

European Commission  
Directorate-General Environment

# **Impact assessment study into possible options for amending the Seveso II Directive**

Final Report

September 2010



COWI

COWI A/S

Parallevej 2  
DK-2800 Kongens Lyngby  
Denmark

Tel +45 45 97 22 11  
Fax +45 45 97 22 12  
[www.cowi.com](http://www.cowi.com)

European Commission Directorate-General  
Environment

## **Impact assessment study into possible options for amending the Seveso Directive**

Final Report

September 2010

Document no. 70610-L-1\_Final report  
Version 8  
Date of issue 07.10.2010

Prepared MMS, FHHE, HHU  
Checked HHU, MMS  
Approved MMS

## Table of Contents

<b>Executive summary</b>	<b>3</b>
<b>1 Introduction</b>	<b>8</b>
1.1 About this report	8
1.2 Background and objective of the IA Study	9
<b>2 Key issues for potential amendments</b>	<b>12</b>
2.1 Approach to the review and assessment of amendment components	15
<b>3 Assessment of amendment components - procedures for change of Annex I</b>	<b>31</b>
3.1 Derogation rule	31
3.2 Include safeguard clause	36
3.3 Amendments to Annex I via delegated acts	37
<b>4 Assessment of amendment components - technical motivated changes to Annex I</b>	<b>40</b>
4.1 Carbon dioxide	40
4.2 Fuel oil	52
4.3 Hydrogen	57
4.4 Threshold values for aerosols	64
4.5 Sodium hypochlorite	66
<b>5 Assessment of other amendments to facilitate effective implementation of the Directive</b>	<b>69</b>
5.1 Information obligations and information to the public	69
5.2 Coordination of inspections	81
5.3 Mutual Joint Visits Programme	83
5.4 Formalising the Commissions role in supporting effective implementation	84
5.5 Integration of information requirements and procedures with other legislation	86
5.6 Safety Performance Indicators	86

5.7	Safety management requirements for lower-tier establishments	89
5.8	Safety Report guidance etc.	92
5.9	Domino effect	93
5.10	Land use planning	94
5.11	Underground storages	98
5.12	Environmental aspects	98
5.13	Emergency planning - deadlines	99
5.14	Emergency planning - guidance	100
5.15	Specific deadline for reporting of accident	100
5.16	Change threshold for when accidents have to be reported	101
<b>6</b>	<b>Impact assessment of option packages</b>	<b>104</b>
6.1	Options packages	104
6.2	Option 1: "No action" option package	107
6.3	Option 2: The "Key amendments" option package	108
6.4	Option 3: The "Ambitious amendments" option package	113
6.5	Comparison of options	118
<b>7</b>	<b>References and literature</b>	<b>121</b>

## Executive summary

This report presents the results of an impact assessment study covering possible amendments to the Seveso II Directive.

### Background

Through a review process and stakeholder consultation initiated by the European Commission all aspects of the implementation and working of the Directive have been assessed and possible amendments identified. Simultaneously the introduction of the CLP legislation implies that certain parts of Annex I of the Seveso II Directive will have to be changed. It all leads to a need for assessing impacts of alternative options for adapting and changing the Seveso II Directive.

It is important to note that the current study does not cover the adaption of the Annex I to the new CLP legislation. There is a specific impact study that addresses the question of the impacts of alternative alignment options for Annex I of the Directive with regard to hazard categories for substances and mixtures.<sup>1</sup>

### Objective

This study relates to the results of the review process and stakeholder consultation where a number of issues have been identified, intended mainly to clarify and update certain provisions to improve implementation and enforceability. The objective of this impact assessment study has been to assess the impacts of alternative options for each of the identified amendment issues.

### Scope of the study

The list of amendment issues includes the following categories:

- Amendments related to how Annex I could be changed and based on which criteria (amendments through application of an expanded derogation rule and safeguard clause via delegated acts);
- Technical motivated amendments related to the content of Annex I (specific substances etc);
- Other amendments to facilitate effective implementation of the Directive (information obligations, land-use planning, coordination, provision of guidance etc).

---

<sup>1</sup> See: COWI 2010, "Impact assessment study into the possible options for adaption Annex I of the Seveso II Directive into the GHS", for the European Commission DG Environment

In total more than 20 individual amendment issues have been considered. For each issue, the economic, environmental and social impacts have been assessed for alternative options including a "no action" alternative.

#### How to change Annex I in the future

In relation to the amendment issues related to the how Annex I could be changed in the future, an important issue is introduction of a derogation rule that allows for EU wide harmonised substance derogations. This issue is motivated by the recently introduced CLP and the REACH legislation which could change the classification of certain substances and mixtures and it could bring within scope substances/mixtures that were not previously included. If these substances (and mixtures) fulfil certain criteria about not having any major accident hazard potential, it could be relevant to have the option of excluding these substances. This would require a widening of the derogation provision in the Directive combined with allowing changes to the Annex I through the procedure of delegated acts. The important impact of these amendments is the introduction of a flexibility that could prevent future increases in costs or reductions of the protection level.

See Chapter 3 for the detailed assessment of the impacts of the alternative option for each of these issues.

#### Specific changes to Annex I

A number of specific substances (and Annex I categories) have been considered. This includes CO<sub>2</sub>, hydrogen, heavy fuel oil, sodium hypochlorite and aerosols. CO<sub>2</sub> storage is a new emerging risk that potentially could be considered included within scope of the Directive. The assessment shows that it can not be demonstrated that including CO<sub>2</sub> is justified as the specific use of new technologies such as CCS is still at very preliminary state. For the other substances, the considered amendment options are about changing thresholds and here no major changes have been identified as having clear positive impacts.

See Chapter 4 for the detailed assessment of the impacts of the alternative option for each of technical Annex I issues.

#### Other issues to improve efficiency of the Directive

The last group of amendment issues that have been investigated include various issues on information, coordination, guidance, clarifying requirements etc.

Currently the provision of information to the public varies across Member States and therefore alternative amendment options for clarifying or improving the quality and accessibility of information have been assessed. Improving the information to the public can take alternative forms and generally the more information to be provided the higher the costs and the benefits. By moving to more electronic provision of information and also by reporting through electronic means the administrative costs of the information and reporting obligations could be reduced.

Options for expanding the requirements for lower tier establishments have been addressed. This will lead to higher costs but also to higher benefits in terms of increased protection level. There is a similar situation with respects to expanding the land use planning requirements from only new establishments (and

changes to existing sites) to cover all existing upper tier establishments. This would lead to significantly higher costs but also to higher protection level.

For all these amendment options, it is characteristic that an increased protection level is accompanied by higher costs for both industry and CAs. For the majority of issues, it is not possible to quantify the benefits in terms of increased protection level. Hence, it is a political decision to find the level of requirements that will achieve the right balance between the costs and the benefits of these requirements.

Further options on improving coordination and providing better guidance have been assessed and they tend to provide improvements at low or no costs or even to allow cost savings by more efficient implementation of the Directive.

See Chapter 5 for the detailed assessment of the impacts of the alternative option for each of these issues.

### Three option packages

Having made the detailed assessment of alternative options for each issue or component, three option packages have been analysed.

#### *Option 1: 'no action', i.e. no changes to the Directive*

Option 1 is the baseline option. Due to the follow-on effects of the CLP and REACH regulation, the "No action" option will not be a simple continuation of the current situation. The impacts will depend on the alignment options in relation to CLP (which are addressed in the separate study) but there could be changes to scope.

#### *Option 2: key amendments to the Directive to clarify and update certain provisions*

Option 2 focuses on provisions that could improve various aspects of the efficiency of the overall working of the Directive as well as several minor clarifications. The key elements of this option package are the introduction of the derogation rule and safeguard clause based on the delegated act procedure. Furthermore, improved information management, coordination and better guidance are part of this package.

#### *Option 3: more ambitious changes and improvements to the Directive*

Option 3 sets forth more ambitious changes to the Directive. These changes include expanding the requirements for information to the public, increased requirements for lower tier establishments and extending the LUP requirements to also cover existing upper tier establishments.

The impacts of the three option packages are illustrated in Table 0-1. The more amendments are included the higher the costs and the benefits.

Table 0-1 Summary of the impacts of the three alternative option packages

	<b>Economic impacts (administrative costs)</b>	<b>Protection level impacts</b>	<b>Other effects</b>
<b>Option 1: No action</b>	2- 5 million EUR per year	No significant change	Risk that effect of CLP and REACH could increase costs or reduce protection level
<b>Option 2: Key amend- ments</b>	4 -5 million per year Not-quantified cost savings 6-8 million EUR one-off costs	Increased protection level	This option will increase the flexibility of future amendments to Annex I and increase quality and efficiency of information provision
<b>Option 3: Ambitious amendments</b>	7 -8 million per year Not-quantified cost savings > 50 million EUR one-off costs Plus costs related to LUP for all establishments - could be several hundred millions EUR or even billions of EUR	Increased protection level	Same as Option 2 plus future provision of non-technical information for upper tier sites and more requirements for lower tier e.g. "mini" SR and LUP requirements also for existing upper tier sites

Source: Consultants estimates

Though many of the impacts can not be quantified, some of the economic impacts have been estimated and they indicate that the administrative costs for Option 1 and 2 are moderate. Option 2 might give cost savings which reduce the net costs or even make the economic impacts positive. The impacts from the "Ambitious amendments" option package are significantly higher than those of the other options. The increase in protection level is also higher for this option but it is a political judgment whether the increased protection justifies the additional costs.

There are no detailed estimates of the total administrative costs related to the Seveso Directive - a rough estimate suggest administrative costs in the order of at least 100 million EUR per year. Compared to this level of costs the options could lead to increases in the order of 5-10% though Option 2 could be lower or even reduce the total administrative costs.

#### Consideration on impact on SMEs

There are limited data to support a specific assessment of the impacts on SMEs. Although there is not necessarily a correlation between the quantities present in an establishment and the size of the operator, assuming that lower tier sites are

more likely to be SME it can be roughly assessed whether the option packages could result in a relatively higher cost burden for lower tier sites.

Most of the amendments will lead to moderate costs and they would be in proportion to the existing costs. Therefore very limited additional administrative costs to SMEs are expected as result of the "No action" or the "Key amendments" option packages. For the "Ambitious amendments" option package, the further requirement on lower tier obligations could lead to more significant costs to SMEs.

For upper tier SMEs, already the existing cost burden could be high so any further increase could have impacts on business activity. Apart from the example of the metal finishing industry where in some Member States there are upper tier establishments, there are limited data available to this study on upper tier SMEs.

Differences in Member State implementation makes it difficult to draw general conclusions. There are Member States that have imposed additional requirements on lower tier establishments which have increased the administrative costs for them and hence the burden for lower tier SMEs. In general, the approach in Member State implementation is an important factor determining the cost facing any operator.

What should be noted in relation to SMEs and the proposed option packages is that the amendment component about derogations could lead to more flexibility in exempting SMEs if it can be demonstrated that there is no major accident hazard potential related to their activity. The "Key amendments" option package could therefore lead to reductions in costs to industry that could be particularly important for SMEs.

#### Sensitivity assessment

The nature of many of the amendment component options considered in this impact assessment study does not allow for quantification of the impacts.

For the quantified impacts - mainly the additional administrative costs to industry and CAs - the values presented are subject to a degree of uncertainty. The applied unit costs are our best estimate. The uncertainty was assessed to be a range varying with a factor of 2 around the "best" estimates. It means for example that the above annual costs for the "Key amendments" option packages would vary from 2 to 10 million EUR.

The non-quantified effects -for example cost savings - from enhanced coordinating and improved guidance could be important. As mentioned above a rough estimate of the total annual administrative costs of the Directive was estimated to be in the order of 100 million EUR. If more efficient implementation leads to just a few percentage of cost reductions, it could easily off-set the additional costs.

Overall, the economic impacts of the amendments would in the case of the "Key amendments" option package be moderate compared to the total costs of the Directive.

# 1 Introduction

## 1.1 About this report

### Final report

This report is the final report for the study on 'Impact assessment study into possible options for amending the Seveso II Directive'. The study is implemented under the Framework Contract for Economic Analysis of Environmental Policies and of Sustainable Development (ENV.G.1/FRA/2006/0073).

### Objective

The objective of the study is to assess the impacts of possible changes to the Seveso II Directive based on the ongoing review process. Through the review process and stakeholder consultation a number of issues have been identified, intended mainly to clarify and update certain provisions to improve implementation and enforceability. This impact assessments study addresses each issue and assesses the impact of alternative options.

The assessment of each of the amendment issues or components is typically analysed under the heading of economic impacts and protection level impacts. The effect on the protection level includes both environmental effects and health effects (part of the social category).

Finally the three main option packages have been defined as combination of amendment components and the impact assessment has been carried out following the structure of IA guidance.

### Content of the report

The report is structured with:

- Chapter 2 listing all the amendment issues that have been address and present the key assumptions regarding the cost data that have been applied in the impact assessment;
- Chapter 3 present the amendment issues related to procedures for changing Annex I of the Directive;
- Chapter 4 includes the assessment of a set of technical motivated changes to Annex I;
- Chapter 5 assess all other amendment issues that can facilitate an effective implementation of the Directive.

- Chapter 6 presents the option packages (no action, key amendments and ambitious amendments option packages) and compare the options with respect to the economic, environmental and social impacts. Hence, this section provides a summary of the overall impacts of the considered amendments.

## 1.2 Background and objective of the IA Study

The Commission has initiated a review of the Seveso II Directive. The review process has included several elements and the issues that have been identified are the subject of this impact assessment study.

The Seveso II Directive<sup>1</sup> on the control of major accident hazards is aimed at the prevention of major-accident hazards involving dangerous substances and at the limitation of the consequences of any such accidents in order to protect human health and the environment.

The Directive was last amended in 2003. However the basic structure and the main requirements have remained unchanged for over 12 years.

The Directive applies to fixed industrial sites where certain dangerous substances are present in large quantities. There is a tiered approach to the level of controls, with the larger the quantities of substances, the stricter the rules. The main requirements are that all operators caught by the Directive must notify their activities and establish a major accident prevention policy. In addition, operators of 'upper tier' establishments have to establish a safety report, a safety management system and an internal emergency plan. There are also obligations on public authorities relating to, inter alia, external emergency plans and public information on safety measures for upper-tier establishments, land-use planning, accident reporting and inspections. Currently, the Directive covers around 9000 establishments storing or using dangerous substances, mainly in the chemicals, petrochemicals, storage, and metal refining sectors. It does not apply to nuclear safety, intermediate temporary storage outside establishments, ports, railway yards or the transport of dangerous substances by pipelines.

Every three years, the Commission publishes a summary of the information provided by the Member States on the implementation of the directive. The latest report, covering the period 2003-2005 was published in 2007. However this information is essentially quantitative in nature and does not really enable a more qualitative analysis to be made of the Directive's effectiveness.

Against the above background, about two years ago the Commission decided to launch a review of the effectiveness of the Directive. To contribute to that process, a number of studies have been undertaken and views of Member States and other stakeholders obtained.

The review should also be seen the relation to fact that the Directive has to be amended to align it with the changes to the EU system on classification of dangerous substances (the CLP regulation).

It is important to note that the current study does not cover the adaptation of the Annex I to the new CLP legislation. There is a specific impact study that addresses the question of the impacts of alternative alignment options for Annex I of the Directive with regard to hazard categories for substances and mixtures.<sup>2</sup> To complement the work already undertaken, and to complete the review process, this impact assessment study has been prepared to guide and inform the next steps leading to the elaboration of a legislative proposal from the Commission regarding all amendment issues apart from those directly related to the alignment with the CLP legislation.

## Contents of Impact Assessment

The IA guidelines set out a number of recommendations that support the IA process. In the context of Seveso and the long list of potential issues presented by DG ENV, it is particularly relevant to keep in mind that *'An IA should provide... solid evidence on the impacts and advantages and disadvantages, but it should also avoid unnecessary effort that would not lead to further insight or alter the conclusion or their robustness'* (IA guidelines, page 12). This is also referred to as the 'proportionate level of analysis', which concerns not only the completed IA but also the IA process. As will be seen below, we suggest a three-step approach that gradually narrows down the number of elements in the key options for the impact assessment. A closer discussion of the significance of impacts, political importance and policy development stages is therefore also highly relevant (i.e. the IA guidelines).

In the development of options, it is also imperative to consider that a clear requirement to the policy options is that they must be *'closely linked to the causes of the problem and to the objectives'*. A general issue to consider for the selected options is the proportionality principle, which states that *'any Community action should not go beyond what is necessary to achieve satisfactorily the objectives which have been set'* - this also refers to compliance costs (EC IA Guidelines, p. 28).

Furthermore, it is also relevant to address the type of legislation involved. The IA guidelines operate with five types of initiatives, where the Seveso II Directive is foremost related to the definition of a 'narrow' legislative action. This means that the Directive relates to one particular field. Based on this, the IA guidelines underline that the study must look at the options, including different implementation modes or choices of instruments. Also, the guidelines underline that the analysis must address impacts of all options *in relevant pillars* - this is the same as the options or option packages that we propose, and finally, the guidelines mention the measurement of the administrative burden.

The issues on the DG ENV list are not solely of legislative character. There are some aspects that relate more to the 'non-legislative' initiatives. They will be included -where relevant - in the IA in terms of possible resource requirements and impacts. There are also examples where an issue could be addressed either by a legislative action or by a non-legislative action. In these situations, both type of actions or options will be investigated.

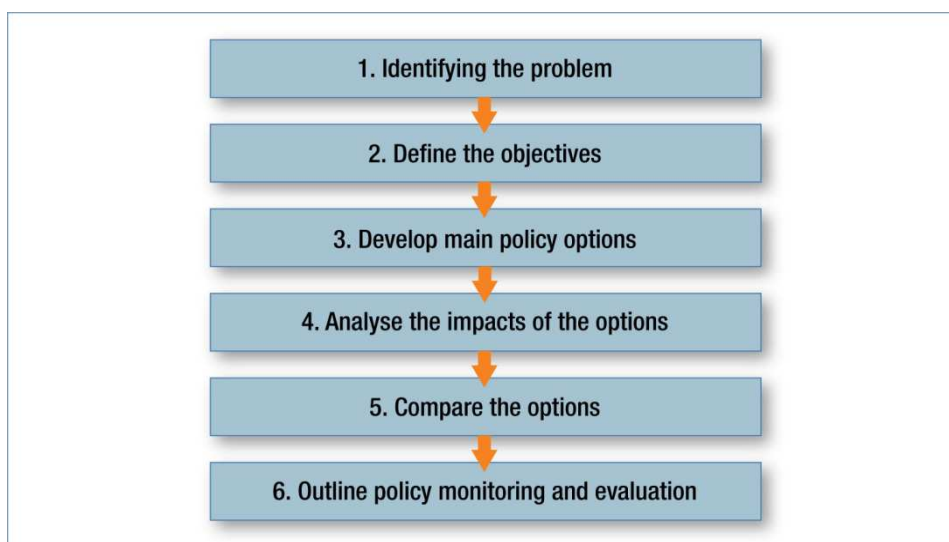
---

<sup>2</sup> See: COWI 2010, "Impact assessment study into the possible options for adaptation Annex I of the Seveso II Directive into the GHS", for the European Commission DG Environment

## IA process

To recap the basis for the methodology: in addition to being a requirement when conducting Impact Assessments for the Commission, the IA guideline are a very useful tool to ensure that a consistent and comprehensive IA is made. The following key analytical steps are being applied for the Impact Assessment to be submitted in the Draft Final Report in June 2010:

Figure 1-1 Key analytical steps - Impact Assessment



In the relation to this impact assessment the problem definition is the following:

- The CLP legislation on classification and labelling of chemicals replaces the Dangerous Substance Directive and other legislation which was the basis for the categories of dangerous substances used in Annex I of the Seveso II Directive. This has initiated a revision of the Directive and combined with the results of a review process where the actual implementation and working of the Directive has been assessed, it forms the bases for defining options to improve the directive.

The objectives of the options are:

- To improve the effectiveness and efficiency of the Directive
- Consider whether there are new major accident hazards that should be covered by the Directive.

Steps 3 to 5 of the IA are covered in the subsequent sections.

The key issues for potential amendment discussed in this report have been identified by the Commission based on the results of a review process that has included various studies and consultation of stakeholders<sup>3</sup>.

<sup>3</sup> See the relevant EU Commission website for details about the review process.

<http://ec.europa.eu/environment/seveso/review.htm>

## 2 Key issues for potential amendments

The amendments are organised in three main categories:

- Amendments related to how Annex I could be changed and based on which criteria (amendments through application of an expanded derogation rule and safeguard clause via delegated acts)
- Technical motivated amendments related to content of Annex I (specific substances etc)
- Other amendments to facilitate effective implementation of the Directive (information obligations, land use, coordination, provision of guidance etc)

For a more detailed description of what each amendment issue is about and what the presented options will imply see the discussion of each issue in Chapter 3, 4 and 5 respectively regarding each of three categories of issues.

### Mechanism(s) for amending Annex I

The first category is a number of amendment issues aimed at allowing more effective changes to Annex I. These amendments are motivated by the fact that the CLP and REACH regulation can introduce unexpected changes to the classification of substances which might require changes to the Annex I in order to avoid impacts on the scope of the Seveso II Directive.

Table 2-1 List of issues related to how Annex I can be changed

Amendment components	Alternative options for component
Possible broadening of derogation rule (Article 9.6 and Commission Decision of 26 June 1998 on harmonised criteria for dispensations) to allow also for harmonised EU wide substance derogations	1) Do nothing 2) Extend the current derogation to allow for more requirements to be exempted 3) Extend the current derogation rule to allow for substances to be exempted from scope based on harmonised EU decisions. 2) and 3) can be combined
Include Safeguard clause for substances and mixtures (linked with derogation, information obligation to the Committee)	1) Do nothing 2) Include safeguard clause for substances and mixtures
Delegate to the Commission the power to adopt amendments to Annex I via delegated acts	1) Do nothing 2) Expand the provision of the use of Article 22 to include changes to Annex I

### Technical motivated amendments

The next set of amendments components concern a number of technical issues and proposed changes to the Annex I mainly in relation to named substances (Annex I Part 1). These amendment issues are motivated by various technological and other developments in the European society. Some of the amendments are proposed by stakeholders.

Table 2-2 Long list of issues related to content of Annex I

Amendment components	Alternative options for component
CO <sub>2</sub> , inclusion as named substance	1) Do not include
	2) Include with high thresholds
	3) Include with low thresholds
Heavy fuel oil to be included as named substances with higher thresholds	1) No action (Do nothing) 2) Include as named substance - consider alternative thresholds
H <sub>2</sub> : Delete as named substance leading to higher thresholds	1) No action (H <sub>2</sub> remains a named substance with 5/50 tons thresholds) 2) H <sub>2</sub> (hydrogen) is deleted as named substance and the threshold is changed to 10/50 tons.
Aerosols (FEA proposal to increase thresholds)	1) Apply the threshold from CLP alignment work (the no action option) 2) FEA proposed thresholds (higher than the CLP alignment proposal).
Sodium hypochlorite (Include as named substance with current thresholds)	1) No action - the thresholds will increase due to reclassification under CLP 2) Include as named substance (with current thresholds)/derogation based on packaging

### Other amendments to facilitate effective implementation of the Directive

The last category includes a long list of various amendments. The review of the directive has identified a number of issues where the effectiveness or efficiency of the Directive could be improved.

The long list is presented in Table 2- 3 in a non prioritised order.

Table 2-3 Long list of issues related to various aspects of the Directive

Amendment components	Alternative options for component
Information obligations in relation to Article 19 and 13.1(Annex V) in particular information to the public - options for improving content and management of information	Content of information to the public: A) As today B) As today plus on-line availability C) Revised Annex V with e.g. accident scenarios D) Non-technical summary of SR and EEP Management of information:

	<ul style="list-style-type: none"> <li>1) As today</li> <li>2) MSs have to operate website/database with public access</li> <li>3) EU central website/database as entry to publicly available information</li> </ul>
Coordination: Improve coordination of inspections	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Encourage coordination</li> </ul>
Codification of Mutual Joint Visits programme	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Encourage mutual joint visits as means to maintain experience sharing between Member States.</li> </ul>
Coordination: Option to include a mandate for the Commission to cooperate with and to support Member States doing implementation and especially inspections	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Include a "mandate" for the Commission to cooperate with and to support Member States with regard to implementation and inspections (by referring to these activities in the directive)</li> </ul>
Extend possibility of using info provided already under legislation (second sub paragraph of Article 9.2)	<ul style="list-style-type: none"> <li>1) No action</li> <li>2) Using other reporting formats and information in Seveso context (e.g. provide specific Seveso relevant information contained in an IPPC report)</li> </ul>
Possible integration of procedures under LUP and EIA/SEA	<ul style="list-style-type: none"> <li>1) No action</li> <li>2) Make reference in the directive about Integrate Seveso requirements with LUP and EIA/SEA procedures</li> </ul>
Use of Safety Performance Indicators (SPIs)	<ul style="list-style-type: none"> <li>1) No action</li> <li>1) Include requirements in the directive to use SPIs</li> <li>2) Make reference only</li> <li>3) Provide guidance on their use</li> </ul>
Requirements for lower tier (LT) establishments around safety management etc.	<ul style="list-style-type: none"> <li>1) Clarify existing requirements through revision of the relevant provisions</li> <li>2) Extend full SMS to LT</li> <li>3) 'Mini' safety report including IEP for LT</li> <li>4) Require SMS, IEP and mini SR for the LTs</li> </ul>
Safety Report (SR): guidance /exchange of information on best practices as regards assessing SR	<ul style="list-style-type: none"> <li>1) No action</li> <li>2) EC provides guidance and information on best practice regarding assessment of SR</li> </ul>
Exchange of information with and need to take account of risks from non-Seveso sites (in relation to Domino effect)	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Include requirement in Article 8 to include the link with non-Seveso sites</li> </ul>
Underground storages (Revise definition to specifically include underground gas storages)	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) clarify text to include within scope</li> </ul>
Change to land use requirement Article 12	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Minor clarifying modifications, no significant changes,</li> <li>3) Extension of Article 12 provisions:</li> <li>4) Take out Article 12, -&gt; planning issues</li> </ul>
Environmental aspects (revise Directive text to include more details in relation to environment)	<ul style="list-style-type: none"> <li>1) Do nothing</li> <li>2) Include more details in relation to the environmental aspects in Annex II, IV and LUP</li> </ul>

Impose clear deadlines for Member States to complete external plans	1) Do nothing 2) 12 months' deadline (Article 11)
Develop guidance on emergency planning	1) Do nothing 2) Develop guidance
Specific deadline for reporting of an accident	1) Do nothing 2) Specify deadline as 12 months
Change the requirement (Annex VI, I.1) for the reporting obligation	1) Do nothing 2) Increase requirement by reducing threshold for when an accident should be reported

## 2.1 Approach to the review and assessment of amendment components

### 2.1.1 Criteria and considerations

This impact assessment is based on the EU IA guidelines which categorise impacts in economic, environmental and social effects.

The below criteria includes the tailoring of the gross list of impacts to those that specifically described the effects of changes to the Seveso II Directive.

The following table presents these criteria and considerations and the reasoning and reservations (pros and cons) for each.

Criteria	Pros / Cons
Protection level - health	Reasoning: Regardless of the economic impact, each amendment could impact on the protection level. Changes to the protection level are changes to the risks to human health. It important to assess if any of the amendments have benefit in terms of increased protection level or whether they result in a reduced protection level.  Pros/Cons: The level of risk can be difficult to estimate exactly, however, we have an experienced expert on the team who will be able to make risk profiles of the issues where necessary and thereby rate the risk level.
Risk level of impacts - environment	Same reasoning and Pros/Cons as above for environmental protection..
Economic magnitude of impacts	Reasoning: The economic effects are an important element to consider in the impacts assessment. Section 2.1.3 presents in detail the approach and assumption to the assessment of the economic effects.  Pros/Cons: This criterion ensures that the options or sub-options with the highest economic impacts (both positive and negative) will be included in the IA.
<b>Other considerations when assessing the criteria</b> ( <i>these considerations will not delimit issues from being included, however, they might affect the approach we take to certain issues.</i> )	
Political sensitivity	Reasoning: The purpose of the IA is to present some relevant and potential changes to the Seveso Directive, and in some cases, political sensitivity makes an amendment more or less relevant.

