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# **Process Safety / Risk Management of Chemical Parks in Europe**

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## **Preliminary Report**

**Prepared for the European Process Safety Center**

**by**

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## **The European Process Safety Centre**

### **Objectives**

#### **1. Information**

To provide advice on how to access safety information and whom to consult, what process safety databases exist and what information on current acceptable practices is available.

#### **2. Research and Development**

To collect European research and development (R&D) needs and activities in the safety and loss prevention field, to inform members accordingly, to act as a catalyst in stimulating the required R&D and to provide independent advice to funding agencies priorities. "R&D" here includes experimental research and the development and review of models, techniques and software.

#### **3. Legislation and Regulations**

To provide technical and scientific background information in connection with European safety legislation and regulations, e.g. to legislative bodies and competent authorities.

#### **4. Education and Training**

To provide a single source of information on training materials for:

- (a) the teaching of safety and loss prevention at undergraduate level; and
- (b) courses and materials for training and continuing education at all levels of the workforce.

### **Benefits of Membership**

- Improved cross-European co-ordination on safety standards.
- Identification of areas where manuals and guidelines could be produced.
- Improved co-ordination of safety R&D and handling of complex technical research programmes.
- Stimulation of R&D in areas where there are gaps in knowledge.
- Transfer of knowledge from elsewhere to Europe and between European countries.
- Technical input to legislators and standard makers to ensure more realistic legislation.
- Sharing and dissemination of information on safety technology and accident prevention.
- Access to information from a single source.

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## Preface

The European Process Safety Center has picked up the issue of industrial/chemical parks a number of years ago. It organized workshops on "Management of Industrial Parks" (Feb. 20, 2001 at Clariant, Sulzbach/D) and on "Major Accident Hazards and Chemical Parks" (June 22, 2004 at Deltalinqs, Rotterdam/NL). EPSC was also represented at a seminar on "Industrial Parks and Multi-Operator Sites" (Oct. 15, 2003; Cagliari/IT), organized by the Committee of Competent Authorities Responsible for the Implementation of Directive 96/82/EC.

EPSC commissioned this report to make available the existing knowledge about process safety and risk management issues of chemical parks. However, other health, safety and environmental (HSE) issues are also mentioned. The report is based on the experience especially in Germany, where the discussion of these issues seems to be have the longest tradition. As the legal framework in this area is widely harmonized in the European Union (EU) the statements in this report should be applicable at least in all member states of the EU. However, it is strongly recommended to verify at least all legal statements in any specific case.

This report may later be combined with work done on this subject in the U.S.A. by the Center of Chemical Process Safety (CCPS). As this is a preliminary report, any comments are very welcome.

In addition to the above mentioned workshops a number of colleagues provided valuable input. Special thanks are directed to Yngve Malmen (VTT), Willem B Patberg (DOW), Ralf Schaaf (Ensacon) and Bob Ormsby (CCPS).

## Definitions

One thing common to all chemical parks is the fact that they accommodate several chemical facilities in close proximity to one another. These facilities have different owners but share infrastructure which is usually (but not always) provided by a third party, and they usually (but not always) share a fence. As will be explained in Sections 1.2 and 2, chemical parks differ greatly from one another. The same applies to the terminology which they and others use to describe them. Sometimes, this is a reflection of business policy. Some parks purposely use the term “chemical park” in order to appeal to chemical companies who may be potential users. Others use the term “industrial park” to emphasize their open attitude towards other sectors.

It has to be stressed that the chemical park starts with the second legally (not necessarily economically!) independent **chemical** company on site. Some of the legal problems may even start when a non-chemical company (e.g. a service company) shares the site, but this would extend the definition of a chemical park far too wide.

This report uses the following definitions:

- **(Traditional) site:** A site owned and operated by a single company. All the activities on the site are conducted directly by this company or are carried out by third parties exclusively for the company.
- **Chemical park:** A site accommodating several chemical companies which are legally separate entities. The infrastructure and a variable range of services are provided by the largest chemical company on the site (the **major user**) or by one (or more) independent **infrastructure companies**.
- **Industrial park:** Similar to the chemical park, but is (also or more heavily) used by companies from other sectors.
- **Chemical park operator:** Infrastructure company (or major user) which owns the land on which the chemical park is built and therefore fulfils the role of owner/landlord.
- **Chemical park users:** All companies which are not infrastructure companies.
- **Chemical park partners:** All the companies involved in a chemical park (users plus infrastructure company).
- **Plant operators:** Companies which operate chemical facilities in the chemical park and therefore are addressees of process safety regulations. These may be chemical park users or the infrastructure company.

# **1. Introduction: From single-user sites to chemical parks**

## **1.1 Reasons behind this trend**

From their beginnings in the mid-19th century through to the middle of the 20th century, the development of chemical sites has been characterized by a tendency towards increasing size. This is because larger sites offer:

- Economies of scale
- The ability to make optimum use of energy by bringing several production facilities together
- The opportunity to share materials, make optimum use of the by-products of chemical reactions, and set up shared treatment and disposal facilities for offgases, waste water and waste
- Reduced land use and optimum transport connections

For these reasons, numerous large chemical sites grew up around the world. Generally, they were each owned by a single company. They were self-sufficient in terms of the services required for their core chemical production activities. In some cases, the range of services provided was vast, incorporating everything from maternity wards and crèche facilities to bakeries and cultural institutions.

These large sites were generally organized along very strict lines. There was a site director who was responsible not only for the infrastructure, but also for some or most of the services, and who represented the site to the outside world. His managerial authority within the company varied. In some cases, he was the direct superior to all the employees on the site. Even when this was not the case, he had considerable influence over the way the company was run. In either case, he was directly in charge of emergency management and security for the site, and had a great deal of influence over matters of safety management and process safety.

