



DUTCH
SAFETY BOARD

Summary

Chemistry in cooperation

Safety at the Chemelot industrial complex



Summary

Chemistry in cooperation

Safety at the Chemelot industrial complex

The Hague, June 2018

The reports issued by the Dutch Safety Board are public.

All reports are also available on the Safety Board's website: www.safetyboard.nl

Cover photo: Aerophoto-Schiphol

The Dutch Safety Board

When accidents or disasters happen, the Dutch Safety Board investigates how it was possible for these to occur, with the aim of learning lessons for the future and, ultimately, improving safety in the Netherlands. The Safety Board is independent and is free to decide which incidents to investigate. In particular, it focuses on situations in which people's personal safety is dependent on third parties, such as the government or companies. In certain cases the Board is under an obligation to carry out an investigation. Its investigations do not address issues of blame or liability.

	Dutch Safety Board	
Chairman:	T.H.J. Joustra E.R. Muller M.B.A. van Asselt	
Secretary Director:	C.A.J.F. Verheij	
Visiting address:	Lange Voorhout 9 2514 EA The Hague The Netherlands	Postal address: PO Box 95404 2509 CK The Hague The Netherlands
Telephone:	+31 (0)70 333 7000	
Website:	safetyboard.nl	
E-mail:	info@safetyboard.nl	

N.B. The full report is published in the Dutch language. If there is a difference in interpretation between the Dutch report and English summary, the Dutch text will prevail.

CONTENT

Summary and consideration..... 5

Recommendations.....11

SUMMARY AND CONSIDERATION

The Chemelot industrial complex in South Limburg is one of the six chemical clusters in the Netherlands. The 800-hectare site encompasses over 150 different companies and institutions. A large number of companies carry out high-risk industrial activities at Chemelot. Eleven of those companies work with hazardous substances on a large scale, as a result of which they must comply with the regulations of the Major Accidents (Risks) Decree (*Besluit risico's zware ongevallen, Brzo*).

In 2016, four major incidents took place involving Brzo companies at Chemelot: one accident that resulted in a death as well as a serious injury and three incidents with an emission of hazardous substances from chemical processing plants. Similarly, various incidents took place at the complex in 2015. As a result of these incidents, the Dutch Safety Board has decided to investigate how parties at Chemelot control safety as well as to identify what shortcomings and weaknesses there are.

The companies at Chemelot endeavour to control the safety risks of the chemical processing plants by complying with the existing standards and legal obligations. In addition, the relevant authorities use their legal options to monitor safety in and around Chemelot. Although the efforts of companies and the authorities contribute to ensuring safety at the industrial complex, they are insufficient to achieve the high level of safety that is required given the location and size of the complex, the presence of the Campus and Chemelot's ambitions for growth.

Chemelot's special circumstances

Chemelot is special as an industrial complex in three respects. First, it is situated within a densely populated area adjacent to the residential areas of Sittard-Geleen, Stein and Beek. In order to ensure the safety and well-being of local residents, the companies are required to do their utmost in order to minimise the risks of their operations.

Second, Chemelot grew out of a site where a single company (DSM) previously operated all chemical plants. After DSM began divesting its activities at the site and sold off its plants, Chemelot grew into a multi-user industrial complex with a large number of different companies. Many of the industrial activities are still closely linked to one another. As a result, the various companies have developed a system of cooperation over the years, in which the umbrella environmental site permit for all companies within the complex plays a key role. This umbrella site permit ensures that the cooperation between relevant companies is not optional and gives the Chemelot Site Permit B.V. partnership (CSP) formal powers over the ensemble of companies where permit compliance is concerned. The permit is the only umbrella permit of its kind for a chemical cluster of this size in the Netherlands and therefore requires a tailored approach from the regulators.

Third, the Chemelot Campus for chemistry-related research and education is located within the industrial complex. For the Province of Limburg, further development of Chemelot and of the Campus in particular is a key priority of economic policy. The Campus currently employs roughly 2,500 researchers, entrepreneurs and students. Their presence in the vicinity of Brzo companies is an additional safety risk. Although the Campus within the industrial complex derives its existence from the relationship with the chemical companies at Chemelot, there is often no relationship with the activities at the Industrial Park, particularly for the new activities at the Campus. As such, the potential synergy between the knowledge development at the Campus and the industrial activities goes unused.

In the *Vision Chemelot 2025* (Visie Chemelot 2025), the parties at Chemelot expressed the desire to become the most competitive and sustainable chemicals and materials site in Western Europe as well as to develop the Chemelot Campus further. Given its location in the vicinity of an urban environment as well as the large number of people that work at the Chemelot industrial complex and the Campus, controlling process safety of the chemical plants at Chemelot is crucial to Chemelot's *licence to operate*. The growth ambitions previously outlined make this priority all the more urgent, as they require a high level of safety.

