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Development of the Convention: guidance by the Conference of the Parties

Draft technical guidance on land-use planning, the siting of hazardous activities and related safety aspects

Note by the Bureau

Summary

At its eighth meeting (Geneva, 3–5 December 2014), the Conference of the Parties to the Convention on the Transboundary Effects of Industrial Accidents decided to include an activity in the workplan for 2015–2016 on the development of guidance on safety and land-use planning (see ECE/CP.TEIA/30, annex II, table 1).

The draft technical guidance in the present document, drafted in response to that request, aims to support Parties in their application of the provisions of the Convention in land-use planning, siting and related safety aspects of hazardous activities. The document complements policy and legal guidance on the same topic (ECE/MP.EIA/WG.2/2016/10–ECE/CP.TEIA/2016/8).

The Conference of the Parties is invited to consider the draft technical guidance and to adopt, endorse or welcome it as appropriate. Once adopted, the legal and technical parts of the guidance will be compiled and published in a single volume.

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I. Introduction

A. Mandate

1. At its eighth meeting (Geneva, 3–5 December 2014), the Conference of the Parties to the United Nations Economic Commission for Europe (ECE) Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention) adopted the workplan for 2015–2016. The workplan included an activity on the development of guidance on safety and land-use planning, to be carried out under the leadership of the European Union/European Investment Bank (see ECE/CP.TEIA/30, annex II, table 1).

2. The guidance was expected to explain how the notion of land-use plans and programmes used in other relevant legal instruments applied to the Industrial Accidents Convention's provisions on the siting of hazardous activities.

B. Objective

3. The present technical guidance aims to support the implementation of the Industrial Accidents Convention in relation to land-use planning, siting and related safety aspects of hazardous activities, with a focus on the risk aspects of hazardous facilities. It supplements the legal and policy guidance document on the same topic (ECE/MP.EIA/WG.2/2016/10—ECE/CP.TEIA/2016/8).

C. Framework of the Convention and safety guidelines

4. The Convention and the following ECE safety guidelines set the framework for the present technical guidance by providing provisions to assist countries in preventing the occurrence of industrial accidents, mitigating or minimizing their impacts, and promoting active international cooperation between countries before, during and after an accident:

(a) The *Safety Guidelines and Good Practices for Tailings Management Facilities*[1] address the need for land-use planning considerations to be taken into account when evaluating optimum siting of tailings management facilities, and the need to carry out an environmental impact assessment prior to construction as well as a risk assessment;

(b) The *Safety Guidelines and Good Industry Practices for Oil Terminals*[2]recognize that siting and land-use planning can have significant effects on oil terminal hazards and identify the need for risk assessment. For new oil terminals, the competent authorities must take into account appropriate safety distances from transport routes and the locations of public-use and residential areas and areas of natural sensitivity or interest;

(c) The *Safety Guidelines and Good Practices for Pipelines*[3] suggest that land-use planning considerations should be taken into account both in route planning for new pipelines and in decisions concerning proposals for new developments near existing pipelines. An annex is dedicated to risk assessment and land-use planning.

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[1] ECE/CP.TEIA/26, available from http://www.unece.org/index.php?id=36132.
[2] ECE/CP.TEIA/28, available from http://www.unece.org/index.php?id=41066.
[3] ECE/CP.TEIA/27, available from http://www.unece.org/index.php?id=41068.

5. The Guidelines to Facilitate the Identification of Hazardous Activities for the Purposes of the Convention[4] provide two location criteria for the purpose of identifying hazardous activities capable of causing transboundary effects under the Convention:

(a) Within 15 kilometres from the border, for activities involving substances that may cause a fire or explosion or involving toxic substances that may be released into the air in the event of an accident;

(b) Along or within the catchment areas of transboundary and border rivers, transboundary or international lakes, or within the catchment areas of transboundary groundwaters, for activities involving toxic or extremely flammable substances or substances that are very toxic to aquatic organisms.

II. Technical guidance on planning and risk assessment methods

A. Introduction to land-use planning

6. There are several formal definitions of land-use planning but all of them have a common understanding that it is a process by which land is allocated and regulated for different socioeconomic activities such as agriculture, housing, industry, recreation and commerce, in order to manage the siting of activities and prevent land-use conflicts. Hence, land-use planning decisions must account for all sources of risk, both natural and man-made, which include potential threats to human health, property and the environment arising from hazardous facilities (both existing and proposed new facilities).

7. The technical, administrative and legislative processes for making decisions on the siting and type of activities, including hazardous activities, should be consistent with applicable national laws, regulations, policies and legislation or international agreements.

8. This chapter describes the methods for land-use planning and risk assessment close to hazardous facilities, with consideration of transboundary effects. It should be noted that emissions of hazardous substances into water bodies have been responsible for the vast majority of transboundary accidents to date and therefore drainage, flooding and other hydrological matters around hazardous activities should be given particular attention. The following land-use planning approaches should be considered as illustrative and not as recommendations by ECE. The approaches may have changed since this guidance was issued.

9. National urban planning policies and frameworks must take into consideration new legislation (e.g., the European Union Seveso III Directive)[5] to explicitly address the risks posed by existing or future hazardous activities.

B. Land-use planning and risk assessment approaches

10. The ECE countries rely on technical and scientific information to support their land-use planning decision-making, a part of which is based upon the risk assessment

[4] See decision 2003/3 (ECE/CP.TEIA/2, annex IV, appendix), as amended by decision 2004/2 (ECE/CP.TEIA/12, annex II), both available from http://www.unece.org/env/teia/guidelines.html.

[5] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC.

methodology and risk acceptance criteria. The land-use planning approaches can be grouped under four categories:

(a) **Deterministic approach**: defines generic distances which are determined by the kind of hazardous activity considered, operational acquired experience, environmental impact and expert judgment;

(b) **Consequence-based approach**: identifies worst-case potential consequences and evaluates the effects (e.g., fatalities and injuries to individuals);

(c) **Risk-based approach**: assesses both the consequences and frequency of the accident occurrence to evaluate the individual and/or societal risk;

(d) **Semi-quantitative (or semi-probabilistic) approach**: a method based on a quantitative evaluation of the consequence and a qualitative estimation of its occurrence frequency.

Hybrid approaches combining two or more of the methods above are also used.

11. The deterministic approach is a straightforward method that relies on expert judgment in defining generic distances between areas designated for hazardous activities and areas designated for residential, public or other community purposes. Predefined generic distances are set for different types of hazardous activities, based upon the types of hazardous substances and activities present at the facility, historical data and previous accidents occurring at similar facilities. Hence, these distances are not related to risk or based on a detailed analysis of the facility. Under this approach, a gradual land-use plan should be developed whereby incompatible activities (such as industrial and residential areas) are located at a specified minimum distance from each other.

12. The consequence-based approach focuses on the assessment of the most significant potential impacts arising from accidents, including thermal radiation, overpressure and toxic concentration effects. It does not involve an evaluation of the frequency of occurrence of accidents. Damage threshold values for these consequences are determined (examples are given in table 1). Based on the damage threshold values, distances can be specified and mapped, showing different levels of consequences. An illustrative example of five threshold values for chlorine continuous release is provided in figure 1. Based on these thresholds, urban planners can stipulate the areas where certain activities, such as residential use, are forbidden (i.e., within the red zone) and where they may be considered (i.e., within the dark blue zone). Such an approach was used in France before the major accident at Toulouse in 2001 and is being used in other countries.

13. The risk-based approach uses a quantitative risk assessment method to calculate both the consequences of the identified accident scenario and its expected frequency of occurrence. The analysis is performed for a set of accident scenarios and requires large amounts of data, such as components failure frequency data, effect endpoints values and population and environmental data, as well as models for calculating the consequences and effects. The two risk measures that are usually calculated are individual risk and societal risk, which are represented respectively under the form of risk contours, societal risk curves and societal risk maps. The Netherlands evaluates land-use compatibility through societal risk and societal risk maps, the latter being easier for the public to understand.

Table 1
Examples of types of damage thresholds for determining distances

Consequence	*Effect-Distance*
Thermal effects	Determination of a distance corresponding to a thermal radiation which, for a given exposure period, can cause burns likely to be lethal or cause serious injury
Explosion	Determination of a distance corresponding to an overpressure likely to be lethal or cause serious injury (e.g., burst eardrums)
Toxic release	Determination of a distance corresponding to a lethal toxic dose or serious injury

Figure 1
Example of chlorine continuous release

Source: Major Accident Hazards Bureau of the European Commission's Joint Research Centre.
Note: Figure shows release as modelled by ADAM 1.0 and against a backdrop provided by Google Earth.