The concept of a site run by a single company was largely retained when chemical companies began to adopt a more decentralized strategy in the 1970s and 1980s. There was a trend towards the formation of largely independent business units. However, since these were not initially legal entities in their own right, the managerial structures of the sites, and in particular the strong position of the site manager in the various safety-related areas mentioned above, remained largely unchanged. This trend became more pronounced as globalization took hold during the 1990s. In many cases, the former business units became legally independent companies. Most of these were initially still owned by their parent companies, but a series of sales and joint ventures changed this structure, sometimes considerably. In many instances, service functions were outsourced or handed over to independent companies. Sites which had previously been owned by one company and operated under a single management structure became chemical parks. In some cases, this progression was actively driven. In others, it was accepted as a side effect, and sometimes it went completely unnoticed.

In the Socialist states of Central and Eastern Europe, the picture was quite different. There, as a result of the command economy, the chemical sites – some of which were very large – were under an even more uniform management structure, and their service functions were even more diversified. Following the break-up of the Eastern Bloc and the opening up of the markets in these countries, the old structures in the former GDR collapsed. Many production plants were outmoded, run-down and uncompetitive, and therefore had to be closed down. The remaining plants could only survive if they were freed from the overbearing infrastructure. This situation resulted in a direct economic drive towards the formation of chemical parks. Although this development took place particularly quickly in Eastern Germany, the large chemical sites in other countries of Central and Eastern Europe are expected to follow suit or have done so yet.

It would be wrong to assume that chemical parks are merely by-products or even waste products of current economic trends. Instead, they are well-placed to deal with the major challenges which today's economic, environmental and political environment presents to the chemical industry. Key issues at stake here include:

- The need to minimize land use
- The need to protect the environment and resources as much as possible by networking the use of energy and materials
- The importance of allowing companies - small and medium-sized ones included – to make optimum use of existing internal and external infrastructures

Ultimately, chemical parks ensure that the benefits which led to the formation of large sites can still be enjoyed to the full in a changed economic environment- a fact which has been well recognized by China, where a growing number of new chemical parks are being set up.

The benefits of chemical parks are particularly relevant when it comes to matters of safety, security and emergency management. However, the transition from one owner who is responsible for the entire site to several companies which are legally independent but closely linked in terms of their use of premises, materials and energy can be particularly tricky in this sensitive area. This issue is considered in greater detail in Section 1.3.

## **1.2 Typical chemical park models**

A wide range of different chemical parks has developed as a result of their differing histories and the different entrepreneurial concepts applied by operators. Today, chemical parks cover the entire spectrum between (but not including) sites operated by a single owner and public industrial or trading complexes. This makes it extremely difficult to come up with a legally-watertight definition of the chemical park. One thing common to all chemical parks is the fact that they accommodate several chemical

facilities in close proximity to one another. These facilities have different owners but share infrastructure which is usually (but not always) provided by a third party, and they usually (but not always) share a fence. Figure 1 demonstrates the wide variety of different chemical parks.

Criteria	Site	Chemical Park	Industrial Estate
<b>Spatial/technical</b> <ul style="list-style-type: none"> <li>• Infrastructure</li> <li>• Production</li> <li>• Neighborhood</li> <li>• Land use policy</li> <li>• Industrial sector</li> </ul>	Joint Interconnected Closed Restricted Homogenous	(Partly) joint. Interconnected. Closed – open Partly restricted Relatively homog.	Public Isolated Open Public Heterogeneous
<b>Legal</b> <ul style="list-style-type: none"> <li>• ownership</li> <li>• operator</li> </ul>	One owner One operator	(mostly) Several (always) Several	Several Several
<b>Organizational</b> <ul style="list-style-type: none"> <li>• EHS policy</li> <li>• Governance</li> <li>• Coordination</li> <li>• Service provider</li> <li>• Choice of. Services</li> <li>• External representation</li> </ul>	One Centralised Close Internal Mandatory Centralized	Several (partly coordinated) Decentralised Close – loose Contractors (restricted) Market Centralized – decentralized	Several Decentralised (mostly) None Contractors Market Decentralized
<b>Emergency Mgmt.</b> <ul style="list-style-type: none"> <li>• Planning</li> <li>• Response organ.</li> <li>• Operations coord.</li> </ul>	Centralized One Centralised	Coordinated One – several Strong - loose	Decentral./authorities Several/authorities Authorities

Fig 1: The chemical park between (traditional) site and industrial estate (courtesy of Th. Friedenstab, Gerling Risiko Consulting)

To facilitate the discussion of process safety / risk management, we can roughly distinguish between four types of chemical park:

- Major user parks
- Closed parks
- Open parks
- Regional clusters

This distinction, which is explained in further detail below, permits a better assessment of the different requirements relating to the relevant EHS (Environment, Health and Safety) issues than the system chosen by other authors<sup>1</sup>, which is based on

<sup>1</sup> Bergmann, Th.; Bode, M.; Festel, G.; Hauthal, H.G. Industrieparks: Herausforderungen und Trends in der Chemie- und Pharma-Industrie. Hünenberg: Festel Capital, 2004

the ownership of the infrastructure company. The role of the infrastructure company as a service provider varies greatly in the different models. This will be explained further in the following sections.

### 1.2.1 Major user parks

Parks of this type have a single company operating large parts of the production facilities and the infrastructure. This company is often also the owner of the land. The “major user” plays a dominant role, particularly in matters relating to EHS, and sets most of the rules on the basis of its economic strength. The other user(s) has/have to follow these rules as a condition for using the site.

In terms of EHS management, this park model is very similar to that of the traditional site, although there are some clear legal differences because of the presence of at least 2 different operators. This model is often also the first step when a traditional site is opened up to become a chemical park.

The boundaries between a traditional site and a major user chemical park are fluid. Even on the typical traditional site, there are often other companies established alongside the controlling company, as especially service companies (contractors). The transition from such a site to a major user chemical park commences with the first legally independent subsidiary which operates a chemical facility, even if it is wholly owned by the major user itself. However, a second step has to take place, which is difficult to define legally: the major user has **deliberately** to open up his site to other companies. It sees these companies as partners (or at least junior partners) and gives them certain rights to have a say in decisions. Notwithstanding all the legal differences, major user parks are managed along uniform lines with regard to EHS issues as though they were a traditional site, and are still viewed as “one site” by their neighbors (and often by the authorities).

