established best practice approach. The latter may be based on a "cost – benefit"- philosophy (such as is suggested in the ALARP principle), on an extensive use of the precautionary principle or principles like "ALARA" (as low as reasonably achievable). It is evident that consequently some of these approaches give more room for additional technical measures than others; e. g. a very conservative safety concept based on the precautionary principle may not offer too many options for additional technical measures.

The general options for prevention are shown in the picture below.

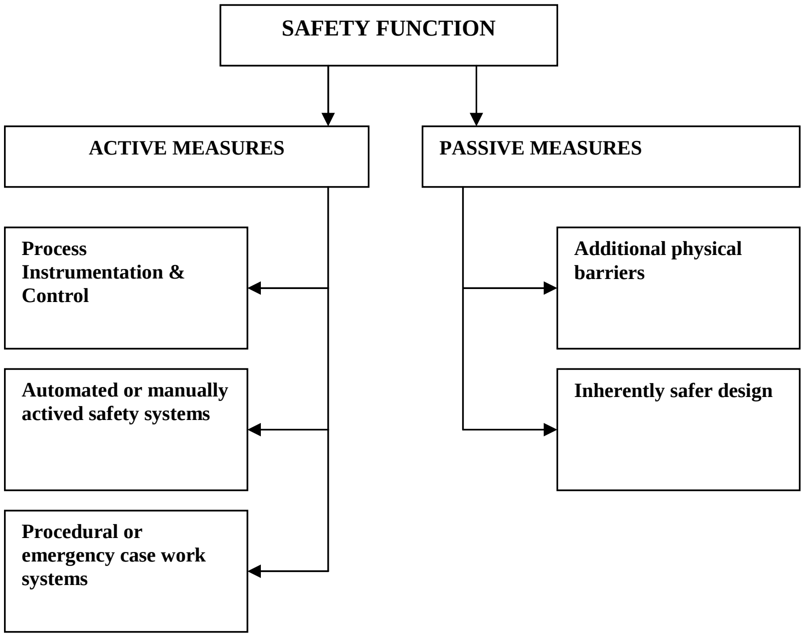

FIG 17 Active and passive measures for risk reduction and emergency response

For mitigation the various possibilities may be distinguished in a more concrete way according to the type of the “dangerous phenomenon” as shown in the next picture.

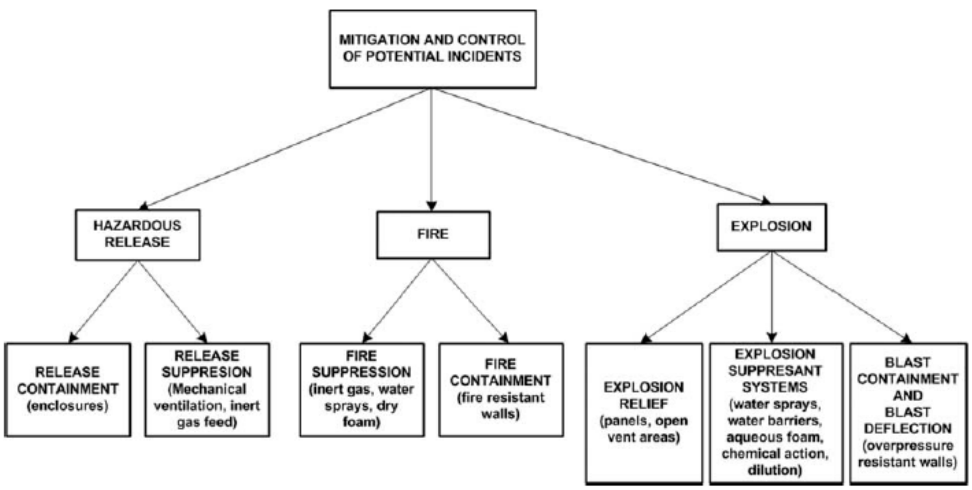

FIG 18 Mitigation and control of potential accidents

VII. EXISTING SITUATIONS

Some establishments that fall under the scope of the Seveso Directive have been founded and developed across the EU prior to the introduction of LUP controls. Such establishments existing prior to Article 12 of Seveso II have legal and continuing rights for their operation and their revocation might not be possible or at least not without huge costs. At the same time, communities have grown around them, sometimes reliant on their wealth creating benefits. There is a significant synergistic relationship between such establishments, its environment and the people working and living nearby. The knowledge of relevant risks, hazards and measures to reduce them is definitely features of the control regime but an ideal situation may not be achievable or economically feasible in comparison with a new plant.

"Pre-existing" in the context of Seveso II means

- establishments that had a legal right for operation prior to February 3rd 1999 (when the Seveso II Directive came into force) or
- establishments that did not exceed substance thresholds of Seveso II at that date and fell into the scope later because of subsequent threshold amendments or changes of substance classification.

Although the application of Article 12 in the case of such an existing situation is triggered only by a modification of an existing establishment or a development in the surrounding area (and thus in theory no application is necessary for existing situations where the location of a Seveso establishment in the given context would be regarded undesirable) certain principles defined for the Article 12 implementation may be extended to those cases. This recommendation is justified by the fact that many of these critical situations are located in urban and densely populated areas. Some key figures[65]:

- EU 27 – overall area ……………………….......4,330.402 km^2
- EU 27 population ………………….............494,607.000
- EU 27 urban area (> 500 inhabitants/km^2)……ca.100.000 km^2

These figures show that only 2, 3 % of the European areas are urban agglomerations, as demonstrated by the picture below.

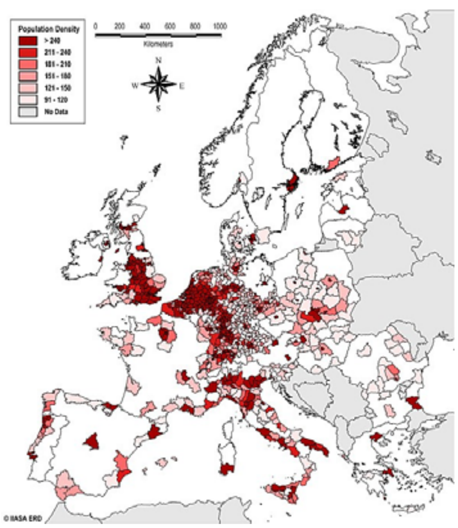

FIG 19 Urban agglomeration in the European territory

[65] Source: EUROSTAT

Many urban developments took place near industrial establishments, mainly built during the "industrial revolution" of the 19th century or around World War I, thus creating critical situations from a recent viewpoint. Still it is a decisive factor for a growth of industrial establishments to have a big city and related infrastructure (airports, harbours) nearby. So we find a "legacy of the past" which now causes concern for consequences of major industrial accidents. In the next picture it can be seen that many existing industrial agglomerations cover the same area as the urban ones.

FIG 20 The overlap between urban agglomeration and industrial sites

The LUP Guidance already proposes several guiding and supporting principles for compliance of land-use planning with Article 12 of Seveso II. With particular respect to existing situations these principles may be summarized[66] as follows:

<u>- Identification</u>

It is evident that the existence as such of Seveso establishments must be known and communicated to the planning authority responsible.

- <u>Priority to risk prevention and reduction of risk at its source</u>.

Any industrial establishment must be, in the present and in the future, compatible with its environment and therefore, priority should be given to risk prevention and reduction at source.

<u>- Risk acceptability</u>

Once risk prevention and reduction at source have been assessed and done, risk acceptability of the establishment should be assessed before any LUP initiatives.

- <u>Territory concern</u>

Land-use planning, especially for existing situations, should clearly state that it applies to a territory or a site that could be called for example a "risk basin". Therefore, several installations or establishments generating risks on the same territory and belonging to the same "risk basin" should be treated at the same time.

- <u>Responsibility of the Competent Authority</u>.

The Competent Authority should accept full responsibility in managing the LUP on existing situations development process.

- <u>Stakeholder engagement</u>.

Risk communication should be promoted either via partnership (bringing together a limited set of relevant stakeholders at work meetings) or via dialogue (bringing together the general public, and enabling information sharing and discussion leading to better risk appropriation).

[66] Contribution of the French delegation in the EWGLUP

- Consistent policy.
National principles have to be developed so as to provide local authorities with a general decision-making process support presenting the necessary flexibility to adapt all decisions to a local context.
- Full coherence between LUP for future and LUP for existing situations.
Action on existing situations should enable to reach the same level of safety as the one that is ensured by action on future situations. When new installations are authorized, it should not imply action on existing elements.
- Major accident selection.
The use of identified major accident scenarios should be relevant for the risk prevention policy under concern. Special attention should be given to the selection of relevant major accident scenarios for LUP-issues, some having to be considered only in emergency plans. This selection has to be done following harmonized methods of risk assessment and national criteria.
- Balance between actions on the territory and risk reduction at source.
The LUP process should facilitate the development of regulatory measures equitable to the various local stakeholders by achieving a cost-benefit balance between territory and risk reduction at source actions.
- Co-ordination of risk prevention policies.
The co-ordination of risk prevention policies should be extensively considered, especially in the light of other policies such as emergency planning policies.
- Technical, strategic aspects and transparent choice.
An integrative framework for decision-making should be clearly defined. Within this framework, special consideration should be given to the following key issues:

- The Technical assessment sequence. The achievement of this technical sequence should provide clear technical results allowing:
    - Each proposed regulatory measure to be well-proportioned and justified;
    - different sets of measures to be compared.
- The Strategic phase. The achievement of this phase should allow the risk prevention principles to be applied on the territory. This phase should take into account all relevant stakeholders of the “risk basin”
- The “synthesis” document. A public document of presentation, which justifies the orientations selected during the strategic phase would ensure that the process is clear and well documented.

Derived from the LUP Guidance furthermore the following relevant issues for “existing situations of concern with respect to Article 12 of Seveso II” may be distinguished:

- Identification: it is evident that the existence as such of Seveso sites must be known and communicated to the planning responsible;
- Pro-active decision-making: it is certainly not judicious to wait for developments to come forward as there is constant pressure for new developments especially around cities which justifies the recommendation to prepare decisions whenever the fact a Seveso site is identified[67]
- Pro-active decision-making: it is certainly not judicious to wait for developments to come forward as there is constant pressure for new developments especially around cities which justifies the recommendation to prepare decisions whenever the a Seveso establishment or a planned development near it is identified[68]

[67] The text of Article 12 of the Seveso II Directive does not require any activity in the case of existing situations when there is no triggering factor, i. e. a modification of an establishment or a new development in the surrounding area.
[68] The text of Article 12 of the Seveso II Directive does not require any activity in the case of existing situations when there is no triggering factor, i. e. a modification of an establishment or a new development in the surrounding area.