14. The semi-quantitative approach uses a hybrid method based on a quantitative evaluation of the consequence of an accident and a qualitative estimation of its frequency of occurrence. The worst-case accident scenario is generally selected. The assessment needs data such as effect endpoint values, population and environmental data and models for calculating the consequences and effects. The outcomes of the consequence assessment can be presented as damage thresholds values. The frequency of accidents is represented under four to five classes. Then the consequences and frequencies are presented on a risk map, representing different levels of risk. This approach is used in France and Italy.

15. The environmental risk assessment of an accident and its potential effects on fauna and flora is more qualitative in nature compared to the approaches used for human risk. There are a lack of mature (and standard) mathematical models to estimate the effects on fauna and flora, making the identification of acceptable environmental risk levels or criteria inherently difficult. The qualitative approaches focus on hazard identification and assessing prevention and control measures. Belgium (Flanders Region), Ireland, Italy, Spain and the United Kingdom of Great Britain and Northern Ireland use these approaches, whereby their authorities determine whether sufficient measures have been taken by the facility or operator to prevent, protect and minimize accidents and their effects on the environment.

C. Key steps in land-use planning procedures

16. This section provides guidance on mapping and the key steps that Parties should adopt in their land-use planning and risk assessment procedural frameworks for:

(a) Decisions on new land-use policies, plans or programmes. The major challenge is determining and managing the compatibility of hazardous activities or land uses with surrounding land uses;

(b) Decisions on siting of new hazardous facilities (projects). The challenge is determining and managing the risk and effects associated with the siting of a new hazardous facility;

(c) Decisions on modifications to existing hazardous facilities (projects). The challenge is determining and managing the increased risk and effects of an existing hazardous facility owing to modifications to the facility's buildings, hazardous substances, activities, etc.;

(d) Decisions on new developments near existing hazardous facilities (projects). The challenge is determining and managing the increased risk and effects of an existing hazardous facility owing to a new development (e.g., residential) near an existing facility.

1. Important land-use and risk mapping considerations

17. Decision-making on land-use policies, plans, programmes and projects should take into consideration how the risks to health, environment and property can be minimized in the event of an accident involving hazardous substances, in order to determine whether to approve or refuse the proposal.

18. Mapping is a necessary part of planning, to illustrate clearly the existing environmental conditions, the location of urban areas, land uses, potential risk sources and potential effects. For land-use planning and risk assessment in relation to hazardous activities, a set of maps should be produced that describe the area and show the location of:

(a) Existing land uses in areas surrounding the hazardous activity (e.g., residential (high-density, medium and low-density areas), industrial, commercial, public and agricultural);

(b) Existing urban development (e.g., buildings and infrastructure), transport networks and local population;

(c) Existing environmental features and hydrogeology (e.g., topography, vegetation, surface water and groundwater);

(d) Areas of interest (e.g., forest, recreational spaces and coasts);

(e) Sensitive and protected areas (e.g., national parks, protected habitats and cultural heritage);

(f) Vulnerable people (e.g., in hospitals, old people's homes, schools and parks) or where high numbers of people may be present at one time (e.g., churches, shopping centres, theatres and railway stations);

(g) Existing industrial risk sources, considering both facilities and transport of hazardous substances;

(h) Other potential risk sources, such as transport of hazardous substances and natural disasters (flooding, earthquakes and domino effects);

(i) Proposed hazardous facilities and activities, including the boundaries, dimensions, infrastructure, buildings, substances, utilities, workforce and off-site transport;

(j) Potential off-site effects of proposed hazardous activities;

(k) The location and availability of external emergency response capability (fire brigades, hospitals, etc.).

19. The above set of maps should be overlaid to evaluate the compatibility of hazardous activities with the land uses around them. By using modern risk assessment tools (based on geographical information systems), all georeferenced maps and spatial risk data can be overlapped to clearly present the data. The result is a new land-use map and risk map in which the compatibility of hazardous activities with other land uses and developments can be evaluated.

20. The above mapping procedures should be incorporated into national land-use planning policies, plans, programmes and projects.

2. Considerations for off-site transport corridors

21. Determining and managing land-use compatibility near transport corridors and the risks and effects of transporting hazardous substances (by road, rail, pipeline and waterway) within the land areas crossed are major challenges. It requires different methods of evaluation and control as the risk source moves between land-use zones. It is important to note that the Industrial Accidents Convention only covers transportation on the site of the hazardous activities (article 2, para. 2 (d) (ii)).

22. Emergency management plans should be established, detailing preparation and response measures that aim to minimize the risk of adverse effects on people, property and the environment along the route. In the case of pipelines, the planning controls are similar to those applied to fixed hazardous facilities.[6]

3. Seven key steps to adopt into national land-use planning procedures

23. This subsection provides seven key steps for making land-use and siting decisions, which countries should adopt in their national procedural frameworks.

Step 1: Analysis of the site and the surrounding area

24. A crucial first step in planning procedures is identifying and assessing the existing conditions (the natural elements, climate, buildings, infrastructure and other features) of the area, without the proposed land use or project. This will help to determine the changes or impacts of the proposal and whether it is compatible with the site and surrounding area.

25. This type of information is elaborated and periodically updated by experts or planners and should be available for use at the local municipality. It comprises a set of thematic maps (in digital or paper form), which describe the land use and land conditions before the development of the new land use or new or modified hazardous activity.

Step 2: Review of the relevant laws and legislation

26. The next step is to review the existing laws and legislation that are relevant to and will influence the parameters of the proposal, such as the siting of hazardous facilities, the

[6] See *Safety Guidelines and Good Practices for Pipelines*.

different types of activities permitted or not permitted and environmental laws to be followed.

27. For example, some national legislation establishes the criteria under which a modification should be considered as significant and requiring a permit. For instance, the United Kingdom's Health and Safety Executive (HSE) provides criteria for determining whether modifications could have significant repercussions on the levels of risk to people and the environment.

28. This step also includes a review of the current land-use policies and plans (if present) that designate which types of land use are allowed on the site and the surrounding land. Under some national legislation, these land-use policies and plans (i.e., zoning) stipulate controls such as:

(a) A set of minimum performance requirements that apply (i.e., to any hazardous activity);

(b) A mechanism for distinguishing between the types of activities (e.g., low-risk hazardous facilities that are permitted activities, or higher risk facilities that require consent from authorities and may be subject to further controls).

Step 3: Review of documentation about the proposal or land use and the hazardous risk sources

29. It is important to review the documentation available regarding the operation of the proposed development (the new land use, proposed hazardous facility, or new development near existing hazardous activities). These types of documents, for example, planning application reports, land-use plans, safety reports and other expert material, are generally required by regulations, for example by the Seveso III Directive in the European Union.

30. For example, the operator of a proposed facility must inform the relevant authority about the planned activities or modifications and, if considered significant, has to submit a safety report. A safety report must demonstrate that necessary and sufficient measures have been taken to prevent accidents from occurring and, should they occur, to limit their consequences to the population, environment and property.

31. A hazardous facility description may cover:

(a) The site;

(b) Meteorological data;

(c) Main activity and production;

(d) Organigram and personnel;

(e) The safety management system;

(f) Facility perimeters, layout, access routes and protection against intrusion;

(g) Location of hazardous substances;

(h) Processing units, storage facilities and waste treatment;

(i) Substances data (chemical, physical and toxicological properties);

(j) Monitoring networks (toxic, flammable) and alarms;

(k) Information made available to the public;

(l) Activities and safety measures on-site;

(j) Adopted analysis procedures, models and software tools;

(k) Hazard identification and accident database consultation;

(l) Investigation of facility behaviour in case of loss of utilities and external events;

(m) Accident scenarios based on clear selection criteria;

(n) Potential consequences of selected scenarios;

(o) Estimation of accident frequency;

(p) Prevention and mitigation measures for each scenario;

(q) Individual and societal risk measures;

(r) Internal emergency plan.

Step 4: Select a planning approach or risk assessment method

32. There are different approaches to land-use planning and risk assessment but they all aim to verify whether the level of risk associated with the proposal is acceptable near a hazardous facility.