### 1.2.2 Closed parks

Figuratively speaking, closed parks lie roughly in the center of the picture painted by Figure 1. They are managed by an infrastructure company which is legally independent of the users of the chemical park. The infrastructure company may well be linked to the users of the park in capital terms, for example through a shared holding company or by the fact that some of the users are shareholders in the infrastructure company. What distinguishes a closed park from a major user park, however, is the fact that none of the companies operating in the park exert a **dominant** influence on the infrastructure company or on the management and development of the park as a whole.

The infrastructure company usually coordinates cooperation between the companies operating in the park, and this cooperation is particularly strong in the area of EHS. There is a shared risk management strategy, the perimeter of the park is fenced, and access by third parties is controlled.

The infrastructure company performs its services in a more competitive environment than in the major user model. However, some of the services provided by the infrastructure company have to be taken up by all park users. This applies in particular to emergency management, security, waste water treatment (including the sewage system), pipe networks, power supplies, and the like. By default (though not necessarily in legal terms), the infrastructure company therefore has a relatively strong position and sometimes takes on the (now legally defunct) role of site manager in relations with the outside world.

### **1.2.3. Open parks**

Open parks are characterized by the fact that cooperation between the various companies operating in the park and the infrastructure company is comparatively loose. There are relatively few rules applying to the park as a whole. As a result, the individual operators have greater freedom but also greater responsibility. In contrast to a public industrial complex, there is a private infrastructure company (sometimes several). However, these companies see themselves as service providers rather than site managers. In this type of park, major elements of EHS, such as emergency response and security, are no longer managed centrally but are instead handled by the individual companies. These parks may be even not fully fenced. In the spectrum between traditional sites and industrial complexes shown in Figure 1, open chemical parks often lie quite close to the public industrial complex, and the boundary between the two is fluid (as it is between traditional sites and major user parks).

### **1.2.4 Clusters**

In some regions (e.g. Rotterdam), favorable framework conditions such as transport routes and water and power supplies have led to the formation of clusters of chemical sites, some of them more closely integrated than others.

These clusters do not fit neatly into the system depicted in Figure 1, nor are they chemical parks in the strict sense of the term. However, some sites within the cluster may well qualify as chemical parks! The more closely infrastructures are shared, the more these clusters resemble chemical parks. They are an option for infrastructure companies to make specific use of the economy of scale. However, they are even more akin to public industrial complexes than are the “open” parks.

## **1.3 Concerns raised by the development of chemical parks**

Large chemical sites with many potentially hazardous facilities operating in close proximity to one another and interconnected by pipe networks constitute an overall risk which may be greater than the sum of the hazards presented by the individual facilities. In chemical parks, there is nobody with direct responsibility for this overall risk. The responsibility lies with all the companies operating in the chemical park. They have to find ways of replacing the single management structure of the traditional site with appropriate cooperation arrangements between themselves. The decisive issue at stake here is not whether the overall risk presented by a chemical park can be

managed, since the high safety levels of traditional sites have already shown that it can. The important question is how the necessary cooperation should be organized. The legal framework conditions are a particularly important consideration here, since statutory EHS legislation in Europe does not recognize chemical parks as such. Although it would be beyond the scope of this report to discuss the legal particularities of chemical parks in detail, a few points of principle will be made in Section 2.

## 2. Basic legal issues

Chemical parks are a new phenomenon for EHS legislation. This has raised a series of unresolved issues, which will be considered more closely below. There is some talk of specifically regulating certain typical chemical park scenarios, so that certain privileges enjoyed by traditional sites can be extended to chemical parks. In order to do this, a clear legal definition of a chemical park would be required. There is obviously widespread agreement about what constitutes a chemical park. However, in view of the great differences between chemical parks described in Section 1, it would be extremely difficult to come up with a definition which is both legally unambiguous and does not exclude or disproportionately privilege any chemical park model. It would also be counter-productive at a time when economic necessities are prompting the various types of chemical parks to find their own individual niches – a process which is currently in full swing.

### 2.1 Defining the operators

The main difference between the traditional site and the chemical park is the fact that the site has a single operator, while the chemical park always has several (and often many) operators. It is these operators to whom legislation in both Europe and the US is addressed. Responsibility for the individual risks posed by the facilities on the site and for the overall risk now lies with several companies rather than just one. The consequences of this are dealt with in Chapter 4. Since in many chemical parks, particularly those of the major user and closed types, the individual companies and the infrastructure company do not just cooperate closely but are also linked in terms of their capital and legal structures, their situation should be examined carefully with reference to relevant national legislation to assess whether they do in effect constitute a joint undertaking which would in particular hold responsibility for managing the overall risk posed by the site. A detailed examination of the situation under German law has demonstrated that this is generally not the case.<sup>2</sup>

In some chemical parks, installations owned and managed by separate companies may have a common control room etc. and might be run by operators from only one of the companies (possibly only during the night and weekend). Both for legal as for organizational matters such situations should be thoroughly evaluated under national law. It must be absolutely clear for the authorities and the operators who is responsible for the safe operation.

The common-sense principle whereby the party with actual control of a facility is the responsible operator of that facility generally allows responsibility to be clearly divided between the companies present in the parks. However, individual cases should be assessed with reference to national law to examine the extent to which responsibility is carried through to the relevant parent companies. The clear assignment of all legal obligations to the individual operators means that their cooperation is particularly

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<sup>2</sup> Friedenstab, Th.; Jochum, Chr.; Peter, J.; Spindler, G. Industriepark und Störfallrecht. Texte 31/02 Umweltbundesamt (German Federal Environmental Agency); Berlin 2002 or Carl Heymanns Verlag; Köln 2003.

important, especially when it comes to managing the overall risk posed by the park. The Seveso II Directive of the European Union offers some guidance on this matter (see Section 2.2).