Process safety and ageing of chemical plants

The incidents in 2015 and 2016 that were considered in this investigation indicate shortcomings in controlling process safety. For example, adequate maintenance was lacking and work instructions were insufficient. The risk of emissions was underestimated or the risk was not identified. In addition, no lessons were drawn from previous similar incidents. The survey has also shown that the ageing of the chemical plants is an underlying factor that allowed the incidents to take place.

As is the case for many other chemical plants in the Netherlands, the design of several plants at Chemelot dates back to the 1960s and 1970s. An older design does not entail by definition that the plants themselves are unsafe. Nevertheless, this aspect does entail specific risks that must be controlled. A clear example that emerged from the incidents which were examined, is the limited view that operators have on the process parameters of the chemical plants. The Dutch Safety Board notes a marked absence of urgency on the part of the companies as well as the authorities to apply the latest technology in order to implement innovations in the safety of existing plants. In practice, plants are often only modified if their integrity has precipitated such changes. However, given the special circumstances at play, it is crucial that the Brzo companies at Chemelot should proactively consider how process safety at chemical plants can be improved using the latest technology in order to increase the inherent safety of existing plants. In addition to the existing operational focus on controlling process safety, a more strategic approach is consequently required for controlling process safety of the entire site.

The shortcomings that have come to light by the incidents must be addressed by the parties at Chemelot. Although the responsibility for such action principally rests with the companies that operate the plants, the collective ensemble of companies at Chemelot equally have a duty to act. The process safety risks are shared risks that affect all chemical companies at Chemelot. Moreover, the unique nature of Chemelot affects safety management at the industrial complex. The individual companies and their organised collective – CSP – are responsible for controlling and managing the mutual, shared and joint risks.

The parties at Chemelot are in a position to use the system of cooperation in order to improve the process safety of the Brzo plants. The parties at Chemelot should focus on collectively identifying and controlling the shared, mutual and joint safety risks of the chemical processing plants at Brzo companies. Up to now, controlling these safety risks at Chemelot has been primarily based on compliance with laws and regulations. In order to achieve a higher level of safety, additional action is required in the form of a strategic long-term vision of safety and a collective proactive approach to continuous improvements in process safety. The serious incidents that took place in 2016 and the previous incidents in 2015 underline the need for such measures.

Recent ammonia emission at Chemelot

On 31 May 2018, an amount of ammonia was released through a chimney during the start-up of the OCI Nitrogen melamine plant. Due to the weather conditions, the ammonia precipitated at the adjacent Fibrant plant, where hundreds of people were working at the time due to major maintenance works. A number of them became unwell as a result of exposure to ammonia.

Although the release of ammonia during start-up of the plant had been foreseen, it was larger than normal as a result of particular process conditions. The magnitude and the impact of the emission only became clear when people became unwell at the adjacent plant.

This recent incident demonstrates the importance of cross-Chemelot management of mutual risks at the site. The ammonia emission became a safety concern for those present at the neighbouring company. Furthermore, the incident overlaps in part with the accident factors identified in the investigation, such as underestimated or incorrectly estimated risks of the emissions and inadequate insight into the emission of substances through a chimney. In sum, this incident demonstrates the need for collective improvements to process safety at Chemelot.

Collective safety improvement

A key starting point to achieve the necessary improvement of process safety is expressing a high ambition for safety and developing a proactive approach. Moreover, this point is crucial in view of the ambitions held by Chemelot to become the most sustainable chemicals and materials site in Western Europe (*Vision Chemelot 2025*). Explicitly setting out this safety objective provides a major impetus towards realising safety improvements at Chemelot. This approach ensures that attention is paid to safety at the strategic level (cross-Chemelot), thus highlighting safety at the tactical level (among the individual companies) as well as allowing better management and control at the operational level. As the holder of the umbrella environmental site permit and as the driving force of cooperation at Chemelot, the CSP has a pivotal role in this regard.

In order to increase the effectiveness of cooperation in the area of safety, it is essential that the checks and balances under the cross-Chemelot management are strengthened. In particular, this issue relates to the organisation of independent and expert contradiction and criticism that ensures a continued stimulation to developing and implementing the more stringent safety objective. Furthermore, the Board expects major companies who hold considerable influence at Chemelot to make an active contribution towards setting ambitious safety objectives for Chemelot as a whole, even if these objectives result in more stringent safety standards than they themselves currently apply.