33. Land-use approaches and risk assessment methods are described in section II.B. Different approaches can be selected to assess the proposal, based on the risk contours or risk maps produced, or a hybrid approach (combining two of more of the methods) can be applied. National authorities should choose the approach that is most appropriate for dealing with land-use planning and siting of hazardous facilities within their country and for neighbouring countries in the case of potential transboundary effects.

Step 5: Evaluate the potential risks, effects and the compatibility of the hazardous activity

34. Using the planning approaches and risk assessment methods in step 4, the compatibility and risk acceptability of the proposed land use or development with the surrounding area and its potential effects on the population, environment and property can be evaluated.

35. First, a set of criteria must be developed, which the results of the risk assessment are compared against, in order to determine whether the proposal is compatible with surrounding land uses or acceptable in terms of the level of risk and potential effects on the surrounding area.

36. The criteria are created taking into consideration:

(a) The site and context analyses (including the identification of land uses, development and important natural features);

(b) A description of the proposal (including the land-use plans, siting, hazardous activities and measures);

(c) The land-use planning and risk assessment approach (e.g., deterministic, consequence, risk or semi-quantitative based);

(d) An accident risk map showing the land uses, zoning and/or development.

37. In order to describe and illustrate the level of risk, the potential risks posed by the proposal are overlaid on an existing risk map (described in subsection II.C.1). An analysis of the new situation (using the criteria) allows authorities and stakeholders to examine and draw conclusions about the risks, compatibility with surrounding land uses and development and whether decision makers should approve or refuse the proposal.

38. Sophisticated risk quantification software tools are available to evaluate the potential effects of a hazardous activity. For less complex methods of evaluation, the consequence approach can be used, which includes the selection of endpoint values for the different consequences, such as four kilowatts per square metre for thermal radiation. This example represents the fatalities threshold and can be compared with the compatibility criteria. Examples of compatibility are the absence of light industrial buildings, warehouses or two-storey offices within 100 metres of a hazardous facility, low-density housing or hotels within 200 metres and schools, hospitals or care homes within 300 metres. If the hazardous facility is a liquid petroleum gas storage facility, then 100 metres could be added to each distance.

39. When the area of interest for the analysis is described in digital maps, the risk assessment and evaluation of effects can be undertaken using geographical information system-based software tools. For example, the hazardous facility can be represented using different digital maps describing the facility's spatial elements (e.g., building boundaries, layout, location of hazardous substances, utilities, points where accidents may occur and the possible extent of accident effects and/or individual risk contours). A georeferenced grid of a defined cell dimension is then overlaid on all maps. With all data in digital form, each cell can then be assessed in terms of the effects of accidents (or individual risk value) and compared with the compatibility criteria. This provides, as a result, the areas of incompatibility that require further consideration.

40. For example, a risk assessment for the siting of a hazardous facility includes the following key elements:

(a) Assessment of the types of potential accidents that can lead to the release of hazardous substances;

(b) Estimation of the location, size, rate and duration of the releases;

(c) Determination of the probability of occurrence of the identified type of releases;

(d) Determination of the consequences of each type of release in terms of specific hazard criteria or exposure of people, environment and property;

(e) Comparison of the calculated risk with the risk acceptability criteria.

41. The above risk assessments are more complex when evaluating land-use policies, plans and programmes, as specific projects are not proposed at this stage. These proposals may include national land-use plans that designate areas of land within the country for industrial activities to occur, such as industrial land-use zones. However, general high-level risk assessments and evaluations can be undertaken for these proposals, such as evaluating the distances between, for example, zones for industrial purposes and zones for residential purposes.

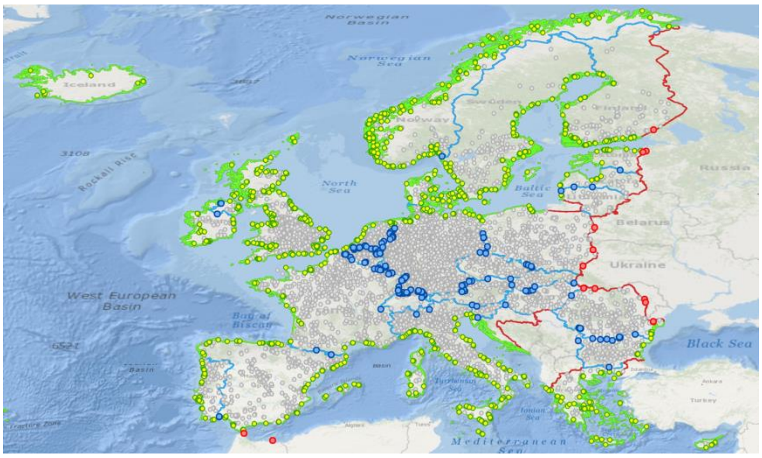
For areas that could be affected by industrial accidents of a transboundary nature

42. Past accidents have shown how the off-site effects of an accident at a hazardous facility in one country can have disastrous effects in neighbouring countries. Well known past accidents are those that occurred in Switzerland (1986) and Romania (2000). On 1 November 1986, a major environmental disaster began with a fire at an agrochemical storehouse in Schweizerhalle, Switzerland. Fire brigades sprayed millions of litres of water to extinguish the fire, but the volume of water was too great for existing bunds. Consequently, much of the firewater, mixed with insecticides and other chemicals, entered

the Rhine through the Sandoz sewer system.[7] On 30 January 2000, a tailings dam overflowed at the Aurul Mine in Romania and released 100,000 cubic metres of effluent containing cyanide into the Tisza River, which reached the Danube River. A very low level of cyanide was still detected in the river water when it eventually reached the Black Sea.[8]

43. Figure 2 shows the 2,295 facilities subject to the Seveso III Directive that in 2015 were within 5 kilometres of a national border or coastline, of the 10,340 facilities in total. This distance is well within the 15-kilometre proximity criterion under the Industrial Accidents Convention, though the Convention applies broadly to the more significant, upper-tier Seveso facilities, not the smaller, lower-tier ones.

Figure 2
Seveso facilities located within 5 kilometres of national borders or coasts



Source: Seveso Plant Information Retrieval System, European Commission Joint Research Centre Major Accident Hazards Bureau.

Notes: A total of 225 facilities (in blue) are close to national borders within the region comprising the European Union and the European Free Trade Association; 71 (in red) are on borders between that region and other States; and the remainder (in green) are in coastal areas.

44. When hazardous activities are capable of causing transboundary effects, the provisions of the Industrial Accidents Convention should be followed. In this case, the above risk assessment and evaluation procedures are still applicable, provided that the concerned countries agree on common approaches for both risk assessment and compatibility criteria.

45. Figure 3 represents a case where a hazardous facility, located in country A, could have effects on the border area in country B. The situation is compounded when hazardous facilities exist on both sides of the border, in countries A and B, as shown in figure 4. In

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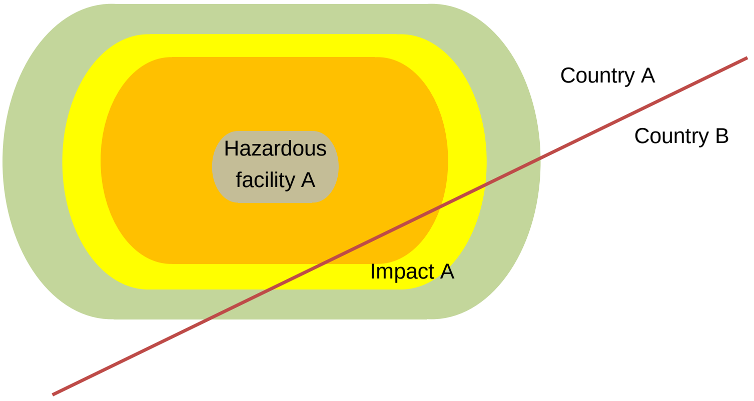
[7] France, Ministry of the Environment, "The Rhine polluted by pesticides" (DPPR/SEI/BARPI, No. 5187, October 2006). Available from http://www.aria.developpement-durable.gouv.fr/wp-content/files_mf/FD_5187_schwizerhalle_1986_ang.pdf.

[8] United Nations Environment Programme and Office for the Coordination of Humanitarian Affairs, "Cyanide Spill At Baia Mare Romania: Spill Of Liquid And Suspended Waste At the Aurul S.A. Retreatment Plant in Baia Mare" report of the assessment mission, 23 February–6 March 2000 (Geneva, March 2000). Available from http://reliefweb.int/report/hungary/cyanide-spill-baia-mare-romania-unepocha-assessment-mission-advance-copy.