	Pros/Cons: The advantage of considering this is that it will prevent too many resources from being spent on a potential amendment that will never be accepted politically.
Impacts that are impossible to assess by quantitative means	Reasoning: By considering this, the intention is to capture any issues that will challenge the methodologies for the IA. By doing this beforehand, we gain better control of the quality of the IA results.
Short/long-term impact	Reasoning: Some issues will not have the same impact over time, e.g. a shared database of Seveso establishments will initially entail high costs and much work for the Member States, however, in the long term such a database will most likely decrease costs. Such impacts must also be handled in the IA, and the criterion allows for a potential variation of an option if relevant.

### 2.1.2 Assumption on number of Seveso establishments

Key assumptions concern:

- Number of Seveso installations
- Assumption on cost of compliance etc.

This section presents the assumption on the number of Seveso sites that has been used on the impacts assessment.

Number of Seveso II establishments

According to a summary of data from SPIRS, there are 9725 establishments included in the Seveso II (November 2009). Out of these, 5227 are included in the lower tier, and 4496 are included in the *upper tier*.

Figure 2-1 List of SEVESO establishments, based on SPIRS (as of November 2009)

Country	Total number of plants	Upper Tier	Lower Tier	Not known/not applicable
Germany	2119	1071	1048	
UK	1147	411	736	
Italy	1117	519	598	
France	1106	553	553	
Spain	673	267	406	
Netherlands	384	221	163	
Sweden	379	199	180	
Poland	366	158	208	
Belgium	365	174	191	
Romania	277	115	162	
Finland	264	128	136	
Czech Republic	190	115	75	
Greece	189	83	106	
Portugal	164	57	107	
Austria	146	80	64	2
Hungary	144	64	80	
Bulgaria	135	54	81	
Denmark	121	31	90	
Ireland	88	34	54	
Slovakia	78	41	37	
Latvia	63	30	33	
Slovenia	60	23	37	
Lithuania	53	19	34	
Estonia	50	25	25	
Luxembourg	21	8	13	
Cyprus	16	10	6	
Malta	10	6	4	
<b>TOTAL</b>	<b>9725</b>	<b>4496</b>	<b>5227</b>	<b>2</b>

Source: SPIRS 2009

### 2.1.3 Assumption on unit costs

#### Compliance costs

Costs of compliance include:

- Costs to establishments (divided on initial cost and recurring cost);
  - Administrative costs;
  - Investment and operational costs related to physical compliance measures; or
  - Costs of avoiding becoming a Seveso site by supply change management actions.

- Cost to competent authorities (administrative costs - measured in time usage (days)).

Any establishment facing a situation where it is about to become within scope of the Seveso II Directive might have the option of either complying with the Seveso requirements or avoiding to become within scope by supply chain adjustments - reducing its maximum stocks of dangerous substances.

One would assume that the company would evaluate the two alternatives and use supply chain measures to reduce stocks of dangerous substances if that option is cheaper than complying with the Seveso requirements. Thus, using the costs of complying with the Seveso requirements when assessing the impacts of scope change would give an overestimation of the total costs, as some establishments might choose to apply the supply chain adjustments to avoid becoming within scope.

It is not so simple to estimate the costs of physical modifications (infrastructure costs) as it is to estimate the administrative costs. A company that looks to optimise their operations could consider the risk of accident that they face:

- Identification of the events;
- Consequence (impacts of each event); and
- Probability of the event occurring.

For each event they might assess relevant mitigation measures where each measure will reduce the consequence and/or the probability but will imply additional costs. There will be an optimum level of risk reduction based on the losses that the company will suffer if an accident will happen and the costs of reducing or eliminating the risk. The cost of an accident could comprise production losses, clean up costs, compensation costs in case of injuries etc. In most cases some prevention measures such as monitoring equipment, leakage detection etc will be profitable to invest in based on the direct financial cost-benefit assessment. Not directly financial elements such as safe working environment, reputation etc will provide further incentives to reduce risks. On top of this legislation on workers protection, etc might require additional measures to be taken. It is not possible to generalise about whether this will be sufficient to comply with requirements with respect to investment in physical measures stemming from the Seveso II Directive. In some cases it might be sufficient and the company will only face the administrative costs as the additional costs of compliance with the Directive. Even if physical measures are required, the costs of such measures will be very site specific.

#### Administrative costs

This section describes the total costs per establishment - a figure used to estimate the marginal costs of changes to scope. It also includes unit costs for certain requirements of the Directive, and these unit costs support the assessment of changes to these requirements. A unit cost is for example the cost of a safety report which upper tier establishments are required to prepare. If an amendment option would imply that lower tier establishments had to do the same this unit cost is applied to assess the marginal costs of such a possible change to the Directive.

Our assessment has identified the following studies that include relevant information and data regarding the cost of becoming and being a Seveso II establishment. Sources on cost information include:

- EU-VRi (2008) Study of the effectiveness of the Seveso II Directive, August 2008;
- UK (2005) Regulatory Impact Assessment (final) of Seveso II;
- Nutek (2006) Näringslivets administrativa kostnader på miljöområdet; and
- The estimates presented by FEA at the 4th TWG meeting;
- Administrative burden study<sup>4</sup>;
- Data from European Committee for Surface Treatment - Plating section (CETS) regarding costs for the plating industry and in particular data on SME issues; and
- Data from AISE (used mainly in relation to the sodium hypochlorite issue, see Section 4.5).

#### F-Seveso study

In particular, a new study from EU-VRi (2008) presents estimates of the costs to industry based on a survey. Estimates here suggest that costs for the safety report are 'less than 10 person months' for the major part of the respondents (62%). On average, the financial costs of the safety report ranges from EUR 20-50 k<sup>5</sup>. Implementation of the safety management systems are for the major part of respondents (75%) estimated to 'less than 10 person months', the same goes for the costs of emergency plans (81% of respondents). The major part of Competent Authorities (77%) did not have estimates on costs of administration. A general observation was that approximately half of the respondents have not estimated the costs of the Seveso II implementation.

The estimate of "less than 10 person months" is not very precise. Assuming that the other elements mentioned, the SMS and the IEP imply expenditure similar to the safety report, total costs would be about 60,000- 150,000 EUR. Though the costs of the SMS could be high, the IEP is less than the SR so this combined estimate of the total administrative costs is on the high side. As these are not annual costs, they should be annualised over at least 5 years. In doing so the annualised costs would be between 13,000 and 33,000 EUR per year. The average value would be a bit more than 20,000 EUR and would be for an upper tier establishment.

---

<sup>4</sup> FINAL REPORT (2009) Measurement data and analysis as specified in the specific contracts 5&6 on Modules 3&4 under the Framework Contract n° ENTR/06/61 Report on the Environment Priority Area, EU PROJECT ON BASELINE MEASUREMENT AND REDUCTION OF ADMINISTRATIVE COSTS.

<sup>5</sup> EU-VRi (2008) Study of the effectiveness of the SEVESO II Directive, August, pp.46-47

**UK COMAH IA** A study of the English COMAH estimate 'costs to business ...' of the existing Seveso II requirements at GBP 42,000 (excl. control costs (present value over appraisal period. An appraisal period of five years (after which the safety report must be renewed), makes yearly costs at GBP 11,070, which equals roughly EUR 13,179. These numbers are for the lower tier of the COMAH - upper tier estimates range at GBP 255-268,000. The average GBP 261 500 translated into Euro *per year* equals EUR 62,256.<sup>6</sup>

**Nutek study** A Nutek study (2006) estimates the total costs of implementing Seveso II in Sweden at SEK 2,203,440<sup>7</sup>. The report divides the costs on population and total hours. Although, the study does not reveal the number of establishments in Sweden, each cost of documentation demand can be divided by the population, and subsequently summarised on the different types of documentation. The calculation estimates cost per establishment ranging from SEK 13,350 to SEK 239,972, this equals EUR 1,298 - 23,328.

In sum, these three brief examples present an administrative compliance costs ranging from EUR 1,298 - 13,179 for the lower tier and EUR 23,328 - 62,256 for the upper tier per year.

**Cost data from aerosol industry** The FEA cost estimates are based on data from the survey conducted by Atkins on behalf of the FEA. The costs of an establishment (not manufacturing) included in the Seveso II are displayed in the following table.

*Table 2-4 Industry estimate of Seveso II costs in EUR (Estimates by FEA)*

	Lower tier	Upper tier
Duty holder initial costs	197,000	568,000
Competent authority costs (first five years)	10,000	61,000
Duty holder ongoing costs (first five years)	30,000	183,000
<i>Total costs</i>	<i>237,000</i>	<i>812,000</i>
<i>Total annual costs</i>	<i>50,000</i>	<i>180,000</i>

Source: Atkins 2009 on behalf of FEA

As the table displays, the costs of becoming a Seveso II establishment is EUR 227,000 including the initial costs and current expenses. In addition, the costs to the competent authority are EUR 10,000 over five years. For the upper tier establishments are about three times higher, at EUR 751,000 for the establishments (including ongoing costs for five years), and EUR 61,000 for the Competent Authority over five years.

<sup>6</sup> UK (2005) Regulatory Impact Assessment (final) of the 2003 amendments to the SEVESO Directive.

<sup>7</sup> Nutek (2006) Näringslivets administrativa kostnader på miljöområdet

The table indicates that administrative costs to the CA are about 4-8% of the industry costs. It is generally assumed that costs to the CA for inspection etc are 10% of the administrative costs to the industry.

#### Administrative burden study

In January 2007, the EC launched an Action Programme to reduce the administrative burdens in the EU with a focus on the administrative cost from EU legislation. The Programme has 13 priority areas of which one is the environment. Within environment the Seveso II is one of the Directives selected for particular attention.<sup>8</sup> The study has estimated that the Seveso II has a yearly administrative cost of EUR 52 million in total<sup>9</sup>.

The study has covered the following main activities:

- Written update of safety report (one every five years)
- Written update of internal emergency plan (updated every three years)
- Cooperation with inspectors (frequency not indicated)
- Notification of presence or changes in presence of dangerous substances (5-10% of establishments every year)

Based on estimates of the time spend for each activity, the hourly salary for the relevant staff, consultancy support, and the number of occurrences, the total costs for each activity have been estimated. Update of safety reports is most expensive at 19.7 million per year. The cost per establishment is therefore around 22,000 EUR. Updating of internal emergency plans is estimated to cost 13.9 million EUR. With the occurrence of once every three years, the cost per establishment is around 9,300 EUR. The estimated notification cost is around 8.1 million EUR and that is approximately 11,000 EUR per establishment.

Updating of safety reports and emergency plans are required by upper tier only while notification is for all Seveso establishments. Using these data to estimate the costs of the new establishment entering scope of Seveso II means that the costs for a lower tier establishment will be around 11,000 EUR while the costs for an upper tier will be around 42,000 EUR. Annualising these initial costs, the lower tier establishment will have annual costs of 2,200 EUR while the cost for upper tier establishments can be estimated to 10,400 EUR.

These costs are for update of plans etc and there less than what a company will face first time it become within the scope of the Seveso II Directive.

#### CETS - costs from the metal finishing industry

During the Commission's general stakeholder consultation on the Seveso II Directive review, the European Committee for Surface Treatment provided data

<sup>8</sup> [http://ec.europa.eu/enterprise/policies/better-regulation/administrative-burdens/action-programme/index\\_en.htm](http://ec.europa.eu/enterprise/policies/better-regulation/administrative-burdens/action-programme/index_en.htm)

<sup>9</sup> *Conclusions of a DG ENTR study* as part of the Commission's programme of reducing the administrative burdens of EU legislation (which included the Seveso II Directive) 2009

on costs and other information related to the industry's coverage by the Seveso II Directive.

Based on reporting from several Member States the CETS have collected data on costs of complying with the Seveso. Many of the companies within the industry are SMEs.

The collected cost data are summarised in the below table.

*Table 2-5 Cost data from CETS*

Country	Examples of costs for compliance with Seveso II in '000 EUR	Type of costs and/or comments
<b>Netherlands</b>		
	44	Annual costs from specific company (upper tier)
	49	Annual costs from specific company (upper tier)
	24	Annual costs from specific company (upper tier)
	21	Annual costs from specific company (upper tier)
	200-250	One-off entry costs – general estimate for upper tier
<b>Italy</b>		
	25	Annual costs from specific company
	157	One-off entry costs from specific company (upper tier)
	178	One-off entry costs from specific company (upper tier)
<b>France</b>		
	1 to 5 million	One-off entry costs for upper tier - no actual upper tier company currently
<b>Germany</b>		
	30	Annual - one company
<b>UK</b>		
	25	Lower tier one-off (general estimates from study on costs of COMAH (2003))
	180	Upper tier one-off (general as above)
<b>Denmark</b>		
	24 -50	One-off entry costs estimates from one company

Source: European Committee for Surface Treatment (CETS) in undated paper (costs are from 2008 or 2009)

It is indicated whether the data refers to upper or lower tier except that this information is not stated for some of the examples. It is here assumed that the costs refer to upper tier.

If one takes the average of the annual costs provided the result is a value of 32,000 EUR, while the simple average of the one-off costs is 163,000 EUR.<sup>10</sup>

From the reporting, it is not possible to identify exactly what is included in the stated costs. It seems that the main element is the administrative costs though in some examples also physical modifications are included. From one of the Member States that have reported data to the CETS survey there is an example of the composition of the one-off costs.

Type of expense	Budget range, euro	Budget estimate, euro
External consultants	10.000 – 20.000	20.000
Modification of buildings	0 – 50.000	25.000
Modification of production facilities	10.000 – 50.000	30.000
Lost production, one month	3.000 – 5.000	5.000
Capitalized time, in house hours	10.000 – 20.000	20.000
Unforeseen	20%:	20.000
<b>Total expenses euro</b>		<b>120.000</b>
<i>Administrative costs<sup>1</sup></i>	<i>25,000 - 50,000</i>	<i>48,000</i>
<i>Other compliance costs<sup>1</sup></i>	<i>16,000 -125,000</i>	<i>72,000</i>

Source: CETS paper

Note: 1) Consultants estimate

This example shows a larger variation in the other compliance costs and that they amount the same or up to twice the administrative costs.

In terms of the difference between the one-off entry costs and the annual costs it could be assumed that annual costs do not include any "depreciation" of the one-off entry costs. If the entry costs that are one-off are annualised over 5 years and 4%, the average annualised cost is about 37,000 EUR. Adding the two elements give a value of about 70,000 EUR as total annual costs for the first 5 years, after that the annual costs will be less - around 30,000 EUR.

The data from CETS includes also other relevant observations.

- They present an example of an SME investing 40,000 EUR in reducing the vats used in their manufacturing process in order to go below the Seveso

<sup>10</sup> This assumes that the 1-5 million costs for upper tier for France are excluded. The figure is significantly higher than any of the other data.

threshold. There is no information about possible loss of income caused by this behaviour but the investment cost suggests that it is cheaper to reduce the qualifying quantities of the chemicals used rather than complying with Seveso.

- The CETS paper compares the estimated Seveso costs with the typical turnover values for SME in metal finishing industry. The comparison indicates that with turnover values from less than one million EUR to about 10 million EUR the share of Seveso compliance costs range from 0.5 % to about 3%.

#### AISE

There are a few examples of costs reported by AISE<sup>11</sup>. The reported costs seem to include also investments in physical modifications and not all the administrative costs and they are therefore difficult to compare with data from the other sources. Costs for two companies in France are reported to exceed 12,000 EUR per year for a lower tier site, while figures of 25,000 and 100,000 are reported for upper tier sites. As examples of estimates including also investments they are in line with what is discussed below on both administrative and non-administrative costs.

#### Summary of costs

Table 2-6 below presents an overview of the cost data by source and the resulting costs used in this impact assessment. The best estimate is the average of the identified sources (except the high industry estimate); the low estimate is 50 per cent of the best estimate, while the high estimate is three times higher.

The cost estimates include only the administrative costs for industry. The extent to which companies will need to invest in protection measures and reorganising of storage facilities etc is not known. Therefore costs could be higher for new establishments entering the scope of the directive. In general, the costs of both safety plans and physical measures depend on whether safety management systems already exist due to other types of legislation for example protection of workers. However, the estimates presented here are the best available estimates of the Seveso costs.

---

<sup>11</sup> AISE 2010b, *Follow-up paper on sodium hypochlorite-containing mixtures: Impact and costs of the Seveso Directive on SMEs and retailers*, AISE July 2010

Table 2-6 Overview of cost estimates in '000 EUR - total annual administrative costs per establishment

Source	Lower tier	Upper tier
EU-VRI (2008)		<20
UK (2005)	13	62
Nutek (2006)	1.3	23
FEA (2009)	50	180
CETS (2008/2009)	-	≈70
Administrative Burden study (2009) <sup>1</sup>	2	10
Average used in IA	2-15	15-100
Low	2	15
Best	5	30
High	15	100

Note 1): This is for updates of reports and plans

#### Differences in cost estimates

The EU-VRI report observes that the majority of respondents recognise that Seveso II implementation differs greatly across borders, and even within a given country (EU-VRI, p. 9).

The EU-VRI (2008) and the Administrative Burden studies are based on surveys or assessments covering in principle several Member States and industries and they are therefore likely to be more representative.

The variations in costs can be caused by many factors:

- Differences in actual implementation where some Member States have more demanding requirements than others;
- Cost and price level differences; and
- Cost elements included - though the above data in principle cover the administrative costs there could be physical measures included.

#### Cost differences between MSs

There are some data on country-specific costs from the Administrative Burden study. They have based the cost estimation on data from six Member States (CZ, FR, IT, LV, SK and ES). The country specific data show that there are differences in the time estimate for the different requirements and the unit costs (salary level) vary across Member States. There is a factor of up to 10 in the unit costs while the time spends varies by a factor 2.

The majority of the costs of Seveso II compliance are man-hour costs. They will vary with the price level in each Member State. It means that the relative burden is likely to be of the same order of magnitude across MS measures as costs per GDP.

Cost assumption for specific requirements Based on the Administrative Burden study, where on time consumption and other cost elements have been compiled for key administrative requirements, the following cost assumption has been applied for the impact assessment.

Table 2-7 Unit cost assumptions for administrative requirements - EUR per event

	Low	Best	High
Notification		3,000	
Notification of change		2,500	
Safety report – new	20,000	35,000	50,000
Safety report – update	15,000	17,000	20,000
IEP- new	6,000	8,000	10,000
IEP – update	3,000	4,000	5,000

Source: Final Report on Modules 3&4 for Environment Priority Area July 2009 - part of an EU (DG ENT) project on baseline measurement and reduction of administrative costs (which included the Seveso II Directive).

Note that the costs in Table 2-6 are unit costs per event and therefore higher than the annual average unit costs displayed in Table 2-5.

Non-administrative compliance costs

The description has so far looked only at administrative costs. In case an establishment become a Seveso II site they might need to undertake investments in changes to their manufacturing process or to way they store chemical substances. As discussed earlier, such costs are difficult to estimate due the following factors:

- They are very site specific and they vary with an order of magnitude
- There is other legislation for example all regulation addressing worker protection, product/equipment safety, industrial emissions, etc that might lead an establishment to invest in the physical changes to reduce the risk of a major accident.
- The level of safety systems in each Member State

The kinds of modifications that a site might need to invest in could include:

- Equipment to monitor processes and storage facilities;
- Additional storage capacity; and
- Containment infrastructure to prevent liquids to leave the site.

Such investments could range from 10,000 EUR to several million EUR; see also the example from CETS with such other compliance costs in the range 16,000 to 125,000 EUR. From our own experience with analysing major accident scenarios and identifying measures to reduce the risk of the accidents, we have examples of investments for oil depot at around 1.5 million EUR and for

UK studies on control costs	<p>an ammonium tank at around 1 million for the maximum risk reduction measures.</p> <p>There are a few studies which have looked at the non-administrative costs under the heading of control costs have estimated how much has been spend at various changes. These studies cover the costs for UK industries of adapting to the Seveso requirements as they implemented in the UK's COMAH regulation.</p> <p>In the Regulatory Impact Assessment<sup>12</sup> - made when implementing the 2003 amendments to the Seveso Directive - it is argued that the status of these control costs are uncertain and they show cost results both with and without the control costs. The main argument was that some of these costs in reality would have been incurred due to other legislation.</p> <p>The control costs were assessed in two studies<sup>13</sup> - the later also providing a review of the data used in the first study. The combined results suggest that the costs for upper tier establishments are in the same order as the administrative costs. For lower tier establishments there is a large variation in the results of the two surveys and they could vary within a range of 5% of the administrative costs to be at the same order as the administrative costs.</p> <p>The above discussed control costs relates the UK industry adoption to the Seveso requirements around 10 years ago. If the level of health and safety management in the European industry has generally improved, the costs for a non-Seveso site to enter within scope of the Directive today might be less than it was 10 years ago.</p> <p>In addition to these factors making the data on physical compliance costs uncertain, there are also the potential financial benefits to consider. Savings from reductions in the frequency of minor incidents that typically lead to loss of production would be such a benefit. This element has not been considered in detail in the studies on the control costs.</p>
Conclusion the non-administrative costs	<p>The conclusion on the non-compliance costs is that it is not possible to provide a sufficiently solid estimate to be used in this analysis. However, a sensitivity scenario could be to apply the UK data as an upper limit estimate. They then suggest that the non-administrative costs would be at maximum the same as the administrative costs.</p>
Industry adaption to threshold	<p>It is sometimes reported that companies adjusts their stocks of substances to quantities below the relevant thresholds and thereby avoid coming within scope of the Seveso II Directive. Such behaviour implies costs but it is assumed that such downsizing only happens if the costs are less that the compliance costs of</p>

<sup>12</sup> UK (2005) *Regulatory Impact Assessment* (final) of the 2003 amendments to the SEVESO Directive

<sup>13</sup> HSE 2003 *Safety report regime - evaluating the impact on new entrants to COMAH*, study by Entec UK Ltd for HSE.

HSE 2006, "*Impact evaluation of the Control of Major Accident Hazards (COMAH) Regulations 1999*" by Risk Solutions for the Health and Safety Executive 2006

being within scope of the Directive. For options that could imply a change in scope no adjustment is made for this effect that could lead to less changes to the number of establishments within scope of the Directive. Therefore, by using the costs per establishments as presented above, the overall cost assessment will in principle overestimate the costs as some companies might find it cheaper to adjust stocks or production volumes.

The effect on the protection level of such behaviour is difficult to assess. If it leads to overall fewer sites which hold dangerous substance then it is positive otherwise it could lead to a decrease if sites are not taking the necessary measures to reduce the risk of major accidents. If such behaviour leads to more transport of substances, this is likely also to decrease the protection level though transport activity is also subject to specific legislation regarding transport of dangerous goods.

Adaption through supply chain management to the Seveso thresholds can have unwanted effects but it is difficult to avoid such behaviour as it is necessary to define thresholds.

## SMEs

In principle all the amendment issues that are considered in Chapter 3 to 5 could have an impact on SMEs. If an amendment option leads to increased costs to the industry, this could also have an effect on SMEs. Here, the general situation with regard to impacts of Seveso in SMEs is described.

There is no exact data on the share of SMEs out of the about 10,000 establishments currently covered by the Seveso II Directive. About half of the establishments are lower tier but there is no link so that lower tier typically is an SME.

An industry questionnaire as part of the F-Seveso study included respondents also from SMEs. Out of 102 respondents 16 were from SME<sup>14</sup>. As this was a web-survey it is not a very precise indicator for the share of SMEs.

The industry survey also covered the question about specific implementation issues for SMEs. The results suggested that guidance and other form of support to the implementation of the Directive is particularly important for SMEs. There were also references to cost burden being high for SMEs but there were no further data included in the study to assess or validate these statements.

The data from the metal finishing industry provides an example of SMEs being upper tier at least in some Member States. The industry association argues that the Seveso requirements comprise a significant burden on the industry. The quote numbers where the annual Seveso costs amounts up to several percentage of the annual turnover.

Using the unit administrative costs as presented above a rough assessment can be made. The estimated annual cost is the order of 5,000 EUR for lower tier and this would be equivalent to 0.5 % of total turnover for a company with a

---

<sup>14</sup> EU-VRi (2008) Study of the effectiveness of the SEVESO II Directive, August, pp.44-45

turnover of 1 million EUR. If the profit rate of such a company is assumed to be 10% of turnover, the administrative costs would be 5% of the profit. On its own, this not a high burden but combined with many other pieces of legislation it could be an issue for certain SMEs.

If the SME as in the case of the metal finishing industry in many cases are upper tier and using average value of 30,000 EUR, the share of Seveso costs in turnover is around 3% as quoted by the industry and using the assumption of profit of 10% of turnover, the costs for upper tier SME could be in the order of 30% of the company profit.

This discussion shows that if SMEs are upper tier establishments the cost burden could be significant and therefore any amendment option component that increases the costs for upper tier establishments could worsen the situation. It is not possible to quantify the specific impacts on SMEs more than the above general discussion, but the specific issue for SMEs should be kept in mind when deciding on individual amendment option component.

The overall assessment of the amendment option packages in Chapter 6 includes a discussion of whether the amendments would significantly change the administrative costs to SMEs.

#### **2.1.4 Total costs of the Seveso II Directive**

It is relevant to be able to compare the changes in costs that could result from the amendments being considered in this impact study to the total costs of the Directive.

The total costs have not been subject of any identified study. Various previous assessments have addressed certain aspects. The Administrative Burden study provides an estimate of the administrative costs to industry (operators). Compliance costs in physical modification are very difficult to assess as described above. The Admin Burden study estimates the total administrative costs of Seveso II to be in the order of 50 million EUR.

The costs to the CAs have not been directly assessed. The study on the effectiveness of implementation<sup>15</sup> includes replies from a number of respondents on the average man-years used for Seveso in the organisation they represent. In most Member States there are several organisations that have a formal role in the implementation of the Seveso II Directive. By assuming an average number of organisations with responsibilities in the implementation, it is possible to make a rough estimate of the total costs for CAs in Member States.

Based on ERM (2009) the average man-year per organisation can be estimated to roughly 5 and assuming that there are 3 organisations involved in each Member State the total number of man-years is about 400. Assuming an average day rate

---

<sup>15</sup> ERM (2009) Seveso II Directive - Study of the Effectiveness of the Requirements Imposed on Public Authorities

for experts of 500 EUR, the total annual costs would be the order of 40 to 50 million EUR.

The UK RIA made in relation to the 2003 amendment of the Seveso Directive includes also an assessment of the implication to the CA and to other authorities involved - for example the emergency services. Though the RIA is addressing specifically Seveso II, it includes some unit costs that can be used to indicate the possible costs of public authorities. The data indicate costs per establishment of in the order of 10k EUR per year and 40k EUR per year respectively for lower and upper tier establishments. This suggests total costs for CAs and other public authorities in the same order or even higher than the administrative costs for the operators. Applying these estimates to provide EU wide costs would most likely be an overestimation as the UK costs are higher than the EU average. It suggests though that the above estimate of 40-50 million EUR is at the lower end and that the costs to Member States CAs could be higher.

This leads to an overall estimate of the total administrative costs to both industry and CAs to be at least in order of 100 million EUR. Though it should be emphasised that this is only an order of magnitude estimate it provides nevertheless a basis for assessing the cost of the various amendments.

### 3 Assessment of amendment components - procedures for change of Annex I

This chapter reviews each of the amendment components under consideration regarding the way Annex I could be changed in the future based on the list of issues set out in Section 2 (See Table 2.1). The procedural issues include:

- Expand the scope of application of the derogation rule (EU-wide substance specific derogations from Annex I and/or national establishment-specific derogations at Member State level);
- Include safeguard clause (where Member States considers that a substance not covered by Annex I presents a major-accident hazard); Delegate to the Commission the power to adopt amendments to Annex I (Adoption of derogation criteria and amendments to Annex I via delegated acts).

For each procedural issue or component the analysis defines a set of alternative amendment options and estimates the impacts of each alternative option.

#### 3.1 Derogation rule

What is the issue?

Currently, the possibilities for derogation dispensation for specific substances are rather limited. The only possible exemption is a lowering of the safety report requirements when it can be shown that a substance does not have major-accident potential. In relation to the adaption of Annex I to CLP and in relation to the wider impact of the gradual phase-in of CLP and REACH, changes in substance or mixture classifications could bring into scope establishments with no major accident hazard potential. To allow for dispensations in such situations, the derogation rule would have to be broadened.

