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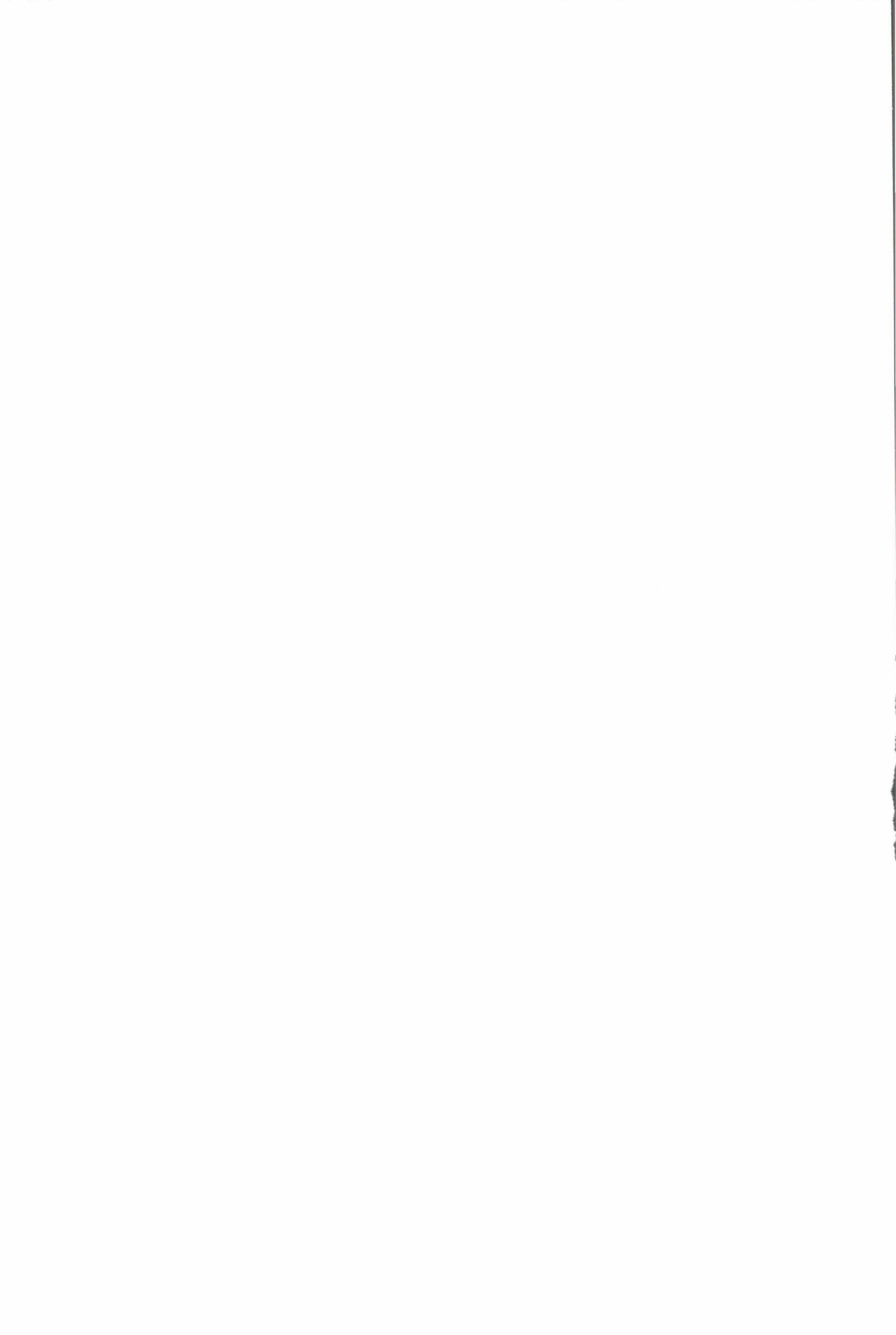
Support activities for the Directorate-General for Environment, Nuclear Safety and Civil Protection
on the implementation of the Council Directive
on the major accident hazards of certain industrial activities

COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK

EC STUDY - LESSONS LEARNT FROM EMERGENCIES AFTER ACCIDENTS IN THE NETHERLANDS INVOLVING DANGEROUS SUBSTANCES



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1 Introduction

This report shows the results of the fourth 'Lessons Learned From Emergencies After Accidents Involving Dangerous Substances'. Similar projects have been carried out in the United Kingdom, Germany and France. These projects have been initiated by the Joint Research Centre of the Commission of European Communities. The purpose of these projects is to analyze information and lessons learned from experience during and after emergencies in the EEC countries. The accidents analyzed are limited to accidents involving dangerous **chemical** substances. The analysis will be mainly focused on emergency response activities. The cause of the accidents and preventive measures do not fall under the scope of the study. The information and conclusions resulting from these projects will be distributed amongst organizations in all EEC countries. This in order to encourage the learning process in these countries.

After the Joint Research Centre assigned the project to the Department of Industrial Safety of TNO¹⁾, the TNO project group started to form a steering committee. The steering committee consisted of representatives of several ministries, involved in emergency response, and some representatives of other parties involved. A compilation of the composition of the project team and the steering committee is given in Appendix 1.

In the first stage of the project a proposal on the contents of the report was made by the project team. This proposal contained a compilation of the subjects to be described in the report, such as laws, regulations, plans and organizations involved. A list of selected accidents was also attached to this compilation. This selection was made by using the accident database FACTS²⁾. The selected accidents had to meet the following criteria:

- The accidents should have occurred over the past ten years;
- Sufficient relevant data about the accidents should be available;
- Chemical substances mentioned in the Seveso Directive should be involved in the accident;
- The accident should have had external effects (on people or the environment outside the plant's territory);
- Activities of (several) emergency response teams were necessary;
- The selection should cover both accidents with fixed installations and storage and transport.

This initially resulted in a selection of six accidents.

The proposal was discussed with the Steering Committee. The discussion resulted in the subjects treated in this report and a final selection of seven accidents. These were the only accidents which occurred in the Netherlands in the last ten years and to which the criteria were applicable. These seven accidents covered all three required work fields (fixed installation, storage and transport). The selection of an eighth accident was under discussion. Although lessons can be learned from this accident it did not meet all criteria (the accident did not involve chemical substances falling under the scope of the Seveso Directive). The Steering Committee therefore decided

¹⁾ Netherlands Organization for Applied Scientific Research.

²⁾ Failure and Accidents Technical Information System. This database has been developed by TNO and is kept up to date at TNO.

not to include this accident into the selection. At special request of the Joint Research Centre a description of this accident is, however, attached to this report (Appendix 3), because important lessons can be learned regarding emergency response from an accident like this.

Although the number of eight accidents cannot be regarded as very high, we can state that with the information on these cases, the variety in the accidents and the complete coverage of the work fields, combined with the experience of the project team and the steering committee, can lead to valuable lessons to be learned.

Information on the accidents was retrieved by using several sources:

- Information was obtained from the database FACTS;
- Publications such as reports, articles in professional literature and newspapers were reviewed by the project team;
- Information was obtained by asking additional information from several organizations involved in the emergency response such as the companies concerned, the municipality, fire brigade, health authorities, etc. We would therefore like to thank all people who gave us information regarding this project.

The information needed had to be collected according to a standard data collection form. This collection form was approved by the Steering Committee. A blank copy of this data collection form (accompanied by some explanation) can be found in Appendix no. 2.

The project and this report can be roughly divided into three parts. The first part (chapters 2, 3, 4 and 5) gives an overview of the organization of emergency response in the Netherlands. This part contains descriptions of laws, regulations, tasks and organization of emergency response organizations and preparatory activities such as plans and other tools. To improve the readability for Dutch readers, the names of specific terms, well-known organizations, etc. are also given in Dutch (*in italics*). An index of all subjects and organizations described in this report is attached to this report.

The second part, chapter 6, describes seven accidents. In addition to a (chronological) description of events, the chapter also contains conclusions and critical remarks stated by several organizations involved. Most accidents led to lessons learned by the organizations involved. These lessons are given for each accident individually. Some of these lessons were followed by actions of the organizations involved. A distinction was made between these actions and the more general or global lessons. The lessons learned were critically reviewed by the steering committee and the project team.

The review of the individual lessons led to the third part, chapter 7: Lessons Learned, Conclusions and Recommendations. The information about the organization of emergency response described in the first part, combined with the individual lessons, leads to lessons, which can be grouped into a restricted number of subjects. Regarding these subjects, conclusions and recommendations were made by the project team. These recommendations are meant to further improve the organization of emergency response in the Netherlands and in the EEC as a whole.

2 Statutory Basis: Laws, Directives, Rules and Manuals

2.1 Introduction

In the last ten years the organization of emergency response has been reorganized. The reorganization puts the responsibility of emergency response on the local authority and puts the fire brigade in charge of the co-ordination of the operational activities of emergency response. A basic starting point of the reorganized emergency response is that emergency response has to be integrated with 'routine' activities (such as smaller accidents). Operating procedures and co-ordination during a small incident have to be basically the same as during a large incident or disaster. During an incident, upscaling has to take place. The rules, regulations and organizational structures resulting from this reorganization are in most cases especially set up for disasters. A definition of a disaster is given in the Disaster Law. Recently a discussion about this definition started: most organizational structures for disasters can also be used for major accidents, such as those described in this report. The final report on the reorganization of the emergency response was published in March 1991.

The report emphasises the importance of emergency response and describes the reorganization process of emergency response and the results of this process. It considers the future developments and policy on emergency response.

Starting-points of the reorganization were:

- The managerial responsibility is in the hands of the local authorities;
- The operational emergency response activities are carried out by the already available assistance services in the region, such as the fire brigade, ambulance services and the police;
- The facilities and organization will as long as possible function in the same way as usual;
- It is possible to use the capacities of other institutions and organizations;
- When the consequences of the emergency are greater, the emergency response organization will also grow and the co-ordination will go to a higher managerial level.

The results of the reorganization of emergency response in the Netherlands, in the form of new laws, regulations, tasks and organization of emergency response organizations, are described in several parts of this report (chapters 2 till 5).

In this chapter some of the most important laws and directives concerning emergency response are described. Some other laws and rules concerning (prevention and repression of) accidents involving dangerous substances will also be mentioned here, but will not be worked out in detail. Several specific matters and details of laws are sometimes worked out in 'Orders in Council' (*Algemene maatregel van bestuur*). These measures or rules, worked out in Orders in Council, are developed at the ministry involved and do not have to be approved by parliament. These detailed rules will not be discussed here.

As a result of the reorganization of emergency response, a number of manuals regarding emergency response have been developed (mainly under government authority). These manuals are described in section 2.4 of this chapter.

2.2 Laws

Disaster Control Act (*Rampenwet*)

The Disaster Control Act was promulgated in 1985. In this law, rules about the organization, responsibilities, assistance regulations, tasks and preparations necessary in the event of a disaster, are given. The law gives this definition of a disaster: a disaster is an event which

1. causes severe disruption of public safety, threatening the lives and health of many people or endangering sizeable material interests to a serious degree, and
2. requires the co-ordinated deployment of various public services.

Preparations in the form of plans, education and training have to be taken by the local authorities. They are mainly responsible for the emergency response and the preparations for it. Every municipality has to have a disaster plan (*rampenplan*) for the municipality (see section 5.1). The contents of this plan is outlined in the Disaster Control Act. Additional to this disaster plan, disaster control plans (*rampbestrijdingsplan*) have to be made. A disaster control plan has to be made for every disaster where the place and the nature can be foreseen (see also section 5.1). The responsibility for the disaster control/emergency response lies with the mayor, who is the commander-in-chief. All emergency response activities are under his command. The mayor will get assistance from the municipal disaster staff (see section 3.3). The Fire Brigade Commander is the operational leader, who is in charge of the operational activities.

If a disaster has more than local significance, the Queen's Commissioner (provincial authority) can give instructions regarding leadership and co-ordination. He also has to approve requests for assistance by services from other municipalities. Requests for assistance by national services or institutions have to be approved by the Minister for Home Affairs. The Minister for Home Affairs can provide instructions in the event larger interests are at issue. For military assistance the provincial authority (the Queen's Commissioner) has to address to the Minister for Home Affairs, who passes this request on the Minister of Defence. In special circumstances the mayor can place a request for military assistance with the provincial military commander.

The provincial authority has to draw up a Provincial Co-ordination Scheme.

Fire Services Act (*Brandweerwet*)

The Fire Services Act has been published at the same time as the Disaster Control Act. A new Fire Services Act was necessary at the same time as the Disaster Control Act, as the Disaster Control Act made the fire brigade responsible for the co-ordination of operational tasks of emergency response. The Fire Services Act determines the tasks, responsibilities and organization of the municipal fire brigade and the regional fire services.

The local authorities are made responsible for the organization of the municipal fire brigade. They have to take care of the prevention, limiting and repression of fire, fire danger and accidents during fire. They also have to limit and control danger to people and animals involved in accidents other than fire accidents. The operational activities for this are delegated to the fire brigade.

In the Fire Services Act the following rules and statements are given:

- The rights and obligations of the fire brigade;
- Rules on the tasks and responsibilities of the fire brigade (see section 3.6);
- The creating of regional fire services, these are regional co-operative associations

of local fire services. This body is set up to stimulate the execution of the activities regarding emergency response in a well organized and co-ordinated way;

- Rules on assistance to and from other fire services;
- It gives the local authority the right to make rules on prevention, keeping within bounds and repression of fire, fire danger, accidents during fire;
- It gives the local authority the right to oblige certain companies with higher risks, to have a works fire brigade. Guidelines on which companies should be appointed and what facilities a company fire brigade should have, are given in a special Order in Council;
- Rules on the personnel, the equipment, education, etc. are stated in Orders in Council;
- The tasks of the Inspection for the Fire Service.

The tasks of this Inspection are presented in section 3.2.

Law on Medical Assistance in Emergencies

(Wet Geneeskundige hulpverlening bij rampen)

The Law on Medical Assistance in Emergencies was published in 1992 and is also a result of the reorganization of emergency response. This law is closely connected with the Disaster Control Act and can be compared with the Fire Services Act. The responsibility and authority for the medical assistance are described in this law. The law states that organizations which are responsible for medical assistance in normal situations are also responsible for the medical assistance during emergencies. The law gives certain responsibilities to the local Health Authority and to the Red Cross (see also section 3.6).

The mayor is made responsible for the medical assistance in the town. The head of the local Health Authority is in charge of the medical assistance. He can give instructions to the Central Ambulance Station (*Centrale post ambulancevervoer, CPA*) and has to make sure that the activities of the Central Ambulance Station and the hospitals in the region are in co-operation with one another. The hospitals and the Central Ambulance Station have to make preparations regarding emergency response (in the form of plans, see section 5.1). A special Order in Council has been added to this law, which orders hospitals to have a disaster procedure.

The provincial government has to designate regions in which a number of towns have to make mutual agreements on medical assistance. These agreements consist of a plan regarding the co-operation, co-ordination and organization of the hospitals and other medical organizations in the region. The agreements also have to describe the tasks of the medical organizations in the region. Furthermore, the agreements give rules for assistance by other organizations and for recognition of the organizations. The law itself also gives guidelines for assistance and recognition as well as guidelines for compensation for costs regarding emergency response.

Occupational Safety and Health Act (*Arbeidsomstandighedenwet*)

The Occupational Safety and Health Act sets rules for the safety, health and the well-being of the employees. Through this law the employer and the employee are both made responsible for the safety, health and the well-being of the employees. The law was published in 1980, but has been implemented in several phases starting from 1983 to 1990. The law was updated in 1993. In this updated version the European Directive of 12 June 1989 (*Kaderrichtlijn*) came into effect.

The company, as well as the employees, is held responsible for the execution of the rules. Organizations for employees such as the Council of Employees (*Ondernemingsraad*) or other committees can play an important role in controlling and improving the labour conditions. Companies which have more than 100 employees are compelled to make an annual report on the actions that are taken and

progress made with their labour force. Companies are obliged to give proper education and training directed towards the function and the task of the employee. In return, employees are obliged to work in accordance with the safety rules.

A certain category of companies is obliged to make an Occupational Safety Report (*Arbeidsveiligheidsrapportage*). This category is described in an additional 'Order in Council'. In the law the contents of the Occupational Safety Report is described (see also section 4.1). The company has to make an inventory of all the potential operational risks in the company. Employers have to appoint company emergency units (such as a first aid unit and a fire brigade) which can give aid and assistance in accidents and fires, within the company's responsibilities and capacities.