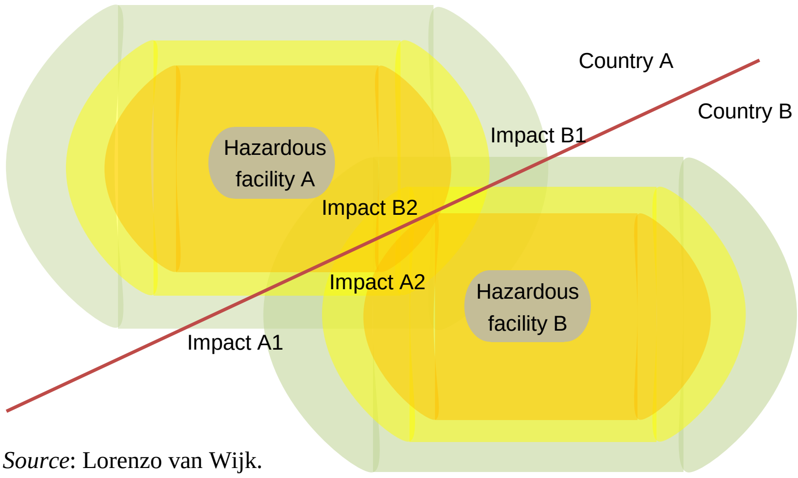
this case, on each side of the border there are two areas that can be differentiated based on the level of impact. For example, in country A the zones that are exposed to the potential effects of an accident occurring in both countries A and B are marked with “Impact B2”.

Figure 3
Transboundary effect of an accident at a hazardous facility located in country A, which may have effects on country B



Source: Lorenzo van Wijk.

Figure 4
Transboundary effects due to the presence of hazardous facilities located in each country and which may have effects on the other country



Source: Lorenzo van Wijk.

46. It is important that both countries apply the same risk assessment approach, accident consequence models, frequency estimation methods, environmental data, components reliability data and the compatibility criteria. This enables countries to fulfil the provisions of the Convention and integrate effectively land-use policies, plans, programmes or projects. Unfortunately, this is not often the case.

47. These land-use situations are complex to resolve as they require a strong collaboration between the involved countries and full agreement on the issues above. For this purpose, each country should have full access to all details and safety reports for the relevant hazardous facilities in the adjacent country.

48. Once agreement on methods and models has been achieved, data on the release of hazardous substances (e.g., the release conditions, wind rose and stability classes, consequence models, vulnerability and population distribution) must be collected and shared. Then, the risk assessment for both countries can be repeated with common models and data. As already mentioned, the risk model can be rapidly recalculated if suitable geographic information system-based tools are available.

49. Following this stage, each country can apply its own compatibility criteria to the proposal.

Step 6: International cooperation and public participation

50. Neighbouring countries should exchange information and consult each other to prevent accidents capable of causing transboundary damage and mitigate effects in case they do occur. The country with the existing or planned hazardous activity should provide the relevant information about the activity to all potentially affected countries. The potentially affected countries should provide the country where the activity is located with all relevant information about the area potentially affected. The public in areas capable of being affected should be given the opportunity to participate in land-use planning, siting and licensing procedures for hazardous activities.

51. The above actions should be undertaken in accordance with the Convention.

Step 7: Decisions

52. The previous steps will assist the relevant authorities in making a final decision to approve, refuse, or conditionally approve (subject to changes to the proposal or the stipulation of conditions that must be met):

(a) The proposed land use (land-use policies, plans or programmes);

(b) The proposed project (new hazardous facilities, modifications to existing facilities, or developments in the vicinity of hazardous facilities).

53. Decision makers and stakeholders will need to determine whether these new land uses or developments should be allowed, taking into account the results of the risk assessment and mapping completed in the previous steps.

54. In relation to siting decisions, the project proposal should be permitted when the risk posed by the hazardous activity is below the acceptable threshold and should not be permitted if the calculated risk is above the maximum threshold. However, between the upper and lower acceptability thresholds, the risk is in a grey area where safety improvement and additional mitigation measures may be enforced on the hazardous facility to reduce the risk to the population.

55. In relation to land-use decisions, new land uses in a land-use policy, plan or programme proposal must be compatible with surrounding land uses, taking into account whether the distances between these land uses (e.g., hazardous industrial and residential land uses) are adequate and adhere to national legislation and zoning controls. For incompatible new land uses, the proposal must be either abandoned, or changed by investigating how to reduce the potential risks and effects associated with hazardous activities in the area of interest.

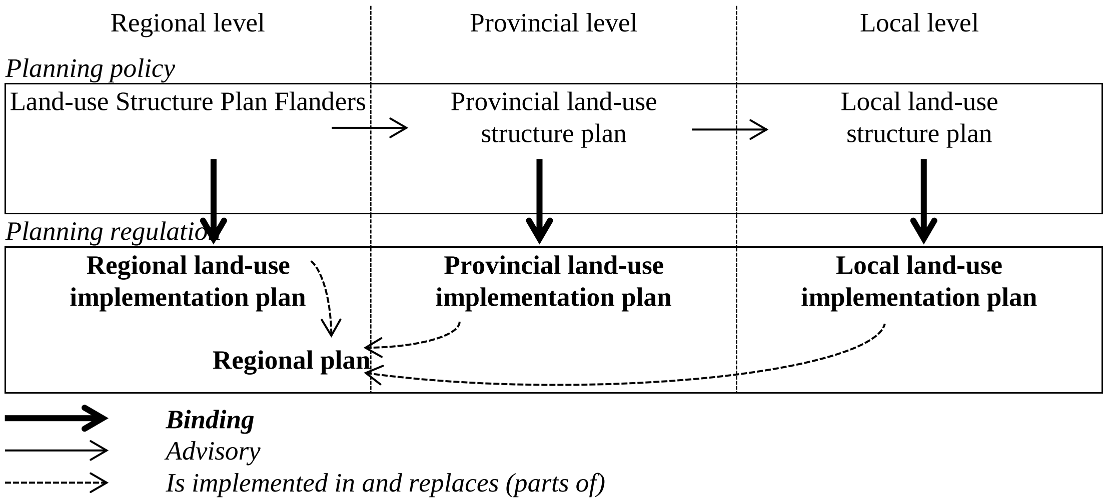
III. Examples of planning approaches and technical risk assessments in member States

56. In ECE countries, there are different land-use planning approaches based on the methods described in section II.B (or a combination of these). This chapter presents examples of land-use planning approaches in selected countries that have a well-established framework for considering industrial accidents in land-use planning.

A. Approach of the Flanders Region of Belgium

57. In the Flanders Region of Belgium, the regional authorities are responsible for land-use planning policies. There are three tiers of government: regional, provincial and local (municipal), as shown in figure 5.

Figure 5
Structure and interaction of land-use planning



58. The regulations on land-use planning include a large part of the Seveso III Directive and contain provisions for external human safety (i.e., for people outside the boundaries of the facility), such as environmental impact and safety reporting and spatial safety reporting. For upper-tier Seveso facilities, the proponent prepares an environmental safety report for the siting of new or modified hazardous facilities, as part of the environmental permit application. The Safety Reporting Service is the competent authority to approve or reject the environmental safety report. For new developments in the vicinity of Seveso facilities (both lower-tier and upper-tier), advice on external human safety is provided by the Safety Reporting Service, which may request that a spatial safety report be prepared by the competent authority for land-use planning.

59. In addition, the Belgian Cooperation Agreement[9] incorporates a large part of the Seveso Directive into Belgian law. This Agreement includes provisions on safety reports about Seveso facilities.

[9] Cooperation Agreement between the Federal State, the Communities and the Regions on the representation of the Kingdom of Belgium in the Council of Ministers of the European Union (1994).

1. Risk analysis

60. A risk-based approach is used in risk assessment and land-use planning. A quantitative risk assessment is conducted for accident scenarios covering lethality to humans by inhalation of toxic substances, heat radiation of fires, or overpressure effects of explosions.

61. To start with, annual probabilities of accident occurrence are mapped as iso-risk contours[10] and a societal risk curve is calculated for each upper-tier Seveso facility. For the societal risk curve, external people include workers (outside the boundary of the facility), residents, people in traffic and in recreational areas and others nearby. Their estimated presence (in time) on an annual basis is taken into account and the numbers of people indoors and outdoors are treated separately.