The derogation rule has a parallel provision in the safeguard clause, as a situation could arise where a substance of concern would no longer be classified so the relevant establishments would not be covered. There is also a link to the issue of allowing certain changes of the Annex I to be adopted by delegated acts. These aspects are addressed below in Sections 3.2 and 3.3

Criteria for dispensation

Currently, the harmonised criteria for granting the site specific derogation include:

- 1 *Physical form of substance*: Substances in solid form, such that, under both normal conditions and any abnormal conditions which can reasonably be foreseen, a release, of matter or of energy, which could create a major-accident hazard, is not possible.
- 2 *Containment and quantities*: Substances packaged or contained in such a fashion and in such quantities that the maximum release possible under any circumstances cannot create a major-accident hazard.
- 3 *Location and quantities*: Substances present in such quantities and at such distances from other dangerous substances (at the establishment or elsewhere) that they can neither create a major-accident hazard by themselves nor initiate a major accident involving other dangerous substances.
- 4 *Classification*: Substances which are defined as dangerous substances by virtue of their generic classification in Annex I, Part 2 to Directive 96/82/EC, but which cannot create a major-accident hazard, and for which therefore the generic classification is inappropriate for this purpose.

The specific options for this component have been developed by considering the following three dimensions:

- The situations where a derogation can be granted (and which of the above criteria would be relevant for the dispensation)
- The requirements that can be reduced through the derogation (whether it should be of the requirements under each tier only or outside the scope altogether)
- The degree of harmonisation in the process of granting the derogation.

Situations eligible for derogation

If the derogation rule should be a measure to deal with situations where the CLP alignment or re-classifications caused by REACH change the classification of particular substances, it should be on an EU wide basis.

The objective of expanding the derogation rule is to provide for more flexibility in the implementation of the Directive. This should, however, not be at the expense of too many requests for derogation. The balance with an extended derogation is also to avoid a situation where the implementation of the Directive becomes a case-by-case assessment where each establishment will argue for derogation.

Two main situations

The way to strike the balance would be to define two types of situations where the derogation can be granted:

- At EU level and for a given substance based on harmonised criteria 1 and 4 where the specific properties in relation to the major accident hazard potential deviate from the general classification; and

- AT Member State level and for specific establishments based on criteria 2 and 3.

These two situations will be different in terms of the requirements that can be disregarded and the process of deciding on the derogation.

#### EU wide substance derogation

Providing for derogation for a specific substance would be a new type of derogation compared to the existing provisions. The purpose of such derogation would be to provide a flexible mechanism to overcome problems caused by the CLP and REACH legislation where the standard classification is not appropriate in the Seveso context.

This type of derogation could provide for:

- Reduced requirements (such as the SR, IEP and EEP) or
- Exclusion from scope altogether.

If there is a basis for excluding a certain substance as a measure to mitigate the changes in scope that the difficulty of a one-to one alignment with the CLP legislation causes, a complete exclusion should be part of the derogation provisions.

The provision could be defined so that each derogation decision determines the extent of the exemptions. In principle, the exemptions could span from a few of the obligations all the way to a full exclusion from scope. As the purpose of this type of derogation for a given substance is to mitigate some the scope changes that are introduced by the CLP legislation, it would give most sense to see this type of derogation as a complete exemption from scope, including where appropriate by means such as increased thresholds.

Derogations that exclude a certain substance from the scope should be EU27 wide. Therefore, such derogations require a harmonised decision. It is almost a precondition for extending the derogation to allow for complete exclusion of certain substances that adoption of criteria for derogations and amendments to Annex I will in the form of delegated acts. For further analysis on this specific procedural matter, see Section 3.3 below.

#### Establishment specific derogations

The current derogation rule allows for derogations based on the above listed criteria. That provision should remain a measure for Member States to grant derogations when at either criteria 2 or 3 is fulfilled.

Today, the derogation procedure is initiated by a Member State with the obligation to inform the Commission about derogation decision.

An issue to be considered in relation to this type of derogation is whether the current provision to reduce only the requirements to the safety report should be extended.

The alternatives would be to increase the exemptions to include also:

- Safety reports
- Emergency plans (IEP and EEP)
- Information to the public.

It seems that if a basis has been established for reducing the requirements to the safety report, then other requirements could be reduced as well.

#### Alternative options

The alternative option components to consider would include:

- Leave derogation rule unchanged
- Increase only the extent of exemptions allowed under the current 9(6) provision to include more than safety report; or combine with:
- Introduce new harmonised exemptions for a particular substance where they can be completely exempt from scope of the Directive.

The next section addresses the impacts of each of the two derogation situations.

### 3.1.1 Impacts of option components on derogation provisions

The impacts of the alternative options for this component are assessed qualitatively by considering:

- The frequency of each of the two types of derogation amendments
- The costs of granting a derogation
- The cost savings for each derogation decision.

The specific assessments of the options are made for each of the two derogation situations separately.

#### Impacts of harmonised substance derogation

The impacts of introducing a derogation rule for specific substances is analyzed by considering the likely situation where a committee is formed to process the substances identified under the CLP alignment process as potential relevant for derogation. The number of relevant substances depends on the choice of CLP alignment option. The results of the work on defining the alignment options for adoption of Annex I to the new CLP categories indicate the relevant number of substances to consider for derogations could be significant.

The costs of making the derogation will for the period from adoption of the amended Directive and until it comes into force depend on the number, though not in a proportional way. If a committee is set up to assess the substances and recommend the derogations, it can deal with several substances with limited additional costs. The cost of each substance evaluation depends on how objectively the criteria for the derogations have been defined.

To illustrate the potential impacts of the derogation rule, the following example is analysed. It is based on expert estimates of the requirement and implications.

It is assumed that there are 20 substances, and their inclusion under the scope of Seveso will increase the number of both lower and upper tier establishments by 5%. This is about 250 lower and upper tier establishments and the assumption for the costs of the administrative requirements see Section 2.1.3. Applying a cost of 5,000 and 30,000 EUR per lower/upper tier establishment per year as average administrative costs, the total costs would be around 8 million EUR.

It is assumed that a CCA technical work group will comprise Member States and representatives from the Commission totalling about 30 people and that they will use 1 day for each substance then the total costs of such a committee can be estimated.

Furthermore, it is assumed that technical experts will provide input to the assessment of each substance. Assuming that 5 experts will use 10 days per substance to support the committee before it takes a decision means that in total 50 days per substance is used to produce all evidence that demonstrates that there is no major accident hazards for that substance. The expertise on substance could come from Member States or from stakeholders, mainly industry and it is assumed that 75% is spent by Member States and 25% by industry.

The additional administrative compliance costs for industry and CA in relation to the "do nothing" options are annual costs, while the costs in case of derogation process are one off costs. They have been annualised assuming the decision is valid for only five years.

The impacts on the protection level will be very limited as the condition for granting derogation is that the substance has no major accident hazard potential so therefore almost by definition no impacts should be expected on the protection level.

Table 3-1 Overview of impacts of derogation rule

Option	Change in no of establishments	Economic impacts in EUR				Protection level
		% change	Industry	CA	COM	
Do nothing	5%	8,000,000	800,000		8,800,000	Very limited increase/unchanged
Exemption for substances	0	40,000	220,000	30,000	290,000	Unchanged

The example illustrates that there could be potential significant cost savings from introducing the possibility for EU wide substance derogations that will exempt substances that do not have major accident hazard potential from scope of the Directive.

Impacts of amending the establishment specific derogation provision

The extension of the existing provision to grant derogations will create impacts depending on the frequency which with it will be applied. Up to now few exemptions have been granted. The costs of providing the necessary information to support the exemption case would entail similar costs as preparing the safety report and as the safety report is only requirement that is exempted, there is not much incentive to apply for derogation.

Derogations should be granted only when the one of two criteria on containment or location is fulfilled so that in the specific case there is no major accident hazard. However, in situation whether criteria are fulfilled there no need to limit the derogation to cover only the safety report. It therefore seem reasonable to extent the exemption provision to include in principle all requirements.

Having the possible to exempt a particular case is a flexibility to avoid unnecessary burdens for industry and competent authority. As this derogation will be applied only in cases where such a burden exists there is net benefit to society from having that flexibility.

However strict adherence to the criteria will be necessary in order to ensure that operators are treated equitably so that there is no risk of possible distortions to competition.

Table 3-2 Overview of impacts of options for specific derogation

Option component	Economic impacts	Protection level
Do nothing - no extension of derogation provision	No impact	No impact
Allow MS to grant derogations from some or all Seveso requirements based on harmonised criteria	Potential savings for industry and CAs	No impact (condition for derogation)

### 3.2 Include safeguard clause

What is the issue?

The amendment option of including a safeguard clause is a parallel to the derogation rule issue. If the scope for excluding certain substances or mixtures due to changes in classification is expanded, there should be a symmetric provision for bringing back substances that would fall out because of changed classification but where there is a major accident hazard potential.

It is also linked to the question of delegating to the Commission the power to adopt amendments to Annex I. The safeguard clause will work for specific substances that would be included in Annex I similar to other named substances.

Alternative options

The safeguard clause should allow specific substances to be included in Annex I. In the situation with the derogation rule two types were discussed: one for harmonised EU decisions and one for Member State decision. For the safeguard clause the situation is different. Here, there is no need for a more specific

Member State provision as it is already possible for Member States to include further activities in national major accident regulation

The relevant options to consider for this component is whether to have a safeguard clause whereby a substance that has a major accident potential but is not included based on the general classification can be brought under scope of the Directive at EU wide level.

The safeguard clause will work similar to including a named substance in Annex I Part 1 and as amendments to Annex I are foreseen to be adopted via delegated acts, a specific safeguard clause will not add anything to that provision.

#### Impacts

The impacts of such a safeguard clause depend on how often it is used. In any specific use of such a clause, the benefit will be an increased protection level for human health and the environment. The costs will be the compliance and administrative costs for industry and the competent authority.

It can be assumed that the clause will only be used when there is an important case, and in each case the costs and benefits of including an additional substance will be investigated.

The safeguard clause will add to the flexibility of the Directive. The added costs of this additional flexibility are only costs of the process of investigating each case. As this will be in the form of delegated acts, costs are described in the section on delegated acts, see next section.

### 3.3 Amendments to Annex I via delegated acts

#### What is the issue?

As described above, the new EU chemicals classification legislation, as set out in the CLP Regulation, is likely to require recurrent adaptations to Annex I of the Seveso II Directive beyond the foreseen alignment to the CLP Regulation (e.g. in the form of derogations from Annex I or through application of the safeguard clause to include a named substance in Annex I)..

Seveso II currently provides for adaptation of all Annexes of the Directive but Annex I through the Comitology procedure (the regulatory procedure with scrutiny as set out in Article 5a of Commission Decision 1999/468/EC). Against this background, the Commission considering to proposing that the power to supplement or amend Annex I of the Directive be delegated to the Commission in accordance with TFEU Article 290. Amendments to Annex I would thus be adopted by delegated acts.

#### - and the context...

The COWI impact assessment study into possible options for adapting Annex I of the Seveso II Directive into the GHS, found that the Seveso II Directive is potentially the piece of EU legislation which is most affected by the change in classification criteria introduced with the CLP Regulation of 16 December 2008 (1272/2008/EC). The scope of the Seveso II Directive is largely determined by the generic classification categories for substances and preparations

outlined in the Substance Directive (DSD) (67/548/EEC) and the Preparations Directive (DPD) (1999/45/EC). Whilst the classification systems in Seveso and CLP are similar and cover approximately the same hazards, the CLP introduces new hazard classes and categories. When translating Annex I of DSD into Annex VI table 3.1 in the CLP Regulation, applying the minimum classification, not all substances hazardous to health are categorised correctly according to their toxicological properties. As a result, some establishments, currently governed by Seveso II, may fall outside the scope of application of Seveso II. The study suggests that there is no simple one-to-one translation of the health hazards, in particular as regards the acute toxicity categories. Furthermore, whilst the foreseen alignment of Directive's requirements to that of the CLP Regulation would address most of such situations, the new classification criteria as contained in the CLP Regulation are likely to require recurrent adaptations to Annex I of the Seveso Directive beyond the foreseen alignment to the CLP Regulation - in particular with regard to preparation/mixtures.

The option component

The option component of allowing for amendments to Annex I of the Directive via delegated acts is largely a political issue. Against this it may be argued, as described above in Sections 3.2. and 3.3 that the new classification system under the CLP is likely to require more frequent adaptations to Annex I of the Seveso Directive to ensure that the scope of application of the Directive remains effectively the same as today. This is in particular to avoid that establishments currently governed by the Directive, due to reclassification of substances or mixtures under the CLP, would fall outside the scope of application of the Directive.

### 3.3.1 Impacts of option components concerning the procedure for amending Annex I

The principles options components are:

- No further EU action (amendment through co-decision procedure)
- Delegate to the Commission the power to adopt amendments to Annex I (Adoption of derogation criteria and specific amendments to Annex I via delegated acts) (other than the foreseen alignment to CLP).

No further EU actions

If adaptations to Annex I of the Seveso Directive would only be possible through the co-decision procedure, it is likely that some establishments currently governed by the Directive, due to reclassification of substances or mixtures under CLP, would fall outside the scope of application of the Directive. The protection level (environmental, health and social) would thus be reduced - until possible amendments to the Directive would enter into force. It should be noted that revision of Directives through the co-decision procedure is typically a two-year process.

The administrative costs at EU and national levels would not be insignificant given the relatively high number of meetings required for amending the Directive through co-decision procedure (for the Commission the secretariat function

and for the Member States participation in meetings and communication to national actors).

Adaptation of Annex I through delegated acts

Delegate to the Commission the power to adopt amendments to Annex I of the Directive in accordance with TFEU Article 290 would provide a flexible mechanism to ensure that the scope of application of the directive remains effectively the same as today. In particular to make sure that establishments currently governed by the Directive, due to reclassification of substances or mixtures under the CLP, do not fall outside the scope of application of the Directive. In this context it should be noted that amendments to Annexes I to VII of the CLP Regulation, including criteria for classification in hazard classes and in their differentiations and the provisions on how the criteria may be met would be adopted through Comitology procedure.

The environmental and social impacts

The protection level both in terms of environment and social would remain the same or slightly increase.

The administrative cost

The administrative cost at EU as well as national levels would be limited since the task would be taken up by the Committee of Competent Authorities for implementation of the Seveso II Directive (CCA).

The table below provides an overview of the impacts of the option component - on the procedure for amending Annex I of the Directive.

*Table 3-3 Overview of impacts of amendments via delegated acts procedure for Annex I*

Option component	Economic impacts	Protection level
No further EU action (amendments through co-decision procedure)	Some impacts	Reduced scope of application leading to decreased protection level
Amendments of Annex I via delegated acts	Limited impacts	Maintain or increase protection level

## 4 Assessment of amendment components - technical motivated changes to Annex I

This chapter reviews each of the amendment components under consideration that regard specific substances and other changes to Annex I based on the list of issues set out in Section 2 (See Table 2-2). The list includes:

- Carbon dioxide
- Heavy fuel
- Hydrogen
- Aerosols
- Sodium hypochlorite

### 4.1 Carbon dioxide

What is the issue?

Carbon dioxide is an odourless and colourless gas. When refrigerated it has a solid state and a liquid state, the solid state is known as "dry-ice". In industrial and technical applications it is often kept at high pressures in its liquid or in its so-called super-critical state, a state where the liquid and gaseous phases become indistinguishable. At large scale storage at industrial sites CO<sub>2</sub> is stored in its liquid state in refrigerated, insulated and pressurized tanks – typically at 30 °C, at which the gas has a vapour pressure of about 1.5 MPa (15 barg). At those conditions the density of the liquid carbon dioxide is roughly similar to that of water.

As a result of global climate concerns, carbon dioxide capture and sequestration (CCS) schemes into deep geological formations are being considered as an option for reducing greenhouse gas emissions to the atmosphere. Even for relatively minor subsurface injection and sequestration schemes this would involve very large amounts of carbon dioxide that in scale and magnitude will dwarf existing CO<sub>2</sub> storage facilities. This constitutes an emerging risk which therefore is considered as part of this revision of the Seveso II Directive.

Carbon dioxide is currently outside the scope of the Seveso directive. It is not classified as a dangerous substance under EC legislation and therefore not covered by the categories of dangerous substances listed in Part 2 of the Seveso

directive. It is not a named dangerous substance in Part 1 of Annex I of the directive either. Although the gas is not classified as a dangerous substance, it is certainly capable of doing harm and it has for many years been recognized as a significant workplace hazard. (Benson et al., 2002; Harper, undated)

The main concerns are oxygen displacement hazards (asphyxiation), compressed gas hazards, and low temperature concerns such as cryogenic burns. They are discussed in turn below.

**The asphyxiation hazard:** Carbon dioxide gas is about 50 percent heavier than regular air. Releases of heavy gasses lead to ground-hugging clouds for which atmospheric dispersion and dilution effects are impeded and lead to larger travel distances compared to gasses that are buoyant or of neutral density. Due to its larger density, releases of carbon dioxide gas may accumulate in low-lying areas such as basements and natural depressions in the terrain and displace regular air. The displacement of regular air can lower the concentration of oxygen to a level that is immediately dangerous for human health. The asphyxiation risk is a well-known occupational hazard in situations where carbon dioxide may be released in a confined or unventilated area. The asphyxiation effect is intentionally used for “humane slaughtering” in some abattoirs where the animals are guided down into pits where odourless and colourless carbon dioxide is present in high concentrations - the animals quickly pass out due to oxygen deficiency after which they are slaughtered.

**Compressed gas hazards:** As with any other type of pressurized storage, the pressure vessel may fail catastrophically producing a blast wave and generating high-velocity vessel fragments that may travel considerable distances. Either effect may cause serious harm to its surroundings. These effects are classified as physical hazards and outside the scope of the Seveso directive’s definition of a dangerous substance. Gasses under pressure are not covered by the hazard categories in the current directive.

**Low temperature hazards:** Sudden depressurization of liquid or supercritical carbon dioxide produces a significant cooling effect and part of the carbon dioxide may change into its solid state and form dry ice. Uncontrolled releases may lead to cryogenic burns and a number of derived low-temperature hazards such as thermal shock and low temperature embrittlement of certain grades of steel which commonly lead to cracks and sudden catastrophic failure. This is also classified as a physical hazard and outside the scope of the Seveso directive.

#### **4.1.1 Carbon dioxide consumers**

The food industry is a major consumer of carbon dioxide. Available statistics for USA indicate that the food industry accounts for about half the total consumption. Major applications are for refrigeration purposes and for food storage and packaging. Many foods achieve improved shelf life when stored in an atmosphere with an elevated carbon dioxide concentration. Carbon dioxide is

also used extensively in the soft drink industry and 18 to 20 percent of the total output is used for carbonation (DNV 2008).

Carbon dioxide is the most commonly used “inert” gas agent in fire suppression and extinguishment systems. Carbon dioxide systems have replaced a number of older halon-based systems that were phased out due to environmental concerns over the ozone depletion potential of CFCs.

Carbon dioxide is also used in greenhouse gardening. Plant growth rates can be boosted with up to 30 percent if grown in a carbon dioxide enriched atmosphere.

#### 4.1.2 Accidents

Pressurized liquid carbon dioxide storage tanks have been a source of several major accidents. In a not entirely recent publication (LPB 1995a) a list of recorded accidents was available.

*Table 4-1 Examples of industrial accidents*

Location/equipment	Year	Size	Fatalities
Sweden/tank	1960	25 tonnes	unknown
Hungary/tank (purification plant)	1969	24 tons	9
Italy/tank	Unknown	50 tonnes	3
Germany/rail car	1976	23 tonnes	1
Spain/road tanker traffic accident	Unknown	Unknown	Unknown
Ireland/tank (brewery)	1986	15 tonnes	0
Germany / tank( foods/drinks)	1988	30 tonnes	3
Mönchengladbach (Germany).	2008	50 tonnes	0 fatalities (107 injured)

For the 1988 accident in Germany a more detailed description was found in (LPB 1995). Due to a process deviation the 30 tonnes tank experienced a low-temperature deviation, in which the temperature temporarily dropped to -60 °C. This was 10 °C below the minimum safe temperature limit, expressed as the lower design temperature. The temperature excursion introduced a defect in the steel of construction and five weeks later the tank failed catastrophically from a sudden brittle fracture mechanism. Three employees were killed, eight other were hospitalized, the property damage was in excess of USD 20 million and three months of production were lost. About 80 percent of the tank travelled in

excess of 300 m and landed in a nearby river. While there is no specific information on the type of injuries sustained, pictures and other circumstantial evidence make it highly plausible that the harmful effect was the blast wave, not asphyxiation.

A liquid CO<sub>2</sub> storage vessel in Hungary in 1969 is believed to have failed in a similar way (DNV 2009:61).

From 1975 to 2000, 51 carbon dioxide incidents were reported that involved the discharge of carbon dioxide from fire extinguishing systems. The number of casualties from these accidents amounted to 72 deaths and 145 injuries (DNV 2008). The majority of reported incidents occurred during maintenance on or around the carbon dioxide fire protection system. The most plausible interpretation is that the harmful effect was from asphyxiation.

There has been particular interest in a 2008 incident involving the malfunction of an industrial fire suppression system in a large warehouse located in a mixed industrial/residential area in Mönchengladbach (Germany). The fire suppression system released about 50 tonnes of carbon dioxide inside the warehouse that stored paints and flammable solvents. The release took place Saturday in the early morning hours, under a meteorological inversion condition, which produced unfavourable atmospheric dispersion. There were no employees present at the premises and fire fighters who entered the building did so with self-contained breathing apparatus due to the asphyxiation risk. Outside the warehouse however, several fire fighters collapsed due to oxygen deficiency and 14 citizens collapsed on the nearby public road, including one motorcyclist who collapsed while riding and fell off the bike. The large number of casualties triggered the disaster response plan. Emergency response measures included a 200 m evacuation zone, low-flying helicopters to create turbulence and dilute pockets of carbon dioxide in depressions in the terrain. Residents were only allowed to return to their houses after their basements had been tested for elevated levels of carbon dioxide. A total of 107 persons were affected, 19 were taken to hospitals and 10 were hospitalized (Lampe and Schattka, undated).

Natural disasters involving large releases of carbon dioxide are rare. A relatively recent well-documented disaster took place in Lake Nyos, Cameroon, in 1986. Due to an unusual combination of factors it is possible for carbon dioxide of volcanic origins slowly to accumulate as a dissolved gas in the dense saline lower strata of the lake, eventually leading to a highly unstable situation. In 1986 a sudden violent eruption of carbon dioxide from the lower strata took place, possibly triggered by a landslide. It is estimated that the amount of carbon dioxide suddenly released may have been up to 1.5 million tonnes. The denser than air plume of carbon dioxide followed the natural topographic depressions of the land. It then travelled up to 25 km and killed an estimated 1,700 people and a large amount of livestock due to asphyxiation.

Other less extreme natural releases of carbon dioxide are known. In 1990, carbon dioxide began leaking upwards along faults from a natural subterranean reservoir of CO<sub>2</sub> near Mammoth Mountain, California, following a series of small earthquakes. It was estimated that about 300 tonnes of carbon dioxide

were released per day over an area of several square miles. Three ski patrol members were killed in 2006 when they fell into a depression in the snow that contained a very high concentration of carbon dioxide (Price et al. 2007).

Catastrophic releases of the Lake Nyos type have only occurred in volcanic, hydrothermal and metamorphic (VHM) settings. No eruptive events have ever been recorded in sedimentary basins<sup>16</sup> nor have any been recorded for underground natural gas sites<sup>17</sup>. The Environmental Impact Assessment carried out for the US Futuregen project concluded that it was highly improbable that an eruptive release could occur in a stable sedimentary basin of the kind that would be considered for CO<sub>2</sub> storage. The frequency ascribed to it would be vanishingly low (e.g., probability of less than 10<sup>-6</sup> per 5,000 years).

Table 4-2 Examples of natural accidents

Location	Year	Event	Consequences
Mammoth Mtn, CA, USA,	1989+	Diffuse CO <sub>2</sub> emissions	1 person, 100 to 170+ acres of tree-kill area
Tavurvur, Rabaul, Papua New Guinea	1990	CO <sub>2</sub> release from volcanic vent	6 people killed
Vulcano Island, Italy	1980-1990	Accumulation of diffuse CO <sub>2</sub> emissions	2 children and many animals including rabbits and goats killed
Dieng, Java, Indonesia	1988	Pulse of CO <sub>2</sub> from geothermal well	4 workers died
Lake Nyos, Cameroon	1986	Limnic eruption of CO <sub>2</sub>	1746 people, 3000+ cattle, and many other animals
Lake Monoun, Cameroon	1984	Limnic eruption of CO <sub>2</sub>	37 people killed
Dieng, Java, Indonesia	1979	CO <sub>2</sub> released from vent during phreatic/pneumatic eruption	149 people, some livestock, and many fish

Source: Benson et al. (2002:53)

<sup>16</sup> IEA Greenhouse Gas R&D Program, 'Natural releases of CO<sub>2</sub>'

<sup>17</sup> IEA Greenhouse Gas R&D Program, 'Safe Storage of CO<sub>2</sub>: experience from natural gas storage industry'

### 4.1.3 Estimation of maximum CO<sub>2</sub> inventories

Most commercial carbon dioxide is produced as a by-product from ammonia production. After separation and purification processes, it is stored in its liquid state in refrigerated and pressurized tanks, typically at -30 °C and 15 barg.

Retailers of commercial carbon dioxide have reported that it is not economically attractive to construct pressure vessels with a capacity exceeding about 330 m<sup>3</sup> at those storage conditions. For practical purposes, this can be taken as the maximum tank size. Larger capacity is obtained by installing additional tanks. The typical storage capacities at production sites have not been studied in detail as the sites are covered by Seveso legislation already for their inventories of ammonia.

Commercial bulk carbon dioxide is transported to distribution centres in relatively small ships with a typical capacity about 1,000 tonnes. For distribution centres in the EU, it is estimated that sites typically have three to five, maximum 10, tanks, corresponding to a storage capacity of about 1,700 - 3,300 tonnes.

From the distribution centre to the final consumer, most carbon dioxide is transported by road tanker. Retailers of commercial carbon dioxide have reported that the maximum storage capacity at most consumer sites is about 50 tonnes, often significantly less.

Besides the amount kept on premises in bulk storage tanks, breweries may have significant amounts of carbon dioxide dissolved in carbonated drinks at their premises. While this carbon dioxide is unable to constitute a major hazard in the normal understanding of this term, it is relevant to quantify the amount as the Seveso Directive concerns the total amount present at the entire facility. A brewer has informed that one bottle (33 cl) contains about two grams of carbon dioxide. Large breweries may have around 50-100 million bottles of beer (about 100-200 tonnes of dissolved carbon dioxide). The very largest of breweries may have about five to ten times that amount; i.e. about 1,000 tonnes carbon dioxide. This is an upper limit, and no breweries within the European Union are expected to have this kind of storage capacity.

### 4.1.4 Sequestration hazards

Carbon dioxide capture and sequestration schemes do have obvious potential for causing harm due to the sheer size of the carbon dioxide tonnage/amounts. A single 1000 MW coal-fired power plant emits about 30,000 tonnes of carbon dioxide *per day* (Price et al. 2007). For comparison, we estimate that there may be a maximum of 10 storage installations in the EU with an average capacity of 1,700 tonnes, the largest of such installations may have a storage capacity of about 3,300 tonnes. The daily production from a single coal-fired unit thus exceeds the total storage capacity of the largest existing storage and distribution facility by an order of magnitude.

Carbon dioxide capture and sequestration schemes presently considered for power plants involve either pre-combustion or post-combustion capture technology. Pre-combustion capture involves reacting coal with water vapour in an advanced gasifier to produce a hydrogen-rich synthesis gas from which carbon dioxide is removed before combustion. In post-combustion capture, the carbon dioxide is removed from the combustion gases. When captured, the carbon dioxide is concentrated, liquefied, compressed and sent by pipeline to injection well(s). The separated carbon dioxide may contain impurities of other hazardous compounds, in particular highly toxic hydrogen sulphide. Projects presently considered involve sequestration of 1-3 million tonnes per year of carbon dioxide for a facility with a nominal capacity of 275 MW (DOE 2007).