- Definition of decision indices: since the LUP system in general should be have a consistent structure it is necessary to define indices for the decision required by existing Seveso situations
- Improvement of the situation may be achieved by an array of activities, as there are additional technical measures as described in the previous chapter (on-site, off-site), emergency response measures or long-term change of land-use around the establishment. The decisions on additional on-site measures may take into account the standard of safety technology when the establishment was built and economically viable improvements.

From the considerations above the following point of concern may be defined:

- Indices: what are the potential indices to serve as decision-making basics?
- Prioritization: According to the ranking of indices a prioritization of concrete activities what would represent "Best Practice"?
- Contingencies: what are the options to solve undesirable situations?

The decision as such will normally be based on the overall timeframe and hierarchy of other documents and plans, such as strategic plans or development decision factors. It is beyond the scope of this document to list those elements. It rightly notes that the whole process is part of a framework for LUP in general. Prioritization is a necessary step that needs no further explanation. It would seem appropriate that the possible indices and the contingencies the LUP process for Seveso establishments may require further determination.

a) Indices:

In principle there are indices based on risk figures or based on the consequence severity:

- Risk figures: the figures for the individual risk or societal risk as described in chapter IV may serve is indices for a subsequent decision process
- Severity extent: here there are various options, e. g. the inherent properties of the substance(s) triggering the decision or the more concrete scenario which takes into account the spatial extent of the consequences and the time period of the hazardous scenario. There are also more complex concepts that combine effect values with weighting factors in order to calculate an overall index.

b) Contingencies:

The options for activities following the result of the calculation of indices and the priority ranking are in principle additional technical measures, relocation of the establishment or changes of the land-use around the establishment.
The matter of additional technical measures is described in the previous chapter as far as concerns measures on-site. Besides this option measures may be taken off-site, although there are only limited possibilities such as firewalls off-site or the change of the construction of buildings according to the actual hazard; furthermore the emergency response measures may offer some improvement (e. g. alarm systems with extended range).

If the situation is extremely undesirable, the decision may result in the relocation of the establishment.
In all cases the decision might require monetary considerations for the costs of the measures or the relocation of the establishment with subsequent incentives for the company to start operation elsewhere.

Acknowledgments

This document was first elaborated as a Report collecting the results of the questionnaire-based survey the MAHB promoted in early 2004. Following the interest shown by all Member States represented by the European Working Group on Land Use Planning (EWGLUP) in the development of the Report, and considering the firm intention of the Authors to provide the result of the investigation in a supporting and extensive form, the concept of *Roadmaps* took form. We could therefore say that their development, where all main topics related to land-use planning in the context of the Seveso II Directive *as developed in the analyzed Member States* are treated, is due to the interest of the EWGLUP delegates as well as on the assumption that the General Guidelines on LUP will take advantage from their content.

Due to this participative approach which characterized the development of the initial Report up to the current Roadmaps, we have to aknowledge the work of the EWGLUP members and of the National Competent Authorities who took part to all LUP seminars and plenary meeting of the last four years.

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- The representative of the Italian Ministry of Environment and of ISPELS, particularly Ms. Fausta Delli Quadri, Ms. Roberta Gagliardi, Ms. Paola de Nictolis, Ms. Elena Floridi and Ms. Nicoletta Trotta;
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Bibliographic reference[69]

- Ale B.M.J, (2005) *Tolerable or acceptable: a comparison of risk regulation in the United Kingdom and in the Netherlands,* Risk Anal. 25 p. 231–241
- Amendola A., Wilkinson D.R., (2000), *Risk assessment and environmental policy making*, Journal of hazardous Materials nr. 78, Elsevier
- Amendola A. (2002) *Risk assessment within the control process of major accidents hazards*, Kluwer Academic Publishers – The Netherlands
- Amendola A., Contini S., Ziomas I. (1992), *Uncertainties in chemical risk assessment: results of a European benchmark exercise*, Elsevier
- Amendola A. (2001) *Integrated risk management: recent paradigms and selected topic,* Research Booklet nr.2 edited by the Integrated Management for Disaster Risk (IMDR), Kyoto University
- Amendola A. (2002), *Gestione dei rischi: dai rischi locali a quelli globali,* Quaderni CRASL (Centro di Ricerche per l'Ambiente e lo Sviluppo sostenibile della Lombardia) nr.2, publication on-line: http://www.crasl.unicatt.it/
- Basta C., Zlatanova S., Neuvel J. and B.J.M Ale (2006), *Risk Maps informing land-use planning processes: A survey on The Nettherlands and the United Kingdom recent developments*, The Journal of Hazardous Materials, Volume 145, Issues 1-2, 25 June 2007, Pages 241-249
- Beck U. (1986:1992), *Risk Society – Towards a new modernity*, London, SAGE Publications
- Christou D. M, Amendola A., Smeder M. (2000), *The control of major accidents hazards: the land-use planning issue*, Journal of Hazardous Materials No. 78, Elsevier
- Chistou M., Mattarelli M. (2000), *Land-use planning in the vicinity of chemical sites: risk-informed decision-making at a local community level,* Journal of Hazardous materials n. 78, Elsevier,
- Christou M., Porter S. (19990, *Guidance on land-use planning use required by Council Directive 96/82/EC*, Institute for System Informatics and Safety, Joint Research Centre, EUR 18695 EN
- Contini S, Bellezza F., Christou M.D., Kirchsteiger C. (2000), *The use of geographic information systems in major accident risk assessment and management*, J. Hazard. Mater. 78, pp. 223–245.
- Cozzani V., Bandini, C. Basta, M. Christou (2006), *Application of land-use planning criteria for the control of major accident hazards: a case-study*, J. Hazard. Mater. 136, pp. 170–180
- Functowicz, S. O. and Ravetz, J. R.: *Three Types of Risk Assessment and the Emergence of Post-Normal Sciencein*, Social Theories of Risk (Praeger: Westport and London 1992), 251-273;
- Jones, A. (1997), *The regulation of major accidents hazards in France, Germany, Finland and The Netherlands,* ISBN 0 7176 1349 6, The Health and Safety Executive, London UK
- Leiss W. (2001), *In the Chamber of Risks: Understanding Risk Controversies*. Montréal: McGill–Queen's University Press, Pp. xv, 388
- Porter S., and Wettig J. (1999). *Policy issues on the control of major accident hazards and the new Seveso II directive.* J. Hazard.Mater.65, pp. 1-14.
- Renn O. (1998), *Three decades of risk research: accomplishments and new challenges*, Journal of Risk Research, Volume 1, Issue 1 January 1998 , 49 – 71
- Renn O. and Graham P. (*eds*), *Risk Governance – towards an integrative approach*, White Paper n.1, edited by International Risk Governance Council, pp. 157, Geneva 2005
- Vlek C. (1996), *A multi-stage, multi-level and multi-attribute perspective on risk assessment decision-making and risk control*, Risk Decision Policy, pp. 9–31.

[69] Considering the amount of literature this Technical Report refers to and mostly reported In the footnotes, only the most relevant reference the Authors suggest for further investigation are listed in the bibliography. References related to the five countries analyzed in Annex I are listed separately.

Tables

Figures

ANNEX I[70]

Implementing Art 12 of Directive Seveso II
Selected European practices

1. UNITED KINGDOM

Top- tier establishments	Lower- tier establishments
360 [71]	800

Background

The United Kingdom has one of the longest European policy formulation experiences in the risk prevention domain. A safety culture has been created and supported since the 70's by one of the best-known European safety institution, the Health and Safe Executive (in Northern Ireland, the HSE of Northern Ireland).

At National level, with respect to the licensing procedure and risk assessment methods, the legal references are the Installation Handling Hazardous Substances Regulations (NIHHS) and/or the Control of Industrial Major Accidents Hazard Regulation (CIMAH) 1999. LUP in the surroundings of chemical sites is regulated by the Planning (Hazardous Substances) Act 1990 and the Planning (Hazardous Substances) Regulations 1992.

Territorial planning is managed at two different levels: the Structure Plans (general level) and the Local Plans (municipal/ local level). In England and Wales, Structure Plans are prepared by the County Councils, which define strategic planning policies. Local Plans instead are under the responsibility of the District Councils, which define land-use destinations taking into account the risk prevention requirements of the Seveso II Directive.

Within local plans, the sitting and modification of new establishments and the new urban developments in their surroundings are based on HSE advice. For each plant HSE establishes so-called "consultation zones", within which HSE consultation is required for any planning decision. To assess safety distances, depending on the substances involved and the kind of scenarios, both the probabilistic and the deterministic approaches are used.

1.1Operating permits procedure

The sitting of new establishments and the modification of existing ones are subject to the "Hazardous Substances Consent" procedure. The application is submitted at the local level by the operator to the corresponding Hazardous Substances Authority; than the HSE will be consulted on the application. HSE that advises Local Authorities both on the requirements to be applied to the plant on case of consent (internal safety, operative measures, etc) and on the eventual lack of compatibility with respect to surrounding land-use destinations.

1.2 Territorial governance & UK planning instruments

Planning procedure[72]

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[70] It must be noted that, as mentioned also at other parts of this document, it was left to some extent to the contact points to deliver information they regarded relevant. Since there were differences in the amount, the authors tried to compress the country examples as far as possible without loosing important information. Nevertheless there are still differences of the length of the individual summaries which entirely due to the above mentioned fact.

[71] The numbers indicated at all 5 summaries refer to the information received at the time of the MAHB survey, i.e. first half of 2004.

The general legislation related to land-use planning in the United Kingdom, England and Wales is:

- The Town and Country Planning Act 1990;
- The Planning (Listed Buildings and Conservation Areas) Act 1990; and
- The Planning (Hazardous Substances) Act 1990[73].
- The Planning (Hazardous Substances) Regulations 1992, as amended by The Planning (Control of Major-Accident Hazards) Regulations 1999. These latter regulations have implemented the land use planning requirements of the Seveso II Directive *[Council Directive 96/82/EC of 9 December 1996]***.**

Land-use planning and urban and environmental management are under the responsibility of Local Planning Authorities. Commonly, Local Plans indicate where land has to be allocated for both human developments and industrial installation. These plans are evaluated with advice from the Health and Safety Executive. HSE Although the advice of HSE is not legally binding, if proposed developments in the vicinity of hazardous installation are considered to be at risk HSE can apply to the Secretary of State to take over the decisions of Planning Authorities .