62. The methodology for the quantitative risk assessment includes the frequency of failures (that trigger accidents), meteorological conditions, models for effect calculations and damage models for humans.[11]

2. Acceptance criteria for the calculated external human risks

63. The risk criteria for external human risks are as follows:

(a) Local risk based on iso-risk contours (see table 2). Residential areas relate to land with residential zoning and groups of at least five dwellings in non-residential zoning. Areas with vulnerable people are schools, hospitals and retirement homes, which are designed with a higher level of safety;

(b) Societal risk curve (see figure 6).

64. The acceptance criterion takes into account not only the above-mentioned areas, but also other areas, which are included in the societal risk curve in the quantitative risk assessment, in particular:

(a) Public use buildings and areas, where the average presence is at least 200 people per day or 1,000 at peak times;

(b) Major transport routes and air traffic;

(c) External sources of danger, such as pipelines, wind turbines, high-voltage lines and liquefied petroleum gas filling stations.

3. Siting of a new Seveso facility or modification of a Seveso facility

65. The siting or modification of an upper-tier Seveso facility requires the preparation by the proponent of an environmental permit application, including an environmental safety report. The Safety Reporting Service can approve or reject the report based on its content or the quantitative risk assessment.

66. For lower-tier facilities, the licensing authority reviews the safety aspects and can require the proponent to prepare a safety study to examine the risks of the facility against the risk criteria.

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[10] Iso-risk contours are calculated for probabilities that are expressed in standard index form, for example, 10^{-6} means one in a million.

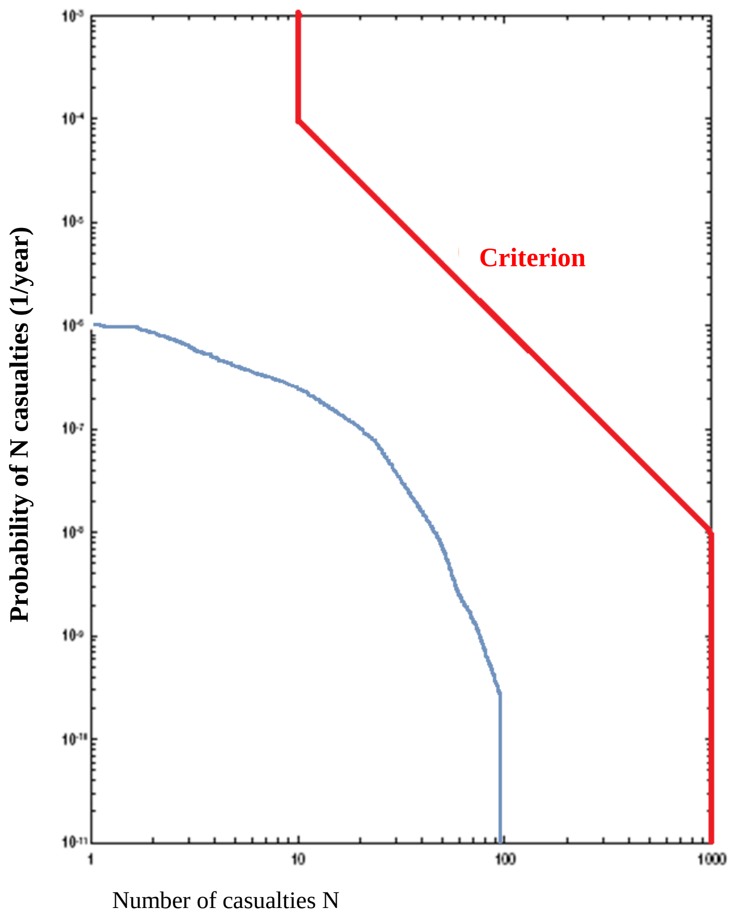
[11] Damage to human beings is calculated using probit functions, these being quantile functions associated with the normal distribution.

67. If determined that the facility complies with the risk criteria, an environmental permit is issued. Where the risk criteria are exceeded, the licensing authority can reject the application or impose special permit conditions, such as the reduction of hazardous substances or additional safety measures (e.g., full containment tanks instead of regular ones).

Table 2
Iso-risk contours

Evaluation on location	*Iso-risk contours (per year)*
Border of the facility	10^{-5}
Border of residential area	10^{-6}
Border of area containing vulnerable location	10^{-7}

Figure 6
Societal risk curve showing criterion (in red) and an example probability curve for causalities (blue)



4. Land-use planning

Advice on land-use implementation plans and planning permits

68. Any new land-use implementation plan must be submitted by the land-use planning authority to the Safety Reporting Service for a review of the safety aspects of land-use changes near a hazardous activity. The Safety Reporting Service decides whether: (a) a spatial safety report should be drawn up; (b) a modification to the urban planning regulations should be undertaken; or (c) nothing more needs be done. The decision on whether a new spatial safety report is required depends on whether areas of special attention are within 2 kilometres of a Seveso site and whether the risks are already known.

69. For areas that are not part of a land-use implementation plan, the Safety Reporting Service can provide advice.

Spatial safety reports

70. The spatial safety report contains a description of the proposed development, the site and surroundings, the land-use implementation plan, the quantitative risk assessment, the description of preventive and mitigation measures, and the evaluation of the calculated human risks against the risk acceptance criteria.

71. For new Seveso facilities, a risk-zoning map is prepared based on a variation of the quantitative risk assessment methodology, taking into account land within a 2-kilometre radius. In addition, a safety-zoning map of the area can be prepared, with iso-risk contours of 10^{-6} per year and 10^{-7} per year, showing where no residential areas and no areas with vulnerable people, respectively, are allowed.

72. For a new development for vulnerable people near Seveso facilities, the spatial safety report indicates the risk contour of 10^{-7} per year, where no areas with vulnerable people are allowed. If necessary, it can also provide proposals for safety measures to be fulfilled by existing facilities, such as the provision of water curtains to reduce exposure to a toxic gas, or no glass windows facing the direction of Seveso facilities in buildings with vulnerable people.

B. Approach of France

73. The Toulouse accident in 2001, which caused 31 fatalities, over 3,000 injuries and damages estimated at €3 billion, highlighted the weaknesses of the French land-use planning approach, which was based on the estimation of consequences generated by all representative scenarios, without considering the occurrence probability of these events. Following this accident, the French legislation was strengthened,[12] particularly on siting of hazardous facilities, new urban developments in their vicinity and the flow of information between operators, relevant authorities and the local community.

74. Under the new laws, all possible accident scenarios (a consequence-based approach) at a hazardous facility must be studied and their probabilities of occurrence (a risk-based approach) must be estimated in order to achieve an acceptable safety level. To achieve this, the new regulation sets three requirements:

(a) Harmonizing the risk assessment approaches;

[12] Jérôme Taveau, “Risk assessment and land-use planning regulations in France following the AZF disaster”, *Journal of Loss Prevention in the Process Industries*, vol. 23, No. 6 (November 2010).

(b) Integrating the risk-based and consequence-based approaches;

(c) Identifying corrective actions for existing or developing urban areas near hazardous facilities and controlling future developments through land-use planning.

75. To address the above requirements, technological risk prevention plans were introduced to develop and manage land-use planning.

76. Furthermore, safety reports must be prepared and contain the following information:

(a) Description of the process and equipment;

(b) Identification of risk sources;

(c) Characterization of the main hazards, based on an estimate of the consequences of instantaneous release of energy and/or toxic substances;

(d) Reduction of hazards based on technical and economic analysis;

(e) Analysis of similar past accidents to identify counter-measures and lessons learned;

(f) Identification of the most critical events through a preliminary risk assessment;

(g) Detailed risk assessment, to assess the impact due to component failure or human error;

(h) Use of mathematical models to estimate the intensity of effects;

(i) Assessment of the probability of accidents and fault protection systems;

(j) Assessment of the potential fatalities and injuries per accident;

(k) Classification of accident scenarios using the national risk acceptability matrix (later used for land-use planning purposes).

77. The safety report provides the basis for societal and individual risk assessments. The societal risk is assessed using a risk matrix. Individual risk is established using alert level maps, which help set up the technological risk prevention plans for land-use planning. The risk assessment is based on the following key elements:

(a) Risk of accident assessment, based on:

(i) Gravity (the intensity or magnitude of the effects), determined by combining the intensity of the effects on the population with the number of people exposed (see table 3) and the number of potential fatalities for each type of effect (see table 4);

(ii) Probability of the accident occurring, calculated using a semi-quantitative approach based on reliability models, such as fault trees (quantitative) and past events and the frequency classes shown in table 5 (qualitative);

(iii) Kinetics (the swiftness of the effects, referring to the time available to respond to the accident with emergency measures), classified as either fast or slow (e.g., an explosion is fast, whereas a toxic release is slow);

(b) Risk acceptability, based on the criteria established for the maximum level of effects that are deemed acceptable. For a given accident, determining the frequency class and gravity level parameters is necessary to identify the risk level according to the national risk acceptability matrix illustrated in table 6.