The tasks, rights and obligations of the Labour Inspectorate are given in this law. The Labour Inspectorate has the task of controlling and inspecting companies regarding the Occupational Safety and Health Act.

Law on Environmental Conservation (*Wet Milieubeheer*)

The Law on Environmental Conservation came into effect on 1st March 1993. This law replaces the Law General Regulations on Environmental Protection (*Wet Algemene Bepalingen Milieuhygiëne*), the Hindrance Law (*Hinderwet*) and several articles in other sectional laws.

The Law on Environmental Conservation is focused on organizations; this means that on a legal basis there are rules to control the activities of organizations, which can damage the environment. The most important basis for these rules is the integral environmental permit. This permit has to contain regulations which guarantee the highest possible protection of the environment. Regulations have to be made by which harmful effects on the environment can be prevented or restricted. Future developments and possible risks have to be taken into account.

The law also gives regulations for measures to take in extraordinary circumstances. This concerns extraordinary or unusual events in organizations, which can have harmful effects on the environment. The management of the organization has to take all measures (within its competence) to prevent or restrict the outcome of the event. This can mean the temporary close down of the organization. The organization has to inform the authorities as soon as possible about the event, the measures taken and all other relevant information. The competent authorities have to investigate the event and have to determine the final outcome.

Law on Dangerous Substances (*Wet Gevaarlijke Stoffen*)

The Law on Dangerous Substances was published in 1963 and has been reviewed and adapted several times. Some of these adaptations were necessary in order to comply with international (EC) regulations. The law gives rules on transport, packing, delivery and storage of dangerous substances, ammunition, explosives and fireworks. The law gives a definition of dangerous substances which divides these substances into several groups: explosive substances, compressed or liquefied gases, inflammable substances or substances which react with water and form inflammable gases, toxic, corrosive and nauseating substances, organic peroxides and other substances which can endanger the public safety and health and people working with the substances.

The law forbids the transport, delivery and storage of substances falling in the groups of explosive substances, compressed or liquefied gases, inflammable substances or substances which react with water and form inflammable gases, nauseating substances and organic peroxides, unless strict rules are followed. These rules are worked out in more detailed regulations and Orders in Council. Substances belonging to the other groups, can also be assigned as substances for which special

rules have to be followed in order to obtain permission for transport, delivery or storage. These substances can be assigned by an Order in Council. The law states that there is a Central Advice Committee for advice on the transport of dangerous substances. This committee can give advice to the Minister of Transport. The law puts the Body of Controllers of Dangerous Substances (*Korps Controleurs Gevaarlijke Stoffen*) and some other governmental bodies (which are also mentioned in other laws) in charge of the control on the compliance of the law. The law describes rights of the Body of Controllers of Dangerous Substances regarding their task in controlling the law on Dangerous Substances. The law on Dangerous Substances has been made in addition to the already existing laws which also give rules on (transport of) dangerous substances, such as the Railway Law, the Law on Ships, the Law on Goods, the Fire Services Act and the Occupational Safety and Health Act.

2.3 Decrees and Rules

Decree 'Risks of Severe Accidents' (*Besluit Risico's Zware Ongevallen*)

The Seveso directive and the Sandoz directive are implemented in the law on Environmental Conservation, the Occupational Safety and Health Act, the Fire Services Act, the Disaster Control Act and the Decree 'Risks of Severe Accidents'. This decree requires companies where certain chemical substances are present, to make an External Safety Report (ESR) (*Extern Veiligheidsrapport*) and an Occupational Safety Report (*Arbeids Veiligheid Rapport*). These companies are also required to make a company contingency report (*bedrijfsnoodplan*). Towns should make a Borough Disaster Control Plan for those companies within their area (see section 5.1). The following rules on the ESR are stated in this Decree:

- The contents of the ESR (see also section 4.2).
The decree gives the Minister of Housing, Physical Planning and the Environment and the Minister for Employment and Social Security the right to make further rules on the contents of the ESR;
- The nature and amount of chemicals present on company grounds for which an ESR has to be made;
- The authorities to which the ESR has to be sent, such as the local and provincial authority in whose territory the company (or the area within the 10^{-8} risk curve) is located.

The decree requires the management of the company to report every unusual incident, where danger may occur in the surrounding area, to the authorities and to the regional environmental inspector.

Regulations on Dangerous Substances

Dutch regulations on transport of dangerous substances are closely related to the international regulations, such as IMDG¹⁾ code, ADN²⁾, ADR³⁾, RID⁴⁾, ICAO TIS⁵⁾, RSTRM⁶⁾. These international regulations are implemented in the Dutch Law on Dangerous Substances and the Dutch Regulation on Dangerous Substances. In addition to the Law on Dangerous Substances, the Regulations on Dangerous Substances set rules for transport, storage, import and export, delivery and usage of

1) IMDG: International Maritime Dangerous Goods.

2) ADN: Règlement pour le transport des matières dangereuses sur le Rhin.

3) ADR: Accord européen relatif au transport international des marchandises Dangereuses par Route.

4) RID: Règlement concernant le transport International ferroviaire des marchandises Dangereuses.

5) TIS: Technical Instructions for the Safe Transport of Dangerous Goods by Air.

6) RSTRM: Regulations for the Safe Transport of Radioactive Materials.

dangerous substances. These regulations do not apply to explosives belonging to the police or Ministry of Justice, ammunition for which a licence has been given and certain fireworks (which are mentioned in a specific fireworks list). The regulations state that permits have to be obtained for storage or transport on land or on inland waters. These permits can be provided by the mayor of the borough where the transport ends or where the storage takes place. Additional conditions and regulations can be attached to this permit. The permit can be withdrawn if the transport (or storage) endangers the public order and safety. During transport, transport papers have to be available.

Regulations on transport are worked out further in rules for:

- Transport by land (*VLG, Vervoer over land van gevaarlijke stoffen*);
- Transport on inland waters (*VBG, Vervoer over binnenwateren van gevaarlijke stoffen*);
- Transport by railway (*VSG, Vervoer over de spoorweg van gevaarlijke stoffen*).

In these regulations rules are given for composition, packing, labelling, obligatory instructions on transport documents, handling empty packages, rules on transport and vehicles. The rules are based on international regulations and contain additional Dutch rules such as rules on equipment, permits, reporting obligations, routing obligations. The international regulations for transport of dangerous substances on sea and by air are also implemented in the Dutch regulations.

2.4 Manuals

In this section an overview is given of some official and most used manuals. Besides these manuals other (reference) books on emergency response or dangerous substances can be used by the different emergency response organizations. These books will not be mentioned any further.

‘Disaster Control’ Manual (*Handleiding Rampenbestrijding*)

The manual is made under the authority of the Ministry for Home Affairs. The manual is meant for:

- Authorities who are responsible for maintaining order and safety;
- People with co-ordinating, advising or management functions in emergency response organizations;
- People who are in one way or another involved in the preparation of emergency response.

The aim of the manual is that all organizations and people involved will work with the same view in respect of the organization of emergency response (or disaster control).

The manual gives a compilation of all laws and directives regarding emergency response. These laws and directives are the basis for the structure of response to emergencies. This structure is described in the manual. It gives a description of the hierarchical lines, the necessary co-ordination, the co-ordination centres and the facilities available.

All activities which could require an emergency response are divided into 25 processes; these processes are described in the manual. The procedure of each process, the way a process has to be executed and the relation with other processes is described in the manual.

Furthermore, some specific characteristics of 17 types of emergency are described. Besides possible consequences of the emergency, it describes the preparations which can be taken, which processes have to be carried out and what the necessary co-ordination will be.

The contents of the manual can be used to make disaster plans and disaster control plans (see section 5.1). The manual is currently being revised and updated.

'Medical Assistance at Accidents and Emergencies' Manual

(Handboek Geneeskundige hulpverlening bij ongevallen en rampen)

This manual has been made under the authority of the Ministry of Welfare, Health and Cultural Affairs and the Ministry for Home Affairs. Several organizations involved in medical assistance and emergency response have co-operated to make this manual. Together with the Disaster Control manual, this is one of the results of the reorganization of the emergency response. This manual has to lead to a uniform strategy for all organizations involved in medical assistance after emergencies. The strategy has to be followed by the medical disciplines, but all other organizations involved in emergency response have to be familiar with this strategy too.

The manual is mainly focused on the organizational structure of the medical assistance process and the role the organizations play in this process. The tasks and organization of all the different units such as the local Health Authority, the ambulance services, trauma teams and Red Cross, are described (see also section 3.6). These organizations have to work together in a chain of medical assistance activities. How this chain has to work, who are in charge and how the communication has to work is described in the manual.

'Disaster Medicine' Manual *(Handboek rampengeneeskunde)*

The 'Disaster Medicine' Manual has been written by several experts in the medical field and emergency response. The manual is specifically meant for professionals in the medical field and is meant to give these professionals more insight into all different aspects of medical treatment in emergency circumstances.

The manual is divided into three parts. The first part describes the more general aspects of disaster medicine such as definitions, psychological, organizational and legal aspects. The second part describes the special procedures which have to be followed regarding medical activities during and after emergencies. The third part gives a description of all organizations involved in emergency response and medical assistance as well as the preparations which have to be taken in the form of plans such as disaster control plans, hospital emergency reception plans and injuries dispersion plans.

'Practice Exercises: Teamwork is Vital' Manual

(Handleiding Oefenen, samenwerking is noodzaak)

The 'Practice Exercises: Teamwork is Vital' Manual was published in 1991 by the Fire Service Inspectorate of the Fire Service Directorate. This manual is the result of the Co-ordination Committee Practising Policy. The manual gives systematic information on how to set up, carry out and evaluate exercises regarding emergency response. The manual can be used by all organizations which play a role in emergency response.

The manual consists of one general part and several specific parts. The specific parts focus on one particular process of emergency response. For every organization or team which is operational in the described process the goal, organization, necessary facilities, exercises, etc. are described. The general part describes the basic assumptions and goals of the practising policy. It also gives advice on how to organise and evaluate exercises and how to plan series of exercises. Practical information on preparations, implementations and costs of exercises are also given in this general part.

'Information at Emergencies' Manual (*Handboek Voorlichting bij rampen*)

This manual has been published under the authority of the Ministry for Home Affairs. This manual gives advice and instructions on how to inform the public regarding emergencies. The manual can be used by all local and provincial authorities who are responsible for informing the public before, during and after emergencies.

The manual consists of three parts. The first part deals with informing the public about the risks on possible emergencies in their environment and informing the public about actions they have to take when emergencies occur. The manual gives information and advice to the local and provincial authorities on how they have to organize information campaigns to the public (information **before** an emergency). The second part deals with informing the public **during** and **immediately after** an emergency. It describes the tasks of the authorities, preparations which are necessary (such as making agreements with the (local) media), co-ordination and the different possible outline details.

In the third part information to the public **after** the emergency is described.

3 Organizations Involved In Emergency Response

3.1 Ministries

Ministry for Home Affairs (*Ministerie van Binnenlandse Zaken*)

The General Directorate of Public Order and Safety (*DG Openbare Orde en Veiligheid*) of the Ministry for Home Affairs is responsible for the policy concerning public order and safety. The Fire Service Directorate, the Directorate of the Police and the State Co-ordination Centre are some of the divisions that come under this General Directorate. The tasks of the State Co-ordination Centre are described in section 3.4. The Fire Service Directorate is (amongst other things) responsible for (the policy of) emergency response in general. The duty of the Fire Service Directorate is to carry out proper fire and accident control, assistance, disaster control, crisis management and public safety policy. This includes tasks such as developing policy and preparing legislation, including evaluation and testing. The Fire Services Directorate can also provide actual support in the event of large-scale incidents or disasters. If necessary, co-ordination at a nation level of (emergency response) activities will be done by the Ministry for Home Affairs.

Most of the tasks of the government regarding emergency response are carried out by the section 'Crisis Management and Emergency Response' (*hoofdafdeling Crisismanagement en rampbestrijding*) and the Fire Service and Disaster Control Inspectorate (*Inspectie Brandweezorg en Rampenbestrijding*, see section 3.2). Some tasks of the section 'Crisis Management and Emergency Response' are:

- Development of tools for the benefit of accident and emergency response such as guidelines, doctrines and procedures;
- Development of policy regarding emergency response;
- Development of practising strategy and policy;
- To deal with technical and organizational aspects of fires, accidents, emergency response and the control of risks;
- To investigate and perform risk analysis of public safety.

Ministry of Welfare, Health and Cultural Affairs

(*Ministerie van Welzijn, Volksgezondheid en Cultuur*)

The Ministry of Welfare, Health and Cultural Affairs plays a role in situations where the quality and the organization of the health care is involved and when medical assistance is necessary. At the moment a reorganization of the tasks of the ministry regarding crisis management and emergency response is taking place. The Directorate Civil Defence and Peace Calamities has recently (October 1992) been dissolved. Some of the tasks of this Directorate will be integrated with the tasks of policy Directorates. Some of the tasks regarding the organization of medical tasks of emergency response have been taken over by the Ministry for Home Affairs. A small unit Crisis Management will remain at the Ministry of Welfare, Health and Cultural Affairs.

The ministry has initiated the development of several manuals, plans and committees, such as the National Organization of Trauma Teams, Hospital Reception Plans, Casualty Delivery Plan, Ambulance Assistance Plan, education in disaster medicine, medical protocols, a national medical record card and the National Triage Methodology (see also section 3.6 and 5.1).

Ministry of Housing, Physical Planning and the Environment

(Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer)

The General Directorate of the Environment of the Ministry of Housing, Physical Planning and the Environment is responsible for the preparation, the forming and fulfilling the policy regarding the environment. It has to supervise and uphold the legal regulations regarding environmental control (such as stated in the Law on Environmental Control and the 'Risks Severe Accidents' decree.

The Inspectorate for the Environment falls under the authority of the General Directorate of the Environment. This inspectorate has an important advising role during, and after incidents with effects on the environment. Besides the Inspectorate for the Environment, the other inspectorates of the State Health Inspectorate can also play a role in advising local authorities and operational services. These inspectorates fall mainly under the authority of the Ministry of Welfare, Health and Cultural Affairs. The State Health Inspectorate consists of several inspectorates:

- the Inspectorate for the Environment (*Inspectie voor de Milieuhygiëne*);
- the Health Inspectorate (*Geneeskundige Inspectie*);
- the Inspectorate for Mental Health (*Inspectie voor Geestelijke Gezondheid*);
- the Veterinary Inspectorate (*Veterinaire Inspectie*);
- the Inspectorate for Medicine (*Inspectie voor Geneesmiddelen*);
- the Inspectorate for Health Protection (*Inspectie Gezondheidsbescherming*).

During and after disasters with effect on the environment (e.g. after chemical releases) these inspectorates can all be involved. If necessary, they inform each other and co-ordinate their activities. If necessary, the General Director or even the minister is warned through one of the inspectorates (most likely by the Inspectorate of the Environment). Measures, advice, policy decisions and other activities after disasters with possible effect on the environment can be co-ordinated by the Departmental Co-ordination Centre of the Ministry. The ministry can be reached 24 hours a day for emergency calls.

Ministry of Employment and Social Security

(Ministerie van Sociale Zaken en Werkgelegenheid)

The General Directorate of Labour (*Directoraat-Generaal voor de Arbeid*) of the Ministry for Employment and Social Security is responsible for all tasks concerning labour conditions and for the development and fulfilment of laws and regulations in this field, such as the Occupational Safety and Health Act (see section 2.2). The Directorate Safety is part of the General Directorate and is mainly concerned with the safety in labour situations. This Directorate consists of several departments. These departments are all concerned with different aspects of safety at work. The Department of Chemical Safety is primarily occupied with the development of policy regarding major hazards with dangerous chemical substances. The work of the Department of Chemical Safety is focused on the prevention of accidents. The department develops publications in which special safe working procedures are described. The department takes part in the interdepartmental 'Prevention and Disasters' committee and is also responsible for policy regarding Occupational Safety Reports (see section 4.1). The tasks of the department and the ministry as a whole are mainly focused on prevention of emergencies and not on emergency response.

Ministry of Defence (*Ministerie van Defensie*)

The Ministry of Defence can provide military assistance at emergencies if this is requested. Such a request has to be made by the Minister for Home Affairs. Until recently the Army Reserve Unit, an organization under the authority of the Ministry of Defence, had some tasks regarding emergency response. This unit could give medical assistance as well as assistance with rescue and clearing activities in case of major emergencies. The Army Reserve Unit was dissolved on 1st January 1993.