Accidental releases of carbon dioxide (and associated impurities) from such facilities are a potential concern, notably releases from the power plant, from the pipeline and from the injection wells, in particular an uncontrolled blow-out from the well. Benson et al. (2002) conclude: *“models for successful underground CO<sub>2</sub> storage exist but so do potential risks. To be deemed acceptably safe by the public, our understanding of containment must improve.”*

The scale and magnitude of the hazards are presently not fully understood. A recent study (Aines 2009) estimated that the blow-out rate from a super-critical carbon dioxide reservoir at a depth of 1.5 km deep through a 7-inch borehole would be around 20,000 tonnes per day. This is a high-energetic release for which jet momentum will cause considerable entrainment of air and initial dilution. For this scenario it is estimated that potentially harmful carbon dioxide concentrations may only occur only within the first few hundreds of meters from the well, even under unfavourable weather conditions. Another study estimates that an accidental leak from a completely severed pipeline would amount to a release of 550- 1,300 tonnes of carbon dioxide (depending on various pipeline characteristics) over a period of just about three minutes (DoE 2007:4-12). For this scenario it is estimated that potentially harmful carbon dioxide concentrations may be present within the first two hundred meters from pipeline (DoE 2007:4-20)<sup>18</sup>. The study does not consider so-called impinged releases, in which part of the jet momentum is lost without the entrainment of air, for instance if the jet is directed towards buildings or process equipment. Impinged releases will result in longer dispersion distances.

It is unclear whether there would be a possible major inventory of carbon dioxide at the power plant itself. The issue is particularly relevant for member states with extensive district heating systems, in which power plants are located in relative proximity to major population centres.

The first distinction is whether intermediate storage is necessary before the carbon dioxide is transported to the injection well. For very large producers the economically optimal solution is transport by pipeline. For other producers,

---

<sup>18</sup> Note that consequence distances are not directly comparable between storage sites, which store carbon dioxide in its liquid state, and pipelines for which it is assumed that carbon dioxide will be in its supercritical state.

project economics might require that the carbon dioxide is moved by ship and for such sites intermediate storage capacity would be needed.

For some underground oil reservoir types, the injection of carbon dioxide can increase the potential amount of oil that can be won from the reservoir. The technology is known as enhanced oil recovery (EOR) and is interesting because the injection of carbon dioxide is not merely a cost but has economic value. An EOR study on the injection of carbon dioxide into the Gullfaks oil field in the North Sea (Berger et al. 2004) considers both pipeline and ship transport options. The study considers pipeline transport from a power plant source in Denmark; compression to 230-280 bars is required for the gas to arrive at the platform at 100 bars after a journey of 680 km. If carbon dioxide is moved by ship, intermediate storage facilities are foreseen; for ship sizes corresponding to a carbon dioxide cargo of 20,000 tonnes the intermediate storage capacity would have to be 30,000 tonnes. These capacities represent a scale-up factor of 20-30 times compared to existing infrastructure.

Even if carbon dioxide is moved by pipeline, some intermediate storage capacity could be required to ensure continuous pipeline operations without abrupt changes in flow and pressure, which may cause operational difficulties and safety concerns, in particular for long pipelines. No studies have been identified which consider the need for such intermediate buffer storage. The relatively detailed risk assessments for a planned project at the conceptual stage (DOE 2007) considers accidental releases from the process equipment at the power plant only. The carbon dioxide is routed to the pipeline immediately after being separated and readied for transport, there is no mention of intermediate storage capacity storage at the power plant. If it is assumed that a suitable buffer capacity would equal a retention time of 30 minutes, a 1000 MW coal-fired power plant producing about 30,000 tonnes of carbon dioxide per day would require buffer storage of 625 tonnes. The total inventory, including purification, liquefaction and compression steps would thus be less than 1,000 tonnes.

*Table 4-3 Overview of carbon dioxide inventories*

Site	Inventory of CO <sub>2</sub>
End-user, foods sector	5-20 tonnes, maximum 50 tonnes
End-user, fire suppression systems	25-100 tonnes (?)
Brewery (dissolved in beverages)	< 500 tonnes
Largest single storage tank	330 tonnes
Storage terminal	1,000-1,500 tonnes, maximum 3,000 tonnes
Ship cargo size	1,000 tonnes
Future CCS, 1000 MW power plant	< 1,000 tonnes

Site	Inventory of CO <sub>2</sub>
Future CCS, ship cargo size	20,000 tonnes
Future CCS, intermediate storage site	30,000 tonnes
Future CCS, storage site (underground reservoir)	Millions of tonnes

#### 4.1.5 Impacts of alternative option components on carbon dioxide

##### Options

The alternative options for this component include:

- Do nothing;
- Include CO<sub>2</sub> as named substances with 5000/10000 tonnes as lower/upper tier thresholds;
- Include CO<sub>2</sub> as named substances with 500/1000 tonnes lower/upper tier thresholds.

##### "Do nothing option"

Key arguments in favour of "do nothing" and against this option revolve around three main themes:

- CO<sub>2</sub> being a toxic gas or not
  - The energy industry argues that CO<sub>2</sub> is not a toxic gas according the CLP classifications and therefore it should not be part of the Seveso II Directive as it is concerned with dangerous substances;
  - Some Member States authorities argue that should be considered as dangerous substance as it has a major accident hazard potential (see e.g. Harper, undated);
- The extent to which existing legislation already cover the safety aspects of large scale CO<sub>2</sub> storage:
  - The new emerging risk from CCS, which is the main reason for considering including CO<sub>2</sub> is already addressed in the other legislation notable the CCS directive itself (2009/31/EC including the relevant implementation rules in different Commission Decisions);
  - There is need to cover potential releases of large amounts of CO<sub>2</sub> specifically under Seveso as the major accident hazard potential is not addressed properly in other legislation.

- Public perception and if impact on the feasibility of CCS schemes.
  - Including CO<sub>2</sub> could lead to public resistance against CCS projects and ultimately prevent this technology considered important the mitigation of climate change.

These arguments are reviewed and subsequently the more specific impacts of alternative thresholds are discussed.

It is not within the scope of the impact assessment to resolve the issue of whether CO<sub>2</sub> should be considered as a dangerous substance or not. As previously discussed some member states argue that the asphyxiation hazard can create impacts similar to toxic gasses.

In relation to the question of whether CCS schemes will be covered by other legislation or legislative action, the main provision of other legislation that should be considered include the following:

- Provision for emergency plans; and
- Provisions for land use planning measures, and
- Community right-to-know issues.

For the three main components of CCS, the legal framework is as follows.

CO<sub>2</sub> capture at the power plant is partly covered by the inclusion of capture facilities under the IPPC Directive. This entails that the requirements on accident prevention in Article 3.1(e) of that Directive and elsewhere must be implemented for CO<sub>2</sub> capture. Land use planning and public information are to some extent covered by the inclusion of all IPPC facilities in the EIA Directive. The provision in the IPPC and the EIA Directives does not include requirements on emergency plans and the provisions on land use planning and information to the public are not as specific on accident prevention/response issues as those of the Seveso II Directive.

Transport of CO<sub>2</sub> is regulated as for transport of natural gas. That is, risks during transportation, including related facilities for intermediate storage, are to be dealt with at Member State level, with the exception of pipeline transport which is subject to Environmental Impact Assessment for pipelines with a diameter of more than 800mm and a length of more than 40km. There are no provisions for emergency plans; land use planning and public information are to some extent covered for pipeline transport by the requirement for EIA.

Storage of CO<sub>2</sub> is regulated under the CCS Directive 2009/31/EC. With regard to how the risk assessment and safety aspects of the CCS should be dealt with, Article 4(4) of the CCS Directive is a key article in this respect as it states "*A geological formation shall only be selected as a storage site, if under the proposed conditions of use there is no significant risk of leakage, and if no signifi-*

*cant environmental or health risks exist.*"<sup>19</sup> The Commission is currently consulting on guidance on the implementation of the Directive and Member States are in the process of transposing the Directive in to national legislation. The guidance in particular Guidance Document 2 on the characterisation and selection of geological storage sites, provides a clear indication of the steps to be taken to address risks to the environment and human health posed by the site.

The CCS Directive does not mention formal requirements for emergency planning. Land use planning requirements are covered to the extent that there are risk analysis requirements before approving a site as suitable for CO<sub>2</sub> storage. The CCS Directive provides in its Article 26 that Member States shall make available to the public environmental information relating to the geological storage of CO<sub>2</sub> in accordance with applicable Community legislation.

Options to include CO<sub>2</sub>

The type of protection to the general public that the Seveso directive would provide for carbon dioxide risks would be related to risk-based land-use planning procedures, emergency planning and community right-to-know requirements.

The analysis has so far shown that an upper-tier threshold limit of 1,000 tonnes would include only the largest carbon dioxide storage installations (note that these are not geological storage sites but installations for the storage of CO<sub>2</sub> for other industrial purposes) of which there may be five to ten in the EU. Assuming a scenario where carbon sequestration projects are implemented for coal-fired power plants and assuming that carbon dioxide is moved by pipeline to the injection site, power plants are unlikely to be included as they probably will be able to manage their inventories to stay below the threshold amount. All power plants with intermediate storage will be included and all land-based injection sites will be included.

A threshold limit of 10,000 tonnes of carbon dioxide would exclude all present installation in the EU. In the carbon sequestration scenario all land-based injection sites will be included and potentially some intermediate storages.

Note that for CCS the added value of inclusion of CO<sub>2</sub> in Seveso would be as follows:

- Capture: the additional protection afforded by the requirement for emergency planning in Seveso, as compared with the accident prevention requirements of the IPPC Directive. Also the land use planning and information to the public requirements are more specific in the Seveso II Directive. It should be noted that with the expected quantities of CO<sub>2</sub> at the capture sites, they are unlikely to be covered;
- Transport: no added value since transport is not included in Seveso;

---

<sup>19</sup> Directive (2009/31/EC).

- Storage: the added value of the emergency planning in Seveso, as compared with the site selection and risk management requirements of the Geological Storage Directive 2009/31/EC.

Table 4-4 Overview of impacts of including CO<sub>2</sub>

Option component	Economic impacts	Protection level	Other impacts
CO <sub>2</sub> not included	No impacts	The effect depends on how accident hazards from CCS are covered by other legislation. Capture might be covered by IPPC Directive. For storage, the CCS Directive's Annex I requirements on risk analysis including exposure scenarios would likely comprise much of the safety report. Aspects of pipeline transport are covered by EIA.	
Include with 10,000 tonnes upper-tier thresholds	No impact on present installations. Limited additional costs to future CCS projects (at intermediate storage sites and injection sites)	For capture: inventories of CO <sub>2</sub> at power plants unlikely to be included. Transport would not be included. Geological storage sites would be included. Thus the added protection would depend on the additional protection provided by Seveso over an above the requirements of the CCS Directive.	Public perception could constrain development of CCS
Include with 1,000 tonnes upper-tier thresholds	Five to ten existing storage sites will be included leading to additional costs.  Limited additional costs to future CCS projects (at intermediate storage sites and injection sites)	Possible increase of protection level as existing non-Seveso sites are being included.  Regarding CCS: The situation is that even at this threshold capture sites are unlikely to be covered; hence the impacts regarding all stages of CCS are the same as for the previous option..	Public perception could constrain development of CCS

The financial costs of complying with the administrative requirements under Seveso II are unlikely to play a major role as the total investment costs of the CCS are very high. Specific modifications of the facilities will be included in the design and whether that will increase the costs compared to the requirements included in the CCS legislation can not be determined at this stage.

In case of the 1,000 tonnes upper tier threshold where 10 existing sites will come under scope, that could lead to administrative costs in order of EUR 0.5 million annually.

The potential number of CO<sub>2</sub> CCS storage sites is not known; it could be more than 100 and also if individual power stations will come within scope the number would be much higher. However, given the overall costs of CCS schemes these additional administrative costs would not be prohibitive. The CCS Directive's Annex I requirements on risk analysis including exposure scenarios would likely comprise much of the safety report. If the safety report accounts for one third of the administrative costs and that cost would be incurred in any case, 100 sites would lead to additional administrative costs of EU 2 million per year.

#### Overall assessment

As CCS schemes are only at a very preliminary research and pilot stage; it is difficult to predict the type of major accident hazard that would emerge if the technology would be widely used in the future.

The review of the available data suggests that there may be a major accident hazard potential but other legislation might deal with the hazard and it is not at present clear what added value inclusion in the Seveso framework would provide. It could be decided to postpone the inclusion of CO<sub>2</sub> until the technology is further developed and the risks better understood.

## 4.2 Fuel oil

### 4.2.1 Background

Crude oil is a complex mixture of compounds, which is separated and further processed into a range of petroleum products that are classified primarily according to their boiling point. A simplified list of the most common petroleum fractions in order of increasing boiling point (and decreasing volatility) is presented below including the terminology commonly used within this field

- Petroleum gases, usually compressed and sold liquefied as LPG (liquefied petroleum gases)
- Naphtha which after additional processing is converted into gasoline (in the UK: petrol), this petroleum fraction has a significant content of volatile components
- Kerosene, which is mainly converted into jet fuel

- Light gas oil, which is converted into diesel fuel
- Heavy gas oil, which may be converted into home heating oils
- Residuum, which is further converted into **fuel oil** and sometimes asphalt.

Gasoline, diesel and home heating oils (derived from gas oil) are distillate fractions, meaning that they at some stage in the refining process have been boiled off and then condensed. Hence, the term "gas oil" refers to the fact that the oil at some point in the refining process has been in its gas phase. Such distillate products are generally referred to as "white products" as they are more or less colourless. In contrast, residuum is a "black product" similar to pitch, and so is the fuel oil produced from residuum. All the petroleum products come in a great number of qualities and grades, manufactured to special purpose specifications, but the above list suffices to highlight industry parlance and the main distinction between gasoline, diesel, gas oil, home heating oils (derived from gas oil) and fuel oil (derived from residuum).

Petroleum fuels are refined, classified and marketed according to their combustibility characteristics and physical properties such as density and volatility profile. As mixtures, they do not have well-defined boiling points; instead they have boiling point ranges and distillation profiles that are measured according to standardized analysis protocols. Product specifications often change with season and climate; winter-time gasoline for instance has a higher content of volatiles than summer-time gasoline, in order to ensure cold-starts of engines.

For fire protection purposes, an arbitrary division of liquids that will burn has been based on the so-called flash point. Strictly speaking, it is not the liquid that burns, it is the gas liberated by the liquid that can mix with oxygen and undergo combustion. The flash point quantifies this important quality of the liquid, and it is defined as the minimum temperature at which the liquid has a vapour pressure sufficient to liberate enough vapour to form an ignitable atmosphere above the liquid. At temperatures below the flash point, there are no ignitable fumes above the liquid, which greatly reduces the fire risk. The flash point is determined experimentally in a standardized apparatus according to protocol.

The Seveso Directive's definition of a dangerous substance comprises a generic category relevant for liquids that can burn. The category is based on the flash point and other parameters, primarily the boiling point. A simplified account of the categories and the flammability designation is provided in Table 3-3.

Table 4-5 The Seveso Directive's generic category relevant for liquids that can burn

Flash point	Designation	Seveso threshold amounts (tonnes) lower-upper tier limits
below 0 °C and boiling point <= 35 °C	" <i>extremely flammable</i> " gasses and liquids	Not relevant for this discussion
below 0 °C and boiling point above 35 °C	" <i>extremely flammable</i> " liquid	10-50
below 21 °C	" <i>highly flammable</i> " liquid	5,000 - 50,000
Between 21 and 55 °C	" <i>flammable</i> " liquid	5,000 - 50,000
above 55 °C	Outside the scope of Seveso and hence no designation given. However, in other classification schemes the designation is " <i>combustible</i> " liquid	Not a dangerous substance, no thresholds

Source: Seveso directive 1996L0082, Annex I, part 1, note 3

In a global perspective, it has been difficult to define a common methodology for classification of liquids (and gases) that can burn. There are currently a number of various fire hazard classification schemes, e.g. OSHA, ANSI, RCRA (EPA), DOT, CPSC and NFPA 30. They do not employ the same limits and classes, or the same terminology. For the purposes of the present simplified overview, the new GHS classification is largely similar to the current Seveso classification.

Flash points and boiling points of some common liquids that can burn are presented in Table 3-4. It is observed that diesel, gas oil, heating oil (derived from gas oil) and fuel oil (derived from residuum) all have flash points that place them in the "combustible" liquids category - they would therefore be out scope of Seveso if the decision were to be based solely on the generic flammability category.

Table 4-6 Flash points and boiling points of some common petroleum fuels

Substance	Flash point (°C)	Boiling point (°C)	Designation
Petroleum-based fuels			
Gasoline (petrol)	-43	38-204 (initial-end)	Highly flammable
Kerosene, jet fuel	45 °C		Flammable
Diesel Gas oil Heating oil (derived from gas oil)	60 °C (minimum)		Combustible

Substance	Flash point (°C)	Boiling point (°C)	Designation
Fuel oil (derived from residuum)	60 °C (minimum)	Not defined, a number of fuel oils are not pumpable unless heated	Combustible

Source NFPA 325 (1994)

#### 4.2.2 Fuel oil

Fuel oil is derived from residuum, what is left of crude oil after distillation, when all lighter petroleum fractions have been boiled off. The exact properties of residuum depend much on the type of crude oil from it is produced. The residuum from some heavy crude oils is well-suited for asphalt production. Residuum may have a very high content of sulphur, up to about 5 per cent, and contain significant amounts of vanadium, sodium and other metals as well as a number of other environmental pollutants.

These properties greatly limit the number of potential applications of residuum, and it is generally the least-valuable product stream from a refinery. Medium-sized refineries process residuum in thermal crackers, visbreaker, and sometimes catalytic cracker units to extract more valuable gas oil and naphtha streams, but they are still left with a residue called pitch or tar. Only the largest refineries have speciality units that can convert the tar into coke. Less complex refineries will have either to export the tar to regions with less stringent environmental legislation or to process it into fuel oil by blending the tar with gas oil fractions.

By carefully controlled blending, a range of different fuel oil qualities can be produced that meet specifications on density, viscosity and sulphur content. A common product is high sulphur fuel oil (HSFO 180 cSt) with about 3.5 per cent sulphur, a viscosity of 180 centistokes when heated to 80 °C and a density just below that of water. This is a common marine fuel (bunker oil) for use in international waters where few environmental restrictions apply. By blending in more gas oil, less viscous fuel oils can be produced, e.g. Fuel77 and Fuel45, the number designates the viscosity measured at 80 °C, and the fuels may have sulphur contents down to about 0.5 per cent.

Fuel oils generally have to be stored at elevated temperatures in special, heated and insulated tanks, as they are too viscous for pumping at ambient temperatures. Fuel oils are sticky and have a highly characteristic smell. It requires extensive cleaning to convert a tank in fuel oil service back into a gas oil service. These special storage requirements obviously limit the number of potential consumers.

The European Petroleum Industry Association states that:

"/"/it seems possible that heavy fuel oil could in future be classified as Chronic Aquatic Toxicity 2 under CLP (NR51/53 according to DSD); this

would bring heavy fuel oil into Part 2 and therefore subject to the default storage limit of 500 tonnes in column 3./

It would seem that fuel oil is about to enter the scope of Seveso legislation as a repeat story of what happened to jet fuel, diesel and gas oil in 2003 with the introduction of Amendment L345.

#### 4.2.3 Consistent policy response

Alternative options

A consistent policy response would be to include fuel oil within the named substance "petroleum products" introduced with Amendment L345 in 2003 as d) heavy fuel oil; bringing heavy fuel within scope of Seveso legislation with a threshold quantity of 2,500-25,000 tonnes.

#### 4.2.4 Impact of options

Exactly how "heavy fuel oil" is to be defined is crucial for the impact assessment. In some contexts, heavy fuel oil is reserved for fuel oils with a sulphur contents in excess of 1 percent by mass. It is possible that only the heavier of marine bunker oil qualities will be comprised by the definition. However, the OECD definition of "heavy fuel oil" comprises any fuel derived from residuum, including those obtained by blending.

Bunker market

The bunker market requires specialized storage facilities that generally are available only at larger oil terminals. They are likely already to be Seveso installations for their inventory of petroleum products other than fuel oil. It is, of course, possible that a small terminal currently just below the lower-tier or upper-tier Seveso threshold amount could be brought just over that threshold with the inclusion of fuel oil, but the number of such terminals is expected to be low.

Onshore use

Onshore, it is expected that only large power plants and other units with advanced flue gas cleaning systems can burn the heaviest of fuel oils due to the high contents of sulphur, metals and other environmental pollutants. This will effectively narrow the number of potential consumers.

Typical tank sizes at large power plants that potentially consume heavy fuel oil are 5,000 - 20,000 m<sup>3</sup>. If a large power plant currently has no inventory of gas oil but only fuel oil, the inclusion of fuel oil would almost certainly bring them within scope of at least lower-tier Seveso requirements.

Informal information requests indicate that all cement-production units either currently do consume fuel oil or have the option to do so. Some producers appear mainly to use coal but keep inventories of fuel oil as a rapid back-up option, in case the coal transporters suffer breakdowns. It is therefore possible that all European cement producers would at least become lower-tier establishments - (preliminary estimate is around 35 cement producers).

A number of other energy-intensive medium-sized industries are possible but somewhat unlikely candidates. A medium-sized agricultural industry reports

that their low-sulphur fuel oil storage capacity is about 5,000 tonnes. Many companies indicate however, that flexibility in supply options would permit them to manage the maximum inventory below the lower tier threshold of 2,500 tonnes, typically by increasing the frequency of resupply. This is most evidently the case when supply takes place by tanker truck<sup>20</sup>.

It is therefore likely that the inclusion of fuel oil will only lead to the inclusion of large energy intensive establishments such as power plants and cement producers.

## 4.3 Hydrogen

### 4.3.1 The issue

Hydrogen is classified as an extremely flammable gas and is a named substance in the Seveso Directive. As shown in Table 3-10, the inclusion as a named substance results in a reduced lower-tier threshold quantity by a factor two as compared to the generic criteria.

Table 4-7 Thresholds for hydrogen

	Seveso lower/upper threshold quantities (tonnes)	
	Named substance	Generic category
Hydrogen	5 / 50	10 / 50

The Hydrogen Industry Federation has proposed to delete hydrogen as a named substance, which would increase the lower-tier threshold from 5 to 10 tonnes.

### 4.3.2 Basic properties of hydrogen

With present technology, hydrogen is stored as a compressed gas (GH) with a density of about 0.09 kg per cubic metre or as a cryogenic liquid (LH) with a density of about 71 kg per cubic metre. Hydrogen can also be stored in a form in which it is chemically bound to certain metals, known as metal hydrides, but there are at present no commercial applications of this type of storage technology. Hydrogen has the highest energy-to-weight ratio of any fuel but at the same time, it also has an extremely low energy-to-volume ratio. This means that large storage volumes are required to store even modest amounts of hydrogen based energy. Hydrogen storage systems are considerably bulkier and heavier than those used for gasoline or diesel.

To give an indication of the scale of volumes and masses, a 40-tonne truck transporting gaseous hydrogen (GH) in high-strength steel tubes at 20 MPa

<sup>20</sup> Note that transport by truck is not covered by Seveso but instead regulated by legislation on transport of dangerous goods.

(200 bar) can only carry a load of 320 kg of hydrogen. Further, it is only able to deliver 80 per cent of its freight (288 kg) if the receiving vessel operates at 4.2 MPa (42 bar). If liquid hydrogen (LH) is transported as a cryogenic liquid at about -250 °C in double-walled super-insulated tanks, a large truck has an effective freight load of about 2.1 tonnes of hydrogen (Rosyid 2006).

### 4.3.3 Hazard profile

Wood (2009) cites an unfavourable accident history as the reason for the current, reduced lower-tier threshold quantity. Hydrogen appears on Kleindorfer's (2000) list of the twenty most commonly reported chemicals involved in accidents, which is based on US accident history data reported to the EPA.

Hydrogen poses a number of safety challenges. Hydrogen has an unusually low ignition energy, about one-tenth of that required to ignite hydrocarbon fumes. This increases the ignition probability as also weak ignition sources, which would pose no threat to traditional fuels, may ignite hydrogen. Hydrogen also has an unusually wide flammability interval (4-75 vol %) compared to e.g. propane (2.1-9.5 vol %) which means that the ignitable envelope of accidental releases of hydrogen is larger compared to traditional fuels, the similar interval for ). When ignited, the hydrogen flame propagation velocity is higher than for hydrocarbons, which leads to more severe blast pressures. Additionally, hydrogen is thought to have a greater propensity for deflagration-to-detonation transition phenomena, which produce very strong blast pressures and lead to larger damage distances. Guban (1979) reports that ignition of an accidental release of only 500 kg of hydrogen was observed to produce a detonation. Flames of hydrogen are almost invisible to the human eye in daylight and pose a danger to humans attempting to flee.

Hydrogen was involved in a 1989 vapour cloud explosion at a polyethylene plant in Pasadena, Houston (USA), which killed 22 people, injured 100, and caused extensive damage to the plant. In 1989, a tank of 100 m<sup>3</sup> gaseous hydrogen pressurized at 45 bar burst without apparent reason at Hanau, Frankfurt (Germany). The blast wave and the missiles of the tank shell caused heavy damage to the plant. There have been a number of other accidents, for example hydrogen explosion and fire in a refinery with eight injuries and nine deaths (Japan, 1992), hydrogen explosion in a power plant with 19 injuries and two deaths (Hong Kong, 1992) and a pressurized hydrogen pipeline failure with a jet fire resulting in eight injuries and seven deaths (USA, 1989). In practice, hydrogen has the potential for major chemical accidents posing a considerable risk not only for onsite, but also for offsite damage (Rigas and Sklavounos 2005).

### 4.3.4 Industrial applications of hydrogen

Hydrogen is used in very large quantities in the petroleum and chemical industry. Very large amounts are used at refineries to remove sulphur from naphtha and gas oil streams. A refinery produces its own hydrogen as a by-product from the process of upgrading low-octane naphtha to high-octane gasoline, and the

produced hydrogen is immediately routed to the hydrogen consuming units. Despite the very large production and consumption quantities, there are generally no major inventories of hydrogen at refineries.

Very large amounts of hydrogen are also used for the production of common bulk chemicals such as ammonia and methanol. The production of ammonia is estimated to consume about half of all hydrogen produced in the world (Ramachandran and Menon 1998) Again, the hydrogen is produced immediately before it is consumed, and there are no major inventories.

Air Liquide's operations in Holland/Belgium are constructing a new high-capacity hydrogen unit able to produce 130,000 m<sup>3</sup>/hour (about 11 t/h), scheduled for start-up in 2011, to supply a renewable diesel plant. The unit will feed a pipeline network and there is no finished product stored on-site. Air Liquide also operates the Northern European hydrogen network, which currently includes eight operating hydrogen units and more than 900 km of pipeline.

Hydrogen is used extensively in the food industry to modify the melting point of fats and oils. The economically most attractive solution for these industries is to produce their own hydrogen in a small to medium-sized units that catalytically convert ammonia or methanol into hydrogen. Hydrogen may be used by catalyst manufacturers as a reducing agent during catalyst activation processes. Many such industries have small buffer inventories of pressurized hydrogen, typically 100-1,000 kg

Hydrogen has a number of specialty technological uses. It is used in the electronics industry to produce polysilicon. In certain metallurgical processes, such as steel annealing, furnace brazing and powdered metal sintering, hydrogen is used as an oxygen-scavenger. Hydrogen also finds use as a shielding gas in some welding processes. In general, the amounts consumed are very modest.

Informal information requests to the main distributors of specialty industrial gases reveal that customer inventories of hydrogen generally are small. The size of a typical customer inventory of pressurized hydrogen gas appears to be around 3,000-5,000 nm<sup>3</sup>. Due to hydrogen's low density, this corresponds only to 250-415 kg. One standard industrial cylinder of pressurized hydrogen holds 50 litres @ 200 bars, about 10 nm<sup>3</sup>, or less than 1 kg of hydrogen. It would thus require an inventory exceeding 5,000 bottles to approach the lower-tier Seveso threshold quantity - an unrealistic number of bottles. Distribution hubs for specialty industrial gases inform that inventories are "small" and nowhere near the lower-tier Seveso threshold quantity. It is also reported that decentralized production units for hydrogen have very small inventories.