78. Following the risk assessment above, the alert level concept is applied to determine, for each accident scenario:

(a) Zoning (which provides land-use planning and development controls), based on the four zones in table 7;

(b) Land-use compatibility, based on the probability that a hazardous phenomenon generates effects (i) of a given intensity, (ii) over a certain period of time and (iii) at a given point within the area, using a combination of the probability from the frequency class (table 5), the alert level and the zoning from table 7 (an example is provided in table 8);

(c) Alert-level mapping, based on the zoning and land-use compatibility above (see figure 7).

Table 3
Intensity of the effects on population

Effects on population	*Fire (thermal radiation in kilowatts per square metre)*	*Explosion (overpressure)*	*Toxic release (individual risk)*
5% lethal effects	8 kW/m^2	200 mbar	Lethal concentration 5%
1% lethal effects	5 kW/m^2	140 mbar	Lethal concentration 1%
Irreversible effects	3 kW/m^2	50 mbar	Irreversible Effects Threshold
Reversible effects	—	20 mbar	—

Note: Percentages represent the proportion of the population exposed that will suffer lethal effects.

Table 4
Gravity levels expressed in relation to the number of people exposed

Gravity level	*5% lethal effects*	*1% lethal effects*	*Irreversible effects*
Disastrous	more than 10	more than 100	more than 1000
Catastrophic	1–10	10–100	100–1000
Major	1	1–10	10–100
Serious	0	1	1–10
Moderate	0	0	0

Table 5
Five qualitative probability classes and their equivalence with the quantitative frequency

Frequency class	*Qualitative frequency*		*Quantitative frequency*	*Semi-quantitative frequency*
E	Extremely unlikely scenario	Possible considering current knowledge, but never occurred anywhere worldwide	less than 10^{-5} event/year	A hybrid risk-based model that takes into account factors/ measures reducing the level of risk
D	Realistic but unlikely scenario	Possible but never occurred in a similar facility	less than 10^{-5} event/year	
C	Improbable scenario	Already occurred in a similar facility worldwide	less than 10^{-4} event/year	
B	Probable scenario	Already occurred (or supposed to have occurred) during the lifetime of the facility	less than 10^{-3} event/year	
A	Frequent scenario	Already occurred (several times) during the lifetime of the facility	less than 10^{-3} event/year	

Table 6
French national risk acceptability matrix for land-use planning evaluations and restrictions in relation to the presence of hazardous activities

		Frequency class				
		E	*D*	*C*	*B*	*A*
Gravity level	Disastrous	NO MMR2	NO	NO	NO	NO
	Catastrophic	MMR1	MMR2	NO	NO	NO
	Major	MMR1	MMR1	MMR2	NO	NO
	Serious	OK	OK	MMR1	MMR2	NO
	Moderate	OK	OK	OK	OK	MMR1

Notes: Red (NO): unacceptable risk; green (OK): acceptable risk, i.e. the hazardous facility can operate without additional safety measures; orange (NO/MMR2): no more than five dangerous phenomena can be placed in these cells after the operator has taken all measures to reduce the risk; yellow (MMR1): a permit to operate a hazardous facility can be issued after all practicable safety measures have been implemented.

Table 7
Zoning criteria in the national guide for technological risk prevention plans

Regulated zones	*Future land-use planning and construction measures*	*Possible real estate measures*
Dark red	Ban on new construction	Expropriations, relinquishment
Light red	Ban on new construction but possibly allows extending industrial buildings and infrastructure if the necessary safety measures are implemented	Relinquishment
Dark blue	New construction possible depending upon the limitations in their use or implemented safety measures	
Light blue	New construction possible depending upon minor limitations in their use. No public buildings which are difficult to evacuate.	Compulsory protection measures for public buildings and industries.

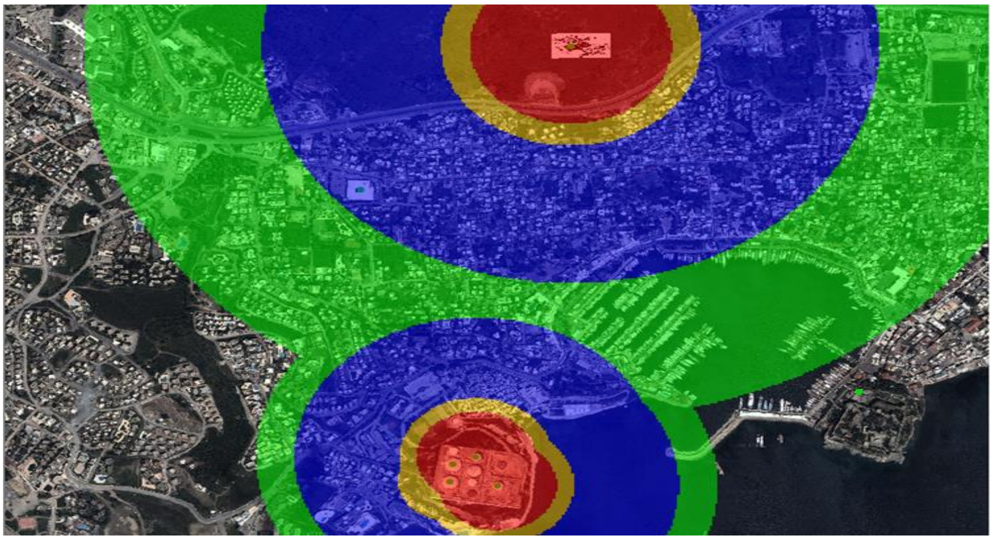
Note: Relinquishment refers to the legal approach whereby authorities can prohibit land or buildings from being reused once they are vacated.

Table 8
General rules for land-use compatibility for the zones around the hazardous facility

Maximum effects on population at a given point	*5% lethal effects*			*1% lethal effects*			*Irreversible effects*			*Indirect effects*
Cumulative probability distribution of dangerous phenomenon at a given point	greater than D	5E to D	less than 5E	greater than D	5E to D	less than 5E	greater than D	5E to D	less than 5E	All
Alert level	Very High (+) VH+	Very High VH	High (+) H+		High H	Medium (+) M+		Medium M	Low	
Zone regulation for thermal radiation and toxic exposure effects	Dark red		Light red			Dark blue		Light blue	Light blue	
Zone regulation for overpressure effects	Dark red		Light red			Dark blue			Light blue	

Notes: VH+ and VH: any existing houses can be subject to compulsory purchase (i.e. expropriation) or relinquishment. H+ and H: areas subject to relinquishment. VH+ to H: development of new buildings (i.e. residential or services) are generally not allowed. M+ to M (toxicity or heat radiation) and M+ to Low (overpressure): development is subject to special conditions. 5E: the probability of five extremely unlikely scenarios (see table 5).

Figure 7
Example of alert level mapping for overpressure obtained with ADAM 1.0



Source: Major Accident Hazards Bureau, European Commission Joint Research Centre.

79. For each one of the three effects (thermal radiation, overpressure and toxic exposures), an alert level map is created showing three contours representing the intensity of the effects on the exposed population (i.e., 5% lethal effect, 1% lethal effect and irreversible damage). A land-use compatibility criterion is obtained by overlapping all alert level maps referring to the same effect and calculating the frequencies of occurrence of these accidents. This can lead to an increase of alert level for a certain location.[13]

C. Approach of Italy

80. National laws are implemented by the Italian regions through their own legislation, which addresses issues of major-accident hazards, industrial safety, public health and safety, civil protection, natural resources protection and regional economic development.

81. The decree on minimal safety requirements for urban and territorial planning in areas subject to major accident risks[14] requires that adequate safety distances (a deterministic approach) be established between hazardous facilities and residential areas regarding:

(a) Construction of new facilities;

(b) Enlargement of existing facilities;

(c) New developments close to a facility.

[13] For example, 10 accident scenarios of class E count as one D. Slow accident effects are calculated separately.