After the planning procedure is completed, the adoption of the Local Plan requires the consultation with the public; to this scope, several instruments and experiences (supported by open meetings, Public Enquiry, press, etc.) were developed I the last years.

1.3 Systematic method in use for LUP in risky areas

LUP evaluations in the surroundings of plants are carried out by means of the risk analysis developed by the HSE. Different methods are used, depending on the specific scenario and substances. Generally, advices related to toxic releases refer to the "risk oriented" approach (QRA applied to "…*all foreseeable scenarios and a representative set of events which describe a set of circumstances which, for that installation, could lead to an accidental release of hazardous substances* [74]), while in the case of thermal radiation and explosions the consequence-oriented approach [75] is adopted. In the first case, safety distances are assessed against the probability to receive at least a dangerous dose; in the second one, safety distances are assessed against the receipt of prescribed thermal dose units[76]. The criteria used to determine the likelihood of incurring these effects are both the individual and the societal risk[77]. The HSE standard method has several well-developed tools for evaluating both. In order to maintain a "judgmental approach" and to evaluate every risky situation in its particular aspects, the calculation of

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[72] Sources: questionnaire submitted within the EWGLUP; literature sources: *Risk Criteria for land-use planning in the vicinity of major industrial hazards*, The Health and Safe Executive, www.hse.co.uk; the National Assembly for Wales, *Review of Land Use Planning Indicators: Final Report*, research carried out by the Wessex University, 2003. Web site: http://www.wales.gov.uk.

[73] These Acts were amended by the Planning and Compensation Act 1991. Due to the devolution of planning functions and decision-making to Scotland, Wales and Northern Ireland since 1997, planning systems in the United Kingdom are diverging from the English model. Scotland and Northern Ireland are using their devolved powers for legislation to develop their own national planning frameworks.

[74] Refer to *HSE's current approach to land-use planning,* http://www.hse.gov.uk/landuseplanning/lupcurrent.pdf

[75] This difference is based on the characteristic of the explosions and the thermal radiation to present a sharp decline at a specific distance, where specific thermal radiation or overpressure is achieved.

[76] *Dangerous dose* is defined as "[…] a dose which related effects lead to "a substantial fraction requires medical attention; some people are seriously injured, requiring prolonged treatment; any highly susceptible people might be killed." (HSE 2004).

[77] The two concepts are largely used in both UK and Dutch practice. Nevertheless, some difference exists and must be clarified.. Basically, "individual risk" is the risk run by a localized human target within a specific effects area, while the societal risk is a measure used to assess the risk of injuries/death of N number of persons potentially involved in potential major accidents. While individual risk can be represented on a map on the base of endpoint values and frequency thresholds, the societal risk is represented by FN curves on the base of likelihood evaluations. Nevertheless, in the UK societal risk evaluations no thresholds apply for LUP purposes. In The Netherlands, recent developments in the norms have indicated also target values for societal risk.

societal risk results from the integration of the individual risk figure with additional population data. The same judgmental approach is applied, for example, to define generic precautionary distances in all cases in which a full assessment is not realizable.
However, when a development is proposed within the consultation zones, a full assessment is performed. The scope of this successive accurate analysis is the individualization of the "consulting zones", more or less compatible with the presence of more or less vulnerable urban populations.
One decisive element of the analysis is the "vulnerability analysis", where the population, the buildings and the infrastructures (generally: *the targets*) are classified using specific indicators[78]; four classes of decreasing vulnerability (A, B, C and D) are determined. Therefore, the deriving evaluation of compatibility can be seen as the "match" among the three variables of *frequency*, *damage* and *vulnerability*. A summary of the criteria is illustrated below:

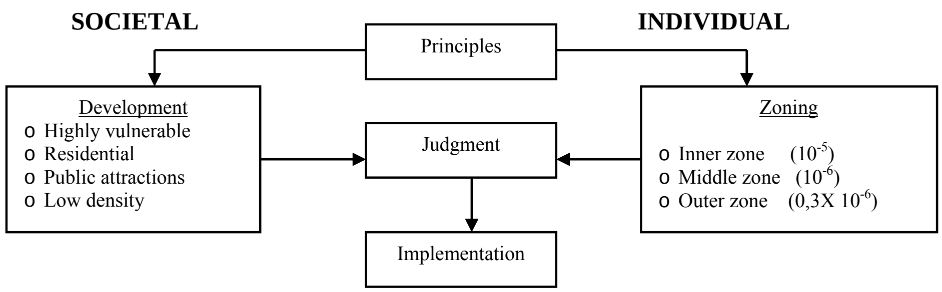

FIG I.1 - Endpoints for societal and individual risk criteria in the UK approaches

1.4 What "tolerable" means in the UK regulatory framework - status of the adopted criteria
Generally, the criteria used to assess the risk's acceptability are those defined in the 3rd report of the Advisory Committee on Major Hazards as the so called "protection concept". In it, the safety distance is defined as "…a separation which gives an almost complete protection for lesser and more probable accidents and worthwhile protection for major but less probable accidents"[79].
Written in a simple form, the advice provided to the Planning Authorities is based on the above-mentioned standard criteria and methodology; 3 zone hazard/risk maps and a matrix approach to the zones and to the classification of types of developments allow ready access to HSE methodology by planners. The clarity of the advice from HSE and the transparency of the information given are the main drivers for the wide acceptance of them by the side of Planning A's.

1.5 Environmental assessment
With respect to the natural environment, The Environment Agencies (England and Wales) and the Scottish Environmental Protection Agency (SEPA in Scotland) are consulted separately.

1.6 Subjects and competences: transparency of the process - involvement of the public
Besides HSE, Local Planning Authorities consult the above-mentioned Environmental Agencies for planning procedures linked to hazardous plants. All the planning information is accessible to the public, and the planning meetings are open to its participation. Planning applications are published in local press. Differently than elsewhere (France, Italy) the Safety Report is not a consultable document.

[78] Among them, and with respect to population, there is the class of age, the daily permanence inside the buildings, the structural characteristic of them, etc.
[79] Source: UK questionnaire.

2. FRANCE[80]

Top- tier establishments	Lower- tier establishments
608	495

Background

The definition of the LUP principles in risky areas is up to the Ministère de l'Ecologie, du Développement et de l'Aménagement Durables (MEDAD). Other three Ministries – the Ministry for Industry, responsible for the DRIRE (Regional Directorate for Industry, Research and Environment), the Ministry for the Interior and the Ministry of Labour – share the responsibility for major hazards prevention & control.

France has a 200 years history in risk prevention regulations related to dangerous facilities. Between 1780 and 1800, polluting factories were moved out of Paris and a Napoleon decree established three classes of dangerous activities. This 1810 decree can be considered as the first regulation addressing risk prevention and enforcing the concept of "safety distances".
With respect to the licensing procedure, the modern legal references are the law No. 76-663 of July 19, 1976 on classified installations for environmental protection and its related decree No. 77-1133 of September 21, 1977. Article 3 of the 1976 law concerns specific classified installations with a major accident potential; these classified installations are known as AS (*Autorisation avec Servitudes*, i.e. authorisation with LUP restrictions) or top-tier SEVESO establishments.
Land- use planning in France according to the Seveso II – Directive took mainly place within the framework of the law of December 13, 2000 on solidarity and urban renewal that makes mandatory for local authorities to account for industrial risk in their LUP documents. But most relevant are the more recent policy developments, six years after the SEVESO II directive, the law no. 2003-699 of July 30, 2003 on the prevention of technological and natural risks and the repair of damage added new measures to the pre-existing set of legislative tools. This law is directly inspired by the lessons learnt from the AZF accident in Toulouse and from the major floods in the southern part of France in 2002.
The new law imposes two new tools dealing with top-tier SEVESO establishments enable to improve the efficiency of limitation of future construction and to deal with existing situation of concern :

- For new installations on existing sites, or modification of existing installations that creates additional risk, the constraint imposed on land use (*servitudes*) because of that additional risk will be financially compensated for by the operator of the installations creating the risk as it was the case for new sites.
- Plans for technological risk prevention mitigating the residual risk for existing situations (PPRT is the French acronym) will be defined and implemented in the areas affected by industrial risk created by top-tier SEVESO establishments or sites.

2.1 Operating permits procedure

Operators must hold the permit or Prefect Authorisation to set up and running a plant. The Prefect – the national representative at local level - gives it using the advice from the DRIRE, which is responsible both for the assessment of the Safety Report and the consultation of the local Authorities/ interests at the stake. Industrial activities are classified according to their potential dangerousness and eventually to their potential impacts on the environment:

[80] Sources: questionnaire submitted within the EWGLUP. Literature sources: Christou et al (1996), *Land-use planning in the context of Major Accidents Hazards*, Report EUR 16452 EN; Jones (1997), *The regulation of Major Hazards in France, Germany, Finland and The Netherlands*, research commissioned by The Health and Safe Executive, London.

- Low dangerousness: declaration scheme (D). A simple declaration is required at the *Prefecture*.
- Medium dangerousness: authorisation scheme[81] (A). A safety report and an environmental impact assessment are compulsory.
- High dangerousness: authorisation scheme with land-use restrictions[82] (AS, or top-tier SEVESO). Land-use restrictions are possible in addition to A establishment requirements.

For A and AS establishments the safety report – under the responsibility of the operator - provides relevant information to the administration for the authorisation, refusal or authorisation subject to conditions. Hereby the Prefect supported by DRIRE is enabled to evaluate the compatibility of the establishment to its environment using a national acceptability matrix[83] which defines the rules depending on the combined probability-gravity parameters. Three areas are defined:

- An unacceptable area: risk deemed too high, no authorization in current state.
- An intermediate area: authorization given after verification that all risk control measures at an acceptable cost have been put in place.
- An acceptable area for which authorization can be given.