The basic comments made above about the responsibility of operators also demonstrate that the infrastructure companies (as any other third party like maintenance companies and other contractors) are exclusively responsible for their own operations. In the first instance at least, they are not responsible for the overall risk posed by the site. However, operators of hazardous facilities may entrust the infrastructure company with obligations which they themselves have with regard to the overall risk posed by the site. A prime example of this is cooperation in the area of emergency management (see Section 2.2). There is no obligation for them to do so, however.

In spite of this fragmentation of responsibilities in a chemical park, the individual operators do have some clear obligations when it comes to managing the overall risk posed by the site. The key responsibilities of an operator include evaluating the risks which his facility may pose to its neighbors and the risks which neighboring facilities may pose to his own. For both aspects the operator has to rely on information about or even given by his neighbors. This makes cooperation between the companies operating in the chemical park unavoidable. Thus, considerable account is taken of the close proximity of chemical facilities, as is typical of chemical parks. The European Seveso II Directive specifically regulates this issue for facilities considered to be at higher risk (“Domino-effect”, see below).

## 2.2 Chemical parks and Seveso II

The EU’s basic legal instrument for dealing with high risk chemical sites (the Seveso Directive) was completely revised in 1996<sup>3</sup>. One of the major new features of the revised Directive, Seveso II, was the introduction of the notion of the “establishment”. This is defined as *“the whole area under the control of an operator where dangerous substances are present in one ore more installations, including common or related infrastructure or activities”*. While the old Seveso Directive (and in turn nearly all other European legal provisions in the field of safety and environmental protection) were aimed at individual facilities, the Seveso II Directive is focused on the overall risk posed by a site, too. When drafting the Directive, the European Commission clearly had in mind sites under a single management structure. Although the transformation of many large chemical sites into chemical parks was already underway at the time, the extent of this change was apparently not clear to the legislators. It is only the provisions relating to the “domino effect” which take specific account of the chemical park scenario. According to article 8, *“the competent authority ... identifies establishments or groups of establishments where the likelihood and the possibility or consequences of a major accident may be increased because of the location and the*

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<sup>3</sup> “Council Directive 96/82/EC of 9 Dec. 1996 on the control of major accident hazards involving dangerous substances”, O. J. No. L 10, 14.1.1997, p. 13-33

*proximity of such establishments, and their inventories of dangerous substances*". If this is the case, the operators of these establishments are obliged to inform each other and cooperate with one another.

In spite of this provision, it would appear that the formation of chemical parks runs counter to the intentions of the Seveso II Directive to evaluate the overall risk posed by sites rather than assessing the risk of individual facilities. The Directive intends the overall risk posed by sites to be evaluated in a comprehensive safety report, but the fragmentation of many large companies means that this aim may not be reached. The safety report has to be prepared strictly for the "establishment", which may now be only one part of the site. The fragmentation may even result in companies holding so little amounts of hazardous chemicals that they do not reach the thresholds of the Seveso II directive, falling not longer under its scope at all.

This situation, which at first glance appears unsatisfactory, is ameliorated by the basic obligation (already mentioned above and contained in the old and new Seveso Directives) to take account of the risks posed by neighboring facilities and to assess the effects which one's own establishment might have on its neighborhood. Ultimately, the exchange of information required for "domino establishments" is merely intended to underpin this obligation. The safety reports (produced for higher risk = "upper-tier" establishments) and the major accident prevention policies (produced also for lower risk = "lower-tier" establishments) must also take account of the way in which facilities can influence each other in the event of a major accident, and must also evaluate the overall risk posed by the site. A full picture of the overall risk only emerges when all the safety reports are put together, but, since the appropriate information also has to be passed on to the authorities responsible for risk prevention, there should not be any shortfalls at the end of the day.

The Seveso II Directive does not specify exactly how the required cooperation between the companies operating in a chemical park is to be organized. Section 4 of this report offers some examples and suggestions for how this can be done. Companies should be strongly encouraged to conclude clear contracts between themselves, particularly when it comes to cooperation in the field of EHS. This is the only way to create the basis for truly stable management systems. It is also the only way of demonstrating to the competent authorities during their Seveso II inspections (and to lawyers and juries, if something goes wrong!) that all the necessary measures required to manage the overall risk posed by a chemical park have been taken.

### **2.3 Other legal issues**

In a similar way to major accident legislation, the development of chemical parks has yet to be properly accommodated in other areas of EHS legislation. This can cause problems to which particular attention must be paid when traditional sites turn into chemical parks. As especially environmental regulations are very country specific, a

detailed examination of this issue would go beyond the scope of this report. However, some major issues are highlighted below. These need to be assessed in individual cases with reference to relevant national legislation.<sup>4</sup>

### **2.3.1 Waste management**

One of the advantages of the traditional site is that it has a shared waste management system covering everything from waste collection through to recycling and disposal. From an environmental and economic point of view, it is highly desirable to retain this system when the site becomes a chemical park or to introduce such a system when new chemical parks are created. It should be remembered that the handling of waste within a company is often regulated less specifically and less strictly than the transfer of waste to third parties. This means that the department responsible for waste management at a traditional site may be in a privileged position vis-à-vis any third party, esp. the infrastructure company of a chemical park, which is usually responsible for this task, even though this may not be required by the safety objective of the relevant legal provisions. Solutions to this issue depend heavily on national legislation and should be discussed with the relevant authorities.

### **2.3.2 Chemicals legislation**

Traditional sites and chemical parks alike are characterized by a common network of materials on their premises. European chemicals legislation sets out stringent requirements when putting chemicals into the market (testing, licensing, labeling, etc.). In-house intermediate products are exempt from a number of these provisions. While traditional sites benefit from this in full, the sharing of materials between the companies in a chemical park must comply fully with all the provisions for putting chemicals into the market. This causes considerable problems, particularly in cases where a material which used to qualify as an in-house intermediate product is neither listed on the EU's register of existing substances nor registered as a new substance and also does not qualify for exemption as a research chemical. This problem may be solved in the longer term by the proposed extension of testing and notification obligations under the EU's REACH program. However, it presents a considerable problem for EU law in the shorter term, even though the majority of the safety considerations relating to the privileged position of in-house intermediates also apply to chemical parks.