In conclusion, it appears that for the majority of industrial consumers of hydrogen, on-site inventories of hydrogen are small and well below the Seveso thresholds quantities. For extremely large hydrogen consumers, such as ammonia or methanol producers, the threshold quantities for hydrogen are of little practical importance as their inventories of ammonia or methanol qualify them as upper-tier Seveso installations, regardless of their hydrogen inventory. For other industrial consumers, inventories seldom exceed 1,000 kg, a fifth of the

lower-tier threshold amount, often far less. Hydrogen may play a role for industries that hold many different dangerous substances, where the inventory of each dangerous substance is below the corresponding Seveso threshold amount. The role is likely to be marginal; however, as hydrogen's contribution to the summation rule (the ratio of the hydrogen inventory to the Seveso threshold amount) is low.

#### 4.3.5 Town gas storages

Traditional town gas is produced by steam reforming, blowing steam through red-hot coal, which gives a mixture of hydrogen, carbon monoxide and other compounds known as syngas. There are several examples of large scale storages of this hydrogen rich gas (Panfilov 2006).

- In Yorkshire (England), a chemical company has stored 1 million nm<sup>3</sup> of nearly pure hydrogen (95% of H<sub>2</sub> and 3-4% of CO<sub>2</sub>) in three salt caverns at about 400 m in depth for a number of years.
- In Beynes (France), a gas company has stored 50-60% hydrogen in an aquifer of 330 million nm<sup>3</sup> capacity between 1956 and 1974. No gas losses or safety problems have been reported
- In Kiel (Germany), a 62% hydrogen town gas was stored in a salt cavern of 32,000 m<sup>3</sup> at 80-100 bar
- In Lobodice (Czechoslovakia), a 50% hydrogen town gas was stored in an aquifer.
- In Russia, pure hydrogen was stored underground at 90 bars for the needs of the aerospace industry

#### 4.3.6 Hydrogen as a future energy carrier

Hydrogen is proposed as a future energy carrier, either for the production of electricity in fuel cells or for use as zero-emission fuel in combustion engines. The introduction of hydrogen as an energy carrier would greatly increase the transportation and storage capacity needs. Most information in this section is taken from the detailed account provided by Rosyid (2006). Because of the rapid developments within this field, we have reviewed more recent work, e.g. Landucci et al. 2010, to verify that key figures on inventory capacities etc. are not outdated.

##### Filling stations

Worldwide in 2006 there were about 80 filling stations for hydrogen-powered vehicles, of which about 30 were located in the EU. Of those 30 filling stations, 16 were located in Germany. A typical current filling station, e.g. one for bus services in Berlin City, has a combined LH and GH storage. The Berlin facility has a 12 cubic meter cryogenic tank that holds about 800 kg of LH and a GH storage of about 60 kg at three levels of pressure: 15, 20 and 35 MPa. The stor-

age capacity is thus less than a fifth of the Seveso Directive's current lower-tier threshold amount. To put the storage capacity in perspective, a hydrogen-powered BMW passenger car with an internal combustion engine and a driving range of 400 km needs a 150 litres cryogenic tank that holds about 6 kg of LH. The storage capacity of the filling station in question may thus supply about 130 cars.

It is obvious that filling stations easily will become lower or upper-tier Seveso installations if hydrogen attains general popularity as an energy carrier. It is also likely that future filling stations will operate at more severe (higher) pressures, which will increase the hazards compared to those of current designs. For example, pressures of 70 MPa (700 bar) are currently being incorporated into hydrogen filling station designs in the USA (LaChance 2009).

### **Household applications**

Hydrogen is also considered as a potential energy carrier for various household applications. One such demonstration project is located in urban surroundings in Hamburg-Bahrenfeld (Germany); where hydrogen powered fuel cells provide electricity and low-temperature district heating for nearby residential buildings. Because of the urban setting, this type of facility is highly relevant in a Seveso context, in particular in terms of the land-use planning and community information obligations of the directive for upper-tier installations. The facility has an LH storage, a cryogenic tank with a capacity of 66 cubic meters holding about 4.2 tonnes of hydrogen. The installation is supplied by LH trailer trucks.

It seems likely that the Seveso Directive's current threshold amounts for hydrogen have influenced storage capacity of the demonstration installation to avoid the added complexity arising from being covered by the Directive. If hydrogen becomes an even moderately popular energy carrier for household applications, such facilities will most certainly become Seveso installations with the current threshold amounts, unless of course facilities are supplied by a hydrogen pipeline, which is outside the scope the Seveso Directive.

### **Production and storage**

Installations that produce hydrogen for energy carrier usage will require hydrogen inventories to buffer upsets in production and level out variability in demand. There is a demonstration facility in Neunburg vom Wald (Germany) that produces hydrogen from solar power. The two largest storage tanks have a combined inventory of 5,000 normal cubic metres of gaseous hydrogen, or about 400 kg.

Rosyid (2006) states that a large liquid hydrogen storage in Germany is located near the Vonburg-Ingolstadt refinery. Hydrogen is supplied by the refinery and the storage facility has a 270-cubic metre cryogenic tank that holds about 17 tonnes of hydrogen. The storage facility supplies hydrogen to filling stations by means of LH trucks.

Information kindly supplied by the European Hydrogen Association in 2010 states that a total of four facilities in the EU has storage capacities of liquid hydrogen in excess of 50 tonnes. The facilities are located in Germany, The Neth-

erlands, France and Kourou (French Guyana). There are three facilities in the EU with a storage capacity above 5 tonnes, but below 50 tonnes, all located in Germany. Two of these are combined GH and LH storages, one is a GH storage. Storage capacities are reported in terms of being lower or upper-tier Seveso sites only, the exact amounts are business confidential.

The world's largest storage tank for cryogenic hydrogen is located At Cape Canaveral (USA). The tank is operated by NASA, and the hydrogen is used for rocket fuel. It is a spherical tank ( $\varnothing=20$  m) with a storage volume of 3,800 cubic meters and an inventory of about 270 tonnes of cryogenic liquid hydrogen. (Rosyid 2006)

In summary, there are seven installations in the EU that employ hydrogen as an energy carrier and have inventories that exceed Seveso threshold amounts. There are also a number of small-scale demonstration projects with modest capacities. Should the technology attain general popularity, such installations would most certainly have inventories that exceed the current Seveso threshold amounts, unless they are continuously supplied by hydrogen pipeline and operate on minimal inventories.

Table 4-8 Overview of hydrogen inventories

Site/equipment	Inventory of hydrogen
Standard 50 liter steel cylinder with pressurized hydrogen @ 200 bar	< 1 kg
End-user, speciality gasses	50 kg
End-user, edible oils	200 – 400 kg
Distributor of speciality gasses	< 500 kg
40-tonnes truck transporting gaseous hydrogen	About 300 kg
Large truck transporting liquid hydrogen	2.1 tonnes
Rail tank car transporting liquid hydrogen	2.9 tonnes <sup>21</sup>
Largest single storage tank (EU)	17 tonnes (perhaps outdated)
Largest storage capacity at a site (EU)	50+ tonnes
Largest single storage tank (world)	270 tonnes

<sup>21</sup> Rail car cargo size taken from accident history in Cancelli et al. (2001)

### 4.3.7 Impacts of options

The options for this component are either to keep the existing situation with hydrogen as named substance or to delete it and the general classification.

- Do nothing and leave as named substance with 5/50 tonnes as thresholds;
- Delete as named substance: Extremely flammable gas with 10/50 tonnes as thresholds

Very few industrial establishments, probably less than a handful, are likely to be covered by Seveso legislation due to their inventories of hydrogen. Inventories at the specialty industrial gas distribution network nodes are reportedly much below the lower-tier threshold. The largest of hydrogen compressed gas customers have maximum inventories of about 500 kg. Very large consumers of hydrogen produce it onsite immediately before consumption and have modest inventories in piping and process vessels. As such, consumers use hydrogen to produce very large quantities of ammonia, methanol or low sulphur petroleum products, which in a Seveso context are dangerous substances in their own right. Such industrial establishments are natural upper-tier Seveso sites, irrespective of their possible hydrogen inventories.

The conclusion is therefore that an increase of the lower-tier threshold quantity for hydrogen from five to ten tonnes has little or no impact on existing industrial establishments. The current lower-tier threshold is set so high that very few industrial establishments have inventories that exceed this amount, either as a single qualifying substance or by means of application of the summation rule. This is a remarkable finding as the reason for including hydrogen as a named substance in annex I of the Seveso Directive precisely was to subject hydrogen to intensified regulatory attention, due to its unfavourable accident history.

The impact on existing energy carrier installations is also very small. Most installations are scaled-down demonstration projects with inventories well below lower-tier thresholds or deliberately set just below lower-tier thresholds. The largest identified hydrogen storage has an inventory of 17 tonnes and will remain a lower-tier installation even if the lower tier-threshold is increased to 10 tonnes.

Is it noteworthy that no installations have been identified which exceed the upper-tier threshold and for which the Seveso Directive's land-use planning, emergency planning and community information obligations would potentially apply.

Table 4-9 Overview of impacts of options for hydrogen

Option component	Economic impacts	Protection level	Other impacts
Leave as named substance 5/50 tonnes thresholds	Limited impacts	Maintain protection level though very few sites are covered currently	Potential impact on future hydrogen filling stations - it could delay the development of H2 as transport fuel
Delete as named substance 10/50 tonnes thresholds	Limited impacts	Reduced protection level as emerging risk in the 5-10 tonnes range is not addressed	

If hydrogen will become a major energy carrier for transport systems and a network of filling stations will be established, it is pre-condition that safety is dealt with in standardised way similar to the existing situation with petrol stations. In this case an exemption will have to be made for hydrogen - maybe for this particular use.

It is a question whether the option where hydrogen is deleted as named substance and the lower threshold value is increased from 5 to 10 tonnes will be sufficient to cover for future quantitative at filling stations.

Choosing either options will have limited short term impact, increasing the thresholds to 10 tonnes will at least postpone the need for further adjustments as the H<sub>2</sub> economy develops.

#### 4.4 Threshold values for aerosols

What is the issue?

The aerosol industry with FEA has proposed to increase the thresholds for aerosols. They have justified the proposal by stating that there are no accident histories with aerosol cans at typical storage facilities.

Possible option components

The relevant alternative option components are:

- Do nothing (use the threshold from the CLP alignment process 150/500 and 5000/50000)
- Increase threshold to 1300/5200 and 5000/50000 as suggested by FEA.

##### 4.4.1 Impacts of option components concerning change of threshold values for aerosol

The argument for the FEA proposal is that the accident history displays no example of major accidents caused by storage of aerosols. This view is not shared by all Member State authorities.

The accident history reporting does not allow determination of whether the few accidents with aerosols were in fact caused by storage of aerosols.

One of the criteria for harmonised dispensations regarding *Containment and quantities* suggest that there could be situations where the packaging prevents the existence of a major accident hazard. It could be argued that the hazard associated with a given amount of flammable gasses in aerosols is less than the same amount in bulk storage. There are examples where this leads to a "discount" in the qualifying quantities and there are examples where it is not the case.

The new category that is introduced via CLP allows for taking the containment aspect into account.

#### Impacts protection level

The total number of storage sites is not known, and therefore the impacts of introducing higher thresholds can only be roughly estimated. The FEA has about 500 members and based on a survey of 90 companies, it is estimated that half would be warehouses and of those, half would be under Seveso currently. The CLP alignment could potentially increase this number slightly. There are also aerosol storages that are not members of the FEA, for example major retailers. A scenario would be to assume that there is the same number of FEA and non-FEA aerosol storages. The analysis of the CLP alignment suggests that potentially 20-40 new sites could come under Seveso II in case the threshold for flammable aerosols containing flammable gases is 150/500 tonnes.

Increasing the thresholds as proposed by FEA is likely to lead to a situation where almost all of the existing Seveso establishments fall out of scope. This means about 200 warehouses with aerosol storage could fall out of scope.

#### Economic impacts

The analysis of the economic impacts is based on these assumptions for effect of the two options on the number of establishments.

An overview of impacts of each of the option components are shown in the table below. The assumptions for the do nothing option is that in total about 40 new warehouses would be included, while the increased thresholds implies about 200 being excluded from scope.

Table 4-10 Impact of options components for aerosols

Options	Change in no of establishments		Economic impacts Annual costs in EUR			Protection level
	Lower tier	Upper tier	Industry	CA	Total	
Do nothing (the CLP proposal of 150/500)	0.5%	0.3%	490,000	49,000	539,000	Unchanged/ slightly increased
Increase thresholds to 1300/5200	-3%	-2%	-3,300,000	-330,000	-3,630,000	Decreased/ no change

By increasing the thresholds there would be cost saving for industry. This economic impact would be in the order of up to EUR 3-4 million annually in cost savings for the affected industries, while the potential increased costs could be in the order of EUR 0.5 million using the CLP alignment.

Most importantly for the choice of option, is whether there is a limited major accident hazards due to nature of aerosol cans compared to bulk storage and whether any such different should be reflected in the thresholds. The case of whether the thresholds for aerosols should be increased is in a way related to the discussion on derogations, where one of the criteria suggested for establishment specific derogations is about packaging and containment. In the case of the aerosols also the effect of other legislation like the APD and PED Directives should be considered.

#### 4.5 Sodium hypochlorite

What is the issue?

Due to the new CLP legislation and its new classification of sodium hypochlorite, it is possible that a large number of new establishments will fall under Seveso II. The industry has raised the issue, and it needs to be analysed in more detail.

Sodium hypochlorite had a concentration limit of 25 per cent according to DSD. The M-factor introduced with the CLP transition, however, could result in a classification of the mixture at significantly lower concentration, e.g. already at 2.5 per cent active chlorine based on M-factor 10 (or potentially the M-factor could be even higher). The classification has not been finally determined yet.

The reason for the possible reduction of the concentration limit could instead of being the result of the M-factor approach be the results of a general re-classification of the substance due to new test data on the effects. However, whatever being the reason, the issue to investigate is the size of the impacts - economic and protection level impacts.

The industry has suggested to either include sodium hypochlorite as named substance or to introduce derogation for packaged products that would exclude sodium hypochlorite from the summation rule

Alternative 1: The suggestion for the named substance is to include sodium hypochlorite in Annex I Part A with the thresholds of 200 and 500 tonnes for lower and upper tier respectively.

Alternative 2: Derogation for packaged products where the specific suggestion is to include the following text in Annex I:

*When calculating the maximum quantities which are present or are likely to be present at any time for the purpose of determining whether a site falls within the scope of this Directive, mixtures containing sodium hypochlorite and classified N, R 50 shall not be taken into account (in plants or warehouses) when they are packaged in limited*

*quantities as specified in the regulation related to the transport of dangerous goods (ADR) – inner pack up to 5 litres and combination pack up to 30 kg -.*

#### Possible options

The alternative option components under consideration are therefore:

- Do nothing so that sodium hypochlorite will fall under the scope based on its CLP classification;
- Introduce sodium hypochlorite as named substance with thresholds similar to the current situation (industry alternative 1); or
- Introduce derogation for packaged products (industry alternative 2).

#### **4.5.1 Impacts of option components for sodium hypochlorite**

The industry has made a survey of the possible impacts of the ways sodium hypochlorite will be covered in the future.

The survey indicates that up to about 200 new sites (or more as not all Member States are included) could come within scope in case of concentration limits for mixtures with sodium hypochlorite of 2.5%.<sup>22</sup> The split between upper and lower tier establishments are not know - here is assumed an even split<sup>23</sup>.

The industry has further investigated the possible impact in particular relating to the impact on SMEs. Data from a few Member States suggests that with the 2.5% concentration limit a significant share of the new sites coming within scope could be SMEs. Based on data from three Member States the share of SMEs are as high as 70% of the new sites coming within scope.

The economic impacts are estimated using the unit cost assumptions presented in Section 2.1.3 where the annual administrative costs for a new site coming within scope of the Directive is estimated at 5,000 EUR and 30,000 EUR for lower and upper tier sites. Data from AISE suggests that the costs for sites in the detergent industry could be higher as there could be investment costs and increased insurance costs. As such costs will be very site specific and the data only cover a few sites from one Member State, it is not possible to make further estimation. However, the sensitivity range for the administrative costs, where the high end unit costs are three times the values indicated above, would indicate the order of magnitude.

---

<sup>22</sup> AISE 2010a, "Adapting the Seveso Directive to the CLP regulation for environmental classification changes", AISE 08.03.2010 and AISE 2010b, "Follow-up paper on sodium hypochlorite-containing mixtures: Impact and costs of the Seveso Directive on SMEs and retailers", AISE 12.07.2010

<sup>23</sup> AISE 2010a includes the results of an industry survey suggesting the number of potential new Seveso sites could be around 140 plus a number of UK retailers which in latest paper-AISE 2010b - is estimated at 57.

Regarding the impact on the protection level, it seems there are not many cases where sodium hypochlorite has been the cause of major accidents. In relation to whether there still is a major accident hazard potential the issue of packaging could be relevant. The sites that would fall within scope would in most cases be handling sodium hypochlorite products in small packages and containers.

Linking the treatment of such sodium hypochlorite products under ADR, the industry has proposed an exemption specifically for mixtures containing sodium hypochlorite when they are packaged in small quantities. Alternatively, derogation could be given by including sodium hypochlorite as named substance similar to way specific conditions around a particular substance has been dealt with.

The assessment of the two options for exempting sodium should be aligned with the way an amended derogation rule will be defined, see Section 3.1

The two alternative ways of giving derogation will have the same similar impacts regarding costs to industry and effect on protection level. The impacts of the two main options are summarised below.

Table 4-11 Impact of options components for sodium hypochlorite

Options	Change in no of establishments		Economic impacts Annual costs in EUR			Protection level
	Lower tier	Upper tier	Industry	CA	Total	
Do nothing (CLP for mixtures will apply)	≈100	≈100	≈3,500,000	≈350,000	≈3,850,000	Increased?
Introduce named substance with current limits	0	0	0	0	0	Unchanged
Derogation based on packaging	0	0	0	0	0	Unchanged

The option introducing sodium hypochlorite as named substance will leave the protection level unchanged compared to the current situation. The trade-off is therefore whether the inclusion of the additional sites results in improvement to the protection level that justifies the costs. It should be mentioned that data suggest that a higher share of the additional establishments could be SMEs and for them the Seveso requirements could lead to a significant cost burden.

This also links with criteria for derogations as mentioned above - the issue being how the specific packaging that characterises most of sites should be taken into account.

## 5 Assessment of other amendments to facilitate effective implementation of the Directive

This chapter reviews the amendment components under consideration that have emerged from the review process. These regard various aspects aimed at facilitating effective implementation of the Directive based on the list of issues set out in Section 2 (See Table 2-3). The list includes:

- Enhance the level and quality of the information provided to the public and the management of information;
- Encouraging coordination and/or integrations of inspections;
- Encourage the sharing and adoption of best practices for inspections through a system of regular information exchange (MJV Programme);
- Formalising the Commission's role in supporting effective implementation (through cooperation and provisions of guidance);
- Clarify safety management requirements for lower-tier establishments;
- Increase information sharing and guidance to Member States in relation to assessing safety reports (SRs);
- Clarify land use planning requirements to better integrate land use concerns in the land use planning practice.

### 5.1 Information obligations and information to the public

#### 5.1.1 What is the issue?

What is the issue?

It is important the public is informed about major accident issues. The public has right to such information reflected for example through the Aarhus Convention and information about specific sites is very important for the awareness and ability to respond correctly should an accident take place.

The review of Seveso II Directive has revealed that there are uneven practices across Member States relating to:

- provision of information on possible accidents to potentially affected groups, including external emergency plans and recommended behaviour
- information on industrial hazards available to the general public

Furthermore, there is general agreement that the safety report is not a very suitable way of informing the public, which may also be supported by the fact that there are not many request for such reports.

It is therefore important to consider ways to improve the level and quality of the information provided to the public, including where appropriate provision of non-technical information in relation to safety reports and emergency plans..

Also, the continued advances in information management systems and procedures suggest that there is a need to consider how management of the information can be modified in order to provide better information to the public and potentially increase efficiency in overall information management.

Hence, there is first of all a need to assess how information currently is made available to the public and consider alternative ways of improving the information to the public. It is both about possible enhancement and expansion of the type of information provided as well as the way it is provided.

When considering options for expanding the information to the public there are crossing concerns regarding restricted access to information on industrial accidents due to state security and counter-terrorism efforts. Therefore, the increased provision should be balanced against these security concerns

The fact that overall limited information has been made publicly available so far means that there is a limited understanding of how the public have used the information. It is possible that information about specific establishments could impact the housing marking in the vicinity of given site. To what extent this has been the case is not known, al though this unlikely to have a significant effect except in extreme cases. This has to be weighed against the benefits of ensuring that people liable to be affected by accidents are properly informed.

Description of existing information obligations

The information obligations are closely linked to the various reporting obligations. The various reports produce information some of which should be made available to public or it is the basis for the compiling information to the public.

Currently, there are the following information obligations and systems:

- Operators:
  - To CAs: Notification (Art 5), Safety reports (Art 9), Info for external emergency plans (Art 11(b))

- Information to the public:
  - Directly to the those around the site that could be affected (Art 13 and Annex V); and/or
  - Via the CA for the use of public information (Art 13 and Annex V): adequate information on safety measures and requisite behaviour in "simple terms".
  - The responsibility is sometime with operator sometime with CAs - the Directive is not prescriptive. The Directive require the information to the concerned population to be given regularly and without the population having to request the information.
- Member State CAs:
  - To the Commission: Information about establishments (Art19) (information held at SPIRS database) and three-yearly implementation report (Art 19 (4))
  - To the public: Information on safety measures (Art 13), Safety reports (13)
- Specifically in relation to Accidents:
  - Operators to CA: Inform about accidents (Art 14)
  - Member States to COM: Info about accident (Art 15)
  - COM: Maintain database with accident info (MARS database)
- Public consultation:
  - Member States to undertake public consultation in case of new upper tier establishment, modification of existing (Art 10) and development around existing establishments.
  - Member States have to consult the public in relation to the external emergency plans both when they are first drawn up and at any later update.

In terms of the information obligations to the public are managed, several Member States have delegated this responsibility to the operator. The more specific organisation is not known as for example information on the EEP is unlikely to be provided by the operator.

There is very limited access to online information about specific Seveso sites with regard to the major accident scenarios and the emergency plans.

Overall most Member States operate databases for internal use in the relevant CAs. These databases might include the information from the operator to the CAs but there is limited or no public access. These databases do not contain Annex V information, so opening for more public access is in itself not a sufficient measure to improve the dissemination of information.

All this suggests that there is a need to consider options for improvement of the provision of information to the public. The concerns are related to the content of the information provided to the public as well as the way it is being communicated.

### 5.1.2 Option components

Components regarding the information obligations

Overall the following components have been addressed in the analysis:

- Provision of information to the public:
  - Consider improving the level of information that is provided to the public;
  - Consider improving the management of information - including database systems - to facilitate more efficient provision of information to the public;
  - Set deadline for submission of information when information is being requested by the public;
  - Adapt the provisions on confidentiality set out in Article 20 in line with Directive 2003/4/EC on public access to environmental information;
- Clarify the requirement of Article 13, section 5 to provide public participation in development and update of external emergency plans and to provide for specific procedures here fore in line with Directive 2003/35/EC on providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment.
- Streamline the provision and updating of information from operators and CAs.

Each of these components with regard to alternative options for amending the Directive will be addressed in turn. The issue of information to the public is linked to both the management systems - databases or online websites - and the content of the information to be provided. These two aspects are the main areas for possible amendment of the Directive.

Deadlines

Regarding situations where a there is public request for a Safety Report, it is suggested as part of any of the amendment options to set a deadlines for submission of this information.

Given that the Safety Report is existing information, and that the requirements to provide this information when requested, there should be no additional cost associated with specifying a maximum period of time between the request and the submission of the information. As long as the overall times lines allow the CA and the operator to consider if there are any parts of the SR that can not be disclosed, no costs are envisaged from setting such a deadline and no further impact assessment is undertaken.

#### Options for type of information

Based on the findings of the review and considerations about how to improve the content of the information provided to the public a set of options has been defined. These options regarding the content of the information to the public the options are:

- A: Information as currently required by Annex V (alternative A);
- B: Information as currently required by Annex V made publically available online (in addition to the other appropriate dissemination) (alternative B);
- C: Additional information regarding:
  - All establishment: Basic info about each establishment similar to what is current in SPIRS and
  - Upper tier establishments: Summary of main major accident scenarios, key recommendation for the public in case of an accident (revised Annex V),
 to be publically available including on-line availability (alternative C);
- D: Requirement as alternative C plus non-technical summary of Safety report and EEP (alternative D).

#### Options for information management

The options regarding management of the information is developed in line with the ongoing efforts to improve the efficiency of information management. The Shared Environmental Information System (SEIS)<sup>24</sup> initiative is based on a set of principles of how to increase efficiency of information management and these principles should be applied when revising reporting and information obligation of any environmental legislation. These principles are about collecting information only once and then sharing it among all relevant parties including the public.

The following list of options for systems to manage information has defined:

- Continue with existing systems. MS to decide whether they operate databases and whether they allow public access (alternative I);
- Require MS to operate databases with public access to Annex V information ((alternative II);

<sup>24</sup> See COM(2008) 46 final: Towards a Shared Environmental Information System (SEIS)

- Central EU wide system:
  - Version 1: Simple website with links to documents either directly uploaded on the EU site or links to MS websites with the information/documents (alternative III);
  - Version 2: Integrated database with information similar to e.g. SPIRS or MARS (alternative IV).

These "technical" system solutions needs to be combined with the contend options and below the relevant combinations are identified.

Combined options

Table 3-20 illustrates the combinations of the options for content and management of information (to the public). It makes no sense to make improvement on one aspect and not the other and therefore the alternative to make no change in one dimension is not combined with an option implying changes in the other dimension.

Table 5-1 Combinations of options

	A: Information as currently required by Annex V	B: Information as currently required by Annex V plus requirement to have it on-line available	C: Additional information on basic data for all sites plus accident scenarios etc for upper tier (revised Annex V)	D: Additional information as C but will non-technical summaries of SR and EEP
I: Continue with existing systems (MS to decide whether they operate databases and whether they allow public access)	X			
II: Require MS to operate databases with public access to information defined by B or C.		X	X	X
III: Simple website with links to documents either directed uploaded on the EU site or links to MS websites with the information/documents		X	X	X
IV: Integrated database with all relevant information similar (expanding SPIRS)		X	X	X

Apart from the no-change options all the options considered for amending the Directive can be combined. Therefore the impact assessment will consider the options for content of information and options for management of information in turn.

### 5.1.3 Impacts of option components concerning information obligations

#### Better data for the public

Alternative A

This is the no-change option.

Alternative B

The first option that goes beyond the existing situation is to require that information currently covered by Annex V should be online available.

As all Member States can be assumed to have governmental websites where this information could be placed, there no further data management system required.

As this information should be produced already there should be no additional costs to CA and operators. This option is just to emphases through an explicit requirement in the Directive that the information is produced and online available.

The benefit of this option is that be easier for the public to access the information and that it will be easier for each CA to monitor that it is actually available.

If the public will have better information on how to behave in case of an accident, it is likely to reduce the impacts of accidents. This impact can not be further quantified.

Alternative C

Alternative C is to extend the Annex V requirement. Firstly, it is to have basic data such as name, location and activity for all establishments. Secondly, all upper tier establishments should have information about the main type of major accident scenarios and the events that could trigger each of these scenarios. It also requires appropriate information from the external emergency plan to be drawn up instead of just making a reference to the EEP.

The additional costs of such information provision are difficult to estimate. To produce this information, it is necessary to review the safety report and extract the information. If the expected format is about 1-2 pages of summary it could be produced in one to two days. Given that there are around 4500 upper tier establishments the costs would be 2-4 million EUR as a one-off costs. Updating of this information would take maybe 25% of the time required to do the initial summary.