2.2 Territorial governance & French planning instruments

Planning procedure
French Land-Use Planning is based on the *Code de l'Urbanisme*, which Article 110 prescribes that the destinations of land-uses must ensure the public health and safety and, specifically, that the prevention of technological risks are taken into account within the urban instruments (Article 121-1).
Urban planning is performed at two levels: the first is the *Schema De Coherence Territorial* (SCOT), defining a general city-regional level project coherent with the principles of sustainable development, concerning both the present and the future situation up to 30 years (i.e. strategic planning). The second level is the *Plan Local d'Urbanisme* (PLU), defining the general regulation for land-use within the Municipalities. The PLU contains, for instance, the zoning map and the rules applicable to the land covered by the plan itself.

2.3 Systematic method in use for LUP in risky areas

General framework
In order to support the planning activity, the Mayor is informed (*Porter à Connaissance*) by the Prefect on the risk is aware of and that should be accounted for in LUP documents (SCOT, PLU).
The *Porter à Connaissance* is mainly based on the she safety report outputs. Following the 2003 law and the regulatory developments with respect to the safety report risk assessment, the Circular of May 4 2007 has been issued to deal with new aspects (especially the probability parameter): technological risk information - *Porter à Connaissance* - and land-use planning around classified installations. It is stated that this information document should include two parts:

- A first part dealing with the *aléas*[84].
- A second part dealing with LUP recommendations based on the *aléas* levels.

[81] About 61.000 establishments
[82] About 600 establishments
[83] Known as the "MMR matrix" (*Mesure de Maîtrise des Risques*, i.e. risk control measures)
[84] Probability that a dangerous phenomenon creates effects of a given intensity over determined period of time at a given point of the territory. (French word, not translated because of its specificity).

Moreover, in addition to LUP tools (PLU) the *Code de l'Urbanisme* enables the Mayor to refuse a building permit if he judges that the "constructions, with respect to their location or dimension, are of such a type as to put public safety or health into jeopardy".
Finally, the Prefect could use two strongly-effective tools:

- The "project of general interest" (*Projet d'Intérêt Général*- PIG). The PIG enables the Prefect to override the decision concerning the land-use in risky areas if the latter has not been taken into account enough.
- The land-use restriction around top-tier SEVESO establishment (*Autorisation avec Servitudes*)

2.3.1 PPRT around top-tier SEVESO establishment: LUP for existing situations

The 2003 law created technological risk prevention plans (PPRT); their objective is to resolve difficult land-use planning situations inherited from the past and to set the framework for future land-use planning. These plans aim at mitigating the residual risk, after risk prevention measures at source have been taken. They delineate a perimeter within which requirements can be imposed on existing and future buildings:

- Restrictions of future construction and land use.
- Consolidation of existing constructions (blast-proof windows…).
- In the areas exposed to very hazardous risks, existing buildings and constructions could be expropriated.
- In areas exposed to hazardous risks, owners could be given the right to force the city (or local community in charge of LUP) to buy their real estate.

Moreover, additional risk reduction measures at sources could be investigated if their cost balances the real estate measure cost that is avoided. These plans are elaborated on a local level under the Prefect responsibility, after a public consultation and in partnership with relevant local stakeholders. Once approved by the local state representative (*Préfet*), it becomes a LUP regulation.

2.4 What "tolerable" means in the French framework - status of the adopted criteria

Tolerability approach	**Related risk management policy**	**Objective**	**Regulatory text**
Endpoint values	Safety report	Used by the operator evaluate distances for each accident (i.e. intensity)	*Arrêté du 29 septembre 2005 relatif à l'évaluation et à la prise en compte de la probabilité d'occurrence, de la cinétique, de l'intensité des effets et de la gravité des conséq uences des accidents potentiels dans les études de dangers des installations classées soumises à autorisation.*
Risk Matrix	Permit to operate: MMR	Used by the prefect to evaluate the compatibility of SEVESO establishment to the environment	*Circulaire du 29 septembre 2005 relative aux critères d'appréciation de la démarche de maîtrise des risques d'accidents susceptibles de survenir dans les établissements dits « SEVESO », visés par l'arrêté du 10 mai 2000 modifié*
Individual Risk	LUP: PPRT around top-tier SEVESO site	Used to determine LUP zoning for existing and future building	*Guide PPRT, MEDD-DGUHC, 2005*

TAB I.1 - The generic relation between tolerability approaches and risk management policy

2.4.1 Endpoint values

French major accident risk regulation refers to endpoint values that are used to calculate “intensity” of phenomena.

<table>
<tr><th rowspan="2">Effects</th><th colspan="4">Level of effects on human</th></tr>
<tr><th>Significant lethal effect threshold</th><th>Lethal effect threshold</th><th colspan="2">Irreversible effect threshold</th></tr>
<tr><td>Toxic</td><td>Lethal concentration 5%</td><td>Lethal concentration1%</td><td colspan="2">Irreversible effect</td></tr>
<tr><td>Thermal</td><td>8 kW /m2 or $(1800\ kW/m^2)^{4/3}.s$</td><td>5 kW / m2 or $(1000\ kW/m^2)^{4/3}.s$</td><td colspan="2">3 kW / m2 or $(600\ kW/m^2)^{4/3}.s$</td></tr>
<tr><td>Overpressure</td><td>200 mbar</td><td>140 mbar</td><td>50 mbar</td><td>Indirect
20 mbar</td></tr>
</table>

TAB I.2 - endpoint values adopted in France

2.4.2 Risk matrix

In the safety report, the hazardous phenomena and associated major accidents are characterised according to three parameters:

- probability: it is assessed by class of probability, according to a national scale of five categories of probability from A (> 10-2/year) to E (<10-5/year). The characterisation method is left to the choice of the operator. Within this approach, real performances of risk control measures to reduce the probability of events occurring are taken into account. The probabilities of catalyst events are assessed taking into account feedback from the operator or the industrial sector. The operator must demonstrate performance of risk control measures.
- intensity: this is determined by calculating effect distances associated with national effect thresholds corresponding to four types of effect: significant lethal effects, first lethal effects, irreversible injury, reversible injury or broken glass. Distances are not generic but calculated for each hazardous phenomenon taking into account barrier performances (response times, effectiveness) and site conditions (weather conditions, etc.).
- gravity of effects: this is established using intensities by assessing the number of potential victims in the accident’s effect envelopes (significant lethal effects, first lethal effects and irreversible injury). Gravity is categorised depending on the number of victims for each type of effect assessed. A national scale is imposed with five categories of gravity.

Gravity	**Significant lethal effect threshold**	**Lethal effect threshold**	**Irreversible effect threshold**
Disastrous	>10	>100	>1000
Catastrophic	1 to 10	10 to 100	100 to 1000
Major	1	1 to 10	10 to 100
Serious	0	1	1 to 10
Moderate	0	0	<1

TAB I.3: Gravity scale depending on the intensity (effect threshold) and on the number of exposed people)

Once the hazardous phenomena and major accidents have been characterized in the safety report according to probability and gravity scales, the Prefect supported by DRIRE could use a national acceptability matrix to make decision. Three areas are defined:

- An unacceptable area (graded NON) for which the risk is deemed too high: the installation cannot be authorised in its current state.
- An acceptable area for which authorisation can be given.
- An intermediate area (graded MMR for risk control measures) in which authorisation is given after verification that all risk control measures at an acceptable cost have been put in place.

Probability / Gravity	E	D	C	B	A
Disastrous	Non	Non	Non	Non	Non
Catastrophic	MMR	MMR	Non	Non	Non
Significant	MMR	MMR	MMR	Non	Non
Serious			MMR	MMR	Non
Moderate					MMR

TAB I.4 - The MMR risk matrix

2.4.3 PPRT national regulatory principle

The following zoning principles are set out in the national PPRT guide.

Regulated zones	Future land-use planning and construction measures	Possible real-estate measures
Dark red	Ban on new construction	Expropriation Relinquishment
Light red	Ban on new construction but possibility to extend existing industrial buildings if they are protected	Relinquishment
Dark blue	New construction possible depending on limitations on use or protection measures	
Light blue	New construction possible depending on minor limitations	

TAB I.5 - PPRT zoning principles

These general zoning principles are related to the *aléas* levels (combination of intensity and cumulative probability):

Maximum intensity of the toxic, thermal or overpressure effects on humans at a given point	Very serious *Significant lethal*			Serious *Lethal*			Significant *Irreversible*			Indirect
Cumulative probability distribution of dangerous phenomena at a given point	>D	5E to D	<5E	>D	5E to D	<5E	>D	5E to D	<5E	All
"Aléa" level	VH+	VH	H+		H	M+		M	Low	
Zoning	Dark red		Light red			Dark blue			Light blue	

TAB I.6 – General zoning principles.

2.5 Environmental assessment

Impact of major accident hazards involving the natural environment should be included in the Safety Report (or, whereas the plant is subject to EIA procedure, in the impact report).

2.6 Subjects and competences: transparency of the process - involvement of the public

Land – Use Plan: After the approval from the side of the involved Authorities, the Land-Use Plan (PLU) is submitted to the community's enquiry.
Safety Report: The Safety Report is accessible to the public. A non-technical abstract, including dangerous phenomena maps, shall be provided, to facilitate public understanding of the information therein.
Information to the public: The 2003 law allowed the creation of local risk-information committees (CLIC) around top-tier Seveso sites by the Prefect. This committee may call upon the expertise of recognised experts, in particular to carry out third-party investigations. It is kept informed of any incident or accident that may affect the security of the facilities specified above. For particular purpose of the PPRT, the principle of dialogue with local stakeholders established throughout the process. Dialogue takes two forms:

- Partnership: this brings partners together through participation at working meetings and consultation over the PPRT project. The partnership is made up of the CLIC (Local Information and Dialogue Committee), the operators of the industrial sites, the relevant communes and the intercommunal bodies that handle land-use planning.
- Dialogue: this brings the general public together and aims to create a common risk culture with local stakeholders. This happens through information and exchange meetings, distribution of PPRT documents, etc.
- Public enquiry: Before approval the PPRT project is submitted to the community's enquiry.

3. GERMANY

Upper Tier establishments	Lower tier establishments
Year 2003: 971 Year 2004: 988 Year 2005: 979	Year 2003: 877 Year 2004: 905 Year 2005: 976

Background[85]

Germany is a federal country consisting of 16 States or *Länder*. The relationship between the national, federal administration and the states is regulated within the "Basic Law" – *Grundgesetz*, legislative and executive competency being divided between them. Land use planning in Germany is regulated within a number of statutes at federal and state level.