### **2.3.3 Transportation of hazardous goods**

Legislation governing the transportation of hazardous goods also makes a marked distinction between transportation on public routes and transportation within the boundaries of a site. Deciding which provisions apply to a chemical park in this area may depend on whether it is fenced and whether access to the site is effectively controlled. The extent to which national provisions cover this issue should be checked on a case-by-case basis.

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<sup>4</sup> A comprehensive overview of German regulations is given by Müggenborg, H.-J.; Bruns, J. *Chemieparke*; Hüthig Verlag; Heidelberg 2003

#### **2.3.4 Licenses**

Licenses may be granted to a particular facility or to a company as a whole. This should be remembered when making the transition from traditional site to chemical park. As part of the EU-backed ENAP project, discussions are currently underway as to whether a system of integrated licenses for chemical parks is useful.

#### **2.3.5. Emissions**

Provisions governing emissions control are in place to protect neighbors outside the site. The protection of workers within the site from emissions of noise, odors and hazardous substances is separately regulated in occupational safety & health legislation. This also covers any contractors' staff. While emissions protection of third parties begins outside the perimeter fence of a traditional site, neighboring companies in a chemical park may also qualify as third parties in the legal sense of the term. Extending the protective provisions which apply to "external neighbors" to "internal neighbors" would not be practicable in many chemical parks. We need to go back to the basis for a system whereby limit values for emissions of noise, pollutants and the like make a distinction between the employees of a company and its (external) neighbors. The assumption behind this system is that employees of a company are better able to deal with these hazards than external neighbors because they have personal protective equipment, are part of the emergency management system and have been given appropriate training. This situation can be replicated in chemical parks by making the appropriate protective equipment available to employees who need it, involving people in the emergency management system and training staff, including those from "non-hazardous" companies. Reference should be made to national legislation to check whether compliance with these conditions (or the conclusion of agreements under private law<sup>5</sup>) would make it possible for the provisions intended to protect (external) neighbors to be dispensed with inside the chemical park. The aforementioned conditions are discussed in greater detail in Section 3.

#### **2.3.6 Waste water**

As is the case with solid waste, one of the main advantages of both traditional sites and chemical parks is the fact that waste water from production processes can be treated in shared facilities. On a chemical site, the same company usually generates and processes the waste water. In a chemical park, on the other hand, the waste water is usually generated by a different company than the one which treats it. Since the input of the various companies into the shared waste water treatment facility has a major influence on the performance of this facility and thus on the quality of the treated waste water, it is very important to check that the correct licenses have been obtained from the authorities and that the contractual relationships between the companies generating the waste water and those treating it are appropriate.

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<sup>5</sup> Under German law at least, provisions intended to protect health cannot generally be overridden by agreements concluded under private law .

### **2.3.7 Security**

Intrusion into chemical plants by unauthorized persons doubtlessly constitutes a “potential major accident scenario”. In Europe, some countries have regulated this area specifically when transposing the Seveso II Directive into their national legislation. The new shape of the threat of terrorism highlights the importance of dealing with the issue. Responsibility for preventing unauthorized access lies with the individual company. In closed chemical parks, this responsibility can be delegated to the company responsible for the security of the park. This is discussed in greater detail in Section 3.

### **2.3.8 Soil and groundwater protection**

When different chemical companies are networked in close proximity to one another on the same site, it can be difficult to ascertain who is responsible if any contamination of the soil or groundwater is detected. This fact must be borne in mind in any environmental due diligence assessment prior to moving into a chemical park and when concluding contracts between the individual companies, the infrastructure company and the owner of the land.

### **2.3.9 Safety distances**

Some regulations make use of safety distances to mitigate the consequences of process safety incidents, esp. fire and explosion. Usually these distances have been determined to protect “external neighbors”. They may only partly or not at all applicable inside the site, where other means to protect the workers are possible. As it has been demonstrated in section 2.3.5, these safety distances may now be applicable also to the “internal neighbors”, which may cause insurmountable problems in existing chemical parks. It has to be checked carefully if the way proposed in section 2.3.5 for emissions can be chosen here, too.

### **2.3.10 Issues of liability**

When traditional sites become chemical parks, it must be remembered that many services which were in the past performed internally are now provided by third parties. In legal terms, the service company is considered to be a third party company. This has consequences in terms of liability law, and may also have labor law implications too. It must also be borne in mind that, unlike the various departments of one company on a traditional site, the different companies operating in an chemical park can all be held fully liable for any consequences of major accidents and the like to other chemical park tenants. It may be possible to limit this liability through private law arrangements, but the issue should in any case be discussed with the relevant insurance company.

### **3. Principles and practices for the safe operation of chemical parks**

As has already been explained, many years of experience with chemical sites, some of them very large and complex, have shown that such sites can be operated safely, in spite of the close proximity of and links between many potentially hazardous chemical facilities. This experience should be applied to chemical parks. As explained in Section 2, there are not usually any insurmountable legal problems here. The important issue is to pay careful attention to the legal framework conditions and in particular to conclude clear and robust agreements governing the required level of close cooperation between the partners in a chemical park. On the basis of the experience outlined in the Preface, this section gives some guidance as to how different types of chemical parks can be operated safely.

In view of the great diversity of chemical parks and differences in national legislation, the suggestions made in this section cannot claim to fully represent best practice. Instead, they are intended to give some guidance as to how certain problems can be solved and how chemical parks can be well managed from an process safety point of view.

#### **3.1 Safety management**

When it comes to safety management systems, there is an intrinsic conflict between the interests of global companies in particular and those of the site. Global players, for whom EHS issues are very important, set great store by having a uniform global safety management system. They will normally only accept limitations to this if national legislation forces them to do so. However, they usually try to design their global systems so that they comply with virtually all national requirements and rather attain higher standards than national laws demand.

The operators of a chemical park and the companies operating in it, on the other hand, are very keen that the safety management systems of the chemical park partners should be as similar as possible, and should at the very least be compatible. This is particularly the case in closed parks. In order to solve these conflicting objectives, an analysis should be carried out to determine which elements of the safety management system are more heavily company-related and which are more heavily site-related.