This option has the same benefit as alternative B in terms of making it easier for the public to access the information and that it will be easier for each CA to monitor that it is actually available. The additional benefit is that provides some basic information about the nature of the accidents hazards and information on how to behave in case of an accident. This is likely to facilitate a more adequate response in case of a major accident taking place and thereby reducing the impacts of such accidents. These benefits can not be further quantified.

Alternative D

The last alternative - D- add to the alternative C requirements by requesting non-technical summaries of the key documents, the safety report, the internal

and the external emergency plans. If today the information that would be expected as part of non-technical versions of the SR, IEP and EEP is not produced the additional administrative costs for both industry and CAs could be more substantial.

Assuming that non-technical versions of all three documents would cost around 10% of the costs to produce the full technical documents, then the total costs - a one off cost - could be in the order of EUR 20 million. Out of these amounts the CAs would account for EUR 3 to 4 million. For the safety report, 10% of the costs of a full report are equivalent to an assumption that it will take about 5 days to produce the document.

Once produced the update of the documents would cost less. The data on updating and production safety plans suggest that the update is half the costs of the full report. For the non-technical reports, updating should be simpler and assuming that the update would amount to 25% of the initial production, requiring an update every third year would lead to average annual costs at around EUR 2-5 million.

The additional benefit of alternative D compared to C is that more information about the risk scenarios and the emergency plans from access to the non-technical summaries will further increase the population's awareness of the possible risk scenarios and motivate why it is important to understand the advice included in the emergency plans. Furthermore, it will generally inform the interested public about major accident potential issues.

Balance between Aarhus Convention and security concerns

The confidentiality concern as covered by Article 20 influences the process of defining the relevant information. The more information that the public should have access to the more effort is required in defining whether the confidentiality is complied with and this potentially increases the costs of the option B to D.

In principle, Member States should already today have determined what kind of information can be provided to the public and the above options are to some extent just codifying what should be done already.

The key issue when determining the appropriate provision of information to the public will be to strike a balance between the Aarhus Convention principles as implemented in Directives 2003/4/EC and 2003/35/EC and security concerns. For certain types of information, there is a trade-off between the public's right to information and security concerns.

It is likely that if more information is made available to the public and it is available online, more focus on the specific details that can be made available will require some additional effort from the CA compared to the current situation.

It is very difficult to estimate the costs of such process as it depends on how many establishments were confidentially and/or security issues are important. If these concerns apply to one-fourth of all upper tier establishments and the CA will need to use five days per establishment - given that several authorities need

to be consulted etc before making the decision - the total one-off costs could be around 4 million EUR.

As argued above, these costs are not necessarily additional costs as Member Status already today should have considered the security and confidentiality issues. Therefore, the costs will not be included in the quantified impacts.

Other impacts of better information to the public

Detailed information could affect property prices, and it could also generate public pressure to reduce the risks or to re-locate certain establishments. If property prices do not reflect the proximity to Seveso sites, more information could result in reduced property prices which will mean a loss of asset value for the current property owners. These impacts can not be further quantified.

Summary of impacts

Summary of impact of alternative options for improving information to the public is presented in the below table.

Table 5-2 Overview of impacts of information provision

Option component	Economic impacts in EUR	Protection level	Other impacts
A: Information as currently required by Annex V	No additional costs	No impacts	
B: Information as currently required by Annex V plus requirement to have it on-line available	Limited additional costs	Better access to information (for public with internet) - less impact in case of accident	
C: Additional information on basic data for all sites plus accident scenarios etc for upper tier (revised Annex V)	One-off costs around 2-4 million EUR Annual costs up to 0.5 million EUR	Improvement of information available Better access to information (for public with internet) - less impact in case of accident	Allow to learn from other - (best practices)-monitoring of actual implementation etc
D: Additional information as C but with non-technical summaries of SR and EEP	One-off costs from up to 20 million EUR Annual costs of up to 2 million EUR	Significant Improvement of information available Better access to information (for public with internet) - less impact in case of accident	Allow to learn from other - (best practices)-monitoring of actual implementation etc

The main difference between option C and D is the scope of the additional information that has to be produced. Either it is a brief summary the most impor-

tant accident scenarios and their implication or it is to ask for non-technical version of all the key documents.

In any case it should be required that all these three non-technical documents are available on-line. Whether this will be sufficient information in all Member States is questionable and the current general Article 13 provision should be maintained. There are examples that the public is unaware of the presence of Seveso sites in their vicinity.

By more clearly specifying which documents should be produced and by requesting them to be available at a central EU database will increase the likelihood that they are properly prepared.

As already mentioned, there is limited knowledge about actual use of the information. For example how the type of information people have might affect their specific behaviour in case of an accident or whether such information impacts on property markets.

#### **Streamlining information and reporting**

The options for management of the information includes alternatives from requiring Member States to operate a system with public access to a fully centralised database with all relevant information.

#### Alternative 1

Alternative 1 is to continue with the current situation with generally very limited on-line systems.

#### Alternative 2

Alternative 2 is to require all Member State to have a system that allows public access to relevant information for each establishment. Given that this requires only a website and for Member States with many establishments a simple database, the additional costs will be limited. Most Member States already operate something similar though there might not be public access to information about individual sites.

To establish a simple structure and uploading relevant documents and information for each establishment should require a limited amount of resources. As an illustration of the possible order of magnitude, it could be assumed that it will require one hour per establishment to do this and therefore the total one-off costs will be 1 million EUR.

The benefit will be that it allows on-line information about the establishments a pre-condition for the option components B to D regarding the content of the public available information. Having to upload information for each establishment will make it easier for Member States to monitor that this information that is already required -in fact exist and is available. In principle it should reduce enforcement costs once the system is in place, though this benefit can not be quantified.

#### Alternative 3

Alternative 3 is to establish a central website which can be used to access information in all Member States. This option is - as mentioned above - in line with the ongoing efforts to improve the efficiency of information management -

the Shared Environmental Information System (SEIS)<sup>25</sup> initiative. One of key principles in that initiative is to collect information only once and then sharing it among all relevant parties including the public. It is also about setting up it systems that allow easy reporting of the necessary information.

A central website does not require a complicated database to be programmed. It could be organised in alternative ways. Given that some Member States have developed their own databases for the relevant Seveso information, a central database (called eSPIRS) could include a mix of specific information and links to existing Member State databases.

Entering the website the user would have to find either general information or site specific information. The site specific information could be organised in alternative ways:

- By Member State: Link to MS website with relevant information - one link per MS
- By Member State and list of establishments - each with a link to relevant documents (link can be to documents uploaded on the central database or link to MS website where documents are uploaded.
- SPIRS kind of database with basic data on each establishment and link to document with further information (will allow use to search for by defined parameters - Member State, type of activity etc);

The last option would provide the most user-friendly set up. If the existing SPIRS could be used to create a database with public information by establishment this set-up would not be more costly than the other two.

In any case the system should allow for i) different levels of access for different users so that certain information can be for CAs only while other parts have public access. Given that most of the information would be in the national languages, the system should also be able to accommodate that. The three specific set-ups presented above could all be designed to accommodate these requirements.

Establishing a central database as described here would not be very costly as it used existing it infrastructure and existing databases. If links or documents need to be made/uploaded for all 10,000 establishments and it will take an hour for each establishment, the total set-up costs would be around 0.5 and one million EUR. The operation and maintenance costs would depend on how frequent the database should be checked - probably half to a full man year per year would sufficient which could cost about 50,000 to 100,000 EUR per year.

This option can accommodate any of the alternatives B to D regarding the available information. It can include any number of documents relevant for the

---

<sup>25</sup> See COM(2008) 46 final: Towards a Shared Environmental Information System (SEIS)

public for example a non-technical version of the Safety report and the non-technical emergency plan.

The benefit of a central database is that it will make sharing of relevant information more efficient. Not only will it provide easier public access to the information as required by the above options B to D, it will also support the CAs in their sharing of information.

#### Alternative 4

The option of centralised database with all information integrated will be a more resource intensive solution and it will redo what some Member States have already invested in.

The integrated database with all information is very ambitious and would require MS that already have systems to change. The specific costs of such a solution can not be estimated without detailed specification of what the system should be able to do.

#### Summary of impacts

The below table includes a summary of the impacts of the alternative information management options.

*Table 5-3 Overview of impacts of database systems*

Option component	Economic impacts in EUR	Protection level	Other impacts
1: Continue with current MS systems	No additional costs	No improvements in information provision	
2: Require MS to operate databases with public access to information at establishment level	Some MS costs for maintenance  One-off costs of 0.5 to 1 million to set up link/upload documents	Better access to information (for public with internet) - necessary for implementation of option B to D	
3: Simple website with links to documents either directed uploaded on the EU site or links to MS websites with the information/documents	50,000-100,000 per year in maintenance plus some MS costs  One-off costs of 0.5 to 1 million to set up link/upload documents	Significant Improvement of information available - through allowing the implementation of option B to D	Allow to draw lessons between establishments and MS (best practices)-Allow monitoring of actual implementation for both CAs and COM
4: Central EU database will fully integration of all relevant information	Substantial costs to adapt all existing systems to one database format	Similar to alternative 3	Similar to alternative 3

It seems not much more costly to set-up an EU website with either directly uploaded information or link to Member States information than having just Member States own systems. It will facilitate better access to information and to draw lessons across Member States when more information available. There, this option of some form of central website is the most advantageous.

Member States that already have electronic databases with public access could maintain those and just submit the link to the central EU database. The central database could be supportive for Member States without own databases.

#### Further reporting obligations

Regarding electronic information and reporting by operators to CAs:

It is up to the Member State CAs how they request the data from operators. Reporting directly to eSPIRS by the operators might not be the most advantageous approach. The SRs or update of SRs should be reviewed and approved by the CA, as should the IEP that the CAs need for updating the EEP.

Submission of information as done under REACH where companies submit directly information to the ECHA is most useful if data are fairly standardised, such as it is the case with substance registration.

Looking firstly at the key documents prepared by the operators of the establishments, the safety reports and the IEP, these documents are likely to be prepared in electronic versions already and if Member States CA do not already hold them in electronic files, it should be fairly feasible to introduce all key documents being electronically available.

The safety reports and IEP prepared in national languages are relevant for the CAs as part of enforcement responsibility and as input the external emergency planning. Whether additionally provisions regarding these documents are necessary is difficult to assess.

Only notification of the use of dangerous substances is likely to be fairly standardised. The initiative on Administrative Burdens identified exactly notification as an area for savings through introduction of on-line notifications. The Administrative Burden study estimated a saving potential of 1.5 million EUR annually.

Member States should be encouraged to consider how on-line notifications could be introduced to make the process as efficient as possible.

## 5.2 Coordination of inspections

The Seveso II Directive requires that there shall be a programme of inspections of all establishments. Unless a programme is in place, based on a systematic appraisal of major accidents hazards of the particular establishment concerned, each establishment shall be subject to at least one on-site inspection every 12 months. It has been estimated that around half of the installations that fall under the Seveso Directive also fall under the IPPC Directive. Currently, several

Member States are coordinating inspections performed by various authorities concerning the Seveso II and the IPPC Directives. In different contexts, it has been proposed that such initiatives should be extended to all Member States<sup>26</sup>.

It has been suggested that coordination or integration of inspections, based on the frequency requirements set by the Seveso Directive would reduce the administrative burden related to the preparation, presence of inspectors and follow-up. In addition, it could facilitate the sharing of information between IPPC and Seveso inspectors to minimise duplication.<sup>27</sup>

Possible component variants

The following component options have been put forward:

- Encourage national inspection authorities to coordinate their inspection of establishments falling under the Seveso II and IPPC Directives to provide a consistent approach and minimise duplication of requests for information. Coordination would be ensured through communication between the relevant inspection authorities and exchange of information gained.
- Alternatively, it may be considered to integrate inspections, e.g. require that inspections take place at the same time such that essentially a single inspection activity aims to fulfil the requirements of the Seveso inspection and inspections for other purposes (IPPC).

### 5.2.1 Impacts of option components on coordination/integration of inspections

The aims and objectives of the Seveso II directive and the IPPC Directive differ in fundamental ways. The Seveso Directive aims at preventing accidental releases; events that are so rare that they are unlikely to happen over the lifetime of any single installation, but nevertheless have such completely unacceptable consequences that special regulatory attention is required. Experience from actual industrial disasters has clearly shown that operators were unaware of the hazard potential and that the accident scenarios that actually took place were largely unrecognized by the operator and authorities alike; and that the necessary preventive measures had not been taken and post-accident emergency measures for damage control were not in place. It has been an ongoing challenge to design inspections for latent and hidden weaknesses in the design or operation of such installations, weaknesses that at some time in the future may or may not result in an accidental release.

In contrast, the IPPC Directive concerns intended and planned emissions of harmful substances. Such emissions are often continuous and monitoring programs can beset up to demonstrate that emissions are within the limits of the permit. Though article 9.6 of the IPPC Directive do concern measures “relating

<sup>26</sup> E.g. by the High Level Group of Independent Stakeholders on Administrative Burdens. See Opinion of the High Level Group, 17 April 2009, Para 15.

<sup>27</sup> High Level Group of Independent Stakeholders on Administrative Burdens, Opinion of the High Level Group, 17 April 2009, Para 15 (f).

to conditions other than normal operating conditions” for which there is an overlap with the Seveso Directive, most other inspection objectives may not overlap.

Integration of inspections...  
- significant disadvantages

Currently relatively few inspections are integrated. Responses from and interviews with stakeholders as reported in the 2009 EC Seveso Effectiveness Report<sup>28</sup> suggests whilst integration of inspections may result in a more consistent assessment - and may reduce administrative burdens to the operator, disadvantages are significant. Disadvantages included inspections being more time consuming, risk of diluting the inspections and making them less effective.

Requiring integration of inspections for certain types of establishments may result in a decrease of protection level as a consequence integrated inspections being less effective.

Coordination of inspections

While integration of inspections may entail significant disadvantages, expanding best practices of coordination of inspections is broadly supported by all stakeholders. Encouraging that current coordination practices of Seveso, IPPC inspections and other inspections related to safety, to all Member States, may reduce some the administrative burden related to the preparation, presence of inspectors and follow up. It is furthermore likely to facilitate the sharing of information between Seveso and IPPC inspectors.

In Member States with a strong regionalism, enhanced coordination of the relevant inspection authorities in the regions would furthermore facilitate harmonisation of practices for inspection of the Seveso Directive and other safety related Directive requirements.

While better coordination on inspections is likely to lead to positive effects in terms of protection level, it is difficult to quantify such effects. Nor is it possible to determine the expected cost saving to business - without specific determination of the scope of such coordination in particular in terms of establishments for which coordination should be encouraged.

### 5.3 Mutual Joint Visits Programme

What is the issue?

The Commissions support for the implementation of inspection requirements via the Technical Working Group on Inspections and the Mutual Joint Visit (MJV) Programme is generally appreciated and there is a high demand for participation from inspectors and experts of member States. The MJV programme is for Seveso inspectors from across EU Member States that make joint visits to learn from how Seveso inspections are done in other Member States. The MJV Programme has since it was launched in 1999 served as a vehicle for promoting technical exchange among Member State Seveso II inspectors. Since 2005, the MJV Programme has encouraged visits focussing on topics of specific interest for Seveso inspections as identified by the Technical Working Group.

<sup>28</sup> The EC Seveso Effectiveness Report prepared by ERM for the EU Commission, 12 October 2009, see p. 74 ff.

- voluntary programme

The Programme is currently a voluntary mean to encourage the sharing and adoption of best practices for inspections through a system of regular information exchange. There is a strongly shared commitment to continuing to work together to increase the effectiveness of inspections practises and to ensure a consistent approach with respect to interpreting Seveso requirements through inspections across the Member States. To this end, it may be considered to include provisions for the MJV Programme in the Directive to ensure the continued development of the programme.

### 5.3.1 Impacts of codifying the MJV Programme

Option component

The following component option is considered:

- Highlighting the importance of the MJV Programme as a means of experience sharing and facilitate effective implementation of the Directive.
- In other words, provide for a codification of the existing MVJ Programme to encourage the sharing and adoption of best practices for inspections through a system of regular information exchange. The visits would continue to be hosted by different Member States and targeted to working inspectors of other Member States charged with assessing compliance with the Seveso II Directive in industrial installations.
- As is the case today the MVJ Programme would be managed by the Major Accident Hazards Bureau in consultation with the Technical Working Group (TWG) on Seveso II inspections.

The environmental and social impacts

A codification of the MVJ Programme would ensure that the MJV Programme is sustained as a vehicle for harmonised implementation of the Directive. It would commit the Commission and the Member States to work more closely to effectively address common obstacles that Member States face when enforcing Seveso II, such as multiple interpretation of rules, performing joint inspections, coordination challenges and updating and improving of inspection methods.

Economic impacts

Codification of the MJV Programme whereby existing tasks and activities at EU and national level would be continued would have no the economic impacts. The administrative cost at EU and national level of implementing the MJV Programme would remain the same.

This option component is suggested for inclusion in the overall option packages.

## 5.4 Formalising the Commissions role in supporting effective implementation

What is the issue?

The Commission plays an active role in facilitating better coordination experience sharing and among Member States and supporting their effective implementation of the Directive's requirements.. However there is currently no provisions for such actions, It has therefore been proposed to provide a mandate

for the Commission to support Member State implementation, including reflecting the role and tasks of the Major Accident Hazards Bureau (MAHB) of the European Commission's Joint Research Centre.

#### Option component

The following component option is under consideration:

- Provide a "mandate" for Commission to provide coordination and support to Member States' implementation.

#### Impact assessment

The Commission, including the Major Accident Hazards Bureau (MAHB) of the European Commission's Joint Research Centre currently carries out a number of functions and activities coordinating and supporting Member States' implementation of the Seveso requirements, e.g. based on the information provided by Member States on any major accidents which have occurred within their territory, the Commission evaluates this information, details lessons learnt from it, and disseminates the results to the Member States and industry. For this purpose the Commission maintains the Major Accident Reporting System (MARS) database at MAHB.

In order to assist Member States with the interpretation of certain provisions of the Seveso II Directive, the Commission in co-operation with Member States has elaborated the following guidance documents that are available from the MAHB, e.g. Guidance on the preparation of a Safety Report, Guidance on Land-use Planning, Guidelines on a Major Accident Prevention Policy and Safety Management System, Explanations and Guidelines on harmonised criteria for dispensations, General Guidance for the content of information to the public, Guidance on Inspections.

Furthermore, a series of answers to frequently asked questions (Q&A's), which have also been agreed upon by the CCA, is published and regularly updated on the MAHB website.

Whilst the guidance documents and Q&A's have no legal status, they provide valuable guidance to industrial operators as well as to enforcement authorities.

#### Impacts protection level

Enhancing the Commission's supportive role would facilitate tackling e.g. some of the identified problems, identified by the CCA Seminars concerning the understanding of some of the terminology of used in the Seveso II Directive, which currently may hamper effective implementation and enforcement of the Directive. To this end the Commission would on a continued basis take the lead in providing adequate and common understanding of terminology to be published in an easy accessible form and maintaining contact with industry to ensure that such common understanding is promoted throughout the whole compliance structure.

Providing a specific mandate in the Seveso Directive for Commission to provide coordination and support to Member States' implementation would ensure that the current tasks and activities of MAHB and the Commission is sustained as a vehicle for harmonised implementation of the Directive.

The environmental and social impacts      Whilst formalising and /or enhancing the Commissions - including MAHBs supportive role in implementation of Seveso II requirements is likely to lead to positive effects in terms of protection level; it is not possible to quantify such effects.

Economic impacts      Formalising the supportive role of the Commission - in whereby existing tasks and activities including those of MAHB would be continued would have no direct economic impacts, as the administrative cost at EU level would remain the same. Indirectly, support to implementation in the above mentioned forms could reduce costs to both operators and CAs. More harmonised implementation could also reduce - if they exist - negative effect on competition and the internal market.

The amendment component could therefore overall lead to cost reductions both regarding existing obligations and new obligations as part of other amendment components. This likely cost reduction effect can not be quantified.

This option component suggested for inclusion in the overall option packages.

## 5.5 Integration of information requirements and procedures with other legislation

What is the issue?      The purpose is to reduce the burden on industry's management system as well as the environmental management system.

Option components      There are two separate issues to be considered:

- Use other reporting formats in the Seveso context (e.g. provide specific Seveso information contained in an IPPC report)
- Integrate Seveso requirements with LUP and EIA/SEA procedures.

The review of the IPPC Directive did not identify a significant overlap in terms of the type of information to be provided. It was concluded that if the same type of information should be provided, it is just a question of attaching the information developed under one of the Directives in relation to either a permit application (IPPC) or safety report (Seveso II).

Some saving or simplification may result, but it is not possible to quantify these. It will depend on the specific requirements of each Member State.

Likewise integration of LUP and EIA/SEA procedures may be helpful if there are any opportunities for integration of procedures. Since procedures vary across Member States, it is difficult to estimate the impact.

## 5.6 Safety Performance Indicators

What is the issue?      Safety performance Indicators (SPI) is a way to attract focus to safety issues and thereby promote a safety culture. Annex III includes requirements that are

related to SPIs without explicit mentioned of them. In principle, monitoring of performance and audit and review are processes where SPIs could be an effective tool. SPIs can be used as an internal tool to monitor progress in the achieved risk and safety management.

While substantial progress within the field has taken place full consensus about the use of SPIs has yet to be reached. The OECD has produced specific guidance on how to develop such indicators for industry and public authorities (OECD 2003). There seems to be some uncertainty whether SPIs are sufficiently mature and well-developed to form the basis for a mandatory tool.

Typically, one distinguishes between lagging and leading indicators. Lagging indicators measure past performance, while leading indicators aim to predict future safety performance. Lagging safety indicators are well-established and in widespread use. Progress within this field relates mainly to the definition of leading indicators.

#### Options components

The following component options are considered:

- Include a specific requirement in the Directive for the use of SPIs (Annex III).
- Make references in the Directive to the benefit of using SPIs (Annex III).
- Provide guidance on how to use SPI. (This is a non-legislative option and it could be combined with any of the above-mentioned sub-options).

#### **5.6.1 Impacts of option components for safety performance indicators**

Before discussing each of the options for promoting the use of SPIs, it is worth considering the effects of using SPIs.

#### Impacts of SPIs

SPIs could for example be an important element for companies when defining and optimising their risk management. By having indicators for performance and combining them with appropriate cost indicators, it is possible to estimate the cost-benefit ratio of alternative measures to reduce or mitigate different kinds of risks. As discussed in Section 2.1.3, a company could be expected to undertake investment or increase maintenance if it lowers the risks so that the reduction in the expected damage costs from possible accidents exceeds the costs of the mitigating measures. In order to do such analysis information indicators of an SPI type would be needed.

The possible benefits of using the right SPIs are not only to support cost-effective operational and risk management but also to increase focus on safety culture and management throughout affected organisations. The right SPIs will allow staff to see the effect of improvement in safety management and this is likely to facilitate a continued focus on such improvements.

As with any indicator, if there is too much focus on a given set of indicators, the effort is targeted towards improving the indicators, which is not necessarily the same as improving overall safety. As the safety culture may vary across the EU, the introduction of the right SPIs needs to be considered in that perspective. New indicators should first of all promote the internal safety culture.

**Cost related to SPIs** Considering the costs of using the right SPI, one should distinguish between the administrative costs related to defining and compiling the relevant indicators and the costs of physical or other measures being identified through the use of SPIs. Regarding the latter, the costs of investments in safety and risk reduction are discussed in Section 2.1.3. These costs can be substantial - up to several million EUR. It should be noted that if the right SPIs are used to improve the basis for decision making, they might support more cost-effective investments in safety management and thereby lead to cost-savings compared to a situation where SPIs are not used or inadequate SPIs are used.

The specific costs of defining the right SPIs, recording data/gathering information and compiling the indicators are likely to be limited. It depends on the overall safety management system; in most cases the information to compile the right SPIs will be available or can be made available at relatively low costs.

**Impact on protection level** It is not possible to estimate the impact in terms of the estimated reductions in the number of accidents from increased use of the right SPIs. By strengthening the safety management systems and culture there is likely to be an impact in terms of fewer accidents though it is not possible to quantify this impact.

**SPIs mandatory** Making SPIs mandatory will lead to costs of developing and implementing the right SPIs at each site. If it is possible to define a standard set of the right SPI that can be immediately applied these costs for each site could be reduced but then there will be costs for CAs and the Commission in developing such a standard set of the right SPIs. Given the current state of SPIs and the varying experience of Member States in applying SPIs it is too premature to include SPIs as a mandatory requirement.

**Reference to SPIs** Instead, the option of including a reference in the Directive to promote the use of SPIs could increase the focus on the use of performance indicators while at the same time providing the necessary flexibility in Member States. For those Member States where the use of SPIs is most advanced the specific reference in the directive could be used as basis for requiring SPIs.

If only reference to the potential use of the SPIs is made in the Directive and inspectors are instructed not to push for those but rather treat their application as voluntary, no significant additional costs are imposed on industry. In this case it is up to each operator to decide whether to apply SPI as a tool in their safety management system or not and they can decide to apply the right SPIs only when it leads to overall cost savings.

Mentioning of the use of SPIs in the Directive could be accompanied by improved guidance on how to use SPIs. Guidance is likely to improve the use of SPIs.

**Guidance on SPIs** The last alternative is to only provide guidance on SPIs and make no change in the Directive as such. Good guidance could be important for the use of SPIs, whether just including the discussion of how to use SPI in the relevant guidance material will facilitate more use is difficult to say.

**Recommended choice of option component** It is suggested to revise the text in Annex III to incorporate specific mention of the use of SPIs. The text could recommend that Member States consider using the SPIs as a tool for monitoring internal safety improvement. This could be combined with better guidance to support the practical application of SPIs.

Including a reference to SPIs in the Directive combined with improved guidance would support the use of the right SPI as an effective tool in the management of internal safety. Such an option would leave it up to each operator to decide about the use and therefore it does not impose significant additional administrative costs on industry.

## 5.7 Safety management requirements for lower-tier establishments

**What is the issue?** The safety management requirements for especially lower-tier establishments are not very accurately defined. In particular, the relationship between the major-accident prevention policy (MAPP) and the safety management system (SMS) is not very clear, Article 7 stipulating only that they adhere to the principles laid down in Annex III.

This has resulted in widely different practices among the Member States. As a result many Member States require lower-tier establishments to require an SMS in one form or another. Moreover about half the Member States go further and impose additional requirements on lower-tier establishments such as a safety report (or mini- safety report) and internal emergency plans. The issue is therefore not only whether the existing provisions should be clarified but also whether there is a case for the Directive's requirements in relation to lower-tier establishments should be extended further bearing in mind the current two-tiered hazards-based approach.

**Alternative option components** The alternative option components are developed by considering the current requirements for lower and upper-tier establishments. Lower-tier establishments currently are under an obligation to:

- Take measures to prevent major accidents and limit impact of accidents (Art. 5)
- Notify about the storage of hazardous substances (Art. 6)
- Introduce a major accident prevention policy (Art.7)

The requirements for upper-tier establishments include several additional elements:

- Safety management systems
- Safety report
- Internal emergency plan (and information to allow CAs to develop external emergency plans)
- Information to the public.

Based on the requirements for upper-tier establishments, alternative ways to improve lower-tier requirements can be defined. The alternative option components to be considered include:

- Clarify the text in the Directive
- Extend full SMS requirement (as described in Annex III) into LT
- Require 'Mini' safety report including IEP for LT
- Require SMS, IEP and mini SR for the LTs (combination of the second and third options).

### 5.7.1 Impact assessment

#### Impact assessment

The impacts of these alternative options comprise the economic impacts on industry and CAs and the effects on the protection level.

Overall, the assessment of the impacts has taken account of the current differences in national requirements for lower-tier establishments. Several Member States have introduced additional obligations on lower-tier establishments, which effectively have reduced the difference between the requirements for lower and upper-tier establishments. This option component is therefore also about making clarifications that will enhance harmonisation across the EU.

#### Clarify the text

This option is to make it more clear what the MAPP means including defining the elements of Annex III which should part of the MAPP.

There is limited cost implication of this option, though it should make the implementation easier and it could reduce slightly costs for CAs and industry by avoiding questions and clarifications about the content of the MAPP.