3.1 Operating permits procedure - Licensing

Federal law (Federal Pollution Protection Act – *BImSchG*) determines the rules for granting licenses for potentially polluting or hazardous installations or activities according to the Annex of the 4th Ordinance for the Implementation of the Federal Pollution Protection Act – *4. BImSchV*[86]). This licensing procedure includes the granting of the Building Permit and the compliance with the spatial planning

[85] ISW, Spatial Planning in Germany, www.isw.de
[86] Vierte Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über genehmigungsbedürftige Anlagen -4. BImSchV), 14 March 1997 last amended 15 July 2006

legislation. This applies to the procedure for granting planning permission as well as to the substantive requirements to be met when carrying out specific projects with a view to avoiding project-related hazards. An application for a license may be refused if the particular site is not suitable for the desired land use,

Recommendations have existed for separation distances between residential areas and potentially polluting activities since the late 1970s. The aim is to prevent serious nuisances or hazards in the neighbourhood due to air pollution or noise.[87]

3.2 Territorial governance & German planning instruments

The *Raumordnungsgesetz (ROG)* – Spatial Planning Act is federal legislation which regulates the general land use planning at national level and defines the mechanisms and principles by which the states and other public bodies should carry out their spatial planning at a regional and local level. The *Baugesetzbuch (BauGB)* – Federal Building Code is federal legislation which defines in detail the procedure for carrying out land use planning from the regional level down to the detailed urban planning. The classifications of the type of use for which an area may be designated within the urban plan are defined within the *Baunutzungsverordnung (BauNVO)* – Federal Land Use Ordinance. This legislation sets the framework for the German zoning principle in the land-use planning which has existed since the 1950s.

The sixteen states have the responsibility to take the goals and principles defined at the federal level and turn them into spatial development aims for state and regional planning. This is carried out via the *Landesplanungsgesetz (LplG)* of the individual States – State Planning Law. The states are also responsible for the coordination and approval of public and private infrastructure with wider ranging spatial relevance, e.g. airports, major roads.

The central planning competence in Germany is anchored at the local level. Here several types and hierarchies of planning exist. The municipalities are obliged to formulate two types of statutory land use plans. The preparatory land use plan (*Flächennutzungsplan*, Scale 1:5000 to 1: 15000 according to the area of the municipality) constitutes a framework instrument, while the legally binding land-use plan (*Bebauungsplan*, scale usually 1:1000) serves as a regulatory instrument. The preparatory land-use plan covers the entire area of the municipality and indicates "the intended development of the community". It is binding for all public bodies; private actors are neither bound by it nor can they base any claims for building permission on it. The legally binding land-use plan is more detailed, defining functions and intensity of use, basic urban design principles and the allocation of public infrastructure. Environmental aspects are an important consideration together with public safety. This legally binding land-use plan is "evolved" from the preparatory land-use plan. This means that it need not be an enlarged copy; however it may not contain major deviations. If these are deemed necessary, the preparatory land-use plan must be amended in a parallel process. Land-use plans usually determine which kinds of land-use are permissible in the respective parts of a town to which the plans apply (e.g. industrial areas; areas for various kinds of uses like housing, trade, etc.; area purely or predominately reserved to housing; and so on).

The legal provisions dealing with issues of spatial planning at different levels (national, state, and local) need to be strictly distinguished from State laws regulating safety and construction issues of buildings (Building Regulations *Bauordnungsrecht / Bauaufsichtsrecht* of the 16 *Länder*).

The different levels of land use planning are listed below:

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[87] Abstände zwischen Industrie- bzw. Gewerbegebieten und Wohngebieten im Rahmen der Bauleitplanung und sonstige für den Immissionsschutz bedeutsame Abstände (Abstandserlass), MBl. NW. 1998, P. 744

	Level	Decision making
1	*Bund* (Federation)	▪ Legislation for federal spatial planning *(Raumordnung*), including material principles ▪ Legislation for local planning
2	*Bundesland* (Federal State)	▪ Legislation for state spatial planning (*Landesplanung*), including sub-regional planning (*Regionalplanung*) ▪ Establishment of State Development Programme (*Landesentwicklungsprogramm*) ▪ Legislation on State Building Code (*Landesbauordnung*)
3	*Region* (Sub-Region)	▪ Establishment of sub-regional plan State Development Programme (*Regionalplan*), coordinating state and local development goals
4	*Municipal council*	▪ Establishment of land use plan (*Flächennutzungsplan*) indicating the intended spatial development for the community ▪ Fixes in statute (*Satzung*) as legally binding local plans (*Bebauungspläne*) for limited areas to be evolved from land-use plan

TAB I. 7 - The competency for spatial planning of various levels of government[88]

Land-use planning connected to risk is regulated more at the level 2, 3 and 4 (States and municipalities), the municipalities are responsible for the more detailed planning (buildings, exact position, etc.). Within the German zoning system the designation of the use of particular areas must be "appropriate", i.e. industrial areas may not border directly on residential areas, moreover they should be separated by a suitable other type of use such as green-belt, commercial zone, etc. .

3.3 Systematic method in use for LUP in risky areas

German guidance on separation distances for major accident hazards

In 2005 the Guidance "SFK/TAA-GS-1[89]" was published jointly by the German Hazardous Incidents Commission (SFK) and the German Technical Committee for Plant Safety (TAA)[90]. The Guidance gives recommendations for separation distances between establishments under the German Major accidents Ordinance (Störfall-Verordnung) and Areas requiring protection within the framework of Land-Use Planning.
The policies according to Article 12, paragraph 1 of the Seveso II Directive are defined in Germany in the Federal Building Code (BauGB) together with the associated Federal Land Use Ordinance (BauNVO) and in Section 50 of the Federal Pollution Protection Act (BImSchG). The consideration of appropriate separation distances should enable that the effects of major accidents in establishments on neighbouring sensitive objects may be avoided as far as possible.

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[88] nofdp - nature-oriented flood damage prevention, Description of the German Spatial Planning System, http://nofdp.bafg.de/servlet/is/13222/?lang=en,

[89] SFK/TAA-GS-1 ‚Recommendations for separation distances between establishments under the Major accidents Ordinance and Areas requiring protection within the framework of Land-Use Planning - Implementation of § 50 Federal Pollution Protection Law (BImSchG), developed by the SFK/TAA Working Group "Land-Use Planning", http://www.kas-bmu.de/publikationen/sfk_gb/sfk-taa-gs-1k-en.pdf (short Version)

[90] Note: The SFK and the TAA were set up pursuant to Sections 31a (repealed) and 51a of the Federal Pollution Protection Act under the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. In November 2005 SFK and TAA merged together to form the Commission on Process Safety (KAS).

The separation distance recommendations are only related to people as the subject to be protected, they are not suitable for the assessment of current mixed situations (existing buildings), for the licensing procedure under BImSchG or as the basis for the external emergency planning.
On reaching or exceeding the recommended separation distances, it may be generally assumed that the effects of a major accident within an establishment, based on the assumptions made, will not lead to a serious hazard as defined in the German Major Accident Ordinance for the population.
Probabilistic risk assessment as carried out in the Netherlands and the UK does not have an equivalent use in Germany. There are a number of reasons for this:

- German major accident policy and legislation have, up until now, only considered a deterministic approach which is "consequence based".
- Establishments which fall under the requirements of the Seveso II Directive in Germany are required to be erected, and operated according to the "State of the Art in Safety Technology". This is a dynamic process which takes account of current technical regulations and standards as well as developments in technology.
- The application of "State of the Art Safety Technology" should therefore mean that the risks of effects of an accident outside of the establishment are negligible.

The method generally used is of the “consequence-based” type. In exceptional cases different tools are applied, e g. probabilistic assessment (with certain conventions, as the pre-selected scenario) or a case – by – case approach (e.g. for existing situations).
The general used “consequence – based” approach refers to pre-selected “worst credible” or “representative” scenarios. With respect to fertilizers (ammonium nitrate) and explosives generic approaches are occasionally used, while in the case of LPG applicable standard scenarios (like the BLEVE) are adopted. In any case, it must be underlined that the evaluation of the safety distance that moves from the ‘worst credible scenario” is based on:

the maximum permitted amount of substance, its temperature and pressure;
the vulnerability of the surrounding environment.

Regarding the effects, the criteria adopted to define the compatibility are:

Injuries or fatalities of a large number of people.
Material damage.
Individual/societal risk (only in exceptional cases)

Examples for endpoints values used in the German practice are reported below:

Endpoint values adopted to assess risk tolerability in Germany		
Toxic: ERPG* 2 * Emergency Response Planning Guidelines[91]	Thermal radiation: 1,6 kW/ m2	Overpressure : 0,1 bar

TAB I.8 – Endpoint values adopted in the German regulation.

3.4 What “tolerable” means in the German regulation - status of the adopted criteria

The SFK/TAA-Recommendations are guidance and the endpoints should be considered as target-criteria. The application is left to the individual State and the executive authorities at regional and local level, which, where justified, may adopt other values.

[91] For explanation see chapter IV

The tolerability of risks under the German Major Accident Ordinance is governed by the concept that *"establishments may only carry out their hazardous activities if they are able to demonstrate that hazardous effects from an accident may be reasonably excluded"* .
This is based on technical regulation and expert judgement. This does not however preclude all and every single accident.

3.5 Environmental assessment

With respect to the natural environment, the risk acceptability evaluation is often carried out in combination with the EIA (Environmental Impact Assessment).

3.6 Subjects and competences: transparency of the process - involvement of the public
Regional and Local Authorities are responsible for the whole procedure, with the Municipality as final decision-maker. Different assignments and responsibilities are regulated by law (Federal Building Code and Federal Pollution Control Act). The public is informed through official publications and consultation procedures regulated by law.

4. ITALY

Top- tier establishments*	Lower- tier establishments*
532	**610**

* last inventory: 2007

Background

Historically structured as a Central State government, the Republic of Italy, since the 90's has been characterized by an ongoing process of devolution to transfer some roles to the regions. The devolution process from national authorities to regions has been carried out by legislative provisions and an amendment to the 117th article of the Constitution, which has increasingly enhanced the responsibilities of local-level institutions, represented by the 20 regions (one of them with two autonomous provinces), their provinces and municipalities. Currently, Regions can adopt their own legislation concerning protection of the environment, and other general-interest matters as civil protection, natural resources protection and (local) economical development. In particular, Regions have a central role in land governance. Provinces and municipalities can adopt regulations with regard to the matters mentioned above.