EHS policy and strategy is largely determined by a company's parent organization, for example. Site-specific factors will probably not be taken into account here. When it comes to issues such as management of contractors, PPE policy and "log out – tag out" (LOTO) policy, uniformity of action across the site is very important. It is vital to ensure that global corporate rules provide sufficient flexibility in this regard. The table below divides typical elements of safety management systems<sup>6</sup> into two categories, "company-related" and "site-related" (Fig. 2). The following sections will analyze this in more detail.

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<sup>6</sup> elements according to Annex III of the Seveso II guideline

<b>Elements of Safety Management Systems</b>	<b>Company - related</b>	<b>Site - related</b>	<b>Coordination Requirements</b>
Organization and personnel	X		Roles and responsibilities should be clear to all partners
Identification and evaluation of process safety hazards	X	(x)	Similar standards should be intended. Hazard information has to be shared
Operational control	X	(Maintenance, personal protective equipment, hazardous works regulations)	Similar standards should be intended!!
Management of change	X	(x)	Similar standards should be intended.!!
Planning for emergencies		X	Notification of company headquarters has to be assured
Monitoring performance	X	Incident investigation & reporting	(Similar standards should be intended)
Audit and review	X	Audit of site specific issues	(Similar standards should be intended)

Fig 2: Mapping of Safety Management Systems Elements in Chemical Parks

The need to standardize certain elements of safety management systems and the differences which remain are important elements of the cooperation which is vital in chemical parks. This will be discussed in greater detail later.

### 3.2 Process safety

Process safety is strongly rooted in the culture of the company and depends heavily on the technology it uses. In many cases, global companies organize process safety at central rather than local level. It must therefore be assumed that different process safety management systems will be in place in chemical parks where various companies operate. Differences in systems are acceptable from the point of view of the chemical park.

A problem would arise if there were differences in safety standards. Chemical park users with (apparently) lower safety standards would be called upon by the public and the authorities to achieve the (apparently) higher standard of other users. An incident caused by one chemical park company would bring all the chemical park users into difficulties, either directly because of the consequences of the incident on neighboring facilities, or indirectly because the public often fails to distinguish between “good” and “bad” chemical park partners in such cases. Although avoiding adverse reactions by the media is not the prime focus of process safety, it should be considered that an incident could therefore also deal a hefty blow to the image of the “good” companies.

This again demonstrates that (as is the case with general safety management) chemical park partners need to have intensive contact in the area of process safety. In addition to the information exchange requirements regarding process risks and safety measures laid down for e.g. “domino establishments”, such contact also promotes an exchange of experience and ultimately should bring overall process safety management up to a higher level. Companies which operate in several chemical parks would be well advised to evaluate this additional input on a cross-site level! Provided that commercial secrets are handled in a sensitive manner, an exchange of experience between companies on a site should be no more of a problem than it is between members of industrial and professional bodies.

### **3.3 Emergency management**

Contrary to process safety, emergency management is heavily site-related. In principle, responsibility for minimizing the effects of major accidents naturally lies with individual operators. Thus, in the first instance, all operators of facilities in a chemical park need to create an appropriate emergency management system for themselves. If the domino effect provisions apply to them, they have to coordinate their risk prevention measures together. If these provisions do not apply and the operators do not cooperate on a voluntary basis, the obligation to ensure coordination in the event of major incidents affecting more than one operator lies with the public emergency response body. This creates numerous interfaces between different organizations which are difficult to manage in an emergency.

The majority of chemical parks with a hazard potential above a certain level have therefore developed a shared emergency services. This is often, though not necessarily, drawn up by the infrastructure company. At the heart of this system lies a site fire brigade responsible for the entire chemical park. As well as eliminating many interfaces, a shared emergency service for a chemical park is considerably more efficient and cost effective than having several emergency services paid for by different companies.

For chemical park users who would otherwise have to set up their own emergency services it makes sound sense to operate or outsource a shared emergency service. Any conflicts are usually with chemical park users whose low risk potential means that they would not otherwise require professional emergency services. These companies need to be convinced that it is in their interests to help pay for the chemical park’s emergency services. Although this is usually a condition for taking up occupancy in major user parks, some work may need to be done to convince users in other parks. The main arguments which can be presented to these companies to convince them of the need for a chemical park emergency service include:

- Improved emergency response thanks to far shorter response times and emergency services which know the premises perfectly
- A resulting fall in the cost of fire protection equipment and insurance premiums

- The fact that the public emergency services only has to be called out for major incidents – thereby drawing less public attention to smaller incidents

As well as presenting these “selling points” for a chemical park emergency service, less hazardous establishments can be brought on board by adopting a system which spreads the cost of the emergency services according to the hazard level posed by individual operators.

Under Seveso II, for higher risk (“upper-tier”) establishments a useful option is for the chemical park emergency service to handle the coordination work required for domino areas. This also resolves concerns about revealing commercial secrets to competitors.

However, smaller or less hazardous chemical parks may rely completely on the emergency services of a nearby municipality. In this case it is important to clearly define the interfaces between public emergency services and the chemical park. The preferred option is to maintain a joint emergency management for all chemical park partners.

All in all, it can be concluded that the overall risk posed by a chemical park can be managed by a shared emergency service in more or less the same way as it can in a traditional site. Deviations from these best practice arrangements may be legally permissible. In such cases, clear and robust contractual arrangements governing alternative routes to this safety objective need to be put in place.

### **3.4 Security**

As explained in Section 2.3.7, hazardous chemical facilities subject to the European Seveso II Directive need to be provided with reasonable protection against unauthorized access.

Anyhow, it is in the interests of every company to protect itself against criminal attack such as theft, vandalism and illegal demonstrations. A chemical park with its various facilities, pipe networks and numerous transport operations is in any case a dangerous place for anyone present on the site without proper training. Of course, the various companies and activities in a chemical park will pose varying degrees of risk. In addition to chemical facilities, the site will usually feature administrative buildings, mechanical workshops, warehouses, canteens and the like.