[14] Ministry of Public Works, 'Minimum safety requirements with regard to urban and regional planning for areas affected by major accident hazards establishments', published in the Official Journal, n.138 (16 June 2001). Available from http://www.mit.gov.it/mit/media/seveso2/pages/documents/nazionali/DM090501.pdf.

82. The Italian land-use planning approach is semi-quantitative and is centred on three stages as described in the decree:[15,16]

(a) Identifying vulnerable territorial and environmental elements near the hazardous facility;

(b) Determining the impact area following an accident;

(c) Evaluating the territorial and environmental compatibility with the hazardous facility.

Step 1: identifying vulnerable territorial and environmental elements

Vulnerable territorial elements

83. Areas of land are categorized into six classes according to an urbanization or construction index and community-related characteristics (see table 9). The categorization takes into account the difficulty in evacuating:

(a) Vulnerable people such as children, the elderly and the sick;

(b) Residents in five (or more) storey buildings and crowds in public spaces;

(c) Residents in isolated or low-rise buildings;

(d) People undertaking low-vulnerability activities (characterized by short-term presence of people);

(e) People undertaking high-vulnerability outdoor activities.

Table 9
Six classes of land categorization

Category	*Type of land-use development*
A	Residential (building land index over 4.5 m^3/m^2)
	Developments accommodating people with limited mobility (e.g., hospitals, nursing homes, schools or kindergartens (over 25 beds or 100 people present))
	Places subject to outdoor overcrowding, e.g., fixed marketplaces or retail stores (over 500 people)
B	Residential (building land index between 4.5 and 1.5 m^3/m^2)
	Developments accommodating people with limited mobility, such as hospitals, nursing homes, schools or kindergartens (over 25 beds or 100 people present)
	Places subject to outdoor overcrowding (up to 500 people)
	Places subject to indoor overcrowding, e.g., shopping centres, offices, schools, universities (over 500 people)

[15] See Italy, Ministry of Infrastructure and Transport, ‘Territorial government and technological risk, intervention methodologies and experiences of implementation of the ministerial decree of 9 May 2001”. Available (in Italian) from http://www.mit.gov.it/mit/media/seveso2/pages/documents/libro_edizione_2/indice.htm (accessed on 16 September 2016).

[16] A. Carpignano, G. Pignatta and A. Spaziante, “Land use planning around Seveso II installations: the Italian approach”, *Proceedings of the European Conference on Safety and Reliability, 16–20 September 2001, Torino, Italy*, p. 1763.

Category	*Type of land-use development*
	Areas subject to significant overcrowding, e.g., public entertainment, sport, cultural or religious sites (over 100 people outdoors, or 1,000 indoors)
	Railway stations and other transport nodes (over 1,000 people/day)
C	Residential (building land index between 1.5 and 1m^3/m^2)
	Places subject to indoor overcrowding (up to 500 people)
	Areas subject to significant overcrowding (up to 100 people outdoors or 1,000 indoors)
	Railway stations and other transport nodes (up to 1,000 people/day)
D	Residential (building land index between 1 and 0.5 m^3/m^2)
	Areas subject to significant overcrowding on a monthly basis e.g. fairs, open-air markets, cemeteries
E	Predominantly residential (building land index over 0.5 m^3/m^2)
	Industries and agricultural, manufacturing and livestock enterprises
F	Hazardous facility area
	Area adjacent to the hazardous facility where no industrial elements or activities and people are present

Note: Amounts expressed in m^3/m^2 indicate the total volume of buildings expressed in cubic metres divided by the area expressed in square metres.

Vulnerable environmental elements

84. Vulnerable environmental elements are identified by assessing the potential environmental damage based on the release of dangerous substances and the type of accident (e.g., the effects of an explosion on water or subsoil may be negligible, whereas the effects of toxic gas dispersion on vegetation must be considered). These elements include:

(a) Landscape and environmental heritage assets;

(b) Natural protected areas;

(c) Surface water resources;

(d) Protected or unprotected groundwater resources;

(e) Agricultural land use.

Step 2: Determining the impact area following an accident

85. Accident consequence models are applied to estimate the level of damage to people and structures for each type of effect, that is, thermal radiation, overpressure and toxic concentration. The damage thresholds values presented in table 10 are defined by the decree. The impact is identified by:

(a) Comparing the calculated damage in the affected area with the threshold values and representing the results on a map;

(b) Overlapping the impact map with the map showing vulnerable territorial and environmental elements.

86. The frequency of occurrence of an accident event is associated with one of four probability classes (see table 11, first column).

Table 10
Threshold values adopted in the Italian regulation

Accident type	*Elevated fatalities*	*Start fatalities*	*Permanent injuries*	*Reversible injuries*	*Structural damage*
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
Boiling liquid expanding vapour explosion or fireball (*variable thermal radiation*)	Fireball radius	359 kJ/m^2	200 kJ/m^2	125 kJ/m^2	200–800 m (storage tank type)
Flash fire (*instantaneous thermal radiation*)	Lower flammable limit	0.5 Lower flammable limit	—	—	—
Vapour cloud explosion (*peak overpressure*)	0.3 bar (0.6 bar open space)	0.14 bar	0.07 bar	0.03 bar	0.3 bar
Toxic release (*absorbed dose*)	Lethal concentration for 50% (30 minute exposure)	—	Immediately dangerous to life or health	—	—

Step 3: Evaluating the territorial and environmental compatibility

Territorial compatibility

87. The compatibility of the zones surrounding a hazardous facility is evaluated by means of a qualitative compatibility risk matrix presented in table 11.

Table 11
Compatibility matrix for land uses A–F (table 9)

Probability class (events/year)	*Consequence category*			
	Reversible injuries	*Permanent injuries*	*Start fatalities*	*Elevated fatalities*
less than10^{-6}	ABCDEF	BCDEF	CDEF	DEF
10^{-4}–10^{-6}	BCDEF	CDEF	DEF	EF
10^{-3}–10^{-4}	CDEF	DEF	EF	F
greater than10^{-3}	DEF	EF	F	F

88. The process for mapping the territorial compatibility around a hazardous facility is as follows:

(a) Select an accident event (fire, explosion or toxic dispersion);

(b) Calculate the frequency of occurrence and select the probability class;

(c) Calculate the effects in each point of the area (high or starting lethality and irreversible or reversible effects);

(d) Identify the compatible building categories by using the compatibility matrix;

(e) Repeat the above steps for each accident event;

(f) Select the most restrictive compatibility level for each point of the area.

Environmental compatibility

89. Land-use planning and risk evaluation must take into account the specific environmental context of hazardous facilities (e.g., seismic and hydrological areas).

90. The classification of environmental damage is related to the potential release of dangerous substances and is defined by considering:

(a) Quantity and characteristics of the substances released;

(b) Specific measures applied to reduce and mitigate the environmental impacts.

91. Two environmental categories are then defined:

(a) Significant damage, for example, whereby remediation and environmental restoration of sites can be completed within the space of two years;

(b) Serious damage, for example, whereby remediation and environmental restoration of sites will require more than two years.

92. Serious environmental damage is always considered incompatible. For significant damage, prevention and mitigation measures should be applied.

Operating permits procedure

93. The permit is issued by the regional authorities (responsible for lower-tier Seveso facilities) and the Regional Technical Committee (responsible for upper-tier facilities).

Involvement of the public

94. The public concerned can consult the safety report of the hazardous facility and the technical report on land-use planning (excluding industrial, commercial, personal, public security or national defence information). The consultation procedures are defined by the planning regulation and the consultation period starts after the publication of an urban plan in the official journal.

D. Approach of the United Kingdom

95. In the United Kingdom, England, Scotland, Wales and Northern Ireland each have their own land-use planning regulations. The planning authorities of each country are responsible for implementing the land-use planning aspects of the Seveso III Directive. The two Health and Safety Executives in Great Britain (England, Scotland and Wales) and Northern Ireland are the bodies responsible for implementing the Seveso III Directive by regulating major accident hazard facilities through the Control of Major Accident Hazards process and providing guidance to local planning authorities on land-use compatibility near hazardous facilities.

96. Local planning authorities are responsible for defining land-use planning and environmental management. They must consult HSE for any development plan regarding hazard facilities and areas that fall within the consultation distance (a deterministic

approach). In this context HSE developed an online planning advice app,[17] which is available to local planning authorities and developers for pre-planning advice on territorial compatibility. The local planning authorities may refuse negative advice from HSE as its advice is not legally binding. However, the Executive can ask the Secretary of State to override the decisions of planning authorities when considering developments near hazardous facilities.