The Minister for Home Affairs and the Minister of Defence have made new

agreements on military assistance in emergencies. They agreed that two medical units in the army can be brought into action. Emergency response exercises where military as well as civil units take part, will also be stimulated.

Ministry of Transport and Public Works (*Ministerie van Verkeer en Waterstaat*)

The Ministry of Transport and Public Works has a very limited task regarding emergency response. The ministry is responsible for legislation in the field of transport of dangerous substances in the Netherlands and for the contribution to the international regulations. The Traffic Inspectorate of this ministry is responsible for superintending the legislation (see section 3.2). The North Sea Directorate (*Directie Noordzee*) of the Ministry of Transport and Public Works holds the main responsibility regarding emergency response on the North Sea. The North Sea Directorate is responsible for efficient and safe maritime traffic and for the management and maintenance of the North Sea, so this includes all emergency response activities on the North Sea. This does include the inland waters such as the Wadden Sea. Inland waters are assigned to adjacent boroughs. These boroughs are primarily responsible for emergencies in their territory.

3.2 Inspectorates

Fire Service and Disaster Control Inspectorate

(*Inspectie Brandweezorg en Rampenbestrijding*)

The purpose of the Fire Service Inspectorate (Inspectie voor het Brandweezewzen) is stated in the Fire Services Act. This inspectorate has recently been reorganized, the Fire Services Directorate has been dissolved and a new inspectorate has been formed: Fire Service and Disaster Control Inspectorate. Therefore the Fire Services Act will be adapted. The tasks of the former Fire Services Inspectorate are taken over by the new directorate. The tasks include the following:

- To test and review the way local, regional or provincial authorities carry out their tasks regarding the prevention, preparation and control of a fire, accident or disaster;
- To investigate the development of fires, accidents or disasters.

The Inspectorate is authorised to collect all the necessary information concerning the cause and development of a fire, accident or disaster.

Labour Inspectorate (*Arbeidsinspectie*)

The Labour Inspectorate has to check if companies apply to the regulations (stated in the Occupational Safety and Health Act) with respect to safety, health and well-being of the employees. Officials of the Inspectorate have access to all companies. They have the right to take measurements and do tests, to make drawings and photos, to take samples and objects for investigation and to investigate accidents. Employers and employees have to give all necessary information to the Labour Inspectorate. The Labour Inspectorate makes a report on the results of the investigation.

If officials of the Inspectorate are of the opinion that certain rules of the Occupational Safety and Health Act are not properly carried out they can give advice to the company. They can also demand that companies make certain changes in order to apply to the rules of the Occupational Safety and Health Act. They have to justify this demand and can set a timetable for carrying out the changes.

If the Labour Inspectorate is confronted with situations which are of immediate danger, they have the right to shut down all vital activities. This decision is valid for only seven days unless it has been authorised by a judge.

The Labour Inspectorate also plays an important role in accident investigations. After an accident the Labour Inspectorate often starts investigating the circumstances under which the accident happened. The attention of the Labour Inspectorate is mainly focused on the cause of the accident, the preventive measures and the labour circumstances.

Inspectorate for the Environment (*Milieu-inspectie*)

The Inspectorate of the Environment consist of one Head Inspectorate (located at the Ministry of Housing, Physical Planning and the Environment) and nine regional inspectorates. During and after disasters the regional inspector has an advising role towards the local authorities. The responsibility and decision remains with the local authorities. The mayor can ask the regional inspector for advice, a second opinion or measurement facilities. Measurement facilities will be supplied by the Unit Environmental Incidents and Environmental Medicine (*Milieu-ongevallen Dienst*, see section 3.6). If necessary, a representative of the Regional Inspectorate will be present in a regional co-ordination centre. The Regional Inspectorate will inform the Head Inspectorate. The Head Inspectorate can give advice to the Regional Inspectorate and will warn the minister (if necessary). If the consequences of the disaster go beyond the territory of one region, the Head Inspectorate will co-ordinate the activities of the Regional Inspectorates.

Recently the Head Inspectorate updated a brochure in which the roles and tasks of the Regional Inspectorate and the other inspectorates of the State Health Inspectorate are described. The approach of incidents with (possible) consequences for the environment consists of seven steps:

1. Verification of the alarm;
2. Judgement of the nature of the incident;
3. Estimation of the risks for the public health;
4. Investigation;
5. Reception, support and aftercare of the public;
6. Communication and information;
7. Evaluation and follow-up.

In all these steps, experts of the Inspectorate of the Environment can use their expertise and experience regarding environmental issues to advise and give support to the authorities.

Medical Inspectorate (*Geneeskundige Inspectie*)

Besides other tasks in the medical field, the Medical Inspectorate has some tasks regarding emergency response:

- Has been involved with the construction of the new law on medical assistance at emergencies;
- To take part in several committees in which the interests of the medical assistance are represented as well as committees regarding training and education of medical assistance (at emergencies);
- To stimulate and give advice to local health authorities regarding their emergency response tasks;
- To judge and advise on (municipal) disaster plans;
- To take part in emergency response exercises.

Traffic Inspectorate (*Verkeersinspectie*)

The Traffic Inspectorate of the Ministry of Transport and Public Works is responsible for superintending legislation in the field of transport of dangerous substances. It has also the task of upholding transport regulations and has to control the safety of the railways. Control of transport of dangerous substances (such as chemicals) has a high priority and the control will be intensified the next few years.

Control on transport can be divided into a few sections. There are routine control actions in which trucks or ships are checked with documents: danger carts, certification of the professional skills of the driver/captain, the (technical) state of the vehicle, etc. Besides these routine actions, special topical actions and international actions are held. Topical actions are special actions during a certain period in which one particular sector of the transport industry will be checked. The Dutch Traffic Inspectorate organized recently an international action which checked transport of dangerous substances in containers. This action was held in the main harbours.

3.3 Control

The **mayor** of the borough where the accident has started, is the commander-in-chief of the emergency response. The mayor can give a so-called 'Disaster Statement'. He has to interpret the actual situation and the definition of a disaster. When a 'Disaster Statement' is given, all rules and regulations stated in the Disaster Control Act are activated. A Disaster Statement is, however, not absolutely necessary. The mayor forms a municipal disaster staff (*gemeentelijke rampenstaf*) which has the following duties:

- Giving advice to the mayor on the policy to be pursued;
 - Translating policy decisions into operational orders;
 - Exercising operational leadership;
 - Co-ordinating the execution of the activities and creating conditions and facilities.
- The disaster staff consists of representatives of the fire brigade, the local health authority, the police, municipal services, other services or organizations and the information service. The disaster staff can be divided into two teams, one team is mainly focused on policy advising (the management team) and the other team is mainly occupied with the co-ordination of the operational task (the operational team). The operational leader is in charge of this operational team. The **Operational Leader** is usually an officer of the fire brigade (unless the mayor appoints someone else for this function). The operational team controls and co-ordinates the activities of the operational organizations. The operational leader keeps in contact with the management team and the mayor, so both teams will be informed on the cause of the emergency and the emergency response. The mayor will keep other organizations (such as mayors from adjacent municipalities and provincial and national authorities) informed. In the following scheme the organizational structure of the municipal disaster staff is represented.

The municipal disaster staff have a meeting in the Municipal Co-ordination Centre. An Incident Site Command Team (*CTPI*) can be established. From this CTPI all operational activities at the scene of the accident are given orders, controlled and co-ordinated. The commander at the place of the accident is the fire brigade officer.

If the outcome of the emergency affects other towns, all mayors concerned can have their own disaster staff. One of the mayors has to co-ordinate this. It is also possible to create an intermunicipal disaster staff.

Especially in multimunicipal emergencies, the Queen's commissioner (*Commissaris van de Koningin*), the head of the involved province, is responsible for the co-ordination between municipalities, national authorities and other (national or regional) services and institutions. The Queen's commissioner has to decide on assistance requests for operational services. The Queen's commissioner can form a provincial disaster staff, which will take place in the Provincial Co-ordination Centre. The Queen's commissioner can give advice to the mayor.

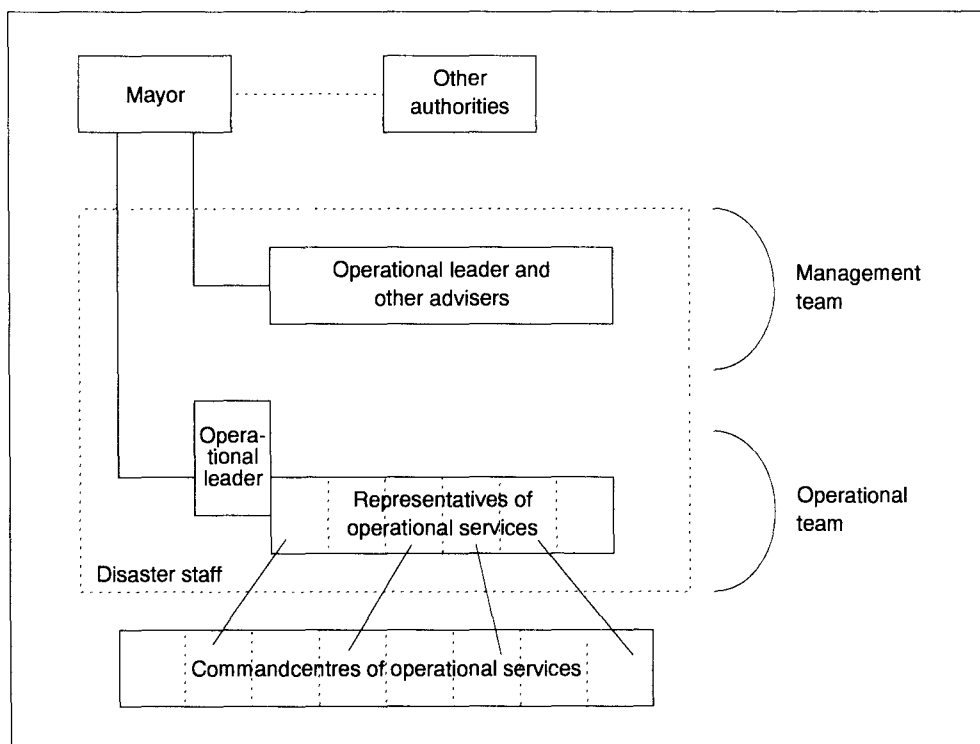


Figure 3.1 Organizational structure of municipal disaster staff

When an emergency has national outcome, the Minister for Home Affairs coordinates the national governmental actions. The Minister can give advice to the Queen's commissioner. If necessary, a national policy can be announced. The co-ordination takes place from the National Co-ordination Centre. It is also possible that Ministers from other departments get involved. When for instance an emergency has severe results affecting the environment, the Ministry of Housing, Physical Planning and the Environment will play the main role in the co-ordination and information during and after the emergency.

3.4 Co-ordinating Bodies

Several co-ordination centres can be made operational in case of emergencies. These co-ordination centres all operate at different levels: national, departmental, regional or local.

The State Co-ordination Centre (*Landelijk Coördinatie Centrum, LCC*) is located in the office of the Ministry for Home Affairs and has the following tasks:

- Co-ordination of the measures regarding emergency response;
- To take care of all facilities which are necessary for a proper co-ordination on all levels (international, departmental, regional and local) and all other facilities which are necessary for the functioning of the national co-ordination centre;
- The development of the policy on public order and safety;
- Preparation of the measures on a national level in the event of disturbances of the public order and safety;
- The evaluation of all actions taken at disturbances of the public order and safety.

The State Co-ordination Centre can be reached 24 hours a day. The National

Information Centre (*Nationaal Voorlichtings Centrum*) can be set up in those circumstances where national co-ordination of the information to the **public** as well as to the media is required.

During nuclear accidents the National Co-ordination Centre co-ordinates emergency response on a national level. This falls under the jurisdiction of the Ministry of Housing, Physical Planning and the Environment. Here for special arrangements regarding the emergency response organizations are made. These rules and arrangements are described in the National Plan Nuclear Accidents (*Nationaal plan kernongevallen, NPK*). In this plan the tasks of the other co-ordination centres such as the Departmental Co-ordination Centre are also described. The National Co-ordination Centre and the other co-ordination centres can also be alerted for other major accidents. A Departmental Co-ordination Centre will be activated if actions or the outcome, regarding the accident, fall under the jurisdiction of a particular ministry. These centres take care of the co-ordination between national and lower levels. The national authorities are usually also present in these co-ordination centres. They can use the communication facilities in order to give or get information on the cause of the emergency. In the event of several Departmental Co-ordination Centre being operational, the National Co-ordination Centre will take care of the co-ordination on a national level.

Most emergencies involving chemical substances will have local consequences. The Municipal Co-ordination Centre will then play the most important role. The Co-ordination Centres at other levels will not necessarily be active. The role of the Queen's Commissioner and the Provincial Co-ordination Centre has been discussed in section 3.3 as well as the role of the mayor and the Municipal Co-ordination Centre.

3.5 Communication

Communication and connections

In the Netherlands there is a national alarm telephone number, 06-11, which can be called at every location in the Netherlands. These phone calls are received in a regional telephone exchange. From here the callers are connected to alarm centres of the regional operational assistance service. The alarm centre immediately alerts the operational service. The operational service can, in almost every circumstance, reach the place of the accident within 15 minutes. This is a maximum time, usually they reach the accident scene earlier (within ten minutes). Research is being done to the correlation between the expected risks of the accident and the time between the first alarm and the moment the fire brigade has to be on the scene.

The organization of these alarm centres differs from region to region. In most regions there are separate alarm centres for the fire brigade, the police and the ambulance services. In some regions the fire brigade and the ambulance service work together in one alarm centre and in a few cases all three services work together in one alarm centre. At this moment this situation is changing slowly, integration between different services is taking place more and more and co-operation between two services from different regions is also possible. The (national) government urges further integration or co-operation between alarm centres. This integration process is, however, a slow one, since there are some differences between the organization and the tasks of the employees at the alarm centre. One of the difficulties in this matter is that the boundaries of the region are not the same for all three services.

The fire brigade, the police and sometimes the local health authority have a

communication command vehicle (*verbindingscommandowagen*). This mobile alarm centre can be transported to the place of the incident. When this centre is made operational this mobile centre eases the task of the alarm centre. The alarm centre will be relieved of most tasks concerning the emergency and can continue its normal business.

A well-known phenomenon immediately after emergencies is the overloading of the telephone system. In an emergency situation, communication is essential for the emergency response organizations. In order to guarantee the possibility of communication a national emergency telephone system (*nationale noodnet*) has been established. All authorities and organizations have access to this system. The system is meant specifically for emergencies and is not used for other purposes.

Warning, information and instructions for the public

In the Netherlands there is a siren network which can be used to warn the population in case of an emergency. This siren network is rather old and not very well maintained in some places. In the next few years this siren network will be replaced by a new network with more facilities. All people can be reached with this siren network. It is also possible to select sirens for a specific area in order to alarm only a limited number of people. The Fire Service is in charge of this network. It is also possible to warn people in certain areas by loudspeakers in police cars. The municipal disaster staff is responsible for informing the public. In 1992 and 1993 all municipalities organized information campaigns by which the public was instructed 'what to do when the alarm sounds'. After a siren alarm further information will be given to the public through messages on (local) radio and television channels. This information will be provided by the municipal disaster staff. At the Municipal Co-ordination Centre an Information Centre for the press will be arranged.

The Municipal Disaster plan has to include descriptions as to how the public will be informed.

For certain emergencies it might be necessary to arrange a Central Registration and Information Bureau (CRIB). This centre has to collect information about victims and evacuated persons and inform relatives of these people. Furthermore, it has to provide information on the number of casualties to the mayor and its Disaster staff. In the Municipal Disaster plan it has to be described how this should be organized.

3.6 Emergency Response Organizations

Fire Brigade

The fire brigade is in charge of the co-ordination of the emergency response during accidents and disasters. The operational leader is (unless the mayor appoints someone else) an officer of the fire brigade. The commander at the place of the accident, who co-ordinates the activities of the operational services, is also a fire brigade officer (see also section 3.3). Tasks of the fire brigade regarding emergency response are:

- To prevent fire or danger for fire and accidents which can take place during a fire. For this purpose the fire brigade can set certain rules for companies/buildings regarding fire safety;
- To prepare possible activities regarding emergency response during and after disasters. This can be done by making (emergency) plans;
- To organize emergency response exercises;
- To repress the results of a fire;

- To rescue victims of accidents;
- To warn and alarm all organizations and people involved;
- To warn and alarm the public, the fire brigade can use the national siren network;
- To collect and evaluate information regarding the cause of the accident and to locate dangerous (chemical) substances. For this purpose the fire brigade can form special teams. More complicated research and measurements can be done by specialized research institutions;
- To decontaminate people and/or objects.