It will be no mean feat to realise the necessary improvements in order to achieve a proactive and ambitious approach to safety, especially since there is no example to hand. Nevertheless, it is inevitable for Chemelot to take such action, given its location, its size, the presence of the Campus and the growth ambitions of the industrial complex. Chemelot will be able to distinguish itself in the field by taking the lessons that it has learned and setting ambitious goals in order to become a benchmark of collective and proactive safety management at a multi-user industrial complex. The cooperation already in place at Chemelot provides a good basis for such action.

However, this development must also be encouraged by Chemelot's administrative environment. As the competent authority of Chemelot, the Province of Limburg in particular should support the firm embedding of ambitious safety objectives in Chemelot's growth and sustainability ambitions.

Central role for the Province of Limburg

As the competent authority over Chemelot, the Province of Limburg plays a crucial role in representing the public interest with regard to safety at Chemelot. The Province also represents other interests. Chemelot has a key position in the Province's economic policy as the driver of growth for the regional economy. In this context, the Province also plays a part as a public shareholder of the Campus and as a funding organisation for projects that centre for example on sustainability.

As the competent authority, the Province uses the legal instruments (permit authorisation, supervision and enforcement) to ensure the management of the safety risks by individual companies at Chemelot. The capabilities of the other roles are not used or used to a limited extent in controlling safety. An explicit and transparent consideration as to the interests of the activities at the Campus and the safety risks for the people on the Campus is absent, for example.

The Province is able to promote safety at Chemelot by explicitly outlining its own safety objectives for Chemelot as well as to make this ambition specific and transparent. These aspirations should be a guiding priority for all the roles that the Province carries out with regard to Chemelot. The interpretation of these aspirations by the companies at Chemelot serves as an important benchmark for the further development of Chemelot, in relation to both the Campus and the Industrial Park.

At the same time, as safety at the industrial complex influences multiple neighbouring municipalities, it requires intermunicipal cooperation. To this end, an administrative arrangement is required in which the Province takes the lead as the competent authority for Brzo companies with knowledge and expertise (including at the South Limburg Regional Implementing Agency, RUD Zuid Limburg) alongside neighbouring municipalities to monitor and safeguard the public interest with regard to safety in and around the chemical cluster in a strategic manner. This strategy should in any case lead to a shared vision of the spatial planning on and around Chemelot in which safety is a key priority.

Chemical clusters

The insights revealed by the investigation are relevant to other existing and future chemical clusters in the Netherlands. Safety management at a chemical cluster requires intensive cooperation between companies and establishment of ambitious safety targets. The framework of an umbrella environmental site permit may significantly contribute to collaboration, provided that the permit holder takes responsibility and acts as a driver for the execution of a collective safety approach. An umbrella site permit is also a good starting point for the execution of the administrative responsibility to ensure safety at a chemical cluster. To this end, the law should continue to allow the possibility of an umbrella environmental site permit for chemical clusters.

The Dutch Safety Board has found that the existing partnership has proved its value to the parties at Chemelot. In that regard, the shared knowledge of the entire site and the shared sense of responsibility for the whole felt by all parties are essential. Such cooperation leads, among other things, to promoting compliance with complex laws and regulations, maintaining a professional emergency response organisation and executing a joint crisis management strategy. It is the combination of formal power deriving from the umbrella site permit with the power of the formal and informal networks present that is of added value to the joint management of safety at a chemical cluster. Chemelot has the potential to set an example for other chemical clusters in the Netherlands with this respect.

The government and the business community regard clusters of industrial activities as an opportunity to achieve the social ambition of increasing the sustainability of industry. As a result, it is vital that safety objectives are given pride of place within the transition to sustainability. In 2016, the Dutch government, the business community and the scientific community began the implementation of the *Sustainable Safety 2030* (Duurzame Veiligheid 2030) programme, with which they intend to improve safety in the Dutch petrochemical industry significantly and sustainably. One of the five roadmaps for this programme is entitled *Space for petrochemical clusters* (Ruimte voor (petro)chemische clusters). This roadmap is founded on the principle that a safety policy based on a long-term vision has the potential further to connect the companies within the chemical clusters. Chemelot's case provides an excellent opportunity to implement the lessons drawn from this investigation.

RECOMMENDATIONS

Ambitious vision on the safety of Chemelot and its surroundings

The collective of companies at Chemelot has major ambitions for the growth and sustainability of the industrial complex. A strong commitment to safety must be part of those ambitions. In addition, the competent authority (the Province of Limburg) needs an ambitious and detailed vision to ensure and advance safety in and around the vicinity of Chemelot.