The security objectives could very well be achieved through decentralized measures such as fencing off the individual hazardous chemical plants, protecting workshops and office buildings from access by unauthorized persons and otherwise allowing access to the rest of the site. However, this solution – which is typical of public industrial estates – does not deal with the hazards posed by the pipe networks and road/rail transport operations usually found in a chemical park. Moreover, in many cases, such a system would considerably increase the security outlay.

A better solution is that common to traditional sites, i.e. perimeter fencing of the site and controlled access through gates. Once a park is protected in this way, internal security measures need only be applied to a few particularly hazardous or sensitive areas, such as safety-critical control rooms, areas where hazardous biological materials are used, GMP areas and the like. An additional benefit of such a system for the operator of the park is the fact that it helps to fulfill his obligations as landlord for the entire site. As was mentioned in Section 2.3.3, a park sealed off in this way will be at least partially exempt from the strict legal provisions applying to the transportation of hazardous goods on the public roads. In a similar way to a chemical park emergency service, the costs of shared security should be spread between the chemical park partners in a manner which reflects the relative hazard they pose.

Even when a chemical park is closed off in this way, the problem still remains that the profile of visitors, suppliers and outside companies coming onto the premises may be more diverse than it would be in a traditional site. Moreover, companies which pose only a small potential hazard may not readily agree to apply heavy restrictions to their outside contacts. After all, nobody really likes working in a high-security environment if they don't have to. One solution may be to operate less strict external controls and to compensate for this by applying additional security measures to the most hazardous or vulnerable areas. When chemical parks are planned as such, it is a good idea to separate areas with different hazard levels. Some of the chemical parks which have grown up over time do attempt to achieve such a situation through their long-term planning.

As for traditional sites, a special challenge is situations where a lot of contractors are present at the park (e.g. a major investment in one company while the production and the corresponding hazards are on a normal level at the neighboring company). It must be absolutely clear who is, for example, responsible for telling the contractors about the hazards in the park and esp. caused by the adjacent facilities.

### **3.5 The problem of “internal neighbors”**

As was explained in Section 2.3.5, the European regulations treat neighboring companies in a chemical park generally in the same way as neighbors outside the fence. This means that safety buffer zones which have to be maintained for the protection of external neighbors under various legal provisions must in principle also be observed inside the chemical park. This applies in particular to operations involving substances which present a risk of explosion, and also to emission limits for noise and hazardous chemicals.

Safety buffer zones may be necessary to comply with noise emissions limits. They are also required to control exposure to hazardous chemicals when the effects of operating malfunctions cannot otherwise be contained with sufficient certainty. In these cases, the traditional site is at an advantage, since it can be safely assumed that all the employees of a chemical company, even if they work in offices or workshops, are subject to a single hearing protection and emergency management system and are therefore better able to cope with noise and emergencies than their neighbors on the

other side of the fence. These conditions are also met by many chemical parks, which certainly undermines the reasoning for applying safety buffer zones in the same way as for external neighbors.

In chemical parks with a more “open” organizational structure and a greater mix of industrial sectors, it is more difficult to defend “normal” in-site safety buffer zones. In the majority of chemical parks which developed out of earlier traditional sites, the distances between the individual companies are usually fixed and any changes would involve considerable – usually prohibitive – expense. In such cases, there is a need to work with the competent authorities to identify measures (such as a shared emergency management system) which can be implemented to compensate for non-compliant safety buffer zones.

### **3.6 Inspections/Audits**

The inspections of hazardous facilities which the authorities are required to carry out (for example under Article 16 of the EU Seveso II Directive) are primarily aimed at the individual operator. However, operators may transfer a large proportion of their legal obligations to contractors, whom they must carefully select and monitor. In such cases, the authorities will check that the operator’s selection and monitoring of the contractors is acceptable and that the contractors fulfill the legal obligations with which they have been entrusted.

In chemical parks, it is normal for operators to transfer a large number of tasks to the infrastructure company. It is therefore wise for the authorities and any other auditors to perform careful checks of the services carried out by the infrastructure company, even if this company would not usually fall under the inspection rules. Checks on the operators (who are the actual subject of the inspection regime) would then be limited to ensuring that the various tasks given to the infrastructure company are properly regulated by contract, that the relevant interfaces are properly managed and that the operators are appropriately monitoring the services provided by the infrastructure company. As has been explained in previous sections, using official inspections to assess management of the overall risk posed by the chemical park is a more transparent procedure when all the operators in the park cooperate closely with the infrastructure company.

### **3.7 The role of the infrastructure company**

Previous sections have explained that the structures of traditional sites, which for many decades proved their worth in managing the overall risk posed even by large sites, have resulted in numerous special arrangements and advantages in legislation. Chemical parks which operate similar structures can to a certain extent benefit from this, or at least enjoy a better negotiating position with the competent authorities. An organizational structure similar to that of a traditional site calls for an appropriately well-integrated and high-performance infrastructure company.

However, the stronger the position of the infrastructure company, the less free market forces can operate in the chemical park. The individual chemical park users have to rescind some of their decision-making freedom in the selection of contractors and in safety and emergency management issues.

It is within this complex context that chemical parks in general and infrastructure companies in particular are evolving. Infrastructure companies may assume such a strong position that they act as site manager both internally and externally. Alternatively, they may restrict themselves to a few services, such as operating and maintaining roads, rail facilities, pipe networks, power supplies and sewers. If they take on this “caretaker” role, it is then up to the users of the chemical park to organize the necessary cooperation between themselves. Services can then be purchased from the free market – with all the benefits and disadvantages this entails.

Parks organized along the lines of traditional sites can benefit from the long experience in running big chemical sites safely. Other options are possible, and the role of the infrastructure company will more and more become a distinguishing feature of chemical parks. However, it should be remembered here that close cooperation between the users and the infrastructure company can hardly be restricted to safety and emergency management in the strict sense of the term. The closer the general level of cooperation, the easier it is for the infrastructure company to organize cooperation in the area of safety and emergency management. The opposite is also true. The stronger the role of the infrastructure company in safety and emergency management, the easier it is for it to take on other functions as well.