Police

The police have a representative in the municipal disaster staff (in the management team as well as the operational team). Within its own organization the police appoint a police-officer who is in charge of commanding the different police units. This police-officer can have his own advisers. The policy regarding the maintenance of public order and maintaining the law will be made by the mayor and the public prosecutor.

The tasks of the police regarding emergency response are:

- To give assistance at the place of the accident (for instance with the rescue of victims) until experts have arrived (such as the fire brigade or the health service);
- To explore the nature and outcome of the accident and give further information to the alarm centre, which can (if necessary) warn the fire brigade or the ambulance service;
- To cordon off the emergency area and to control the access of the press and other people to the emergency area;
- To regulate the traffic; this can include the diversion of the ordinary traffic, to make access for emergency response traffic and to accompany the emergency response traffic such as ambulances and fire trucks;
- To keep the public order;
- To regulate and give assistance in case of evacuations or clearance of buildings or areas;
- To identify victims, in large-scale situations the National Disaster Identification Team can be put into action;
- To do (criminal) investigations on the cause of the accident and possible unlawful actions;
- To give information to the press (in consideration with other services and organizations involved).

Local health authority (GGD) and ambulance services

Many local health authorities have a number of ambulances available, but there are also many ambulances owned by private companies. All ambulances are regionally planned and controlled by the Central Ambulance Station (*Centrale Post Ambulancevervoer*). This alarm centre co-ordinates the use of ambulances and gets in contact with the hospitals. For carrying out their tasks the post can use an Ambulance Assistance Plan and a Casualty Delivery Plan (see section 5.1). Basic life support and triage will be carried out by the ambulance personnel or a trauma team.

A triage method has been developed in which three categories of patients can be distinguished. The first category consists of patients who need basic life support and transportation to a hospital (their breathing, blood circulation or consciousness are unstable). The second category of patients needs hospitalization and treatment within six hours. The third category consists usually of ambulatory victims who need first aid, either in the E&A department of a hospital or by a general practitioner. In war-time a fourth category is added to these three categories. This category consists of patients which cannot be adequately treated or saved under these circumstances. The triage method is focused on mechanical accidents and victims. In disaster situations a trauma team, consisting of a surgeon, an anaesthetist and two nurses, can be called upon from the National Organization of Trauma Teams (*LOTT*).

The head of the local health authority is in charge of the medical assistance at emergency response. He will also give advice to the mayor as a member of the municipal disaster staff. The head of the medical operational teams will take part in the operational team of the disaster staff. A medical co-ordinator will be take part in the Incident Site Command Team.

When the transportation or treatment capacity is insufficient, an assembly point for the injured can be located near the site of the incident. Here, further treatment can be done. The Trauma Team can give medical assistance.

National Organization of Trauma Teams (LOTT)

Special Trauma Teams can give medical assistance in the event of a disaster. The teams can offer specialized life-saving assistance at the accident site. This team can give basic and advanced life support and prepare the patients for transportation to a hospital. The team can also give medical assistance in hospitals near the accident site in order to increase the treatment capacity of these hospitals. The tasks of the team will then mainly be focused on triage, advanced basic life support and outpatients' aid. The team consists of a surgeon, an anaesthetist and two specialized nurses. Thirty hospitals have a trauma team available 24 hours a day. Trauma teams are organized in the National Organization of Trauma Teams (LOTT). The LOTT also has a few specialized teams available, such as a nuclear, a chemical, a burn and a hypothermia team, in cases where specific expertise is needed. These teams can assist with triage and give advice to local hospitals. The chemical teams are connected with the National Poison Information Centre.

National Poison Information Centre (NVIC)

The National Poison Information Centre is located at the Academic Hospital in Utrecht and falls under the authority of the National Institute for Public Health and Environmental Protection (*RIVM*). The National Poison Information Centre gives information on medical treatments regarding toxic substances and can be reached 24 hours a day for assistance or medical advice. The centre has an intensive care unit of 10 beds, which can be extended up to 100 beds. After consultation with, and in co-operation with, medical units of the Ministry of Defence, the hospital can be extended to 400 beds.

Red Cross

One of the tasks of the Netherlands Red Cross Organization is to give medical assistance to injured and sick people during disasters and wartime. When the local medical service do not have enough capacity the Red Cross can offer assistance. The Red Cross is organized in local columns, the size of this column can differ from place to place. Local columns form a district column which has a fixed composition. The district column is equipped for the following tasks:

- To support the local health authorities, ambulance personnel and trauma teams;
- To give first aid in the emergency area;
- To set up an assembly point for injuries;
- To look after the transport to hospitals.

The Red Cross is capable of operating an assembly point for casualties within two hours, with a capacity of approximately 25 triage casualties per hour.

A medical team of the Red Cross ready at hand is the SIGMA team. SIGMA teams are rapid medical intervention teams (*Snel Inzetbare Groepen ter Medische Assistentie*). A SIGMA team can give support to trauma teams and ambulance personnel. The implementation and dispersion of SIGMA teams is in an experimental phase.

Coastguard

The Netherlands Coastguard is a collaborate organization bringing together all ministries involved in some way with the North Sea and the Dutch section of the Continental Shelf. Six ministries signed the Coastguard agreements, which does not exclude the fact that they all retain their own responsibilities. The Coastguard operates as a Rescue Co-ordination Centre and co-ordinates all search and rescue operations. The Coastguard also regulates maritime traffic, maintains communication on the emergency frequency, maintains shipping lane markings, performs surveillance operations and takes care of pollution and disaster control. The area covered by the Coastguard is not limited to the North Sea, search and rescue operations are also extended to the inland waters such as the Wadden Sea, the IJsselmeer, rivers, estuaries and beaches. The Coastguard not only co-ordinates operations of governmental services (such as the police and the Navy), but also Scheveningen Radio, the Royal Live-saving Societies and private rescue services.

Research Institutions

Several national research institutions such as the National Institute for Public Health and Environmental Protection (*RIVM*), the Royal Dutch Meteorological Institute (*KNMI*), the National Institute for Integral Freshwater Control and Wastewater Treatment (*RIZA*) and the National Institute Quality for Agriculture and Garden Products (*RIKILT*) can give advice or do additional research on the consequences of chemical accidents on the environment and food products. These institutions can take measurements, do tests or make model calculations regarding the consequences of the accident.

The RIVM has a special unit, the Environmental Incidents and Environmental Medicine Unit (*MOD*) which does research on the consequences of an accident, especially focused on the possible exposure of the population and on the environment to toxic substances. This department has special equipment for measuring the components of chemical releases. This equipment can be easily transported to the place of the accident, where samples can be taken. The RIVM can evaluate the consequences of exposure during and after a disaster. It can give advice on questions such as whether to evacuate or not, to keep the cattle inside or not, if vegetables can be consumed, etc. It also evaluates the risks and the outcome for the population and environment during the accident, and after the accident has happened. The RIVM also controls the automated National Nuclear Measuring Network. The RIVM plays an important role in advising the government during nuclear accidents on technical questions. The RIVM controls the Information and Documentation Centre (a computer system) for nuclear accidents. The KNMI also plays an important role in advising the authorities after chemical (or nuclear) emergencies. The KNMI can give predictions and estimations on what the dispersion of chemical (or nuclear) clouds will be as well as the other above mentioned research institutes. The RIZA controls a measuring network for chemical releases in the Dutch rivers. On the river Rhine an international detection and alarm system has been set up. If chemical pollution is detected, samples will be examined by the RIZA and (if necessary) all organizations such as waterworks will be warned.

Others

The above mentioned list of organizations involved in emergency response is not complete. Depending on the situation, the involvement of other organizations could be necessary, this can differ from the Salvation Army, the Explosive Clearance Service of the Royal Army to private salvage companies and undertakers. Even if these organizations have no official task regarding emergency response, most organizations will be available in emergency situations. The availability of organizations can be arranged in disaster plans but can also take place on an immediate basis. These organizations can be hired by the local authorities, but can also work on a voluntary basis.

4 Information Provided by the Industry

4.1 Occupational Safety Report (*Arbeidsveiligheidsrapport, AVR*)

The obligation to make an Occupational Safety Report (OSR) is stated in the Occupational Safety and Health Act. The Decree Obligation Occupational Safety Report (from 1981) describes which installations companies have to make an OSR. This decree gives the rules for calculating if an installation is OSR-obligatory. These rules are more extensively described in publication P172-1 'Guideline for Appointment of OSR-obligatory' of the Ministry for Employment and Social Security. The necessity to have an OSR is determined by the nature and amount of chemicals either in production or in storage and the circumstances of the installation. For different circumstances a circumstances factor is defined. For all types of chemical substances a limited quantity is defined. If the quantity present in the installation, multiplied by the circumstances factor, exceeds this limit value, an OSR for that particular installation is needed. Because the introduction of the OSR obligation has been in phases the limit value is multiplied by a phasing factor. In the course of time this phasing factor will be decreased so that eventually all installations which exceed the limited value will need an OSR. A company has to make an OSR for every assigned installation.

The necessary contents of an OSR is described in short in the Occupational Safety and Health Act, a more extensive description is given in publication P172-2 of the Ministry for Employment and Social Security. This publication gives a guideline for drawing up the OSR. The OSR is a non-public document. The OSR has to contain the following subjects:

- A general part, in which the installation, the processes and the emergency facilities are described. This includes management aspects of the organization which apply to the installation, including organization charts, safety management and the periodical maintenance and inspection programmes are also included;
- A specific part, in which detailed information about the installation has to be given. This contains a description of the process steps, the equipment and control and safety systems. This part contains an inventory of the foreseeable risks with respect to the dangerous chemical substances and the technical and managerial measures taken to prevent accidents or to keep the consequences within bounds. Specific organizational aspects regarding the installation such as necessary education and training of operational employees and procedures for maintenance and inspection of critical safety devices are also given in this part.

Every time an important change in the installation has been made, the OSR has to be updated.

4.2 External Safety Report (*Extern Veiligheids Rapport, EVR*)

In the 'Risks Severe Accidents' Degree companies where dangerous chemical substances are present, are obliged to make an External Safety Report (ESR). In the Netherlands there are 75 companies which are obliged to make an ESR; these companies also have to make at least one OSR. In this Decree the contents of the ESR is dictated. An ESR has to contain the following information:

- A general description of the company, including a description of the used substances and the nature of the substances;
- A general description of the processes;
- A general description of possible extraordinary events within the company as well as outside the company grounds, which can be dangerous in and outside company grounds;
- An inventory of measures which have been taken to diminish the chance of extraordinary events and an inventory of measures to limit the consequences of the event;
- A risk analysis of the hazards with consequences outside the company grounds. The risk analysis has to contain an estimation of the chances that the above mentioned events will take place and a map of the surroundings of the company in which the risk curves are given. It also has to contain a graph in which the number of casualties as a consequence of one of the above mentioned events, are plotted as a function of the chance.

The ESR is a public document. The ESR has to be updated every five years.

5 Emergency Planning Development

5.1 Plans

In order to be prepared when emergencies occur, the Disaster Control Act demands preparations for emergencies. The main responsibility for these preparations is put on the local authorities. They have to make several preparatory plans and have to keep these plans up to date. The operational services as well as certain companies have to make their own plans. These plans will be described in this chapter. Besides the plans mentioned in this chapter, the operational services such as fire brigade and the police make plans for a specific situation. In these plans they describe specific actions of their service and how they have to approach this specific location. These plans will not be described in detail in this report.

Disaster plan (*Rampenplan*)

The Disaster Control Act obliges every borough to make a disaster plan. The Disaster Control Act dictates the subjects which have to be described in the plan. These are the following subjects:

- Definitions of all used terms;
- An overview of all disasters which can happen in the municipality;
- An overview of all organizations, services, institutions and private persons which can be involved in emergency response;
- A scheme in which the control and co-ordination of the different organizations is represented;
- An internal and external connections and alert scheme;
- A plan (in outlines) to warn the public;
- A plan (in outlines) for evacuating the public;
- A plan (in outlines) for the medical assistance at emergency grounds;
- A plan (in outlines) to take care of victims;
- A plan (in outlines) regarding food supplies for the public;
- A plan (in outlines) regarding supplies for the emergency response organizations;
- Rules on how to determine information in order to inform the public;
- Rules on how to establish information about damage caused by the disaster;
- Rules about the organization and implementation of a central registration and information bureau (CRIB);
- Rules on how to report the events;
- A list of all bodies which will get a copy of the plan.

The disaster plan has to be approved by the provincial authorities and has to be united with other disaster plans (of adjacent municipalities)

Disaster Control Plan (*Rampbestrijdingsplan*)

The Disaster Control Act obliges every municipality also to make a disaster control plan for every disaster of which the place and the nature can be foreseen. It is already an obligation for every company falling within the rules of the Seveso Directive to make a Disaster Control Plan. These plans are non-public documents. All measures and activities which have to be performed regarding the emergency response have to be described in this plan. The plan has to be approved by the provincial authorities. Although the law does not describe the contents and structure of the plan, there is a model Disaster Control Plan, which is accepted in several provinces as the standard. This plan consists of five chapters. The first chapter describes the scenario of that particular disaster and the possible consequences. In the second chapter an inventory of all tasks and processes which have to be carried out regarding the emergency

response is made. How these tasks have to be performed, who is in charge, how the co-ordination takes place, what subtasks there are, etc. is described in chapter 3. Chapter 4 describes how the logistic measures which are necessary to keep all emergency response tasks going. The last chapter, chapter 5, deals with the control and command of all processes and about communication.

This model is, however, not the only method for making a Disaster Control Plan. In some boroughs they chose to make a basic Disaster Control Plan which can be used for more than one type of disaster.

Company Contingency Plan (*Bedrijfsnoodplan*)

All companies who are obliged to make up an Occupational Safety Report are also obliged to make up a Contingency Plan. This plan is non-public and for internal company use only. The plan contains a description of all measures and provisions taken by the company in order to minimize and repress the consequences of disasters. For each emergency scenario the Contingency Plan can differ. Before drafting the plan, the company has to consult the local authorities. The Contingency Plan has to be in tune with the municipal Disaster Plan and the municipal Disaster Control Plan. The plan has to offer support to the people in charge of the control of the emergency, in making their decisions and doing their activities regarding emergency response. A guideline on how to make a Contingency Plan is given by the Ministry for Employment and Social Security (publication CP-32).

The plan has to include information about the following subjects:

- The organizational structure of the emergency unit of the company;
- An outline of the tasks and responsibilities of the company emergency response organization in relation with the those of the local emergency response organizations;
- A reference to the municipal Disaster (Control) Plan;
- The realization and organization of the co-ordination centre of the company, the command post, the centre for medical services, including the available facilities of the company;
- The warning and alarm procedures;
- The alarm and communication systems;
- Communication with and information for external parties, such as the fire brigade, health authorities, police, media, etc. and relatives of employees;
- Medical emergency supplies;
- A distinction between the several stages in the response activities;
- An overview of the available facilities of the company and the assistance which can be given by external services.

Specific procedures are not necessarily written down in the Company Contingency Plan, for certain specific procedures the reader is referred to other documents or an appendix. The plan has to be flexible and kept up to date. The plan has to be followed by education, training and exercises.

Hospital Reception Plan (*Ziekenhuis rampenopvangplan*)

Hospitals have to make a Hospital Reception Plan for disasters. This plan can help to increase the treatment capacity of the hospital. This treatment capacity depends on the number of available surgeons, anaesthetists and specialized nurses. Since the number of surgeons depends on the number of beds, the treatment capacity is expressed as a percentage of the total bed capacity.

The Hospital Reception Plan contains the specific procedures which are necessary in case of a disaster. When the hospital is alarmed, the surgeon can activate (in consultation with the management) the Hospital Reception Plan. The alarm procedure, as well as the primary activities which have to be executed by the activated personnel, are described in this plan. Preparations can and have to be ready within

15 minutes after the alarm has been given. When the patients arrive the triage will (if possible) be done by the surgeon. Medical information about patients will be given by one source, for instance somebody within the hospital management. Rules on how this information has to be treated can be described in the hospital emergency reception plan.

The plan has to be made by a hospital committee. This committee is also responsible for updating and practising the plan. This committee can furthermore make an inventory of all possible emergencies in their area.