Consequently, the Land Use Planning (LUP) is based on 4 different stages, regulated by the National Urban Law, that sets guiding principles and establishes different roles of regional, provincial and municipal authorities.
Within this process, each region has the power to implement national laws having direct implication with general-interest issues as protection of the environment, control of major-accident hazards, safety, health, etc. As a consequence, in Italy the Seveso II Directive has been implemented not only by the legislative decree n. 334/99 (law of first level) and by the *Ministerial Decree 9 May 2001* (law of second level), that dictate the national criteria for Land Use Planning, but also by regional legislation.

According to the mentioned laws, a municipality must receive a technical advice, given by a Regional Technical Committee[92], before giving a building permit in one of the cases of the art. 12 of the 96/82/EC Directive. The technical permission may be expressed on case by case or during the drawing up of specific planning tools (Technical Paper on LUP).
The Italian regulation states the following procedure:

- Phase 1 – activation of the project affecting the town or territorial instrument, due to a change in the context, or to a preliminary general verification of the existing conditions:
1. new settlements;
2. modification of the settling asset, according to art 10, paragraph 1, of the legislative decree 17 August 1999, n. 334;
3. new settlements or infrastructure around the existing settlements, such as, for example, communication roads, sites open to the public, residential areas, when localisation or settlement or infrastructure may worsen the hazard level or the consequences of a relevant accident.
- Phase 2 – identification of the territorial and environmental elements.
  Territorial elements according to edification index and specific elements.
  (table 1 of MD 9 may 2001 - territorial categories, from Cat A - iff[93] > 4,5 mc/sm – to Cat E iff ≤ 0,5 mc/mq – and Cat F concerning plants) Environmental aspects based on environmental themes potentially included in a major hazard context: landscape and environmental heritage (governmental decree 42/2004); natural protected areas, such as parks and other areas identified by the regulation; superficial waters (such as superficial water, primary and secondary hydrograph systems, water corps according to circulation times and basin volume); deep waters (such as capitation wells for potable or irrigous water; protected or not protected deep water resource; recharging water stratum); land use (such as valuable cultivated areas, woods).
- Phase 3 – validation of territorial and environmental compatibility of settlements.
  The examination of territorial compatibility is based on a maximum level that cannot be exceeded: below it, it is conventionally agreed that there will not be damage; over the level the damage is supposed to occur. Table 2 shows the risk for people and buildings in terms of maximum limits.

4.1. Operating permits procedure

Due to the three-levels structure of Italian governance (Regions – Provinces – Municipalities), licensing procedures are carried out by regional authorities (responsible for lower-tier establishments) and the Regional Technical Committee (responsible for upper-tier establishments). In detail, the operators of upper-tier establishments must submit a preliminary safety report to the CTR and receive its positive technical permission, in order to obtain the building permit. The preliminary safety report must be drawn up in case of new installations and substantial modifications of existing establishments. The preliminary investigation carried out by CTR is the pre-condition to get operational permits and land-use permissions; according to Ministerial Decree *9 May 2001,* minimal safety requirements are to be fulfilled.

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[92] Regional Technical Committees (CTR): technical authorities regarding hazardous industries at the regional level, composed of members of the Regional Fire Departments, National Authority for Prevention and safety at work (ISPESL) and of other local authorities, such as the Regional Agency for Environmental protection (ARPA). They also assess Safety Reports elaborated by the operators of Seveso establishments, and ensure that Safety Management Systems have been elaborated. After the transfer of competencies about Seveso establishments, the role of the CTR will be played by technical authorities under the control of each Region.
[93] Iff = in Italian is the "indice di fabbricabilità fondiaria", which is the building land index and represents the building volume capacity in a specific area, according to which it is possible to acknowledge the maximum density of settled inhabitants.

4.2 Land governance & Italian planning instruments

Planning procedures

The devolution of administrative and legislative powers from national to local authorities, due to Legislative Decree 31 March 1998 n.112 and successive amendment to the 117th article of the Constitution, has changed both roles and subjects connected with the matter of land governance in Italy, extending regional role.

Responsibilities and power of regional, provincial and municipal authorities progressively increased, and now regions and provinces have the power to define their own statutes and (in the case of the regions) their laws concerning crucial themes as regional planning, town-planning principles and criteria, social security, industrial safety and civil protection. The Central Government sets general principles and guidelines, implementing European Directives. As far as the implementation of the Seveso Directive is concerned the principal national law is the Legislative Decree 334/99. The 14th article of the Decree, providing *control of urbanization*, has been implemented by the *Ministerial* Decree *9 May 2001*, concerning "*Minimal Safety requirements for the urban and territorial planning in the areas subject to major accident risks*".

The implementation of the *Ministerial* Decree *9 May 2001,* within the ordinary land-use planning regulation, can be summarized as follows:

	RISK REGULATION	PLANNING REGULATION
CENTRAL GOVERNMENT	Transposes the Seveso II Directive by Legislative Decree 334/99, which LUP regulation is defined by the *MD 9 May 2001*	National Urban Law defines principles and objectives of National interest. The Law must be implemented by all the 20 regions and the 2 autonomous provinces.
REGIONS	Adopt regional laws implementing national legislation; ensure the enforcement of procedures and the assignment of responsibilities.	Define regional plans, that give planning objectives to provinces and municipalities and contain specific provisions regarding matters of regional interest.
PROVINCES	Within their territorial plans, define areas "subjected to specific regulation"; set principles for urban plans.	Define territorial plans, where goods subjected to provincial responsability (protected areas, transportation routes, etc) are disciplined; set principles for urban plans.
MUNICIPALITIES	Define the technical paper on LUP, in which risks connected to establishments and vulnerable elements are represented in a common and easy-reading cartographic base. Land-uses are disciplined on the base of this document.	Define the urban plan on the base of the directives ~~of~~ given by province and region, assign property rights, and discipline use of goods subjected to their responsibility. The plan is subjected to public consultation after its publication in the Official Journal

TAB 1.9 – Assignment of responsibilities in the Italian Competent Authorities framework.

Within this framework, and in order to insert the technological risk evaluation within the ordinary territorial planning practice, the Ministry of Infrastructure has developed a specific programme[94] for

[94] Refer to http://www.infrastrutturetrasporti.it/sites/seveso2/pages/sev_page_05.htm

technical assistance to Authorities dealing with the implementation of th DM 9 maggio 2001. The programme includes the appointment of a scientific committee involving representatives from both institutional and non-institutional parties. With the emanation of the 1st amendment to the Seveso II (the Directive 2003/105/EC), within the Italian implementation (Legislative Decree 238/05) the need for Guidelines for the implementation of the DM 9 Maggio 2001 was underlined. Finally, further regulation will take into account the possibility of integrating the matter of technological risk within the territorial management general regulation together with the definition of instruments to assess the economical and social sustainability.

4.3 Systematic method in use for LUP in risky areas

Specific regulations are in place for high standard storages and all other establishments in which substances classified as "Seveso" are present. For LPG storages and toxic/flammable liquids storages specific national decrees have been issued, and a risk assessment ('semi-quantitative method") methodology is used. The methodology integrates probabilistic elements applying an index method which defines the likelihood of an accident scenario. Each accidental situation is considered case-by-case and impact areas are identified using defined threshold values. Concerning the other dangerous substances a semi-quantitative approach is used to assess both the frequencies of the expected events and the deriving effects. In so doing, the regulation refers to the national legislation on dangerous substances, the Legislative Decree 334/99. The land-use decision is based on the specific requirements of the *Ministerial Decree 9 May 2001*, where the categories of frequencies and effects are combined with 6 categories of vulnerability, as the following table shows:

Frequency of the event (classes)	**EFFECTS categories (Estimated damage)**			
	Elevated mortality	**Mortality**	**Irreversible damage**	**Reversible damage**
$< 10^{-6}$	DEF	CDEF	BCDEF	ABCDEF
$10^{-4} – 10^{-6}$	EF	DEF	CDEF	BCDEF
$10^{-3} – 10^{-4}$	F	EF	DEF	CDEF
$> 10^{-3}$	F	F	EF	DEF

TAB I.10 – Compatibility matrix of the Italian MD 9 may 2001 – the different words indicate different vulnerability category of the land.

The compatible localization of the targets, classified in decreasing vulnerable categories from A to F, is estimated on the base of the overlap between frequencies and effects.
The criteria are those of lethality, initial lethality, irreversible injuries, reversible injuries and material damages (domino effect) due to:

- stationary thermal radiation;
- instantaneous thermal radiation (i.e. flash fire);
- overpressure and missile projection by UVCE/CVE;
- toxic release.

Endpoints are reported in the following table:

Scenario	high lethality 1	starting lethality 2	irreversible lesions 3	reversible lesions 4	Damages tostructures / domino effects 5
Fire **(stationary thermal radiation)**	12,5 kW/m^2	7 kW/m^2	5 kW/m^2	3 kW/m^2	12,5 kW/m^2
BLEVE/Fireball **(variable thermal radiation)**	**fireball radius**	350 kJ/m^2	200 kJ/m^2	125 kJ/m^2	200-800 m (*)
Flash-fire **(instantaneous thermal radiation)**	LFL	½ LFL			
VCE **(overpressure)**	0,3 bar (0,6 spazi aperti)	0,14 bar	0,07 bar	0,03 bar	0,3 bar
Toxic release **(absorbed dose)**	LC50 (30min,hmn)		IDLH		

(*) related to the typology of the tank

TAB I.11- Endpoint values adopted in the Italian regulation.

As deriving from the reported tables, if a vulnerable element (for example: a "B" target, representing a hospital with less than 100 scholars) is exposed to a level of risk (frequencies, damages or both) higher than allowed, additional safety measures are required.

4.4 What "tolerable" means in the Italian regulation - status of the adopted criteria

Both for LPG storages and dangerous substances, the thresholds values of the criteria are legally binding and must not be exceeded in any case.
Also the definition of the target vulnerability is regulated by law: the *Ministerial Decree 9 May 2001* establishes criteria and thresholds for each urban and natural element that can be involved in an accident. The general criterion is the one of more or less easy evacuation of the population. The criteria are translated in several indicators, like for example, the number of beds in a hospital (> 25 = A, ≤ 25 = B), the number of scholars in a school, the number of floors in buildings calculated on the basis of the index of edification (the rate between m^3/m^2) of each land's portion.
This strictly quantitative approach requires the planning authorities to monitor the development of the urban elements constantly, in order to furnish updated data each time a risk evaluation becomes necessary.