At present, the available approach to manage process safety risks is primarily reactive and is aimed at compliance with the rules. Progress can be made by ensuring that the existing cooperation between the parties at Chemelot is also applied to realise improvements in controlling process safety at the chemical installations. The four serious accidents that took place in 2016 and the incidents at Chemelot in 2015 highlight the need for a proactive and ambitious approach to safety.

In sum, the Dutch Safety Board makes the following recommendations:

To the Brzo companies at Chemelot, Chemelot Site Permit B.V. and Stichting Chemelot:

1. Formulate ambitious safety objectives for the Chemelot industrial complex and ensure that they become an integral part of the *Vision Chemelot 2025*. These objectives should exceed merely aiming to achieve compliance with safety laws and regulations and they should be in line with the ambition to become the most sustainable chemical site in Western Europe.
2. Implement a safety approach to execute the ambitions and commitments to safety that Chemelot has as a whole. This approach should lead to a practical implementation in order to identify, evaluate and minimise the shared, mutual and joint safety risks present at Chemelot. The result of this safety strategy should in any case be that:
 - risks associated with outdated designs of chemical plants are assessed and a review takes place of how process safety can be improved by adapting the plants to the latest technology as well as to innovate them using the latest knowledge available;
 - learning capacity in the field of process safety is improved by a systematic, cross-Chemelot approach encompassing accident analysis, accident reporting and implementation of recommendations, as well as by a review of the learning capacity in the field of process safety at Chemelot.

3. Strengthen the management of Chemelot by adding a critical and independent form of checks and balances to the governance of Chemelot, in order to keep the cooperating parties at Chemelot on their toes in relation to the actual achievement of the ambitious safety objectives.

To the management and shareholders of Brightlands Chemelot Campus and Chemelot Site Permit B.V.:

4. Implement an explicit and transparent process for the consideration of the interests when deciding between the expansion or adaptation of non-industrial activities at Chemelot (particularly at the Chemelot Campus) and the safety risks to the people present. Simultaneously ensure that the synergy with the activities at the Industrial Park is strengthened to ensure that the selected location of the Campus within the industrial complex is functional and can be justified from a safety perspective.

To the Provincial Executive of the Province of Limburg:

5. Formulate an ambitious and detailed vision in collaboration with the surrounding municipalities in order to promote safety at Chemelot as well as in the surrounding area. This vision must also serve as a guideline for the spatial planning by the surrounding municipalities. The key principle in this context must be the desire to achieve the most stringent possible level of safety that exceeds the legal standards for safety. Ensure that the formulated safety commitments guide all the roles that the Province executes in respect of Chemelot. The vision should in any case focus specifically on:
 - the steps taken by the Brzo companies to demonstrate that they manage and control the joint safety risks of the chemical processing plants. Calling to account both the individual companies at Chemelot and CSP must be possible in this regard;
 - the safety criteria that are used to assess which industrial or non-industrial activities are permitted both at Chemelot (at the Chemelot Campus especially) and in the immediate vicinity. Within this context, the presence of people should be minimised as much as possible and the further development of Chemelot should be made contingent on the extent to which the increased safety commitments are implemented.

General lessons for Brzo monitoring:

The investigation into the safety at Chemelot has also yielded a number of general lessons in relation to Brzo regulatory monitoring. For example, it has been established that there is no explicit monitoring of controlling mutual risks within the system for permit authorisation, supervision and enforcement for industrial complexes that include multiple Brzo companies under one site permit, in particular the risks of chemical plants at Brzo companies for non-industrial activities. Furthermore, the existing focus on the risks of the ageing of plants within the chemical industry should be expanded to place additional emphasis on implementing the latest technology.

This has resulted in the following recommendations:

To the Minister of Infrastructure and Water Management:

6. Provide instruments within permit authorisation, supervision and enforcement to enable management and guidance aimed at minimising mutual risks related to activities within multi-user industrial complexes such as Chemelot. This should in any case take care of:
 - controlling risks of domino effects between companies in a similar manner as between individual Brzo companies;
 - restricting activities within multi-user industrial complexes which need not necessarily take place there.

To the participants of the Brzo+ cooperation programme:

7. Encourage the supervisors within the context of Brzo inspections to focus actively on the risks of outdated plant designs in relation to the theme of ageing. For example, have Brzo companies identify these risks and create an action plan to innovate existing plants in terms of process safety according to the latest technology.

**Visiting address**

Lange Voorhout 9
2514 EA The Hague
T 070 333 70 00
F 070 333 70 77

Postal address

PO Box 95404
2509 CK The Hague

www.safetyboard.nl