Casualty Delivery Plan (*Gewonden spreidingsplan*)

For emergencies with many casualties, the capacity of the nearest hospital may not be enough. The capacity of the hospital for treating victims of emergencies is determined at about 3% of the total bed capacity per hour. If it is necessary to distribute the casualties over several hospitals, a casualty delivery plan will be used. A casualty delivery plan gives the distances of several hospitals from the place of the emergency. The capacities of these hospitals are predetermined. The hospitals are placed in a table in order of nearness. In this plan, the specialities of the hospitals is taken into consideration. In this plan the capacity of the nearest hospital will hardly be used because this hospital will get many extra patients (also casualties from the emergency) who will come to the hospital with their own transport. In several regions an automated version of this plan is used. This helps the operator of the Central Ambulance Station to determine to which hospital ambulances have to bring certain patients.

Ambulance Assistance Plan (*Ambulance bijstandsplan*)

Every Central Ambulance Station should have an ambulance assistance plan. This plan gives a quick and good overview of the number of available ambulances, how many ambulances from other regions can give assistance and the distance these ambulances have to travel before they reach the scene of the accident.

5.2 Tools

Besides manuals, plans, exercises and the development of organizational structures, which have already been mentioned in this report, several tools in the form of computer software packages have been developed. These tools have been developed in order to give support to the workers in the field of emergency response. The following software tools can be used in the emergency response phase during an accident. This list may not be complete, but is a selection of the most used or most important tools available. The selection has been made by the Steering Committee, which consist of representatives of several Ministries and of other people working in the field of emergency response (see Appendix 1).

ALARMBEL

ALARMBEL is an automated alarm network and information system, developed to increase the efficiency of emergency response during accidents and emergencies on the Dutch rivers (the rivers Rhine, Waal and Meuse). It has been implemented in the province of Gelderland. The systems supports the gathering of relevant data, draws up a list of all parties involved and distributes messages to all these parties. ALARMBEL has been developed by the Department of Industrial Safety of TNO.

AQUABEL

AQUABEL is an information system which can give support to all people involved in

emergency response during environmental disasters on Dutch inland waterways. This system consists of several modules. The system is not yet fully operational but the first modules will be implemented in 1993. The modules of AQUABEL are:

- A report module makes up a report after the accident has been reported¹⁾. The system uses information of other systems, such as information on the water quality and quantity, weather conditions and locations and load of ships;
- An address module sends information automatically to all parties involved¹⁾;
- A disaster plan which supports the disaster co-ordinator in making decisions;
- A chemical file contains information on chemical substances and the effects of these on people and the environment¹⁾;
- Predictions of the dispersion of pollution in the water;
- A graphical presentation gives an overview of the actual situation and the extent of the affected area;
- Information on available equipment for the emergency response;
- A logbook which collects all information on the disaster.

The system can be used by employees at alarm centres, emergency response workers and experts who give advice to the emergency response co-ordinators. The system is being developed under the authority of the Department of Waterways and will be controlled by the RIZA. Several departments of the Department of Waterways have worked together on AQUABEL as well as ICIM, Cap Gemini Pandata (software developers) and TNO.

Emergency Information System (EIS)

EIS is a crisis management system, which contains the following management functions:

- A mapping function, this can contain standard maps as well as plans of special sites and buildings;
- Resource inventory;
- An event log which automatically registers actions;
- Automated emergency planning, this consists of crisis response plans with detailed plans, response procedures, checklists, hazard analysis and automated call-outs;
- A transportation function, this contains information about planning and response related to evacuation activities;
- A personnel function, this gives information about the Crisis Response Organization such as training records and can carry out an automatic call-out;
- A site characterization function with records on hazardous facilities;
- A chemical inventory;
- A printing and reporting function.

EIS has been developed in the USA. It can be used by different types of organizations, governments as well as industrial organizations. The system has been carried out in eight countries including the USA, Canada and several EC countries.

SAFER

SAFER, a Systematic Approach For Emergency Response, is a widely used computerized system for atmospheric dispersion prediction and assessment of hazardous chemical releases. The system simulates the projected path of a toxic or flammable vapour cloud and can predict the downwind areas which might be affected. Real-time meteorological measurements and an atmospheric dispersion model are used to provide a prediction of the impact of the chemical release. Data from sensors for operator alert and leak detection have been integrated with SAFER. Besides information on the path of the cloud, the system also gives step-by-step response instructions, potential areas to be affected and critical telephone numbers. SAFER documents and stores all input data used during the emergency for

¹⁾ These modules will be implemented in 1993.

subsequent recall and review. In order to implement a SAFER system at a company, a site-specific emergency response plan must be prepared and programmed into SAFER. The system can also be used to simulate, train and educate plant operators on the effects of variables controlling the size and impact of the release. The system has been developed in the USA by SAFER Emergency Systems, Inc. The first system was installed in 1982. Over 100 systems have now been installed at (chemical) companies all over the world.

SEABEL

SEABEL is a decision support system for hazard identification and response of chemical spills at sea. The system can make predictions of the effected area and give advice on response measures in a very short time. The system consists of four modules:

- An accident diagnosis module for structured information gathering by means of checklists;
- An effect diagnosis module for prediction of the behaviour of the chemicals by means of simulation models;
- A hazard identification module with graphical presentation of the extent of released dangerous substances either in the air or in water as well as threatened objects and environment;
- An emergency response decision support module which can select and evaluate measures and identify vulnerable locations.

SEABEL is operational at the Coast Guard Centre and the Traffic Control Centre in the Netherlands and has also been distributed to all EC Countries (adjacent to sea). The system has been developed by the Department of Industrial Safety of the Netherlands Organization for Applied Scientific Research (TNO) with contributions of the EC and the Dutch North Sea Directorate. The Coastguard also uses SEAFLOAT: a decision support system for search and rescue at sea. The main functions of this system are:

- Determination of the location of lost persons and objects;
- Allocation of search units.

This product has been developed by the Department of Industrial Safety of TNO.

Toxic Information Systems

Several databases and information systems are available on the nature and toxicity of chemical substances. Most of these databases are used by experts. The Directorate General of the Environment has the database ISIS, made by the Dutch company Haskoning. This database is available on CD-ROM. Also on CD-ROM is the database CCINFO, which is used by the RIVM. This database contains several modules, such as CHEMINFO, which contains information on a great number of chemical substances, and RTCS, which contains information on research on chemical substances. The RIVM also uses the system TOXIS, a system which contains information on the human and animal toxicity, the environmental toxicity and physical aspects of chemical substances. The National Poison Information Centre (*NVIC*) uses TIK (Toxicological Information and Knowledge Bank) for its work and advice on toxicity and medical consequences of exposure to chemical substances.

6 Selected Accidents: Analysis and Lessons Learned

6.1 Introduction

A selection of seven accidents has been made. This selection had to apply to the following criteria:

- The accidents occurred over the past ten years;
- There have to be enough relevant data about the accidents;
- Chemical substances mentioned in the Seveso Directive have to be involved in the accident;
- The accident had external effects (on people or the environment outside the company territory);
- Activities of (several) emergency response teams were necessary;
- The selection should cover accidents with fixed installations as well as storage and transport.

An eighth accident has been added to this selection. The description and analysis of this accident can be found in Appendix 3. Although this accident does not apply to all the criteria, important lessons regarding emergency response can be learned from this accident.

Initially the intention was to have a slightly larger selection of approximately ten accidents. However, no more accidents applying to the criteria could be selected. Since the Netherlands is a relatively small country with a relatively safe industry (fortunately), no more major accidents, than the selected seven, occurred. Nevertheless, the variety of the accidents and the information available on these accidents give a solid basis for some very important lessons to be learned.

The analysis of the accidents contains a (chronological) description of events as well as conclusions and critical remarks stated by several organizations involved, indicated as perceptions. These perceptions are for the responsibility of the initial writers (sources are also indicated). Most accidents led to lessons learned at the involved organizations. These lessons are given for each accident separately. Some of these lessons were followed by actions of the organizations involved. A distinction is made between these actions and the more general or global lessons. The lessons learned are critically reviewed by the steering committee and the project team.

The accidents are given in chronological order. This order also shows that more information could be retained from the more recent accidents. This not only shows that the attention for accident analysis and evaluation has increased, it also stresses the importance of maintaining an up-to-date database of accidents and accident analysis.

6.2 Case no. 1: Ammonia release due to a ruptured unloading hose

General description

Date, time of event¹⁾ : 1 August 1986, 08.15.
Time of alarm : 08.16.
Place²⁾ : Chemical factory situated along the river Merwede near a city in the county of 'Zuid-Holland'.
Type of activity³⁾ : Transshipment (unloading).
Type of accident⁴⁾ : During unloading of a tank vehicle the unloading hose ruptured. This caused a release of ammonia.

Substances involved⁵⁾

Substance no. 1:

Chemical name : Ammonia anhydrous.
UN-number : UN-1005.
State : Liquid gas press.
Concentration : 100%.

Actual harm

To man

Two fishermen, who were just entering the harbour adjacent to the factory, had serious breathing problems. They could be treated efficiently by the local health authorities.

The employees of the factory and of two adjacent companies were evacuated. Some of the employees had a slight irritation of the bronchial tubes.

Residents of a residential area in the vicinity of the factory were warned to stay inside and close the doors and windows. Within a distance of five kilometres, people suffered from slight irritation of the bronchial tubes.

To the environment

Liquid ammonia was spilled onto the road, the liquid dampened. This vapour caused damage to trees and plants. Several trees lost their leaves and plants were affected. Vegetables growing in gardens in the vicinity of the factory could not be used any more.

To the economy

Because of the release of the vapour cloud, the factory and the two other evacuated companies could not work for the period of the evacuation. With the exception of the loss of the contents of the tank and the unloading hose, there was no material damage at the factory.

Vegetables and other garden products of private gardens in the vicinity of the factory were affected and could not be used any more.

-
- 1) The moment that the accident leads to external effects.
2) Factory yard, road, vicinity to neighbourhood and waterways.
3) Production, store, transport, loading/unloading, maintenance, etc.
4) Release, fire, explosion.
5) Raw material, final product, catalysts, formed products, etc.

Potential harm

There was a possibility that the ammonia vapour would ignite.

The wind was headed in the direction of the river, towards a not very highly populated area. The employees of two companies had to be evacuated and two fishermen had to have medical treatment (see above, actual harm). If the wind would have been directed towards the city this would have had more harmful consequences, since a highly populated area would be threatened and could cause breathing problems for the residents.

Emergency action

Alarm procedure and emergency actions

Time	Action
08.15	Release of ammonia by ruptured hose
08.16	Alarm to the Regional Alarm Centre (RAC) of the fire brigade by the company
08.16	Turn out of municipal fire brigade
08.21	Fire brigade on the scene
08.23	Technical Environmental Service warned by the RAC
08.30	Technical Environmental Service on the scene
08.45	Fire brigade in action

Services that came into action at the location of the accident

- The municipal fire brigade;
- The regional fire brigade and the municipal fire brigade of an adjacent city;
- Technical Environmental Service of the region;
- Body of Controllers of Dangerous Substances;
- The municipal police;
- The Labour Inspectorate.

The Fire Brigade

The fire brigade tried to close the valve of the tank vehicle. To approach the tank vehicle they had to wear gas suits. Because of the low temperature (- 33 °C), it was however impossible to get closer to the tank vehicle. The low temperature caused damage to the gas suits, which could not be used any more.

The fire brigade sprayed large amounts of water over the tank vehicle and its surroundings. A water curtain was made by a fire float on the river. This reduced the consequences of the vapour release and the inconvenience suffered by the public.

After one and a half hours the fire brigade succeeded in closing the valve.

The following material was brought into action: 3 fire engine cars, a command car, an emergency response car and a fire float.

The Technical Environmental Service

The Technical Environmental Service did measurements of the concentration of ammonia at several points. The highest concentration measured (near the scene of the accident) was 40 ppm. The MAC value of ammonia is 25 ppm, at 100 ppm people

are starting to feel unwell. They made rough calculations in order to estimate the dispersion of the vapour cloud. In this calculation the actual circumstances could not be completely included. The Technical Environmental Service used one measurement car. The service advised people, living in the vicinity of the factory, not to eat affected vegetables and fruit.

The Municipal Police

The police were instructed to warn the people living in the vicinity and the adjacent companies. For this purpose they used loudspeakers in a police car.

The Body of Controllers of Dangerous Substances checked the tank vehicle and checked if all regulations were followed. No violations were reported.

Several bodies were informed on the course of the accident, such as local authorities of the municipality and authorities of an adjacent municipality, the Regional Inspectorate of Public Health, the Labour Inspectorate and the Department of Repression of Accidents with Dangerous Substances of the Ministry for Home Affairs. Some of these bodies (such as the Labour Inspectorate) did further investigations as to the cause of the accident or related subjects.

Preparedness

The chemical factory had a contingency plan. In the main, this functioned properly.

The municipality has a disaster plan. This plan has not been used. No 'Disaster Statement' has been given.

Information for the public

The public was warned by the police by the use of loudspeakers in police cars.

Perceptions

In the town council questions were asked regarding the cause of the accident, possible preventive measures, how damage will be compensated and on the course of the emergency response actions. There is, however, little comment on the way the emergency response was handled.

Lessons learned

Investigations have been focused on the technical specification of the unloading hose, this will lead to new specifications. Rules on transport and storage have not been tightened.

As a result of the use and damaging of two gas suits of the fire brigade, the fire brigade had contacts with other fire brigade services about the long-term effects of exposure to cold liquids. This resulted in an intensified control of the gas suits.

Actions

Although the contingency plan of the factory functioned properly, this contingency

plan has been updated. The alarm system on the company ground has been improved and the canteen has been assigned as an emergency assembly point.

Sources

Besides the literature mentioned below, information has been obtained through questioning people involved, from the accident database FACTS and from confidential reports, which will not be mentioned here.

1. An (internal) report of the municipal fire brigade.
2. Report of the Body of Controllers of Dangerous Substances.
3. Report of the Technical Environmental Service.
4. Several newspaper articles.

6.3 Case no. 2: Collision between a container ship and a tanker, which sank

General description

Date, time of event : 27 May 1988, 17.10.
Time of alarm : 17.10.
Place : North Sea.
Type of activity : Navigation.
Type of accident : Collision between a Swedish container ship and a Dutch chemical tanker. The chemical tanker sank because of excessive damage at approximately 60 miles west of a port.

Substances involved

Substance no. 1:

Chemical name : Acrylonitrile.
UN-number : UN-1093.
State : Liquid.
Concentration : 100%.

Substance no. 2:

Chemical name : Dodecylbenzene.
UN-number : UN-?.
State : Liquid.
Concentration : 100%.

Actual harm

To man

Two members of the crew of the Dutch chemical tanker died. One crew member was missing and was found several weeks later on board the ship. The other crew member died from (burn) injuries after he had been taken to the hospital by a helicopter. The Swedish container ship took the crew on board and carried on to its port of destination.

To the environment

Approximately 200 tonnes of acrylonitrile were released into the water. The outflow concentration was very low. Only the direct surroundings (100 - 200 metres) of the ship were affected.

No fish mortality was observed during a long time after the accident. Although fish are normally attracted to wrecks, no fish were seen near the wreck. This can be explained because fish normally avoid toxic concentrations.

Effects of acrylonitrile poisoning on phytoplankton and zooplankton were found.

About 118 tonnes of dodecylbenzene was released into the water, this is not very toxic to man or the environment.

To the economy

The Dutch Ministry of Transport and Public Works ordered the recovery of the acrylonitrile and the salvage of the ship. The total costs of the salvage operation cost over 12 million Dutch guilders. The sale of the shipwreck and the remaining cargo yielded almost 1 million Dutch guilders. The costs were paid by the Dutch government.

Potential harm**To man**

Acrylonitrile can irritate the eyes, is corrosive to the skin, hinders the respiration and can affect the nerve system (in serious cases this can cause unconsciousness and death). The odour threshold is above the toxicity concentration: people are in dangerous situations if the acrylonitrile can be smelled. Above all, acrylonitrile is a carcinogen. If the affected tank would break, gas vapours could cause hazardous situations within some kilometres distance from the tanker. This could be dangerous for the ship traffic in the vicinity.

To the environment

Acrylonitrile is toxic for marine organisms at relatively low concentrations in the seawater. By continuing spillage of acrylonitrile during a long time, strong local effects in the direction of the spill can occur. Acrylonitrile is not bio-accumulative and will degrade by microbial action in a few weeks.