4.5 Environmental assessment

The evaluation of natural vulnerability, as defined in the *Ministerial Decree 9 May 2001*, has been showing some problems during its implementation, and further studies are currently under development. The proposed criterion is to measure the time necessary to restore the original state of a natural element in case of an accident. This approach implies, the evaluation of natural vulnerability on the base of possible or less possible restoration of its initial state after having been involved in an accident; the corresponding threshold is > 2 year = incompatible, < 2 years = compatible.

4.6 Subjects and competences: transparency of the process - involvement of the public

Accessibility to information in the safety report (with the exception of some industrial, commercial or personal information not available for public consultation on operator's request, and those related to public security or national defence) is ensured and ordinary consultation procedures are prescribed by planning regulation (a consultation period, after publication of urban plans in the Official Journals). In case of establishments submitted also to EIA and IPPC directives, authorities responsible for administrative procedures must ensure public information and consultation, according to legislation in force.

5. THE NETHERLANDS

Top- tier establishments	Lower- tier establishments
138	172

Background

The most densely populated European country, the Kingdom of The Netherlands, has developed its safety regulation since the '80's, when the increase of the use of LPG became evident together with the connected storage problems. Extensive studies on LPG led to the development of quantitative assessment procedures and, in the light of the scarcity of land, to the development of sophisticated quantitative criteria for the evaluation of risk acceptability based on the likelihood of occurrence of the events.

Divided in 12 Provinces and 480 Municipalities, The Netherlands are well known for being an under-sea level territory for a main part of their extension. The area called "Randstad" (comprising cities as The Hague, Rotterdam, Leiden, Haarlem and Amsterdam) is up to 30 meters under the sea level and, due to the presence of the main industries and commercial harbours, it is also the most populated. Consequently, "safety" matters in The Netherlands are instinctively connected with flood risks, and the probabilistic approach developed for their management in the '70 has led to the current safety culture addressed, firstly, to the quantification of the probability of occurrence of the events for which usually enormous interventions are required.

5.1 Operation permits procedure

In the Netherlands, a full QRA is required in the phase of permit application for the installation of new establishments, as well as for modifications of existing situations. The coordination role for external safety matters has been assigned to the VROM (Spatial Planning, Housing & Environment Ministry) who decided to establish the External Safety Directorate as specific implementation body. According to current legislation, operation permit are subordinated to a fulfilment of the environmental quality defined in External Safety (Establishment) Decree.

5.2 Territorial governance & Dutch planning instruments

Planning procedure

Dutch public authority is defined as a 'gedecentraliseerde eenheidsstaat', that means that a decentralization in the competences of government, provinces and municipalities is in place. This three main levels of government - having direct reflection in the territorial governance – are, according to Dutch constitution, not hierarchically organized, since each of them have the own powers and competences; obviously, supervision from one level to the other, based on geographical scale, is in place.

The main legal reference for land-use planning in The Netherlands are the Spatial Planning Act and the Environment Management Act of the Minister for Housing, Spatial planning and Environment, competent for drawing national policy on spatial planning as well as the official 'National Policy on Spatial Planning' (NPSP). The latter is a document that is updated once every five years and it contains specific aspects of the national policy on spatial planning; it may comprise national structure outline plans, national structure policy sector plans and concrete policy decisions that are of importance to the national spatial planning policy. The SPA prescribes an adoption procedure for the NPSP, including an advice of the State Town and Country Planning Commission, a stage of public consultation and, in the end, the adoption by parliament.

Under the SPA, Provinces and Municipalities may adopt a Regional Spatial Plan (RSP) for the entire area of the province/municipality or for one or more parts in which developments are planned. At the local level, three spatial policy plans are elaborated: the Structure Plan, the Individual Project procedure and the Local Land Use Plan. The latter is legally binding and it regulates the use of the land for a period covering up to 10 years. It also regulates the safety around hazardous installations.

5.3 Systematic method in use for LUP in risky areas

Until 1993 (hence, previously to the emanation of the Seveso II) the prevention of major hazards and the protection of population & environment was up to the Nuisance Act. For "stationary" hazardous activity, a license under the Act was required. This procedure ensured that no nuisance was caused to the surroundings of the plants.

This regulation has been replaced with the Environmental Protection Act and, concerning the specific topic of risk assessment, with the Hazard of Major Accident Decree (BRZO 1999) implemented for LUP by the External Safety Decree (2004). The EPA states that an establishment must obtain a unique license for all the environmental effects it may cause outside its boundaries (air, water, soil, accidental events, etc), and that safety reports have to be submitted for the other environmental certifications; the External Safety Decree regulates the environmental quality requirements to be set for external safety when a land-use decision is taken.

Concerning the risk assessment methodology, the Dutch approach is based on three guiding principles:

- the quantification of the risk through an analytical approach accounting probabilities;
- the evaluation of the individual risk and the definition of thresholds of acceptability;
- the evaluation of the societal risk.

The last step involves the calculation and the representation of location-based risk contours and of a societal-risk diagram. For both, legal definitions are given:

- *individual risk* is the probability that an average unprotected person present at a point around an hazardous installation gets killed consequently to an accident;
- *societal risk* is the probability that a group of more than N persons gets killed due to an accident deriving from an hazardous installation.

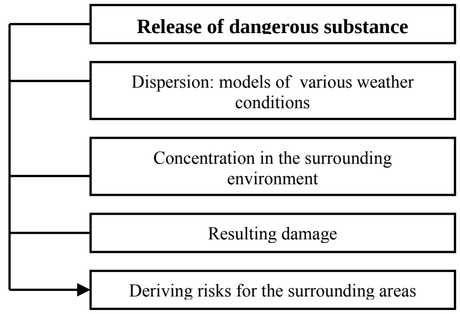

FIG I.2 -Steps involved in Dutch QRA (adapted from VROM, 2005)

The Dutch legislation defines legally binding thresholds for individual risk, and gives target criteria for societal one. Nevertheless, it requires to Municipalities to document how the societal one is taken into account in their planning decisions.
The subjects to be protected are the "vulnerable" objects as hospitals, residential areas, schools; the "less vulnerable" objects are considered buildings, hotels, restaurants, shops, etc. The distinction is relevant only to location-based risk, and endpoints values are prescribed. For vulnerable objects, the limit value is that of the lethal effect area to which 10^{-6} events/year frequency is associated; in the area comprised between 10^{-5} and 10^{-6} events/year, less vulnerable objects are possible in exceptional cases that has to be motivated. At the moment, CA's have three years for the entry into force of the Decree in which they have to achieve compliance with the limit value of 10^{-5} per annum for all the vulnerable objects in the vicinity of the establishments falling under the BRZO or in the vicinity of LGP installation; this target is of 10^{-6} by the end of 2010.

5.4 What "tolerable" means in the Dutch regulation - status of the adopted criteria

The value prescribed for the individual (location-based) risk of 10^{-6} is legally binding for vulnerable objects, while a target value of 10^{-5} applies to less vulnerable objects. For the societal risk, evaluations are carried out case-by-case but no limiting values are in place.

5.5 Environmental assessment

The procedure that regards Seveso plants is regulated, besides the Major Hazard Decree of 1999, by the Environmental Management Act which regulates all the environmental impacts of dangerous installations.

5.6 Subjects and competences: transparency of the process - involvement of the public

External Safety is regulated directly by the Ministries involved in the procedure: next to VROM, other Ministries are the Ministry of Transport, the Ministry of Social Affairs and the Ministry of Economics. Within the VROM the External Safety Directorate has been established. Traditionally, The Netherlands pay great attention to its active environmental communities and participation and consultation with the public is guaranteed.

Selected countries references

The United Kingdom

- HSE (2004), HSE current approach to land use planning (LUP) Online: http://www.hse.gov.uk/landuseplanning.
- HSE (2005), PADHI – HSE's land use planning methodology. Online:http://www.hse.gov.uk/landuseplanning/padhi.pdf.
- HSE (2005), Implementation of the Fundamental Review of LUP. Online:http://hse.gov.uk/landuseplanning.
- HID Safety Report Assessment Guide: Explosive, Health and Safety Executive, UK, Online: http://www.hse.gov.uk/comah/sragexp/crit34.htm
- G. Smith, C. Arnot, J. Fairburn, G.Walker, A national population database for major accident hazard modeling, HSE Research Report 297, 2005.

France

- B Cahen (2006), Implementation of new legislative measures on industrial risks prevention and control in urban areas, Journal of Hazardous Materials 130 (2006) 293–299.
- Ministere de L'écologie, Policy and action programme as concerns the prevention of industrial risks - Online: https://webmail.citg.tudelft.nl/exchweb/bin/redir.asp?URL=http://www.ecologie.gouv.fr/article.php3?id_article=2435
- J.P.Pineau (1999), Application of the Seveso Directive in France, Journal of Hazardous Materials 65, pp. 49–57

Italy

- P. Colletta, R. Manzo, A. Spaziante (eds.), *Pianificazione del territorio e rischio tecnologico – il D.M. 9 maggio 2001*, Celid, Italia, Torino, 2000
- P. Colletta, R. Manzo (eds.), Governo del territorio e rischio tecnologico, Metodologie di intervento ed esperienze di attuazione del D.M. 9 maggio 2001; online, Ministero delle Infrastrutture e Trasporti, http://www.infrastrutturetrasporti.it/sites/seveso2/pages/sev_page_05.htm
- Carpignano, G. Pignatta, A. Spaziante, Land use planning around Seveso-II installations: the Italian approach, in: Proceedings of the European Conference on Safety and Reliability, MG, Torino (I) 2001, p. 1763.
- Provincia di Venezia (2003), La sicurezza del territorio: valutazione e pianificazione concertata del rischio industriale. *Urbanistica* Dossier 62, INU Edizioni