### **3.8 Cooperation and decision-making structures in chemical parks**

Cooperation and coordination between chemical park users and the infrastructure company in managing overall risk and in ensuring the smooth day-to-day running of the park calls for coordination and decision-making structures. It is not possible to run the chemical park properly without a minimum of common rules. Such regulations are a fundamental condition for operating in a chemical park. They should cover issues such as safety and emergency management, and should specify the services which have to be bought in from the infrastructure company.

Coordination and decision-making bodies are also required to deal with day-to-day issues and the ongoing development of the chemical park. The decision-making powers which these bodies have and the way that they arrive at decisions (by unanimity or majority; binding decisions or recommendations) differ from park to park. As we have seen already, such bodies can be a valuable forum for the exchange of experience in the area of EHS.

An important issue for those coordinating bodies is the fact that the different chemical park partners may have different levels of EHS measures. Any attempt should be made to come either to common standards (solving the question “who pays?”, too!), or to make clear where and why there may be differences.

### 3.9 Contractual arrangements

It is vital, not least of all to ensure smooth relations with the authorities, for there to be clear contractual arrangements within the chemical park. While this may be obvious when new chemical parks are established from scratch (a seldom occurrence), the evolutionary process from traditional site to chemical park does bring with it some considerable legal risks in this area. The driving force behind the transition are usually considerations of an economic rather than EHS nature. Contractual arrangements are therefore normally focused on economic issues. EHS experts are often involved at such a late stage in the proceedings that there is insufficient time to regulate EHS issues properly.

The contractual shortcomings which result are not always obvious at first sight. This is sometimes because they relate to emergencies which are rare events, and sometimes because the structures of the former traditional sites persist on an informal basis so that there is no actual shortcoming. Moreover, changes in company law are often barely felt in the day-to-day operations of the chemical park. As a result, it can easily happen that the organizational structure “as it is lived” no longer complies with new legal requirements.

This can have serious consequences when conflicts arise or EHS incidents occur. It has serious implications for relations with the authorities, relations between the chemical park users, and insurance-related aspects.

It is therefore extremely important to ensure that the correct contractual arrangements in the area of EHS are in place and that employees at all levels are aware of them before any conflicts arise or incidents occur. The basis of these arrangements are chemical park contracts. These are dynamic documents which need to be constantly updated as the chemical park evolves.

A hotly-debated point in all chemical park contracts is the issue of penalties. Nobody would disagree that failure to comply with contractual terms and conditions should result in some consequences. On the other hand, chemical park operators may not be in such a strong economic position that they could evict a user for failure to comply with the contract – a condition which no user moving into the park would accept in any case. Dispute settlement arrangements should therefore be built into all contracts. These might involve arbitration clauses and contractual penalties.

## **4 External relations of the chemical park**

### **4.1 Neighbours and the media**

When chemical parks develop out of traditional sites, the changes to their legal structures are perceived even more slowly from outside than they are from inside. The management of the infrastructure company (or the major user) will often be erroneously seen as holding overall responsibility for the site. As the users of the chemical park become more independent, this assumption is increasingly contradictory to the legal and actual situation in the park. It can cause particular problems when incidents occur. In such circumstances, people expect to see someone in overall managerial control. But it can also easily lead to misunderstandings as regards how responsibilities have been assigned and may cause damage to the image of the infrastructure company, the major user or the chemical park as a whole which could otherwise be avoided.

It is advisable to have clear arrangements in place for informing the public. This should be part of the emergency management system. Authorizing the infrastructure company to provide information in the first instance has shown itself to be a useful approach. Once the acute danger has passed, information should be provided by the company in question as soon as possible. The initial information provided by the infrastructure company should always be limited to clear facts about the incident and, if appropriate, some pre-prepared general information about the company concerned. It should be left to the company concerned to provide information about the cause and the economic and longer-term health and environmental consequences of any major accident.

If general information about risks and safety measures has to be given to the neighbors (as required under the Seveso II Directive for higher risk establishments) it has proven useful to do this for the chemical park as a whole.

### **4.2 The authorities**

For the authorities, the fragmentation of chemical sites into chemical parks is not only a new and unusual phenomenon, but also something which creates additional interfaces and an additional workload. There is not usually anything which the authorities can do to influence this development. However, if chemical park users transfer a large number of obligations onto the infrastructure company, this is beneficial from the point of view of the authorities as well, and reduces the inspection workload for both sides (see Section 3.6).

Shared management of the chemical park's relations with the authorities can also be a benefit to both sides. This is a service often offered by infrastructure companies, but could also be provided by one of the (larger) users or an outside contractor. Coordinating applications for licenses also has the positive side effect of achieving a certain degree of standardization in the process safety level of the companies involved.

## 5. Conclusions

The traditional single user sites have shown over many decades that the close interconnection of chemical plants may have considerable benefits regarding energy efficiency, material flows, waste and waste water treatment, the minimization of land use and so on. They also demonstrated that the accumulation of hazardous installations can be handled safely.

Being the result of changes in the economic environment, chemical parks are the way to ensure that the benefits of these single user sites can be enjoyed also by a multitude of users. However, a chemical park constitutes an overall risk in addition to the specific hazards of the individual operations, but has nobody having comprehensive responsibility for the whole site.

It has been outlined in this report that this situation (as well as other issues resulting from the close interaction of different chemical companies at one site) can well be handled. Following an in-depth analysis of the hazards and the interfaces between the different companies and using the existing experience clear and comprehensive contractual agreements should be worked out by the different parties in the chemical park. This is not only possible under the existing relevant regulations – it makes specific regulations for chemical parks redundant. However, there is definitely a need to interpret the existing regulations to capture the specifics of chemical parks and thus achieve a consensus between operators and authorities.

Handling the issues of chemical parks by contractual agreements is by far superior to regulations also because chemical parks are a “moving target”. Ongoing economic pressure and changing economic trends, too, will also change the chemical parks. Only contractual agreements under private law are flexible enough to react to these changes and therefore assure the safe operation of chemical parks.