If the affected tank would leak continuously for 30 - 60 days, organisms staying for 1 - 2 days in a radius of 1 - 2 kilometres from the tanker would die. For very sensitive species (like algae) this radius would be larger.

Emergency action

Alarm procedure and emergency actions

Time	Action
May 27th	<ul style="list-style-type: none">- 17.10: Alarm from Scheveningen Radio (PCH) to the Dutch Coastguard Centre- Start of search and rescue action by the Dutch Coastguard Centre, an injured crew member was taken to a hospital by helicopter- Start of hazard evaluation of the cargo by the North Sea Directorate of the Department of Waterways- A safety area of 4 miles for shipping and 1000 ft for air transport was cleared- Countries of the Bonn agreement were warned with POLREP- Shipping and air transport were warned through navigation reports- A Dutch Royal Navy ship detoured the shipping
May 28th	<ul style="list-style-type: none">- A ship of the Coastguard arrived on the scene and started taking air measurements- No gas was measured, the safe signal was given- The tanker was buoyed by a buoyage vessel of the Coastguard- A survey vessel with a diving team arrived on the scene and started to examine the position and situation of the tanker- The operational team gathered twice; after studying the diving results and supplementary diving results from a private salvage company, they decided that the tanker had to be salvaged, starting on May 30th
June 1st	<ul style="list-style-type: none">- The salvage company started preparations for the salvage operations
June 16th	<ul style="list-style-type: none">- First turn-over attempt was made
June 17th	<ul style="list-style-type: none">- Turn-over operation succeeded- Lifting operations started, ship above sealevel
June 18th	<ul style="list-style-type: none">- Two cables broke, ship sank again- Weather was getting worse: salvage operations had to be stopped
June 30th	<ul style="list-style-type: none">- Tanker was turned over- Sawing operations (in order to saw the tanker in two parts) were started- Air concentrations above the MAC value (4 ppm) were measured: salvage crew withdrew to rescue position
July 1st	<ul style="list-style-type: none">- Tanker was sawed in two parts- Concentrations of 10 - 35 mg/l acrylonitrile were measured in the water at 1 - 10 metres depth
July 2nd	<ul style="list-style-type: none">- Preparations were made to lift the stern part of the tanker
July 5th	<ul style="list-style-type: none">- Air concentrations of 4 - 6 ppm were measured- The weather conditions were getting worse- Lifting preparations were stopped
July 20th	<ul style="list-style-type: none">- The cargo was transferred to another ship, the concentration of acrylonitrile was less than 2%
August 5th	<ul style="list-style-type: none">- Lifting of stern part was started
August 6th	<ul style="list-style-type: none">- Stern part was placed on a barge- Remaining acrylonitrile was transferred to another ship
August 8th	<ul style="list-style-type: none">- Astern part of the tanker was placed on a barge- The dead body of the missing crew member was found, released and taken away
August 10th	<ul style="list-style-type: none">- The tanker entered the harbour of Rotterdam

Services that came into action

- The Dutch Coastguard;
- The North Sea Directorate of the Department of Waterways;
- The Tidal Waters Division of the Department of Waterways;
- The Royal Dutch Navy;
- The Central Environmental Conservation Service Rijnmond (DCMR);
- A (private) salvage company.

Coastguard/North Sea Directorate

Several ships from the Coastguard were put into action during the salvage operation as well as three helicopters and an aeroplane. The ships were used to carry out sampling, supplying, monitoring and detouring the sea traffic. Measurements on air and water concentrations of acrylonitrile were made constantly. Some ships of the Royal Navy were also brought into action. These ships assisted at the detouring of the sea traffic. One helicopter was assigned for assisting the ship traffic, the other two were on stand-by for possible evacuations. The aeroplane made several flights to survey the situation and to assist the maritime traffic.

The North Sea Directorate of the Department of Waterways were in charge of hazard evaluations of the cargo of the ship. The directorate ordered the tanker to be salvaged. Several salvage companies were invited to make an offer. The North Sea Directorate and the Coastguard supervised the complete salvage operation.

For the immediate hazard evaluations the chemical database of SEABEL was used. For the calculation of the dispersion of evaporated acrylonitrile, SEABEL, GASCLOUD (a gas dispersion model of the North Sea Directorate) and estimations of experts of the Central Environmental Conservation Service Rijnmond (DCMR) were used. For the calculation of the dispersion of the dissolved acrylonitrile the dispersion model CHEMSPIL was used, as well as several calculations of experts of the Tidal Waters Division of the Department of Waterways.

The Salvage Company

The salvage operations were carried out by a (private) Dutch salvage company. They carried out all the salvage activities mentioned in the timetable. At first the time needed for the salvage operation was estimated at ten days. Because of bad weather conditions and some bad luck, the complete operation took about six weeks. Several ships, floating sheerlegs and two barges were brought into action. The company was paid approximately 4.5 million Dutch guilders for this salvage operation.

Preparedness

The safety measures during the salvage operation were extensive, because of the possible danger of acrylonitrile releases. The salvage company and the coastguard continuously did measurements for concentrations of acrylonitrile concentration in the air and in the water. An aeroplane was also used to survey the situation. Risk analyses were made by the North Sea Directorate.

Two helicopters were on stand-by for possible evacuation. Ships of the coastguard and the salvage company were kept at a safe distance from the tanker.

A safety area for shipping and air transport was cleared. Sea traffic was detoured.

The Coastguard and the North Sea Directorate possess several computer models with which estimations of the consequences of chemical releases can be made.

Information for the public

The countries of the Bonn agreement were warned with POLREP. The shipping and air transport was warned through navigation reports, and ships of the Dutch Royal Navy and the Coastguard were put into action to detour the sea traffic.

The tanker accident attracted much publicity in the press.

Perceptions

In the parliament questions were asked about the consequences of the accident for the environment and the fish stock. There was also a call for international agreements on (insurance and funding) of salvage operations of chemical tankers.

Lessons learned

The ultimate quantity of acrylonitrile released was much higher than had been foreseen. This was never expected or shown in measurements. The investigations (e.g. done by the diving teams) did not state the damage to the ship's hull [1].

The costs of the salvage operation were much higher than expected. But the weather was not co-operative as it had to be for an effective intervention operation. It must be taken into consideration, whether these costs weigh against the negative effects of chemicals on marine life. The standard situation analysis format identified clearly and on short notice the hazards to human life and to the marine environment [1].

Actions

At the time of the accident there was already a law proposal being treated in parliament in which an increase of the liability of ship owners was proposed.

Sources

1. Incident report on the Anna Broere (May 27th 1988);
North Sea Directorate of the Department of Waterways.
2. Article:
Noordzeemeetplan bij berging van de 'Anna Broere';
Brand & Brandweer, January 1989.
3. Several newspaper articles.

6.4 Case no. 3: Derailment of freight train

General description

Date, time of event : 1 July 1989, 02.25.
Time of alarm : 02.27.
Place : near a city in the province of Noord-Brabant.
Type of activity : Rail transport.

Type of accident : Because of overheating the wheel axle of the sixth wagon broke, 16 wagons derailed, several cars were set on fire.

Substances Involved

Substance no. 1:

Chemical name : Methanol.
UN-number : UN-1230.
State : Liquid.

Substance no. 2:

Chemical name : Vegetable oil (Coco).
UN-number : UN-1386.
State : Liquid.

Substance no. 3:

Chemical name : Coal tars.
UN-number : UN-1999.
State : Liquid.

Actual harm

To man

The engine driver was unharmed. As there were no houses in the vicinity of the accident and the nearest building was a company building where at that moment (the accident was during night time) nobody was present, there was no need for evacuation and there were no personal accidents. Although there was no need for evacuation, some people living at distance of approximately 130 metres were warned and advised to leave their houses. This was, however, not an official decision from the authorities.

To the environment

Approximately 100 m³ of ground was polluted with coal tar. This ground has been dug up, put into containers and taken away for destruction.

Approximately 30 tonnes of methanol were streamed out of the tank wagon. Most of this was burnt. A part of it was dissolved in water and sank into the ground water. Ground water was pumped away. The pumping away of the water took about three months.

The road and the railway track were polluted with vegetable coco oil. This is not harmful to the environment. The coco oil was removed. About 450 m³ of ground polluted with coco oil and methanol were removed.

To the economy

The railway was blocked for 3.5 days. The railway company provided alternative transport (of passengers) with buses. The railway company had to replace material regarding the signal installation, the overhead electrical wires, communication material and a section of the railway. The derailed wagons (nos. 6 - 21) had to be demolished. The contents of these wagons was partly lost.

The nearest building (a company building) suffered slight damage, caused by the heat of the fire. The damage on the company grounds was estimated at approximately 45,000 Dutch guilders.

The damage to municipal property was estimated at about 80,000 Dutch guilders.

Potential harm

To man

There was a possibility that the tank wagons with methanol would explode. This did not happen because the safety valve worked satisfactorily and the fire brigade kept the tank wagons cool. An explosion would have consequences in a radius of approximately 100 metres. As there were no houses in this area and the company building 30 metres away was not occupied, there was no potential harm to man. This situation would have been completely different if the train had derailed in the vicinity of the railway station (which was at a distance of 400 metres away).

To the environment

There was no potential harm done to the environment than the actual damage already mentioned.

To the adjacent chemical production facilities

There were no chemical production facilities in the vicinity.

Emergency action

Alarm procedure and emergency actions

Time	Action
02.25	Derailment of freight train
02.27	Alarm to the municipal police
02.27	Alarm to the Regional Alarm Centre
02.28	Alarm to the municipal fire brigade
02.28	Alarm to the Regional Officer in services
02.34	Alarm to the Centre of the Ambulances
02.34	Turn out of the fire brigade of the city
02.37	Fire brigade on the scene
02.38	Alarm to the mayor of the city
02.40	All the vehicles of the municipal fire brigade on the scene
02.40	Alarm to the Railway Company with the request to switch off the tension and earth the overhead electrical wires
02.40	Alarm to an adjacent fire brigade
02.42	Alarm to the Communication Command vehicle of the fire brigade
02.46	Informing of the press
02.54	Informing of the emergency response organization for dangerous substances of the Inspectorate of the Fire Service
02.55	Obstruct the flow of the liquid streaming out of several tank wagons
03.00	Facade of adjacent factory was sprayed with water
03.00	Detailed information on the contents of the derailed wagons was available
03.10	Tension switched off and overhead electrical wires earthed
03.15	Communication Command vehicle of the fire brigade on the scene
03.45	Foam truck on the scene
04.20	Communication Command Vehicle of the Railway Company on the scene
05.15	Fire extinguished
05.30	Fire under control

Services that came into action at the location of the accident

- Municipal fire brigade;
- Municipal police;
- Several adjacent municipal fire brigades;
- Railway Company police;
- Emergency Response Organization of the Railway Company;
- Environmental officials of the municipality;
- The emergency response organization for dangerous substances of the Inspectorate of the Fire Service;
- The Body of Controllers of Dangerous Substances.

The Municipal Fire Brigade

The fire brigade could not start cooling down the tank wagons until the tension on the overhead electrical wires was switched off and earthed. After this was done, the fire brigade started cooling down the tank wagons. Earlier they had started spraying with water the facade of the company building. The liquid streaming out of the tank wagons was also dammed up. A foam truck was put into action to cool down the burning tank wagons. The fire was extinguished at 05.15, the signal 'Fire under control' was given at 05.30.

Measurements for danger on explosions were constantly held.

The fire brigade supervised during the salvage activities and the pumping over of the chemicals in to trucks. The foam truck was held on stand-by.

The municipal fire brigade was given assistance by fire brigade services of several adjacent fire brigade services. The following material was brought into action: several fire engines, a foam truck and the communication command vehicle of the regional fire brigade.

The Municipal Police

The police closed off the roads and diverted the traffic. They also warned some of the residents in houses in the vicinity. The initial alarm was reported to the police, they alarmed the fire brigade and contacted the central alarm centre of the Railway Company.

The Emergency Response Organization of the Railway Company

The tension on the overhead electrical wires had to be switched off and earthed by the Emergency Response Organization of the Railway Company. This was completed at 03.10. Furthermore, the railway organization gave advice and assistance to the fire brigade. They gave orders to a private company to clean up the polluted ground and ground water and to pump the chemicals over to trucks.

The Railway Police

The Railway Police manned the Communication Command vehicle. This communication command vehicle is used for the internal communication of the Railway Company.

The environmental official of the municipality

The environmental official of the municipality arrived at the place of the accident at 07.30. He had to investigate if it was necessary to take steps to protect the environment, and had to consult the railway company on this matter.

Preparedness

Railway Company

The Railway Company has a nationwide Emergency Response Organization. This organization can be alarmed 24 hours a day. The organization possesses rescue cars,

which are stationed in nine places in the Netherlands. Periodical training, sometimes combined with training of municipal fire brigades, guarantees the quality of the crew.

Local authority

The disaster plan of the municipality was adopted by the authorities in 1984. An emergency response training (to test the disaster plan) regarding a railway accident was held in 1985. The disaster plan was updated in 1988, a great number of supplements were sent to the local authorities on 5th July 1988.

The disaster plan, however, has not been used during this accident. The mayor did not give a 'Disaster Statement', so the plan was not activated automatically. The accident was not judged as a 'disaster' as public safety was not threatened.

Transport papers

The engine driver was carrying all necessary transport papers and handed these over to the fire brigade. The contents of the wagons were therefore immediately known. At first the sequence of the wagons was not known. The Railway Company also has a database with all essential information on the load of the train, such as contents, nature, quality of the substances in each wagon as well as the sequence of the wagons. This information was available within half an hour.

Information for the public

Three families living in houses in the vicinity of the accident were alarmed. Only one family was at home; they were advised to leave their house and go to a safer place. This was done by the municipal police. There was, however, no official decision to evacuate.

The news given to the public immediately after the accident was not consistent with the news which was given later. This caused some confusion to the public. There was no information centre set up. The information given to the public was not clear enough and earlier (incorrect) news was not rectified.

Perceptions

- After the accident there was comment on the way information had been given to the public and other people involved, such as the town council. The Queen's commissioner was also not informed. There was not a special information centre; the information was given by several people and was therefore not consistent. The action committee 'Veilig Spoor' (Safe Railway) was founded as a result of the unsatisfactory information which was given prior, during and after the accident [1, 3, 4, 5];
- After the accident there was some discussion about the use of a disaster plan. Since no 'Disaster Statement' was given by the mayor, the disaster plan was not used. According to some spokesmen of the fire brigade, the use of the disaster plan could have been useful. The procedures written down in the plan could then have been used. This would have improved the information given to the public and other people involved. Using the plan also for 'smaller' accidents can also be seen as practising the plan. It can make people, involved with emergency response, familiar with the procedures in the plan. For accidents like this a reduced disaster plan can be useful. Spokesmen of the railway company think the use of the disaster plan would give too much confusion: people would think the accident was really a disaster, and it would hinder the emergency response workers [3];
- After the accident there was also a discussion about the usefulness of disaster control plans. In the present situation municipalities make only disaster control

plans for fixed installations. As traffic junctions can be more dangerous than fixed installations, it would be wise to make disaster control plans for these situations as well [5];

- It took the Railway Company about three quarters of an hour before the tension was switched off and the overhead electrical wires were earthed. After previous railway accidents (in 1976 and 1982), the Railway Accidents Council (*'Spoorwegongevallenraad'*) already concluded that this should be done faster. The Railway Company promised to make improvements on this point. Apparently these improvements have not been made [4, 5];
- The Body of Controllers of Dangerous Substances concluded that no violation of the regulations had been made;
- The railway police concluded that no violation of the regulations had been made.

Lessons learned

The local authorities made an evaluation report after the accident. In this report several conclusions were made. This resulted in the following lessons learned:

- Although the neighbouring residents were warned immediately after the accident, they were not properly supported by the authorities. Procedures for warning, receiving and supporting residents/evacuees will be improved;
- Information was not given adequately or on time. This caused confusion with the public and gave the impression that the situation was not under control. In future situations an information centre will be established;
- In future situations the Queen's commissioner will be warned in time;
- Consultation between the mayor and the heads of the operational services will take place immediately after the accident. They will then decide whether a 'Disaster Statement' has to be made;
- Although the decision **not** to give a 'Disaster Statement' was correct, a pre-warning will be given in future situations. This pre-warning will be given in order to alert all people involved with the emergency response, so they are informed and can be made operational when this should be necessary;
- Disaster control plans will possibly be made for road or rail sections where dangerous situations can occur;
- More managerial attention will be given to emergency response. This will be done by keeping the disaster plan up to date and by a yearly reflection on emergency response. Periodical practices regarding the disaster plan will be held.