Germany

- Deuster B., Ministry of the Environment (FRG), Regional Planning and Agricolture: Land Use Planning and Plant Safety, Proc. Of the Health and Safety 10 Executive Conference on the Major Hazards Aspect of Land-Use Planning, Chester, UK, 26-29 October 1992
- H. Schütz and P. M. Wiedemann (1995), Implementation of the Seveso directive in Germany — An evaluation of hazardous incident information, Safety Science, Volume 18, Issue 3, 203-214
- W. Kaiser and M. Schindler (1999), Precautions against industrial accidents: experience in applying the Seveso II Directive in central and eastern European countries, Journal of Hazardous Materials, Volume 65, 59-75

The Netherlands

- B.J.M. Ale (2002) Risk assessment practices in the Netherlands, Safety Science, 40, 105-126.
- B.J.M Ale. (2005), Living with risk: a management question, Reliability Engineering and System Safety, Elsevier, *article in press*
- P.H. Bottelberghs, (2000) Risk analysis and safety policy development in the Netherlands, Journal of Hazardous Materials 71, pp. 59-84
- Commissie Onderzoek Vuurwerkramp, De vuurwerkramp, Eindrapport, Phoenix en Den Oudsten, Rotterdam 2001.
- Staatsblad van het Koninkrijk der Nederlanden (2004), *Besluit van 27 mei 2004, houdende milieukwaliteitseisen voor externe veiligheid van inrichtingen milieubeheer (Besluit externe veiligheid inrichtingen).*

ANNEX II

TWG5 - QUESTIONNAIRE

Purpose

Objective 1 of the Technical Working Group on Land-Use Planning requires the Group to "*Give the principles of "good practice" in Land-Use Planning and describe the underlying principles of risk/hazard assessment that will support this (e.g. consistency, transparency, robustness, etc)*". In order to deal with this objective in a more operational way and to collect information on the current status of "good practice" within the Member States, this Questionnaire was developed. The questionnaire should be completed by the experts of the Plenary Group or by the Competent Authorities. It is up to the responders to do this based entirely on own knowledge or to gather the information also from other bodies, e. g. planning authorities or regional/local authorities.

1. Data of the responder to the Questionnaire:

Name:
E-mail:
Organisation:
Country:

Type of authority: EWG-LUP expert / Competent Authority

2. Is a systematic hazard/risk assessment method for industrial hazards in the context of Land Use Planning used in your country (either on national or on regional/local level)?

- ☐ Yes
- ☐ Some regions/municipalities
- ☐ No

If No, what is the basis for answering the "Methodology" Section of this Questionnaire?

- ☐ Internal discussions possibly leading to the adoption of the methodology suggested
- ☐ Personal opinion
- ☐ Official working group opinion preparing a methodology

A. Methodology for Land Use Planning

A1. What hazard/risk assessment method are you using in your Country?[95]

- ☐ Full probabilistic (many accident scenarios – chosen case-by-case - quantifying both frequencies and consequences and basing decisions on their combination)
- ☐ Probabilistic with certain conventions (pre-selected scenarios)
- ☐ Consequence-based (worst case scenario)
- ☐ Consequence-based (pre-selected 'worst-credible' or 'representative' scenarios)
- ☐ Semi-quantitative method (please give details)
- ☐ Generic approach (pre-selected scenarios for plant categories)
- ☐ Generic distances, not calculated individually

[95] Multiple answers possible

- ☐ Case-by-case
- ☐ Other (please explain)

A2. Is there a combination of generic approaches and specific assessments?

- ☐ Generic approaches are generally used. No specific assessment permitted
- ☐ Generic approaches are generally used. Specific assessment is sometimes permitted. Specify when:
- ☐ Generic approaches are occasionally used. Specify when:
- ☐ Generic approaches are never used. Always a specific assessment is required.

A3. What effects of major accidents have been chosen as criteria in order to assess the acceptability (tolerability) of Major Accident Hazards?[3]

- ☐ Individual/ Societal Risk
- ☐ Acute (short-term) fatalities
- ☐ Total number of fatalities (Acute + Latent)
- ☐ Number of Fatalities and Injuries
- ☐ Injuries of large number of people
- ☐ Material Damage
- ☐ Other (please describe)

A4. What respective hazard/risk levels (endpoints) have been chosen as criteria in order to assess the acceptability (tolerability) of major accident hazards? Which values have been adopted?

- ☐ Individual risk of fatality — Value:
- ☐ Both Individual and Societal Risk of fatality — Values:
- ☐ Individual Risk of receiving a dangerous dose or worse — Value:
- ☐ Effects – toxic — Value:
- ☐ Effects – thermal radiation — Value:
- ☐ Effects – overpressure — Value:
- ☐ Material damage — Value:
- ☐ *Other (please describe)*

A5. Please specify how effects to the environment are included into the assessment of the acceptability of Major Accident Hazards?

A6. Do less strict values apply for existing situations?

- ☐ Yes (please specify)
- ☐ No

A7. What restrictions in possible Land Uses/Developments apply within the relevant zones?

- ☐ Totally restricted use
- ☐ Zoning system dependent on generic use categories

☐ Zoning system dependent on societal risk

☐ Case-by-case

☐ Other (specify)

A8. What status do the criteria have?

☐ Boundary values included in the national or regional legislation that in no circumstances are allowed to be exceeded

☐ Boundary values included in the national or regional legislation that can be exceeded under exceptional circumstances (procedure for doing that is in place)

☐ Recommended target values (deviation is possible by local/regional authorities upon justification)

☐ Advised values (responsibility for following them stays entirely within the local/regional authorities)

☐ Other (please describe)

A9. What were the main considerations of giving the criteria this status?

A10. If national or regional criteria for distances are established, are the local authorities allowed to perform specific Risk Assessment that would alter the national or regional advice?

☐ Yes

☐ No

A11. Are there specific measures taken at a national level to reduce the uncertainty in the results of Risk Assessment (e.g. guidelines on tools, criteria, frequencies – standardisation – performance by accredited body – review by accredited body)?

☐ Yes

☐ No

A12. Are there specific measures addressing the impact on land use planning of new scientific knowledge on the criteria and methodology used?

☐ Yes

☐ No

A13. How is the technical advice on the risks arising from the establishment provided?[96]

A14. What authority holds responsibility for the final decision?

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[96] Please specify the type of body (governmental, private) and indicate the relationship to the authority responsible for LUP decisions

A15. Which other authorities are involved? Is there a link to the IPPC-procedure in case of new sitings or substantial changes?[97]

A16. How is the assignment of responsibilities laid down to assure transparency and make the allocation of tasks evident to all involved bodies (e.g. national strategy plans, legal responsibilities etc.)?

A17. How is the public informed to assure the transparency of the decision-making process?

B. Implementation of Art.12 from Seveso II

B1. What procedure ensures that ***modifications*** *of existing establishments are controlled in such a way that technical measures will be implemented in case the risks to people increase?*[98]

B2. What procedure ensures that ***new developments in the vicinity*** *of an existing establishment are controlled?*[6]

B3. What procedure ensures that ***siting of new establishments*** *is controlled in such a way that appropriate distances between new establishments and residential and other LUP-sensitive areas are maintained?*[6]

B4. What procedures are in place such that technical measures are taken so as not to increase the risk or consequences to people?[6]

B5. What ***consultation procedure*** *ensures that the public involved is informed and can influence the decisions to be taken?*

[97] Please note that Article 12 of Seveso II also includes "other related policies" e.g. permit procedures of all kind
[98] Please include in the answer how the monitoring of decisions is carried out in the respective cases

C. Properties constituting "Good practice"

C1. Which properties do you believe that constitute 'good practice' in LUP?
(Give your grade between 1 and 5, 1=not important, 5=extremely important to each element)

- ☐ Transparency[99] 1 2 3 4 5
- ☐ Consistency [100] 1 2 3 4 5
- ☐ Simplicity[101] 1 2 3 4 5
- ☐ Proportionality[102] 1 2 3 4 5
- ☐ Robustness[103] 1 2 3 4 5
- ☐ Other (please describe and give your Grade)

C2. Which elements of your system contribute most in achieving these properties?

[99] "Transparency" means that the methodology has to assure a clear understanding of the decision-making process
[100] "Consistency" means that outcomes of the assessment of broadly similar situations are broadly the same under similar conditions
[101] "Simplicity" means the avoidance of unnecessary complexity
[102] "Proportionality" refers to the balance of constraints with the level of risk
[103] "Robustness" is a super-structural term which includes other properties and expresses the probability how valid a decision will be over time

European Commission

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Author(s*):* Claudia Basta, Delft University of Technology, Civil Engineer Faculty, Section of Material Science and Sustainable Construction, Stevinweg 1, 5048 GA Delft, The Netherlands
Michael Struckl, Major Accidents Hazards Bureau,
Michalis Christou, Major Accidents Hazards Bureau*.*
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Abstract

The Joint Research Centre of the European Commission is responsible for the coordination of the work of the European Working Group on Land Use Planning (hereinafter: EWGLUP), whose mandate is the development of Guidelines for the implementation of Art 12 of the Seveso II Directive as amended by Directive 2003/105/EC. These Guidelines, developed by the EWGLUP and agreed by the Member States at the 16th meeting of the Committee of Competent Authorities responsible for the implementation of the Seveso Directive (Porvoo, October 2006), were adopted by the European Commission on 7 June 2007

A preliminary research, exploring the state-of art of the implementation of Art 12 within the 25 Member States (MS) was conducted in 2004 by the Major Accident Hazard Bureau of JRC in the form of a questionnaire-based survey. Final results were collected, analysed and finally updated up to spring 2007. A group of MS – the Netherlands, Italy, France, Germany and the United Kingdom – was selected for further analysis and invited to comment and revise the result of the investigation.

The European Working Group on Land-Use Planning has, in addition to the development of Guidelines for implementation of Article 12 of the Seveso II Directive, as amended by Directive 105/2003/EC, taken part at the development of this document as a supporting tool addressing the issue of LUP in the context of hazardous facilities. The document provides supplementary information material describing in detail "good LUP practices" available within selected Member States and it has a twofold objective. Firstly, it reports the results of the survey concerning "good practice" for LUP in the context of the Seveso II. Secondly, it proposes implementation *Roadmaps* fulfilling Art. 12 requirements. In that context it should be noted that its character is purely *descriptive and informative* and it cannot be used for guidance or normative purposes. At the same time, it is believed that the structured information provided can substantially help the Seveso competent authorities and planning authorities to deal with the land-use planning issue. The document is therefore published in the form of JRC Technical Report.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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