1. For proposed hazardous facilities

97. There are two processes that HSE conducts: first. the inspection of safety reports to check that operators have demonstrated compliance with the requirements of the Seveso III Directive; and. second, risk assessments of Hazardous Substances Consent applications (for a planning permit to have hazardous substances on-site up to a requested maximum quantity) made by operators to planning authorities. The HSE assessment of Hazardous Substances Consent applications is undertaken separately from assessments of safety reports produced under the Control of Major Accident Hazards for upper-tier Seveso facilities.

98. HSE assesses an application for Hazardous Substances Consent to establish a consultation zone (or distance) around the hazardous facility. The consultation zones represent potentially significant consequences for human health, urban areas and major transport routes. The zone boundaries are derived using the criteria in table 12. In terms of individual risk from toxic release to a hypothetical house resident:

(a) A risk of 10^{-5} per year of a dangerous dose or worse (implying that vulnerable people are at a risk of death of about 10 in a million per year) is used to advise against proposed development cases that are above a certain size;[18]

(b) 10^{-6} per year of a dangerous dose or worse is another boundary that is used;

(c) $0.3.10^{-6}$ per year of a dangerous dose or worse is the boundary used to advise against developments, of a certain size, for vulnerable people.

Table 12
Criteria for the definition of consultation zones around the facility

Consultation zone	*Fire (thermal radiation consequences)*	*Explosion (overpressure consequences)*	*Toxic release (Residual Individual risk of dangerous dose or worse to a hypothetical house resident)*
Inner	1800 TDU	600 mbar	greater than 10^{-5}
Middle	1000 TDU	140 mbar	10^{-5}–10^{-6}
Outer	500 TDU	70 mbar	10^{-6}–3.10^{-7}

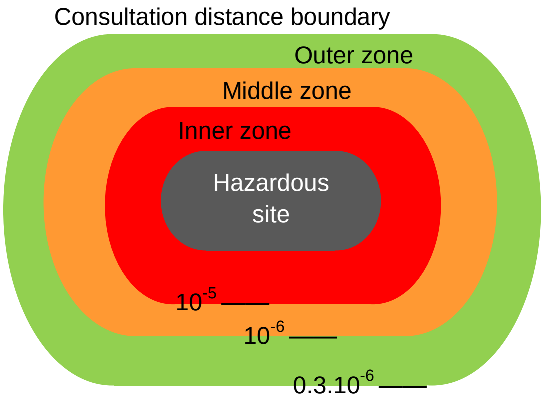
Note: TDU, or Thermal Dose Unit = 1 $(kW/m^2)^{4/3}s$.

[17] Available from http://www.hse.gov.uk/landuseplanning/planning-advice-web-app.htm (accessed 31 August 2016).
[18] See HSE Land Use Planning Methodology, available from http://www.hse.gov.uk/landuseplanning/methodology.htm.

99. HSE is not consulted beyond the outer zones. An example of three consultation zones obtained for a toxic release is shown in figure 8. Following the 2005 Buncefield disaster,[19] HSE introduced a fourth consultation zone for large-scale petrol storage sites.[20]

100. To check the compatibility of an application for Hazardous Substances Consent with the surrounding population, HSE follows its Planning Case and Assessment Guide.

Figure 8
Three consultation zones and their individual risk consultation zones for toxic releases around hazardous facility



Source: Lorenzo van Wijk.

2. For new developments within the vicinity of existing hazardous facilities

101. For making decisions on proposed developments near existing hazardous facilities, HSE established a procedure to assess the compatibility of developments proposed within the consultation zones, which includes:

(a) Vulnerability of the exposed population;

(b) Proportion of time spent by any individual in the development;

(c) Size of the building or infrastructure;

(d) People dwelling indoors or outdoors;

(e) Ease of evacuation or other emergency measures;

(f) Characteristics of buildings (number of storeys).

102. Based on these factors, HSE defined five vulnerability levels (see table 13).

[19] United Kingdom, Control of Major Accident Hazards report, "Buncefield: Why did it happen?". Available from http://www.hse.gov.uk/comah/investigation-reports.htm.

[20] For large-scale petrol storage tanks, a development proximity zone is defined within 150 metres of the tank farm bund, the inner zone up to 250 metres, the middle zone up to 300 metres and the outer zone up to 400 metres. See also the HSE report, "Land use planning advice around large scale petrol storage sites" (version 2). Available from http://www.hse.gov.uk/foi/internalops/hid_circs/technical_general/spc_tech_gen_43/.

103. An advice matrix is obtained by coupling the land-use development category with a vulnerability level and attributing this combination with a consultation zone (e.g., in table 13). The advice is one factor for consideration when making planning decisions.

104. Inside the inner zone, industrial activities and parking lots are allowed. Residential buildings are allowed within the middle zone provided the developments do not include vulnerable centres such as schools and hospitals. Residential areas and small vulnerable centres are allowed within the outer zone. Finally, in the case of large-scale petrol storage sites, unoccupied developments within the development proximity zone are allowed. No restrictions are imposed beyond the outer consultation zone.

3. Access to information

105. The HSE assessment reports are not published, contrary to the practices in France and Italy. However, operators must provide all relevant information on existing safety measures at the facility and the external emergency measures in the event of an accident, without being requested, to the people potentially affected. Land-use planning risk maps can be provided upon request. Some local planning authorities publish consultation zones in their local plans.

106. The public must be consulted on the adoption of a local plan. The local plan application and all other relevant information is made available to the public and planning meetings are held. The public is entitled and given adequate opportunity to express its opinions on the local plans, which the local planning authority must take into consideration. Individual planning applications, including applications for Hazardous Substances Consent, are also subject to public notification and review.

107. Separately, the environmental agencies advise on environmental impacts. The local planning authorities consult the separate environmental agencies in England, Wales, Scotland and Northern Ireland, as the HSE role is to provide advice on the risk aspects to the public.

Table 13
Health and Safety Executive advice matrix for proposed developments around a hazardous facility

Vulnerability level	*Land-use developments (examples)*	*Outer zone*	*Middle zone*	*Inner zone*	*Development proximity zone*
0	Developments usually unoccupied (e.g., long-term parking, storage facilities)	DAA	DAA	DAA	DAA
1	Workplace buildings with less than 100 occupants and less than 3 occupied storeys, and stand-alone car parks (e.g., factories, warehouses and offices)	DAA	DAA	DAA	AA
2	Residential areas of up to 30 dwelling units at a density of no more than 40 units per hectare Hotels up to 100 beds, camping up to 33 pitches	DAA	DAA	AA	AA

Vulnerability level	*Land-use developments (examples)*	*Outer zone*	*Middle zone*	*Inner zone*	*Development proximity zone*
3	Indoor public spaces with over 5,000 m^2 total floor space (e.g., retail and leisure centres) Outdoor public spaces with over 100 people but up to 1,000 at any one time	DAA	AA	AA	AA
4	Highly vulnerable or very large facilities (e.g., hospital or nursing home larger than 0.25 hectares, school larger than 1.4 hectares and stadium)	AA	AA	AA	AA

Abbreviations: DAA = Do not Advise Against development, AA = Advise Against development

IV. Conclusion

108. The present technical guidance provides examples of land-use planning approaches, risk assessment methods and the key steps in evaluating and making decisions on land-use policies, plans, programmes and projects involving hazardous facilities and their potential effects on human health, property and the environment.

109. The previous chapters have highlighted that:

(a) Land-use planning is a necessary process whereby land is allocated and regulated for different socioeconomic activities, including hazardous activities;

(b) Land-use planning controls should aim to create safe and sustainable environments by setting procedures for identifying, assessing and managing all sources of risk to human health and the environment;

(c) When developing or making decisions on national land-use policies, plans, programmes or projects, the proponents, authorities, stakeholders and decision makers should take into account:

(i) The location, safety aspects and risks associated with existing and proposed hazardous activities,

(ii) The relevant provisions and procedures of the Industrial Accidents Convention and ECE safety guidelines developed under the Convention (listed in section I.C);

(d) Different planning approaches and risk assessment methods are used to identify, assess and manage the safety and risk aspects (including transboundary risks and effects) of hazardous facilities;

(e) The potential effects of a proposal on human health, environment and property should be based on the evaluation of the risk assessment and mapping against the compatibility and risk acceptability criteria.