Actions

- The local authorities will make agreements with the Railway Company about information on (new) routes for transport of chemicals, information on the contents of tank wagons and on procedures for switching off the tension on the overhead electrical wires. Arrangements will be made so information on the contents of freight trains can be faxed to the alarm centre of the fire brigade [1, 3];
- More information will be given to the public;
- Following, and in the same period as the train accident, the Railway Company did tests with extinguishing while the electrical power is still on the overhead electrical wires [3];
- Following, and in the same period as the train accident, the fire brigade developed a special training module for railway (fire) accidents.

Sources

Besides the literature mentioned below, information has been obtained through

questioning people involved, from the accident database FACTS and from confidential reports, which will not be mentioned here.

1. Report of the municipality:
Evaluatieverslag spoorwegongeval Boxtel;
April 1989.
2. Police record, no. M 97/89:
Onderzoek naar aanleiding van spoorwegongeval;
January 1989.
3. Article:
Brandweer niet voorbereid op reacties pers en publiek;
Brand & Brandweer, June 1989.
4. Article:
Boxtel, een ongeluk met vraagtekens;
Alert, February 1989.
5. Article:
Hoe lang blijft het goed gaan?
Lokaal Bestuur, March 1989.
6. Several newspaper articles.

6.5 Case no. 4: Explosion of acrylonitrile storage tank

General description

Date, time of event : 17 October 1989, 09.38.
Time of alarm : 09.38.
Place : Chemical storage yard situated in the chemical industrial area (Botlek) near Rotterdam.
Type of activity : Storage/maintenance.
Type of accident : During maintenance, sparks of grinding machine caused explosion of acrylonitrile storage tank, a vapour cloud was produced.

Substances involved

Substance no. 1:

Chemical name : Acrylonitrile.
UN-number : UN-1093.
State : Liquid.
Concentration : 100%.

Actual harm

To man

Three employees (contractors) were killed during the accident; two employees (also contractors) were injured. These casualties were caused by the explosion.

The personnel of the company, as well as the personnel of an adjacent factory, were

evacuated. These people had to be evacuated with ships, as the road was closed. The evacuation was done as a precaution: toxic vapours were heading towards the factory. In total, 250 people were evacuated and brought to an assembly point.

Measurements for toxic vapours were carried out by firemen under the authority of the chemical advisors of the Central Environmental Conservation Service Rijnmond (DCMR). No harmful concentrations were measured.

To the economy

The (indirect) economical loss was estimated at several million Dutch guilders.

Potential harm

Acrylonitrile is a carcinogen. During the release of the acrylonitrile cloud, the wind changed, which caused a potential danger to an industrial area. Residents of the adjacent residential area were also warned and advised to shut the doors and windows. There was, however, no potential danger for this area, the advice and warning given to the population was a result of communication problems.

In fact there was no danger for toxic vapours at all as no dangerous concentrations were measured. So, it is possible that even the evacuations were not necessary. As most of the acrylonitrile was burnt, the concentration in the vapour cloud was lower than would have been expected.

Emergency action

Alarm procedure and emergency actions

Time	Action
09.38	Explosion of acrylonitrile storage tank
09.38	Alarm to the Regional Alarm Centre (RAC)
09.43	Alarm to Chemical Advisor
09.44	Municipal fire brigade at the scene
09.59	Fire brigade gave a 'higher alarm', more men and material were brought to the scene
10.01	Harbour Service connected fire brigade to the company water system
10.04	Police closed off adjacent road
10.17	Two victims were transported to hospitals
10.18	Harbour service cleared an adjacent harbour
10.30	Establishing Incident Site Command Team (CTPI)
10.31	Police asked for helicopter assistance for a better aerial view
10.32	Start measurement plan by Chemical Advisor at the request of the fire brigade
10.39	Employees of the adjacent chemical factory were evacuated with vessels by the harbour service and the river police
10.41	Emergency response bureau of the city was operational, the emergency response of an adjacent city was also operational
10.58	CTPI operational
11.05	Advice of the Chemical Advisor: In industrial parts of the nearby city on the other side of the waterway, doors, windows and ventilation gates should be closed
11.13	Emergency response bureau of the city Rotterdam informed adjacent municipalities

Time	Action
11.20	Fire brigade informed city on other side of the waterway that in an industrial part of the city doors, windows and ventilation gates should be closed
11.25	The residents of the industrial area were warned
12.19	People living in a residential part were also warned
12.45	Start extinguishing with foam
12.56	Fire extinguished
13.09	Tank on fire again
13.48	Second attempt with foam
13.52	Fire extinguished
14.10	Tank on fire again
14.14	Fire extinguished
14.30	Hazard area only the company yard and the adjacent yard of a chemical factory
14.35	Liquidate prevention measures in part of nearby city
14.45	End of the measurement plan
14.49	All warnings to the public were withdrawn
15.00	Fire under control, liquidation of CTPI

- Press conferences were held by the municipalities involved;
- The dead bodies were found the following evening and the day after the accident.

Services that came into action at the location of the accident

- Works Fire Brigade;
- Municipal Fire Brigade;
- Municipal Police;
- Ambulance service;
- Local Health Authorities and an Environmental Physician;
- The Chemical Advisors of the Central Environmental Conservation Service Rijnmond (*Dienst Centraal Milieubeheer Rijnmond, DCMR*);
- The Co-ordinator of the Corporation of Europoort Botlek companies (*Europoort Botlek Belangen*);
- Harbour Services;
- River Police;
- The emergency response bureau of the city;
- The Labour Inspectorate.

Works and Municipal Fire Brigade

The works fire brigade as well as the municipal fire brigade came into action. The fire brigade initially decided to let the fire burn. The reason for this is that the harmful substances will burn and the acrylonitrile will be thinned down. This will reduce the consequences for the environment.

The fire brigade kept cooling down and spraying with water the adjacent tanks. After a few hours, they started extinguishing the fire as the burning tank had collapsed. The fire was extinguished with foam.

A lot of material of the fire brigade was brought into action, such as several fire engines, a Communication Command Vehicle, foam trucks and a fire float.

Municipal Police

The police closed off the roads and diverted the traffic. The police also warned people to close doors and windows with the use of loudspeakers.

Ambulance Service

The ambulance service transported two victims to two different hospitals.

The Central Environmental Conservation Service Rijnmond

Chemical advisors of the Central Environmental Conservation Service Rijnmond ordered measurements to be taken (according to a measurements plan). They discussed this matter with the fire brigade and the harbour service. The measurements were taken by the measurement plan organization; this organization consists of members of the fire brigade.

Co-ordinator of the Corporation of Europoort Botlek companies

The co-ordinator of the corporation of Europoort Botlek companies happened to be an employee of the storage company involved. This co-ordinator was present with the Co-ordination Team at the place of the accident. The co-ordinator was there to give advice about matters concerning the company.

The Harbour Service

The harbour service ordered measurements to be taken. They also took care of the transportation of the evacuees and cleared an adjacent harbour.

The River Police

The river police consulted the Chemical Advisors of the Central Environmental Conservation Service Rijnmond as to whether to block ship passage on the adjacent waterway. Although there was some danger of toxic vapours, they decided not to block the ship passage. They assisted in the transportation of the evacuees.

The Emergency Response Bureau of the city

The Emergency Response Bureau of the city was alerted. This bureau stays alert, collects information and can give advice to the mayor. The Emergency Response Bureau also warned the Emergency Response Department of the adjacent city. As there was no danger to the city of Rotterdam, further actions of this bureau were not necessary. The emergency response staff of the adjacent city decided to warn the residents of a part of a city. For this purpose they contacted the local radio.

Preparedness

Works Fire Brigade

The company has a works fire brigade. In the Botlek area, the works fire brigade and the municipal fire brigades have a mutual agreement on alarming the municipal fire brigade. The works fire brigade has to alarm the municipal fire brigade as soon as possible. If they do not ask for assistance, the municipal fire brigade will not come into action immediately. The works fire brigade, however, has to contact the municipal fire brigade within 15 minutes after the first alarm. Otherwise the municipal fire brigade will come into action.

The company also hired a fireman (from a private company) for this maintenance job. This fireman is responsible for the safety at the place of work. He has to make sure that the work is done according to the rules. He also has to measure the formation of gas.

Corporation of Europoort Botlek companies

(Stichting Europoort-Botlek Belangen)

The Corporation of Europoort Botlek companies is an organization which looks after the interests of the joining companies in the Botlek area. A co-ordinator of the Regional Industrial Community can be reached 24 hours a day. This co-ordinator can give advice in case of emergencies.

The Central Environmental Conservation Service Rijnmond

(Dienst Centraal Milieubeheer Rijnmond, DCMR)

In the province of Zuid-Holland, there is a special service, the Central Environmental Conservation Service Rijnmond, which carries out some of the environmental control tasks of the province as well as tasks of the municipalities, which are joined in the DCMR. These municipalities are all situated in the Rijnmond area. The DCMR has an alarm centre which can be reached 24 hours a day. Complaints from residents (about the inconvenience of smells) or reports from companies are handled here and investigation teams are sent out (if necessary). Chemical advisors of the DCMR can be reached 24 hours a day. They can give advice to the operational services during accidents with chemical substances. They also prepare courses and practices for emergency response workers (e.g. the fire brigade).

In this case they gave advice to the fire brigade and the local authorities. They supervised the measurements plan and analyzed the results. More personnel had to be brought into action in the alarm centre because many questions were asked at the alarm centre.

Disaster plan and disaster control plan

The City of Rotterdam has a disaster plan as well as a disaster control plan. Instead of making a disaster control plan for every possible (major) danger in the Rotterdam area, the city has one basic disaster control plan which can be used for emergencies on different locations.

The accident was not a disaster (no 'Disaster Statement' was given). Therefore, these plans were not used.

The adjacent city also has a disaster plan as well as procedures for environmental incidents and air pollution.

In the region of the Rotterdam and the industrial areas, a central incident (phone)number has been established. Calls to this number are handled by the police. All emergency response services are connected to this number, fax machines are also connected to this number.

Because the news presented by the media was inaccurate (which made people think that the consequences were worse than they actually were), several operational services were alert and held more men and material on stand-by than necessary.

Information for the public

The residents of a residential area in a city on the other side of the waterway were advised to close the doors and windows. For this purpose loudspeakers on police cars were used. The residents were advised to listen to the local radio station (Radio Rijnmond). The local authorities were not aware of this advice and did not use the radio station. They saw no need for informing the public. This caused some confusion.

The local and national media paid a lot of attention to the accident. Some higher authorities heard the news of the accident on the radio and asked the operational services several questions. Their interference was, however, not necessary.

There was no potential danger to the residents of the residential area (there was only slight danger to the industrial area of the same name). Because of a misunderstanding the residents were unnecessarily warned.

The press was informed by the commander at the place of the incident and a press informer of the police. The people at the CTPI were not well enough informed about measures which were taken elsewhere (such as the warning to the residents). This caused some confusion.

The city where the accident started, as well as the city which suffered most of the consequences of the accident, both held a press conference at the end of the afternoon.

Perceptions

Most observations, perceptions and lessons learned concerning this accident concentrate on the cause of the accident and on the guilt question. In this report, we restrict ourselves to lessons to be learned regarding emergency response. This means that matters related to the cause and the guilt question will not be treated here.

- A communication fault resulted in the unnecessary warning of residents in a residential area of a city in the vicinity of the company [2];
- The communication between the chemical advisors of the Central Environmental Conservation Service Rijnmond and the police and river police was somewhat difficult. Despite some danger from toxic vapours the river police decided not to block the shipping passage on the adjacent waterway [1];
- Calculations after the accident showed that the dispersion of acrylonitrile through the air resulted in increase of the acrylonitrile concentration in a much larger area. In this case it would have been better to handle the accident on a regional level, so consequences outside the municipality would be considered better;
- The water used to extinguish the fire contained acrylonitrile concentrations of 60 to 70 µg/l. No information on what has been done with the extinguishing water, is available any more. Information on how contaminated materials have been treated are hardly ever available in the data on the (consequences of) accidents. It is therefore hardly possible to learn any lessons from the response activities regarding the limiting of environmental damage.

Lessons learned

- The information given regarding the course and the effects of the accident was not clear enough. Information should be given not only by word of mouth but also by written messages (e.g. fax). Information should be verified [2];
- In future situations the mayor has to be informed by the commander of the fire brigade. The mayor has to decide if it is necessary to warn the public. The informing of higher authorities should be stated in new procedures [4];
- The media have to be informed properly. It has to be clear who is responsible and takes care of informing the media. Accurate information to the media has to prevent false speculations on the outcome of an accident. The media can also be brought into action when the public has to be warned [2, 4];
- The exchange of information between and inside operational services should be improved. Procedures should be developed. The information streams should also be in both ways of the hierarchical lines [4];
- The CTPI should also be connected to the central incident (phone)number [4];
- Announcements to the public through loudspeakers of police cars can in some cases not be heard well enough. Investigations have to be done in order to improve the announcement of the messages;
- The procedures in the disaster plan have to be in tune with procedures for other (environmental) incidents.

Actions

There were no direct actions regarding the emergency response after the accident. Some safety measurements were taken: the companies associated in the Corporation of Europoort Botlek companies forbid any work on tanks which were not completely empty [2].

- In 1990 the municipality made a new disaster plan and a new basic disaster control plan in which the experiences of this accident were implemented;
- In the adjacent city certain procedures in the disaster plan have been changed. The disaster plan is tuned with the procedures for environmental incidents. The procedures for the warning of members of the disaster staff will be revised. Preparations will be made for establishing an information centre at the city hall in case of emergencies. New agreements have been made with the local radio stations regarding their tasks in informing the public.

Sources

1. Report:
Adviesrapport, Afdeling Chemische Veiligheid, Gemeenschappelijke regeling DCMR;
projectno. 105200.
2. Article:
 - a. Leg essentiële informatie schriftelijk vast, dat voorkomt misverstanden;
 - b. Schokgolf door hele gebied;Brand & Brandweer, June 1990.
3. Article:
Fouten en pech oorzaak ontploffing bij Paktank;
Brand & Brandweer, September 1991.
4. An internal evaluation report of the municipal fire brigade.
5. Several newspaper articles.

6.6 Case no. 5: Chlorine release because of electrical tension disturbance

General description

Date, time of event	: 15 November 1991, 13.44.
Time of alarm	: 14.00.
Place	: Chemical factory situated in the chemical industry area (Botlek) near Rotterdam.
Type of activity	: Processing.
Type of accident	: During processing, the electrical tension of the chemical factory was broken for 1 minute. The emergency electrical supply systems did not work. A release of 100 - 120 kg chlorine occurred.

Substances involved

Substance no. 1:

Chemical name	: Chlorine.
UN-number	: UN-1017.
State	: Liquid.
Concentration	: 100%.

Actual harm

To man

The chlorine spread through the ground towards an adjacent company. **To avoid communication errors, the company where the accident happened will be called company A, the adjacent company, which suffered most of the consequences, will be called company B.** 33 employees of company B (who were working outdoors) were complaining about tingling eyes and skin, and were feeling sick. 18 people were taken to a hospital for treatment of these complaints. No permanent injuries were sustained. Company B was temporarily evacuated.

To the economy

The processing of company A was temporarily stopped. The process was not allowed to be continued until the safety measures were thoroughly tested. On 20th November the company received permission to start processing again.

Potential harm

The release of chlorine came from an oxidation section, which consists of three parallel systems. At the moment of the accident, only one system was in operation. From this system a maximum of 200 kg chlorine could have been released. The actual release was approximately 100 - 120 kg chlorine. If all three systems had been operational, the release could have been 600 kg.

The chlorine cloud headed towards the sea and was dissolved above the sea. If the wind direction had been the other way, the cloud would have headed towards a residential area at a distance of 750 m. Although it could have caused some irritation to the eyes and bronchial tubes of the residents, the concentration would have been much lower and would not have been of any danger.