#### Full SMS

This option would imply that all establishments should have a safety management system as set out in Annex III. Two thirds of the Member States already have introduced further requirement similar to SMS for lower tier establishments. However these requirements are often proportionate to the size of the establishment, degree of risks etc.

There no data available on the specific costs of introducing a SMS and two factors complicate the assessment. One is that the level of safety management

systems varies across organisations. So having a full SMS would entail additional costs. The second factor is that while many companies might already have formulated a SMS involving limited additional costs, there may be many others that do not. If an establishment does not have any formalised safety system, the costs of setting up an SMS could be very substantial. It will not only require analyses of accident hazards and prevention measures but the whole organisational part would take time and resources.

#### Mini Safety Report

Preparing a safety report is one of the most expensive administrative requirements. One of the important elements of the safety report is the work of defining and analysing major accidents scenarios. The complexity of this exercise depends on many site-specific conditions meaning that costs may vary significantly across establishments, even though there are limited data to support the actual degree of variation.

The main feature to consider regarding the "mini" SR is whether the requirement for defining major accident scenarios should be included. This is a potentially a very resource-intensive exercise. Among other things, it will depend rather on the number of dangerous substances at the site than on the quantities. Therefore, costs could be high also for a lower-tier establishment.

A possible definition of a "mini" safety report would be something in between the following two definitions: one where the requirement is similar to that of the upper-tier establishment and one where no major accident scenarios are defined. A safety report that does not consider possible major accident scenarios will be of limited value. Hence, a "mini" safety report could be defined as one based on one or two major accident scenarios.

It is roughly estimated that the costs of such "mini" safety report would be between 25% and 50% of the full SR. As an illustrative example a cost per SR at 25% of the full SR cost is applied. The best estimate for the average costs of preparing an SR amounts to 35,000 EUR and therefore the mini SR will about 8,750 EUR. An equivalent "mini" IEP is estimated at EUR 2,000. In total these administrative costs will be 10,750 EUR per lower tier site.

Based on the CCA survey on existing national requirements, it further assumed that 50% of the Member States (and establishments) already have similar requirements for lower tier.

An assessment of the economic impacts of the alternative options is presented below.

Table 5-4 Overview of impacts of lower tier options

	LT in % <sup>1</sup> of full	Cost per lower tier in EUR	Total costs in EUR	Protection level
Clarify the text in the Directive	Na		Possible marginal savings	No impact
Extend full SMS requirement (as described in Annex III) into LT	100%	Potentially high	Potentially high	Increased
Require 'Mini' safety report including IEP for LT	25%	10,750	25 million one-off	Increased
Require SMS, IEP and mini SR for the LTs (combination of the second and third options).	25%	>> 11000	>> 25 million one-off	Increased

Note 1): The costs of the LT requirement in % of the costs of the upper tier requirement e.g. costs of "mini" SR in % of SR.

The impact on the protection level from increasing lower-tier requirements is difficult to quantify. There no consensus among Member States experts about whether risks are less for lower tier - some see little difference. As for the economic impacts where it is assumed that about 50% of the Member States already have additional requirement, also for the protection level some of the effect should already be realised and impact will be less than if no Member States had additional requirements. Overall an increase in requirements that prompt better safety culture and systems should have an impact on the risks of major accidents, though it can not be quantified.

## 5.8 Safety Report guidance etc.

### What is the issue?

This issue mostly concerns about information sharing and guidance to Member States in relation to assessing safety reports (SRs). The various review studies, primarily the implementation study (the ERM study), include findings on the need for guidance and best practice in relation to assessment of the SRs. The results of these reviews do not point to a specific, defined need. Some Member States have already drawn up their guidance/checklists.

### Alternative options

Given that the need for additional guidance is not precisely defined in the review studies, an option could be to investigate the present uses of and need for more guidance. Findings could be used to develop simple guidance/best practices that can be made available in the form most useful for the relevant Member States officials.

### Impacts

To investigate the specific need for more guidance and best practice, to develop and disseminate the guidance/best practices, a collaborative project involving Member States and Commission participation could be undertaken. The costs of such a project would be in the order of EUR 250,000.

The impacts include in addition to the costs of undertaking a guidance/best practices project, also benefits. One such benefit is that the guidance could improve the efficiency of assessing Safety Reports. If enhanced guidance in this respect leads to savings in the order one hour per upper-tier establishment, effi-

ciency savings in the first year will pay back the costs of developing the guidance material.

Even though better guidance can lead to positive effects at the protection level, it is not possible to quantify such effects.

## 5.9 Domino effect

What is the issue?

A domino effect occurs when a Seveso installation (site A) is impacted by an external accidental event from another (typically non-Seveso) installation (site B). Domino effect provisions (article 8) are only loosely defined. Member States must ensure "a suitable" information exchange between the two parties. In practice, a number of obstacles may hinder this. Firstly, site B may not have systematically identified hazards and thus be unaware of its accident projection potential. Secondly site A (and sometimes authorities) has no legal right to demand that site B undertakes risk mitigation efforts.

The main responsibility lies with the Member State CA, as they are the only party who has sufficient overview to assess whether a domino effect can occur.

In identifying relevant risk situations, CAs should consult reports from the Seveso sites detailing whether external factors can initiate a major accident. This reporting element should in principle form part of the SR (Annex II, IV.A). For lower-tier establishments there is no equivalent requirement.

Another potential outcome of improving the information both from the Seveso sites and from CAs on the external emergency plan is that non-Seveso sites become aware of not only how they can be affected but also how they can initiate a major accident.

Options components

The principle option components are:

- No nothing or
- Improved clarity of information obligations in Article 13, relevant provisions in Article 6(notifications) and Annex II (safety report).

Impact assessment

The costs of clarifying information obligations are likely to be low assuming that the operators already consider external factors. Improved dissemination of information to non-Seveso sites will not be resource demanding and it will part of the general improvement to the provision of information to the public; see Section 3.26.

The impact on the protection level is difficult to assess. First of all the consequences of the domino type of situations are not known. The ERM study includes questions to the CAs on the importance of domino effects in land use planning, but the answers do not provide insight into the actual importance of domino situations.

## 5.10 Land use planning

What is the issue?	<p>The Directive includes requirements on land use planning for new installations and a vaguely phrased requirement "<i>to take account of the need in the long term to maintain appropriate distances</i>" which could include existing installations.</p> <p>Experience has shown that the majority of Member States have been very slow in coordinating and integrating Seveso requirements in land use planning practices and there is obviously a need to review the requirements related to this field. The objective would be consider how land use concerns can be better integrated in the land use planning practice and how the requirement can be extended to cover also existing installations.</p>
Alternative option components	<p>The relevant alternative option components are:</p> <ul style="list-style-type: none"> <li>• Small clarifying modifications, no significant changes             <ul style="list-style-type: none"> <li>- Clarify requirement for both man and environment;</li> <li>- Links to EIA and similar legislation.</li> </ul> </li> <li>• Extension of Article 12 provisions:             <ul style="list-style-type: none"> <li>- Extend LUP obligations to all upper-tier plants;</li> <li>- Clarify requirement for new lower tier sites;</li> <li>- Links to EIA and similar legislation;</li> <li>- Clarify requirement for both man and environment.</li> </ul> </li> <li>• Leave out Article 12, -&gt; planning issues (including risk/hazards) to be addressed better in planning legislation;</li> </ul>

### 5.10.1 Impacts of option components concerning land use planning

Minor clarifications	<p>The option involving minor clarifications is likely to result in few impacts. The additional administrative costs would be very limited. In fact, savings could be achieved if the specific links to the EIA/SEA Directives could prompt the LUP consultation to be part of the EIA consultation. According to the ERM study<sup>29</sup>, this is not very frequent at the moment.</p>
----------------------	--

It is difficult to assess whether the more explicit reference to the environmental aspects will have any impact as it depends on the current practice. In general, there are only a limited number of new Seveso establishments and inherently only few examples of the application of LUP requirements.

---

<sup>29</sup> ERM (2009), Annex C, Question C17, though there are many who have not answered the question.

## Extending the LUP requirements

The rather ambitious option of extending LUP requirements to cover existing upper-tier establishments could bring about significant impacts.

If such an extension implies that certain establishments would have to cease some of its activities or relocate activities or that restrictions would be imposed on the surrounding areas, the costs would be substantial.

There are many different approaches the LUP applied across the Member States<sup>30</sup>. One of the more comprehensive approaches is the French requirement for all upper tier sites to have Plan de prévention des risques technologiques” (PPRT). This plan is compulsory for both new and existing sites. The process involves<sup>31</sup>:

- Land-use planning is decided once all possible risk reduction measures have been taken at facility level;
- Based on a probability-severity approach;
- Sets co-funding as a principle for bearing the cost of the land-use measures. Costs are shared between the industry, the state and the municipality;

The PPRT legislation provides for expropriation of residential and other property in the vicinity of the site if other measures can not reduce the risks. So far only few plans have been prepared as it is being gradually implemented.

Looking at the estimated costs of the French PPRT and the current status provides insight into what the implications of extended LUP requirements could be.

The estimated total cost for French PPRTs (land measures including several thousands of expropriations and relinquishments) is about 2.3 billion €. The average cost for the development of a PPRT is about 30 k€. It takes one person half a year to elaborate the plan<sup>32</sup>.

Currently, the French authorities have approved 44 PPRT (out the total of 420) and none of them has lead to relocation of the establishment. 327 of them are under the process of deciding what should be done. It is estimated that there would be only 4 or 5 relocations. Among the 44 PPRT approved, 7 include land measures (expropriation or relinquishment), and the other measures in relation with these PPRTs are common measures like:

- Building interdiction in the most exposed areas;

<sup>30</sup> Basta, Strukl and Chistou (2008) *Overview of Roadmaps for land use Planning in Selected Member States*, JRC Scientific and Technical Report

<sup>31</sup> Dr. B. Affeltranger, C. Lenoble (2009) *Application of « SEVESO II » Directive in France: Land-use Planning around Industrial Facilities*

<sup>32</sup> Personal communication July 2010: Loïc Malgorn, Ministry of Ecology, Energy, Sustainable Development and The Sea and in charge of green technologies and climate change negotiations, France

- Local regulation imposing reinforcement measures to existing and future buildings; and
- Selection of future land where developments are allowed.

Based on the French experience a rough estimate can be made for the EU. Assuming the preparing the plan - without any physical measures - would cost at least 30,000 EUR as in France, applying this to all 4500 upper tier sites would result in total costs of about EUR 130 million.

Adding physical modifications or even expropriation could lead to very substantial costs even though relatively few sites would require major physical measures. The French estimate for the total costs amounts to 2.3 billion EUR and that covers 420 sites. An upscale to all upper tier establishments lead to total costs estimate for EU27 at 25 billion EUR.

The Austrian Ministry of Environment has considered this issue of a simple safety distance for all sites in a review of the implementation of the Seveso II Directive in Austria. A scenario assuming that an area around each establishment would be restricted in use leads to a total cost of imposing a simple rule for safety distances. In the Austrian case, the costs of a 300 m safety distance leading to about 250,000 m<sup>2</sup> of restricted area. Based on the 145 Austrian Seveso II sites and applying a land value of 95 EUR/m<sup>2</sup> total costs amount to EUR 3.4 billion<sup>33</sup>. Similar scenarios can be made for EU27 using the total number of upper-tier sites and an appropriate land value.

These considerations demonstrate that costs of applying the LUP requirement to existing establishments could result in very high costs - though one-off costs though could amount to at least several hundred million Euros and likely even into billions of Euros.

The benefits system such as the French PPRT could be quite substantial. Given that there are sites that are located for example close to residential areas there could be important improvement in protection levels to be gained. A systematic approach as the PPRT would ensure that the local aspect is taken into account. Though the costs as discussed above could be substantial, the process allows for considering whether expensive measures such as relocation is worth the improved protection level. The approach can build in the balancing of the economic and protection level concerns.

The challenge of estimating the impact of such an extension of LUP requirements is that the number of current establishments that would be affected by the application of LUP requirements is not known.

Similarly, the impact on the protection level depends on the changes entailed by the extension. If there are currently many establishments (upper tier) where appropriate safety distances are not maintained, the extension would increase the protection level.

---

<sup>33</sup> Binter (2008), *Konkrete Effekte der Implementierung der Seveso-Richtlinien in Österreich*, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

Generally, there is good correlation between high compliance costs and a high protection level. This still leave the key issue of balancing how much additional compliance costs that would be justified by the increase in protection level.

#### Remove Article 12

This option is to take out Article 12 and leave the planning issues to the relevant planning legislation (e.g. EIA and national planning regulation). The land use planning aspect is very important for dealing with major accident hazards. The existing planning legislation including EIA does not include sufficient provisions of dealing with major accident hazards. Hence, without changes to other legislation, taking Article 12 out would therefore lead to a significant reduction in the protection level.

The cost implication is difficult to estimate. The CAs have to spend resources on "approving" any new site or modification to a site and so excluding the LUP aspect would therefore not necessarily lead to any reduction in administrative costs. In case public consultation is required, it is likely also to be required under the EIA legislation. So if the two processes are aligned there should be limited specific administrative costs associated with the Article 12 provisions. The first option - about minor clarifications - includes exactly the requirement to align with the EIA legislation.

The impacts of the alternative options are summarised below.

*Table 5-5 Overview of impacts of land use planning amendment options*

Option component	Economic impacts in EUR	Protection level	Other impacts
Minor clarifications	No additional costs - potential savings from aligning consultations with EIA legislation	No significant impacts	
Extent LUP requirement to all upper tier establishments	Potentially very costly to implement  The planning process could alone lead to one-off costs in the order of hundred millions of EUR.  Physical measures would most likely lead to one-off costs of several hundred million EUR and possible to costs of billions of EUR	Potentially significant improvement as many sites are located with insufficient safety distances	
Remove Article 12 (leaving LUP issues to planning legislation)	Limited impacts	Significant reduction in protection level	Would also require other planning legislation to be amended

## 5.11 Underground storages

What is the issue?	It seems that there is a non-harmonized approach among Member States in relation to whether underground gas storage sites are comprised by Seveso II or whether they are exempted due to a classification as "mining extraction sites".
Options	<p>The principle option components are:</p> <ul style="list-style-type: none"> <li>• Do nothing</li> <li>• Clarify Directive so that it clearly stipulates that underground gas storage should be included.</li> </ul>
Impacts	<p>The Commission has made a survey among Member States to investigate the current practices for underground gas storage. The survey from October 2008 shows that about 50 sites across EU27 are not covered by Seveso II. The survey also shows that the majority of sites are already covered. In total there are about 150 underground gas sites out of which 100 is already covered by the Directive.</p> <p>The economic impact of including the 50 sites would be in order of EUR 1.5 million annually assuming that all sites would become upper tier establishments. Currently around 90 per cent of the sites are upper tier establishments.</p> <p>The protection level will be increased given the significant, major accident hazard potential associated with underground gas storage facilities.</p>
Choice of option	<p>Discussion among Member States has indicated that there is agreement that most of the sites should be covered by the Directive.</p> <p>The Directive should therefore be revised to clarify that underground gas storage facilities should be covered by the Directive.</p>

## 5.12 Environmental aspects

What is the issue?	The purpose of this amendment component is to consider how to strike a better balance between health, nature and environmental impacts and to make sure that environmental impacts are more explicitly considered..
Option components	<p>The following option components are considered:</p> <ol style="list-style-type: none"> <li>1 Include more details on the environmental aspects in Annex II</li> <li>2 Include specific reference to the environmental aspects in emergency planning (Annex IV)</li> <li>3 Include specific reference to the environmental aspects in Article 12 (LUP).</li> </ol> <p>These options are not alternatives, and they will be assessed separately.</p>

**Impact Assessment** As mentioned in option component 1, it could be advisable to detail Annex II Safety Report requirements in terms of impacts on human health and the environment. It stipulates that major accident scenarios include a description of the consequences. This could be amended to specify the type of consequences that should be addressed.

If, as in option component 2, only the environmental aspects and impacts are not sufficiently described in SRs, including specific reference to environmental aspects in emergency planning could slightly increase the costs of developing and updating the SR. Similarly, the option could lead to the implementation of more measures thereby reducing the risks of environmental impacts. Overall, the impacts are likely to be small.

For Annex IV, on emergency planning, it could similarly be specified that environmental impacts should be considered and that appropriate measures to mitigate such impacts - typically on the aquatic environment - should be part of the plan. This would increase the costs of developing the plan and would increase the protection level in relation to the environmental impacts.

Option component 3, including specific reference to environmental aspects in Article 12 on land use planning, is less straightforward to assess. The land use planning article is mainly about setting appropriate safety distances to for example residential areas in order to reduce the risks of human health impacts. It is difficult to draw general conclusions on whether locating industrial sites away from residential areas would lower the risk of environmental effects. Most likely the environmental impacts would either remain the same or increase if LUP means moving industrial sites away from residential areas. It is therefore not simple to state how to additional requirements to safeguard to the environment should be specified. If there is a trade-off situation between the protection of human health and the environment, priorities need to be defined.

Overall, explicit information about environmental aspects could increase protection against environmental damage but also lead to higher costs in terms of SR, emergency planning and physical mitigation measures.

### **5.13 Emergency planning - deadlines**

**What is the issue?** The issue is whether to set clear deadlines for the completion of external plans by Member States. Currently, Member States are at varying stages of completing emergency plans.

**Alternative options** The alternative option components are:

- Do nothing
- Introduce a 12 months deadline (Article 11).

**Impacts** This option component does not involve additional costs, as emergency plans have to be developed in any case. Benefits may be reaped in terms of improved

protection level as the period without emergency plans is reduced. This option component is therefore suggested for inclusion in the overall option packages with no further analysis.

### 5.14 Emergency planning - guidance

**What is the issue?** Potentially, there is a need for improved guidance on emergency planning. Both the F-Seveso and the ERM effectiveness study have looked at the need for better guidance on emergency planning with focus on the need for guidance testing of emergency plans. Some Member States have already developed national guidance material and have less need for additional guidance material.

**Option** The principle option considered is:

- To develop additional guidance material for emergency planning.

**Impacts** Given the differences across Member States, the guidance could be developed by reviewing existing practices in emergency planning and testing and by drawing out examples that would be useful to disseminate across all Member States. The guidance would therefore take the form of a best practice and example inventory rather than traditional guidance material.

To investigate the specific need for more guidance and best practice, to develop and disseminate the guidance/best practice, a collaborative project with the participation of Member States and Commission should be undertaken. The costs of such a project would be in the order of EUR 250,000.

Even though improved guidance can lead to positive effects on the protection level, it is not possible to quantify such effects.

### 5.15 Specific deadline for reporting of accident

**What is the issue?** There is currently no specific deadline for when a Member State have to report an accident. This means that in some cases this reporting is only done with a long time lag.

**Option** The principle option component is:

- Specify a deadline of 12 months for reporting of accidents.

In principle, other deadlines may be considered.

**Impact assessment** Limited impacts can be expected of this potential amendment. Potential implications of this amendment relate to the time spent on investigating accidents, which in turn may delay reporting. It is not certain that the most appropriate deadline is 12 months, but a specific deadline will be recommended as part of the overall option packages.

## 5.16 Change threshold for when accidents have to be reported

**What is the issue?** Section 1.1 of Annex VI requires the reporting of any fire or explosion or accidental discharge of a dangerous substance involving a quantity of at least 5% of the upper-tier threshold laid down in Annex I. This means that an accident with for example release of 1 tonne of chlorine (< 5 % of the upper tier threshold) would not require reporting. A reduction of the threshold to 5% of the lower tier threshold or some other threshold could possibly bring more accidents with significant high quantities of dangerous substances within the reporting system and improve its benefits.

**Option components** The alternative option components are:

- Leave the qualifying threshold at 5% of the UT threshold; or
- Reduce the qualifying threshold to a significantly lower level.

There are various ways to define a lower level of the thresholds for reporting of accidents. Pragmatic ways to reduce the thresholds include: i) to define the threshold as 5% of the lower tier thresholds or ii) to reduce it 1% of the upper tier thresholds. Both ways will reduce the thresholds by a factor of 4-5. For example the difference between LT and UT thresholds vary with factor of 2 to 10, for most of hazard categories it is around 4. As it can be seen in the next section on the impact of this possible amendment, it could lead to twice as many accidents being reported from 25 per year to about 45-50.

It should be emphasised that the change is relevant for all establishments as it just defines the qualifying quantity.

### 5.16.1 Impacts of option components related to changes of thresholds for accident reporting

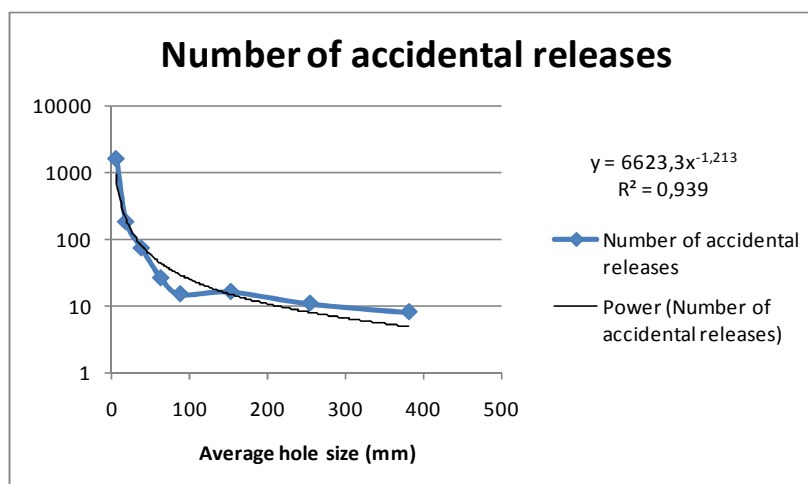
Statistics on accidental releases of dangerous substances were examined in order to estimate the likely increase in the number of reportable accidents triggered by this cha. Releases statistics from Seveso companies are unfortunately not readily available. Instead, we used available data from the UK Health and Safety Executive's (HSE) hydrocarbon releases system. This system contains information on all offshore releases of hydrocarbons reported to the HSE Offshore Division under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR), and prior offshore legislation.

The reported offshore releases include information on the amount spilled. Offshore installations are quite congested, space is limited, and only the most basic processing is carried out for the products to be transported to land where further processing takes place. There is too much difference between the amounts of dangerous substances present at offshore and onshore installations for statistics on the quantity spilled offshore to be useful for Seveso installations.

Release frequencies, however, are more comparable. In the HSE's hydrocarbon releases system, we extracted the number of reported releases for common types of process equipment like piping, flanges, valves, heat exchangers, pressure vessels, pumps and filters. We excluded less common types of process equipment such as compressors and turbines as well as specific types of offshore equipment, such as wellheads and x-mas trees. An analysis of data for 1992-2008 yielded a total of 1,618 reported releases. Breakdown of the data per hole size is not entirely straightforward, in particular for the very large hole sizes and requires data manipulation based on engineering judgement.

The analysis produced a frequency versus hole-size relationship, which is depicted in the graph below. In principle, this relationship should follow an exponential distribution. For reasons of simplicity and various shortcomings in the data, we fitted the data to a power law of the form  $y = b x^a$ . using regression analysis. It can then be shown that a change in the release hole size expressed as a factor  $c$  leads to a change in the number of releases by a factor of  $c^a$ .

Figure 5-1 Estimated frequency versus hole-size relationship for 1,618 reported accidental releases of hydrocarbons on offshore installations



The reporting obligation of the Seveso Directive is defined in terms of total quantity spilled. As a crude measure, the size of the hole could be taken as a proxy for the total quantity spilled. It could be argued, however, that the release rate expressed as mass per second would be a better proxy as the release rate multiplied with the release duration theoretically would compute the amount spilled. Either proxy is imperfect, however, as both ignore other highly important predictors for the total amount spilled, most notably the inventory of dangerous substances present in the section of the plant that experiences a release (as opposed to the total inventory present at the site) and standard emergency interventions, such as isolation of the leaking section to cut off flow to the point of leakage.

For the purpose of this impact assessment, the corresponding increase in the number of reportable accidents has been estimated using both proxies. Factors

range from 2.3 to 16 depending on the proxy used and the difference between lower-tier and upper-tier threshold amounts.

*Table 5-6 Estimated corresponding increase in the number of reportable accidents if reporting threshold amounts are reduced*

		Factor by which the reporting threshold is reduced
		4
Proxy used	Release rate	2.3
	Hole size	5.4

The arithmetic average of all factors results is an overall best estimate - the number of reportable accidents is estimated to increase by a factor of four.

Assuming that there are current around 25 major accidents reported every year and that 5 of them are due to threshold criteria, the reduced threshold value could lead to additionally 20 major accidents being reported.

*Table 5-7 Overview of impacts of changing thresholds for reporting accidents*

Option component	Economic impacts in EUR	Protection level
Do nothing	No impacts	No impacts
Reduce threshold to 5% of LT or to 1% of UT	20 additional major accidents reported	Not quantifiable but it will increase learning as more accidents are being reported

This will lead to a moderate costs to operators and CAs in preparing the reporting document. It is relatively basic information that needs to be reported and assuming the it reporting document can be compiled in about 1-2 days, the total additional man-hour input would be 20-40 days per year. The impact on the protection level can not be directly assessed but more accidents being reported will increase the learning and practice improvement which is important for further improvement in accident prevention.

Overall, this option component would lead to a significant improvement in the potential for learning from actual accidents by doubling the number of accidents being reported at very limited additional costs.

## 6 Impact assessment of option packages

### 6.1 Options packages

#### Option packages

Based on the analysis of the individual amendment components presented in Chapter 3 to 5, the following three main options have been defined as combinations of the individual component:

*Option 1: 'no action', i.e. no changes to the Directive*

Option 1 is the baseline option. Typically the baseline is continuation of the current situation. In this case, due to the follow-on effects of the CLP and REACH regulation, the "No action" option will not necessarily be a simple continuation of the current situation. The difference between the current situation and the "baseline" is taken into account when estimating the impacts of the alternative option packages.

*Option 2: key amendments to the Directive to clarify and update certain provisions*

Option 2 focuses on provisions that could improve various aspects of the efficiency of the overall working of the Directive as well as several minor clarifications. These potential amendments have typically been identified through the review of the Directive.

*Option 3: more ambitious changes and improvements to the Directive*

Option 3 sets forth more ambitious changes to the Directive. Similar to Option 2, this option is based on the amendment issues identified during the review process. It also takes into account the general development that creates new technologies and therefore leads to considerations of many new accident hazards.

#### 6.1.1 Definition and overview of option packages

Based on the assessment in Chapter 3 to 5, the alternative option components to be included in each of three main options are presented in the table below.

Table 6-1 Definition of option packages

Amendment	Alternative option components for each potential amendment	No Action option	Key amendments option	Ambitions amendments option
Possible broadening of derogation rule (Article 9.6 and Commission Decision of 26 June 1998 on harmonised criteria for dispensations) to allow also for harmonised EU wide substance derogations	1) Do nothing 2) Extend the current derogation to allow for more requirements to be exempted 3) Extend the current derogation rule to allow for substances to be exempted from scope based on harmonised EU decisions. (2) and 3) can be combined)	√	√	√
Include Safeguard clause for substances and mixtures (linked with derogation, information obligation to the Committee)	1) Do nothing 2) Include safeguard clause for substances and mixtures	√	√	√
Delegate to the Commission the power to adopt amendments to Annex I via delegated acts	1) Do nothing 2) Expand the provision of the use of Article 22 to include changes to Annex I	√	√	√
CO <sub>2</sub> , inclusion as named substance	1) Do not include	√	√	
	2) Include with high thresholds			√
	3) Include with low thresholds			√
Heavy fuel oil to be included as named substances with higher thresholds	1) No action (Do nothing) 2) Include as named substance - consider alternative thresholds	√	√	√
H2: Delete as named substance leading to higher thresholds	1) No action (H2 remains a named substance with 5/50 tons thresholds) 2) H <sub>2</sub> (hydrogen) is deleted as named substance and the threshold is changed to 10/50 tons.	√	√	√
1.1 Aerosols (FEA proposal to increase thresholds)	1) Apply the threshold from CLP alignment work (the no action option) 2) FEA proposed thresholds (higher than the CLP alignment proposal).	√	√	√
Sodium hypochlorite (Include as named substance with current thresholds)	1) No action - the thresholds will increase due to reclassification under CLP 2) Include as named substance (with current thresholds)/derogation based on packaging			√
CO <sub>2</sub> , inclusion as named substance	1) Do not include	√	√	√
	2) Include with high thresholds			
	3) Include with low thresholds	√	√	√
Underground storages	1) Do nothing	√		
	2) Reviewed definition of underground storage		√	√
Information obligations in relation to Article 19 and 13.1(Annex V) in particular information to the public - options for improving content and management of information	Content of information to the public: A) As today B) As today plus on-line availability C) Revised Annex V D) Non-technical summary of SR and EEP	√	√	√
	Management of information: 1) As today 2) MSs have to operate database with public access 3) EU central website/database as entry to publicly available information	√	√	√
Coordination of inspections;	1) Do nothing	√		
	2) Encourage coordination of inspections in MS		√	√

Codification of MJV programme	1) Do nothing	√		
	2) Make the mutual joint visits mandatory as a means to enhance experience sharing between Member States.		√	√
Provide a mandate for the Commission provide coordination for and support to MS in their implementation of the Directives requirement	1) Do nothing	√		
	2) Provide a mandate for the Commission to provide coordination for and support to MS in their implementation of the Directives requirements g		√	√
Extend possibility of using info provided already under legislation (second sub paragraph of Article 9.2)	1) Do nothing	√		
	2) Using other reporting formats and information in Seveso context (e.g. provide specific Seveso relevant information contained in an IPPC report)		√	√
Possible integration of procedures under LUP and EIA/SEA	1) Do nothing	√		
	2) Integrate Seveso requirements with LUP and EIA/SEA procedures		√	√
Safety Performance Indicators (SPIs)	1) Do nothing	√		
	2) Make reference only		√	√
	3) Include requirements			
Requirements for lower tier (LT) establishments around safety management etc.	1) Do nothing	√		
	1) Minor clarifications		√	
	2) Extend full SMS to LT			
	3) 'Mini' safety report including IEP for LT			
Article 8 (Domino effects): Exchange of information with and need to take account of risks from non-Seveso sites	4) Require SMS, IEP and mini SR for the LTs			√
	1) Do nothing	√		
	1) Include requirement in Article 8 to include the link with non-Seveso sites		√	√
Change to land use requirement Article 12	1) Do nothing	√		
	2) Small clarifying modifications, no significant changes,		√	
	3) Extension of Article 12 provisions			√
	4) Take out Article 12, -> planning issues			
Environmental aspects (revise Directive text to include more details in relation to environment)	1) Do nothing	√		
	2) Include more details in relation to the environmental aspects in Annex II, IV and LUP		√	√
Imposing clear deadlines for Member States to complete external plans	1) Do nothing	√		
	2) 12 months deadline (Article 11)		√	√
Specific deadline for reporting of an accident	1) Do nothing	√		
	1) Specify deadline as 12 months		√	√
Change the requirement (Annex VI, I.1) for the reporting obligation	1) Do nothing	√		
	2) Increase requirement by reducing threshold to 5% of LT threshold		√	√

### 6.1.2 Impacts to be analysed

#### Types of impacts

For each of the three option packages the assessment of the impacts has been carried out following drawing on the results of the assessment of each of the issues. The types of impacts most relevant for this assessment of possible amendments to the Seveso II Directive include:

- Economic impacts
  - Administrative costs to industry
  - Costs to Member State CAs
  - Changes to risk of property loss due to major accidents
- Environmental impacts
- Social impacts
  - Impacts on human health
  - Impacts on employment

#### Key assumption on impacts

For the economic impacts, the focus is on the administrative costs. As discussed on Section 2.1.2 there are also non-administrative compliance costs, for example costs of monitoring and warning systems for storage facilities. Compliance costs related to such physical modifications could be substantial but they are very site specific and it has not been possible to quantify these potential costs. It is also a question of how often such modifications will be additional given that there is other legislation for example on workers protection that will require similar modifications.

Most of the analysed options do not change the number of establishments and they also do not directly require physical changes at existing Seveso sites. Therefore, administrative costs to industry and CAs are main cost elements.

The analysis of each of the amendment issues has addressed how the protection level could be affected by alternative amendments. The protection level aspect covers protection against environmental damage, against damage to human health and against damage to public and private property. Therefore the environmental and part of the social impacts follow directly the results regarding the protection level.

## 6.2 Option 1: "No action" option package

Given that the CLP relegation will introduce changes, there is no option that maintains the exactly the current scope of the Directive. The "No action" option package will thus have impacts compared to the current situation.

The impacts of the "No action" option package depend on the choice of alignment of Annex I Part 2 categories with the CLP legislation. There could be both increases and decreases in scope as a result of the CLP alignment when compared to the current situation.

The "No action" option package includes the "no action" alternative for each of the option components.

### 6.2.1 Economic impacts of "No action" option package

There are a few areas where the CLP alignments as they are expected to be implemented could increase scope. It is the case for aerosols, sodium hypochlorite and heavy fuel oils. Here the new CLP based classification could bring in a number of new sites.

This could potentially amount to at least 2-5 million EUR per year.

The general CLP alignment of the Annex I categories could lead to more significant increases of scope and if it brings in for example 5% more establishments the additional annual costs could be up to 8 million EUR compared to the current situation.

### 6.2.2 Environmental impacts of "No action" option package

The environmental impacts are linked to the changes in protection level. The analysis of the impacts on the protection level that follows from the "no action" option components are generally very limited or there are no impacts. Hence, the "No action" option package will have no or very limited environmental impacts.

### 6.2.3 Social impacts of "No action" option package

Under the heading social impacts, the two relevant types of effects to consider are:

- Impacts on human health; and
- Impacts on employment due to economic impacts on business.

The health impacts are linked to the changes in protection level. Similar to the argument above for environmental impacts, given that there is no or very limited impact on the protection level, the "No action" option package will have no or very limited human health environmental impacts.

No conclusion can be drawn regarding the possible employment effects that could be the result of additional costs to business. As mentioned in the discussion of the economic impacts, there is a potential for an increased scope leading to more substantial cost increases. Though they are unlikely to have major employment effects, there could be minor impacts.

## 6.3 Option 2: The "Key amendments" option package

The "Key amendment" option package includes the following main changes:

- Increased derogation options
- Introduction of safeguard clause

- Provision for changes to Annex I through delegated acts
- Additional information to the public (basic data on all establishments and key accident scenarios for upper tier) and information to be on-line available
- Management of information, databases, etc
- Increase requirements for lower tier sites with SMS
- Reduce threshold for reporting of major accidents
- Other amendments on coordination and deadlines for reporting etc.

The most important change is about the provision for using delegated acts to make changes to Annex I (Part 1 and Part 2) and to give EU wide derogations for certain substances.

The impact of the set of changes are summarised in the below table.

*Table 6-2 Impacts of key amendments option package*

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
<b>Procedure for changing Annex I</b>			
Allow MS to grant derogations from some or all Seveso requirements based on harmonised criteria	Potential savings for industry and CAs	No impact (condition for derogation)	
Allow EU wide substance derogations	Potential significant savings for industry and CAs	No impact (condition for derogation)	Allow flexibility in light of CLP and REACH
Introduce Safeguard clause	Potential increase in scope compared to "no action"	Potential increase in protection level	Allow flexibility in light of CLP and REACH
Provision for changes to Annex I via delegated act	Limited direct costs	Maintain or increase protection level	A pre-condition for derogation and safeguard clause
<b>Changes to Annex I</b>			
Aerosols: Do nothing (the CLP proposal of 150/500)	App. 0.5 million EUR per year	Unchanged/ slightly increased	
Sodium hypochlorite: Do nothing (CLP for mixtures will	Up to 2.7 million	Increased?	

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
apply)	EUR per year		
<b>Other amendments</b>			
Additional information on basic data for all sites plus accident scenarios etc for upper tier (revised Annex V)	One-off costs around 2-4 million EUR Annual costs up to 0.5 million EUR	Improvement of information available Better access to information (for public with internet) - less impact in case of accident	Allow to learn from other - (best practices)- monitoring of actual implementation etc
Information management: Simple website with links to documents either directed uploaded on the EU site or links to MS websites with the information/documents	50,000-100,000 per year in maintenance plus some MS costs One-off costs of 1 million to set up link/upload documents	Significant Improvement of information available - through allowing the implementation of option B to D	Allow to draw lessons between establishments and MS (best practices)-Allow monitoring of actual implementation for both CAs and COM
Require coordination of inspections	Cost savings	No impact or slight increase in protection level	
Codification of the MVJ programme	No additional costs	No additional impact	Important for sharing of best practices so the programme increase efficiency in implementation
Formalising Commission support to implementation	No additional costs	No additional impact	The support could increase efficiency in implementation
Coordination with IPPC and other legislation	Possible cost savings	No impact	
Include reference to the use of SPI for internal safety	No additional costs	Potential increase	
Increase safety management requirements for lower tier to include SMS	Potential significant costs	Some increase	Variation across MS due to difference in national require-

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
			ment
Clarifications of land use planning requirements	No costs or potential savings from alignment with e.g. EIA/SEA procedures	Limited impacts	
Include underground gas storages	App. 1,5 million EUR per year	Increased protection from 50 storages being included	
Introduce deadline of 12 month for External Emergency Plan preparation	No additional costs	Improved protection	
Introduce deadline of 12 month for reporting of accidents	No additional costs	No significant impacts	Better learning as accidents are being reported more promptly
Reduce threshold for reporting of major accidents to 1% of UT or to 5% of LT	20 additional major accidents reported	Not quantifiable but it will increase learning as more accidents are being reported	
Clarify requirements regarding Environmental aspects	Limited additional costs	Improvement in protection level with respect to environmental damage	
Exchange of information with and need to take account of risks from non-Seveso sites (in relation to Domino effect)	Limited costs	Possible improvement	

### 6.3.1 Economic impacts of the "Key amendments" option package

As described above, the economic impacts can only be quantified for some of the amendment components while there are both possible savings and costs that remain described only qualitatively.

There are few cross impacts where one option component increases costs of another option component. No such cross impacts have been quantified.

The cost implications are summarised below.

Table 6-3 *Economic impacts of key amendments option package*

	<b>Costs or savings to industry (administrative)</b>	<b>Costs to Member States</b>
Annual costs	4-5 million EUR	Approximately 0.5 million EUR
One-off costs	2-3 million EUR	4-5 million EUR
Non quantified costs and savings	Introduction of derogation provision could potentially result in savings compared to the baseline	Introduction of derogation provision could potentially result in savings compared to the baseline
Protection level - savings	The option package will increase the protection level and thereby reduce the risk of damage to private property.	

### 6.3.2 Environmental impacts of the "Key amendments" option package

The environmental impacts are linked to the changes in protection level. The impact on the protection level can only be assessed qualitatively. None of the amendment options included in the "Key amendment option" results in reduced protection level. There are several options that potentially increase the protection level. Overall, there will therefore be an increased protection against environmental damages.

### 6.3.3 Social impacts of the "Key amendments" option package

Under the heading social impacts, the two relevant types of effects to consider are:

- Impacts on human health; and
- Impacts on employment due to economic impacts on business.

The health impacts are linked to the changes in protection level. None of the amendment options included in the "Key amendment option" package results in reduced protection level. There are several options that potentially increase the protection level. Overall, there will therefore be an increased protection against human health damages.

The magnitude of the economic impacts is not so significant that it likely to create any follow on effects regarding reduced employment. Hence, no employment impacts are expected.

#### **6.4 Option 3: The "Ambitious amendments" option package**

The "Ambitious amendments option package" includes the following main changes:

- Increased derogation options
- Introduction of Safeguard clause
- Provision for changes to Annex I via delegated act
- Additional information to the public with non-technical summaries of SR, IEP and EEP
- Integrated EU database to facilitate e-reporting and information sharing
- Inclusion of CO<sub>2</sub> with thresholds 1,000 or 10,000 tonnes (upper tier)
- Include heavy fuel oil as named substance
- Delete H<sub>2</sub> as named substance
- Increase requirements for lower tier sites with SMS and mini SR, IEP and EEP
- Expand the land use planning requirements to existing establishments
- Reduce threshold for reporting of major accidents to for example 5% of LT thresholds
- Other amendments on coordination and deadlines for reporting etc.

Compared to Option 2, this option includes further requirements on information provision, on lower tier requirements and an expansion of the land use planning requirements. T

The impact of the set of changes are summarised in the below table.

Table 6-4 Impacts of ambitious amendment option package

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
<b>Procedure for changing Annex I</b>			
Allow MS to grant derogations from some or all Seveso requirements based on harmonised criteria	Potential savings for industry and CAs	No impact (condition for derogation)	
Allow EU wide substance derogations	Potential significant savings for industry and CAs	No impact (condition for derogation)	Allow flexibility in light of CLP and REACH
Introduce Safeguard clause	Potential increase in scope compared to "no action"	Potential increase in protection level	Allow flexibility in light of CLP and REACH
Provision for changes to Annex I via delegated act	Limited direct costs	Maintain or increase protection level	A pre-condition for derogation and safeguard clause
<b>Changes to Annex I</b>			
CO <sub>2</sub> : Include with 1,000 tonnes upper-tier thresholds	Five to ten existing storage sites will be included. For future CCS projects, some power plants may be included. Otherwise limited impact: intermediate storage sites and injection sites will be included	Maintained protection level. While the existing storage sites will be included this is thought to be offset by an increase in inventories at power plants that are not included.	Public perception constrains development of CCS
Heavy fuel oil: Include as named substance with thresholds 2,500-25,000 tonnes.	No impacts compared to current situation	No change to current protection level	
Hydrogen: Delete as named substance 10/50 tonnes thresholds	Limited impacts	Reduced protection level as emerging risk in the 5-10 tonnes range is not addressed	
Aerosols: Do nothing (the CLP proposal of 150/500)	App. 0.5 million EUR per year	Unchanged/slightly increased	
Sodium hypochlorite: Do nothing (CLP for mixtures will apply)	Up to 2.7 million EUR per year	Increased?	

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
<b>Other amendments</b>			
Additional information on basic data for all sites plus non-technical summaries of SR, IEP and EEPs	One-off costs from up to 20 million EUR  Annual costs of up to 2 million EUR	Significant Improvement of information available  Better access to information (for public with internet) - less impact in case of accident	Allow to learn from other - (best practices)- monitoring of actual implementation etc
Information management: Simple website with links to documents either directed uploaded on the EU site or links to MS websites with the information/documents	50,000-100,000 per year in maintenance plus some MS costs  One-off costs of 1 million to set up link/upload documents	Significant Improvement of information available - through allowing online information to the public	Allow to draw lesson between establishments and MS (best practices)- Allow monitoring of actual implementation for both CAs and COM
Require coordination of inspections	Cost savings	No impact or slight increase in protection level	
Codification of the MVJ programme	No additional costs	No additional impact	Important for sharing of best practices so the programme increase efficiency in implementation
Formalising Commission support to implementation	No additional costs	No additional impact	The support could increase efficiency in implementation
Coordination with IPPC and other legislation	Possible cost savings	No impact	
Include reference to the use of SPI for internal safety	No additional costs	Potential increase	
Require SMS, IEP and mini SR for the LTs	> 25 million EUR (one-off costs)  App. 1 million EUR per year	Increase protection level	
Extend LUP requirements to	Potentially very costly with one-	Significant improvement of	

Option component	Economic impacts (administrative costs)	Protection level	Other impacts
cover existing establishments	off costs of several hundred million EUR	protection level	
Include underground gas storages	App. 1,5 million EUR per year	Increased protection from 50 storages being included	
Introduce deadline of 12 month for External Emergency Plan preparation	No additional costs	Improved protection	
Introduce deadline of 12 month for reporting of accidents	No additional costs	No significant impacts	Better learning as accidents are being reported more promptly
Reduce threshold to 1% of UP or to 5% of LT	20 additional major accidents reported	Not quantifiable but it will increase learning as more accidents are being reported	
Clarify requirements regarding Environmental aspects	Limited additional costs	Improvement in protection level with respect to environmental damage	
Exchange of information with and need to take account of risks from non-Seveso sites (in relation to Domino effect)	Limited costs	Possible improvement	

#### 6.4.1 Economic impacts of the option package

As described above, the economic impacts can only be quantified for some of the amendment components. Our analysis has however identified a number of other possible savings and costs, those are described qualitatively.

There are few cross impacts where one option component increases costs of another option component. If more establishments are brought into scope and the costs or requirements for lower tiers are increase, then there is cross-impact that will further increase the costs. The increase in number of new establishments will only be a few percentages and therefore the overall additional cost impact is limited.

The cost implications are summarised below.

Table 6-5 *Economic impacts of the "Ambition amendments" option package*

	<b>Costs or savings to industry (administrative)</b>	<b>Costs to Member States</b>
Annual costs	6 - 7 million EUR	Approximately 1 million EUR
One-off costs	> 50 million EUR Plus costs related to LUP for all establishments - could be several hundred millions EUR or even billions of EUR	5 - 10 million EUR
Non quantified costs and savings	Introduction of derogation provision could potentially result in savings compared to the baseline	Introduction of derogation provision could potentially result in savings compared to the baseline
Protection level - savings	The option package will increase the protection level and thereby reduce the risk of damage to private property.	

#### 6.4.2 Environmental impacts

The environmental impacts are linked to the changes in protection level. The analysis of each of the amendment issues has addressed how the protection level could be affected by alternative amendments. The protection level comprises protection against environmental damage, against damage to human health and against damage to public and private property.

The impact on the protection level can only be assessed qualitatively. None of the amendment options included in the "Ambitious amendments option" results in reduced protection level. There are several options that potentially could increase the protection level.

Overall, there will therefore be an increased protection against environmental damages.

#### 6.4.3 Social impacts

Under the heading social impacts, the two relevant types of effects to consider are:

- Impacts on human health; and
- Impacts on employment due to economic impacts on business.

The health impacts are linked to the changes in protection level. None of the amendment options included in the "Ambitious amendments option" results in reduced protection level. There are several options that potentially could increase the protection level.

Overall, there will therefore be an increased protection against human health damages.

No conclusion can be drawn regarding the possible employment effects that could be the result of additional costs to business. As mentioned in the discussion of the economic impacts, there is a potential for a substantially increased cost to industry. Though they are unlikely to have major employment effects, there could be minor impacts.

## 6.5 Comparison of options

The three option packages are compared. Given that many of the impacts can only be qualitatively described, the comparison will likewise be qualitative.

There are some economic impacts that have been estimated and they indicate that the impacts from the "Ambitious amendments" option package are significantly higher than those of the other options. The increase in protection level is also higher for this option but it is a political judgment whether the increased protection justifies the additional costs.

Table 6-6 Summary of the impacts of the three alternative option packages

	Economic impacts (administrative costs)	Protection level impacts	Other effects
Option 1: No action	2- 5 million EUR per year	No significant change	Risk that effect of CLP and REACH could increase costs or reduce protection level
Option 2: Key amendments	4 -5 million per year Not-quantified cost savings 6-8 million EUR one-off costs	Increased protection level	This option will increase the flexibility of future amendments to Annex I and increase quality and efficiency of information provision

	Economic impacts (administrative costs)	Protection level impacts	Other effects
Option 3: Ambitious amendments	<p>7 -8 million per year</p> <p>Not-quantified cost savings</p> <p>&gt; 50 million EUR one-off costs</p> <p>Plus costs related to LUP for all establishments - could be several hundred millions EUR or even billions of EUR</p>	Increased protection level	Same as Option 2 plus future provision of non-technical information for upper tier sites and more requirements for lower tier e.g. "mini" SR and LUP requirements also for existing upper tier sites

Source: Consultants estimates

Though many of the impacts can not be quantified, some of the economic impacts have been estimated and they indicate that the administrative costs for Option 1 and 2 are moderate. Option 2 might give cost savings which reduce the net costs or even make the economic impacts positive. The impacts from the "Ambitious amendments" option package are significantly higher than those of the other options. The increase in protection level is also higher for this option but it is a political judgment whether the increased protection justifies the additional costs.

There are no detailed estimates of the total administrative costs related to the Seveso Directive - a rough estimate suggest administrative costs in the order of at least 100 million EUR per year. Compared to this level of costs the options could lead to increases in the order of 5-10% though Option 2 could be lower or even reduce the total administrative costs.

### 6.5.1 Consideration on impact on SMEs

As argued in Section 2.1.3, there are limited data to support a specific assessment of the impacts on SMEs. Although there is not necessarily a correlation between the quantities present in an establishment and the size of the operator, assuming that lower tier sites are more likely to be SME it can be roughly assessed whether the option packages could result in a relatively higher cost burden for lower tier sites.

Most of the amendments will lead to moderate costs and they would be in proportion to the existing costs. Therefore very limited additional administrative costs to SMEs are expected as result of the "No action" or the "Key amendments" option packages. For the "Ambitious amendments" option package, the further requirement on lower tier obligations could lead to more significant costs to SMEs.

For upper tier SMEs, the cost burden could be high so any further increase could have impacts on business activity. Apart from the example of the metal

finishing industry where in some Member States there are upper tier establishments, there are limited data available to this study on upper tier SMEs.

Differences in Member State implementation makes it difficult to draw general conclusions. There are Member States that have imposed additional requirements on lower tier establishments which has increased the administrative costs for them and hence the burden for lower tier SMEs. In general, the approach in Member State implementation is an important factor in the cost facing any operator.

What should be noted in relation to SMEs and the proposed option packages is that the amendment component about derogations could lead to more flexibility in exempting SMEs if it can be demonstrated that there is no major accident hazard potential related to their activity. The "Key amendments" option package could therefore lead to reductions in costs to industry that could be particularly important for SMEs.

### **6.5.2 Sensitivity assessment**

The nature of many of the amendment component options considered in this impact assessment study does not allow for quantification of the impacts.

For the quantified impacts - mainly the additional administrative costs to industry and CAs - the values presented are subject to a degree of uncertainty. The applied unit costs as discussed in Section 2.1.3 are our best estimate. The uncertainty was assessed to be a range varying with a factor of 2 around the "best" estimates. It means for example that the above annual costs for the "Key amendments" option package would vary from 2 to 10 million EUR.

The physical compliance costs have not been estimated due the uncertainty about the level of such costs. Such compliance costs would only be relevant for the amendment issues that change scope of the Directive (i.e. increases the number of establishments). For these amendment issues, a sensitivity calculation would suggest that such costs at the most would be in the same order as the administrative costs.

The non-quantified effects -for example cost savings - from enhanced coordinating and improved guidance could be important. In Section 2.1.4 a rough estimate of the total annual costs of the Directive was estimated to be in the order of 100 million EUR. If more efficient implementation leads to just a few percentage of cost reductions, it could easily off-set the additional costs.

Overall, the economic impacts of the amendments would in the case of the "Key amendments" option package be moderate compared to the total costs of the Directive.

## 7 References and literature

Aines et al. (2009) Aines RD, Leach MJ, Weisgraber TH, Simpson MD, Friedmann SJ, Bruton CJ. *Quantifying the potential exposure hazard due to energetic releases of CO<sub>2</sub> from a failed sequestration well*. Energy Procedia 1:2421-2429

AISE 2010a, "*Adapting the Seveso Directive to the CLP regulation for environmental classification changes*", AISE 08.03.2010

AISE 2010b, "*Follow-up paper on sodium hypochlorite-containing mixtures: Impact and costs of the Seveso Directive on SMEs and retailers*", AISE 12.07.2010

Basta, Strukl and Chistou (2008) *Overview of Roadmaps for land use Planning in Selected Member States*, JRC Scientific and Technical Report

Benson SM, Hepple R, Apps J, Tsang C-F, Lippmann M. *Lessons Learned from Natural and Industrial Analogues for Storage of Carbon Dioxide in Deep Geological Formations*. Lawrence Berkeley National Laboratory. LBNL Paper LBNL-51170. Retrieved from: <http://www.escholarship.org/uc/item/5394h3dv>

Cancelli C., Demichela M., Piccinini N. (2001) *Release of hydrogen from a cryogenic tank*. In Zio et al. (eds.) *Towards a safer world*. ESREL 2001 Conference proceedings, Torino, Italy (pp. 1289-1296)

COWI 2010, "Impact assessment study into the possible options for adaption Annex I of the Seveso II Directive into the GHS", for the European Commission DG Environment

DOE (2007) *Final Risk Assessment Report for the FutureGen Project Environmental Impact Statement*. Departement of Energy (DoE), USA

DNV (2008) *Mapping of potential HSE issues related to large-scale capture, transport and storage of CO<sub>2</sub>*. Report for Petroleumstilsynet. DNV Report no: 2008-1993

Gugan K (1979) *Unconfined vapour cloud explosions*. Institution of Chemical Engineers (UK)

Harper P (undated). *The Inclusion of CO<sub>2</sub> as a Hazardous Substance in the Seveso Directive*. Health and Safety Executive (HSE), UK. undated paper, <http://www.hse.gov.uk/seveso/co2-hazardous-substance.pdf>, retrieved 27 april 2010

HSE 2003 *Safety report regime - evaluating the impact on new entrants to COMAH*, study by Entec UK Ltd for Health and Safety Executive 2003.

HSE (2005a) *Summary of changes to COMAH introduced by the Control of Major Accident Hazards (amendment) regulations 2005*. Health and Safety Executive (HSE), UK

HSE (2005b) *Regulatory Impact Assessment (final) of the 2003 amendments to the SEVESO Directive*, HSE 2005

HSE 2006, "*Impact evaluation of the Control of Major Accident Hazards (COMAH) Regulations 1999*" by Risk Solutions for the Health and Safety Executive 2006

JRC (2008). *Council Directive 96/82/EC as amended by Council Directive 2003/105/EC – Agreed questions and answers*. Directorate General Joint Research Centre. ISPRA, Italy

Kleindorfer PR, Feldman H, Lowe RA (2000) *Accident Epidemiology and the U.S. Chemical Industry: Preliminary Results from RMP Info*. Working Paper 00-01-15. Center for Risk Management and Decision Processes. The Wharton School. University of Pennsylvania. February 3, 2000

LaChance J (2009) *Risk-informed separation distances for hydrogen refuelling stations*. International Journal of Hydrogen Energy. 34:5838–5845

Landucci G, Tugnoli A, Cozzani V (2010) *Safety assessment of envisaged systems for automotive hydrogen supply and utilization*. International Journal of Hydrogen Energy. 35:1493–1505

LPB-125 (1995) Clayton WE, Griffin ML *Catastrophic failure of a liquid carbon dioxide storage vessel*. Loss Prevention Bulletin 125:3-9 (Institution of Chemical Engineers, IChemE, UK)

LPB-125a (1995) Clayton WE, Griffin ML. *Catastrophic failure of a liquid carbon dioxide storage vessel - - record of failures*. Loss Prevention Bulletin 125:189 (Institution of Chemical Engineers, IChemE, UK)

L345 (2003) *Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances*. Official Journal of the European Union. L 345/97. 31.12.2003

NFPA 325 (1994) *NFPA 325 – Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids. 1994 edition.* NFPA (National Fire Protection Association) USA

OECD (2003). *Guidance on Safety Performance Indicators. (Guidance for Industry, Public Authorities and Communities for developing SPI Programmes related to Chemical Accident Prevention, Preparedness and Response.)* (Interim Publication scheduled to be tested in 2003 – 2004 and revised in 2005)

Price et al. (2007) Price PN, McKone TTE, Sohn MD *Carbon Sequestration Risks and Risk Management.* Report LBNL-513E. Environmental Energy Technologies Division. Lawrence Berkeley National Laboratory. Berkeley, California

Ramachandran R, Menon RK (1998) *An overview of industrial uses of hydrogen.* International Journal of Hydrogen Energy 23(7):593-598

Rosyid OA (2006) *Safety Assessment of Hydrogen Cycle for Energetic Utilization.* Dissertation, Dr-Ing. Institute of Process Equipment and Environmental Engineering, the Faculty of Process and Systems Engineering, the Otto-von-Guericke- University Magdeburg

Rigas F, Sklavounos S (2005) *Evaluation of hazards associated with hydrogen storage facilities.* International Journal of Hydrogen Energy 30:1501–1510

Wood MH (2009) *The Seveso II experience in the application of generic substance criteria to identify major hazard sites.* Journal of Hazardous Materials. 171:16–28