Emergency action

Alarm procedure and emergency actions

Time	Action
13.44	Electrical tension failure in switch station, company A switched over to emergency electrical turbine
13.45	Electrical tension restored
13.45	Emergency electrical turbine of company A failed
13.50	Chlorine detected by employees of company B, alarm centre of company B alarmed company A about possible chlorine releases
13.53	Chlorine detected by Chlorine Detection System of company A
13.55	Chlorine release stopped, electrical supply back to normal
14.00	Central guard of company B asked company safety expert if a gas alarm had to be given. Safety expert confirmed that a gas alarm had to be given
14.02	Alarm to Central Incident Number (special emergency number) at the alarm centre of the police
14.05	Gas alert at company B, the sign for the employees to leave the company (evacuation procedure started)
14.08	Alarm to the Alarm Centre of the fire brigade
14.10	The Corporation of Europoort Botlek companies reported to Central Incident Number that there were injured employees at company B
14.12	Alarm centre of fire brigade alarmed officer on duty and the chemical advisor

Time	Action
14.35	Police closed off an adjacent crossing
14.36	Fire brigade officer at company A
14.37	Chemical advisor at company B of the fire brigade
14.39	3 victims were transported to the hospital in ambulances
14.47	A signal that everything was safe at companies A and B was given
14.48	6 victims were transported to a hospital in a company van
15.00	The gas alarm was repeated
15.10	Two more ambulances were sent to company B
15.31	The police reported that 22 people had already been brought to the hospital, some of them by private transport
17.22	The incident was regarded as over, investigations will be carried out by the Labour Inspectorate and the Central Environmental Conservation Service Rijnmond.

Services that came into action

- Municipal fire brigade;
- Police;
- Ambulance services;
- The Chemical Advisors of the Central Environmental Conservation Service Rijnmond (*Dienst Centraal Milieubeheer Rijnmond, DCMR*).

Municipal Fire Brigade

Although the fire brigade was alarmed, by the time they were at the scene of the accident there was nothing to be done (any more).

Ambulance Services

Several ambulances transported injured people to a nearby hospital.

Police

The first alarm came in at the alarm centre of the police. The police warned the other services and closed off an adjacent crossing.

Central Environmental Conservation Service Rijnmond

Chemical advisors of the Central Environmental Conservation Service Rijnmond were asked for advice. They stated that the chlorine cloud would dissolve above the sea and would not do any more harm. After the accident they did an investigation in co-operation with the Labour Inspectorate. They also took part in the press conference.

Preparedness

Company A has a special Chlorine Detection System. This system is placed on the fences of the company at a height of three metres. Because the chlorine spread at a lower level, no chlorine was detected at first. Company B also has a gas detection system. This system did not detect anything at first either.

Both company A and company B have contingency plans. The contingency plan of company A was not used, they did not suffer any consequences from the accident. The evacuation procedure of company B was started.

Company A and B had a direct communication system with which company A could warn company B. In this case, however, company B warned company A.

The fire brigade prepared special procedures regarding a co-ordinated emergency response at incidents with dangerous substances. These procedures include arrangements about the following matters:

- The establishment of CTPI (Incident Site Command Team);
- The warning of measurement teams;
- The warning of adjacent areas, companies;
- The determination of the affected area with the aid of a damage contour;
- Informing the authorities, press, etc.

In this case these procedures were not used as the accident had already happened by the time the fire brigade arrived.

Information for the public

The informer of the Central Environmental Conservation Service Rijnmond and the Labour Inspectorate jointly took care of informing the public. In this way the information was uniform. A press conference was held by company A, company B, the Labour Inspectorate and the Environmental Conservation Service. This procedure was very successful.

At approximately 17.00, the local radio started to broadcast news about the accident. In this broadcast, several questions could not be answered. This caused some worries to the public.

Perceptions

- The mayor of the adjacent city did not receive any specific information (except from what he heard on the radio). He had some complaints about this. In his opinion he had to be warned, even if the wind was not heading in the direction of the city. Informing the authorities is important because they have to deal with the questions of the citizens. Earlier (as a result of accident no. 4) the mayor had made an agreement with the police, fire brigade and the environmental conservation service about informing the authorities;
- It took about 10 minutes before the Central Incident Number could be reached by company A. The phone number engaged, since all companies tried to contact the number after the electrical tension failure;
- The Central Environmental Conservation Service Rijnmond concluded that it had taken too much time before company A had warned company B. This could have been done much faster;
- The Central Ambulance Station did not receive a clear indication of the number of victims and the nature of the injuries. This was the reason that the Central Ambulance Station did not send enough (and special equipped for gas victims) ambulances. The hospital where the patients were taken, was not prepared for so many patients. If the alarm centre would have known this, they would have taken some patients to other hospitals in the vicinity;
- It took too much time before the gas alarm at company B was given. The evacuation of this alarm was not very well controlled. There was no assembly point after the evacuation;
- The external communication between the companies involved and the emergency response services should be investigated. The fire brigade has to take care of this. If necessary, the communication should be improved;
- The other companies in the neighbourhood were not warned; this raised some questions.

Lessons learned

- The attention of the authorities is mainly focused on the prevention of harmful effects on the public in the vicinity of the company where the accident takes place. This accident proves that it is also necessary to pay attention to the employees of adjacent companies;
- The alarm and evacuation procedures of company B should be improved (e.g. an intercom system could be used to alarm the personnel). Better information and instructions should be given to the employees;
- Companies have to give better information to their neighbouring companies about the risks of their activities. The co-operation of Europoort Botlek Companies could play a role in this. Company A should have to organize an information meeting in which questions of the employees of the adjacent companies will be answered.

Actions

- An extra (third) emergency energy generator has been placed;
- The Chlorine Detection System of company A has been linked to the gas detection system of company B;
- The Labour Inspectorate carried out several inspections at different companies in which the emergency energy supply was tested;
- The contingency plan of company B has been improved on several points:
 - The alarm procedure is improved;
 - The evacuation procedures are improved, an assembly point for evacuees has been appointed;
 - A co-ordination and command structure is included in the plan;
 - At a gas alarm, the ventilation of the offices will be switched off;
 - Suppliers or other traffic heading towards the company will be warned and diverted in case of emergencies;
- Better procedures for informing and instructing the employees are developed;
- Company A and B informed each other on questions related to the asked alarm regulations, specific risks, etc.;
- In the alarm procedures of the Emergency Response Service, the number of victims should also be taken into consideration.

Sources

Besides the literature mentioned below, information has been obtained through questioning people involved, from the accident database FACTS and from confidential reports, which will not be mentioned here.

1. An internal report of DCMR.
2. Legal proceedings of the Labour Inspectorate;
No. O.R. 549-1991.
3. An internal evaluation of the municipal fire brigade.
4. Internal evaluation and announcements of company B.
5. Several newspaper articles.

**6.7 Case no. 6:
Explosion of a storage tank**

General description

Date, time of event : 13 December 1991, 10.24.
Time of alarm : 10.24.
Place : Chemical factory situated in the chemical industry area (Botlek) near Rotterdam.
Type of activity : Storage, trans-shipment and modification of entrance to storage tank.
Type of accident : During modification of the entrance of a storage tank after unloading, sparks (coming from the equipment) caused an explosion. Two tanks caught fire as well as a chemical waste depot.

Substances involved

Substance no. 1:

Chemical name : Benzoic acid.
UN-number : UN-2770.
State : Liquid.
Concentration : 100%.

Substance no. 2:

Chemical name : Chemical waste.
UN-number : UN-1268.
State : Liquid.

Substance no. 3:

Chemical name : Asbestos (white dust).
UN-number : UN-1346.
State : powder.

Actual harm

To man

Six employees were immediately killed because of the explosion, one employee was seriously injured and died later in a hospital. Three other employees were injured.

Four companies in the vicinity of the accident were evacuated. A soot cloud headed towards a residential area. Some residents had complaints concerning irritation to the eyes and the bronchial tubes.

To the economy

The company paid a total sum of 290,000 Dutch guilders and a pension to the relatives of the casualties.

Potential harm

There was some danger that storage tanks, filled with toluene and located 40 metres from the fire, would explode. To prevent this from happening the fire brigade cooled these tanks.

Asbestos dust dispersed and was found on the company grounds and on the grounds of some of the companies in the vicinity. The asbestos was used for the isolation of

the tanks. Asbestos increases the chance of cancer. A TNO research team investigated the dispersion of the asbestos dust. The wet weather conditions decreased the dispersion of dust, and public health was endangered. Additional preventive measures were taken at the companies where asbestos had been found. The dust was removed by a specialized cleaning company. The dispersion of asbestos and the research and removing of the asbestos took quite some effort and could have been a considerable threat to the health of the employees of the companies where the asbestos had been found.

Emergency action

Alarm procedure and emergency actions

Time	Action
10.24	Explosion of benzoic acid storage tank
10.24	Alarm to the Regional Alarm Centre (RAC)
10.25	Turn out of the company and city fire brigades
10.27	Middle alarm stage, more men and material brought into action
10.30	Telephone contact between police and the company
10.33	Warning to the Central Ambulance Station
10.33	Telephone contact between Chemical Advisor and the manager of the company
10.33	Fire brigade on the scene
10.35	Co-ordinator of the Corporation of Europoort Botlek companies on the scene
10.35	Higher alarm stage, more men and material brought into action
10.45	Harbour Service on the scene
10.45	Road cleared as supply route for the emergency response services
10.45	Establishment of an action centre of the local health authorities
10.50	Communication centre of the municipality operational
10.50	Shipping passage of adjacent waterway blocked
10.53	Police asked for establishing Incident Site Command Team (CTPI)
10.55	Regional gas measurement plan was started
10.58	Communication Command Vehicle on the scene
11.05	Evacuation of companies situated leeward
11.10	Establishing CTPI
12.09	Signal 'Fire under control'
12.45	CTPI liquidated, grounds declared safe
12.50	All traffic measures liquidated (except for one road, which remained blocked for a while)
15.00	A press conference was held at the company's head office
17.00	All dead bodies found and taken away

Services that came into action at the location of the accident

- The municipal fire brigade;
- The works fire brigade;
- The Chemical Advisors of the Central Environmental Conservation Service Rijnmond (*Dienst Centraal Milieubeheer Rijnmond, DCMR*);
- The Co-ordinator of the Corporation of Europoort Botlek companies (*Europoort Botlek Belangen*);
- Police;
- Ambulance service, local health authorities;

- Harbour service;
- River police;
- The Labour Inspectorate;
- TNO.

The Fire Brigade, Harbour Service

The fire brigade could not start extinguishing the fire until the electrical tension was switched off, as some of the electrical wires were on fire. The surrounding tanks were cooled with water and later with foam. The switching off of the electrical tension caused some problems with the water supply. The harbour service assisted with several fire floats. Several fire engines and the communication command vehicle were brought into action. Gas masks were used during the fire-fighting activities.

Central Environmental Conservation Service Rijnmond, Harbour Service

The chemical advisors of the environmental conservation service and advisors on dangerous substances of the harbour service had measurements taken in the vicinity of the accident and in the wider surroundings. As no higher or harmful concentrations were measured, they decided that no further measures regarding (the protection of) the public were necessary. Measurements were taken according to the Regional Measurements Plan.

Harbour Service, River Police

The harbour service and the river police took care of the blocking of the shipping passage. They warned the ship crew.

Police

The police took care of all traffic measures. The press informer of the police, who was present at the CTPI, informed the press. The identification team of the police carried out the identification of the dead bodies.

Ambulance Service, Local Health Authorities

In the early phase after the accident, the substances involved were not yet known. The ambulance service and the local health authorities were on stand-by in case public health was threatened.

Three psychologists were consulted (by the company health service) to help the employees involved to deal with their traumatic experiences.

Corporation of Europoort Botlek companies

The co-ordinator of the Corporation of Europoort Botlek companies was also present in the CTPI. The communication centre of the Corporation of Europoort Botlek companies arranged and co-ordinated the evacuation of the companies in the vicinity of the accident. The Corporation of Europoort Botlek companies has its own communication system with which all associated companies can be reached. The non-associated companies were warned by telephone.

TNO

The TNO research team did several measurements to the asbestos dispersion in the area neighbouring the company. They advised on the removal of the asbestos.

Preparedness

Since this accident was in the same area as case no. 4, partly the same preparatory measures were taken. Some parts of the basic disaster control plan, which had been

updated after accident no. 4, were used. These procedures worked properly. No 'Disaster Statement' was given, so the use of the plans was not officially requested.

The company has a works fire brigade and has a contingency plan. The company is obliged to make Occupational Safety reports; it has made these. The contents of these Occupational Safety reports is confidential. The company is associated with the Corporation of Europort Botlek companies (see also case no. 4).

Information for the public

The local radio reported the accident in a very early stage after the accident. Even some officials had to hear the news from the radio. There were no warnings to the public (no measures were necessary). This caused a lot of questions from people amongst the public about what they had to do.

The information to the press was given by a press informer of the police, who was in the CTPI. As the CTPI was located on the company grounds, where no press was allowed, the informing of the press was somewhat difficult. For this reason, the alarm centre was temporarily used to inform the local radio on the development of the accident. The local radio was also appointed as the official disaster news channel, which caused some confusion. In this case the radio was not used as the official disaster news channel.

The communication centre of the Corporation of Europort Botlek companies arranged and co-ordinated the evacuation of the companies in the vicinity of the accident. The Corporation of Europort Botlek companies has its own communication system with which all associated companies can be reached. The non-associated companies were warned by telephone.

Perceptions

- There were some questions about the cause of the accident and the safety procedure. Later the fact that not all safety procedures were properly followed was stated as the cause of the accident;
- The mayor asked for quick results of the evaluation of the activities of the operational services of the municipality (fire brigade, police, health authorities). This resulted in report [1];
- The emergency response worked, in general, very well. There were only some minor points of improvement;
- The communication between the emergency response workers did not work very well. This was caused by some disturbances in the connections;
- The name and nature of the chemicals in the burning chemical depot were not known by the emergency response workers;
- There was some comment on the infrastructure in the industrial area. With some roads blocked because of an accident, some companies might not be reached or evacuated fast enough.

Lessons learned

Some lessons were learned regarding the prevention of the accident. In this report we will restrict ourselves to the lessons learned regarding emergency response.

- The information exchange did not work properly. The emergency response workers needed assistance from an expert of the company. This expert was not

- available immediately after the accident. In the future, a company expert has to assist and advise the emergency response workers as soon as possible;
- In the future, the location of the Incident Site Command Team (CTPI) will be chosen in the vicinity of the company entrance. This location is better because it can be easily reached (by emergency response workers, company officials and the press). Usually the company offices are also in the vicinity of the company entrance. This means that there will be more facilities near the entrance and the expert of the company will sooner be present at the CTPI;
 - The communication and information to the press and to higher authorities was not good enough. As a result of the news on the (local) radio, the authorities started asking several questions although their involvement was not necessary. Proper information for the press is essential so that the public (and the authorities) get the correct report on the accident. Information has to be given also when there is no danger and when no measures have to be taken;
 - Although no mistakes were reported, the police wanted to make agreements with the Corporation of Europoort Botlek companies about warning and evacuation procedures. This concerned:
 - How the companies which are not associated with the co-operation will be warned (the co-operation has its own communication system);
 - Where will the evacuated persons be taken to;
 - What checks will be made if all people are evacuated.

Actions

- The company took several measures to increase the safety conditions;
- The emergency response services carried out an exercise in which the communication channels were tested. This test was done to find the cause of the communication and connection problems during the accident. The cause of these upsets could not be found.

Sources

Besides the literature mentioned below, information has been obtained through questioning people involved, from the accident database FACTS and from confidential reports, which will not be mentioned here.

1. Report:
Incident bij DSM-Chemicals op 13 december 1991;
Evaluatieverslag over het optreden van de gemeentelijke hulpdiensten;
March 1992.
2. Legal proceedings by the police, the Labour Inspectorate and the DCMR;
Procesverbaal 74.311/1991.
3. Article:
DSM-explosie schudt Rijnmond wakker;
Alert, February 1992.
4. Article:
Communicatieproblemen na DSM-ongeluk leiden niet tot stagnatie
hulpverlening;
Brand & Brandweer, April 1992.
5. DSM-magazine.
6. Several newspaper articles.

6.8 Case no. 7: Run-away reaction in a reactor causing an explosion

General description

Date, time of event : 8 July 1992, 09.53 hours.
Time of alarm : 09.55.
Place : Factory-yard situated along the river Amstel and adjacent to a residential area.
Type of activity : General Chemical Industry.
Type of accident : Run-away reaction in reactor caused jet release leading to explosion and fire.

Substances involved

Substance no. 1:

Chemical name : Dicyclopentadiene (DCPD).
UN-number : UN-2048.
State : liquid.
Concentration : 83% and 75%.

Substance no. 2:

Chemical name : Resin solution flammable.
UN-number : UN-1866.
State : Liquid.

Substance no. 3:

Chemical name : Benzene.
UN-number : UN-1114.
State : vapour.

Except for the above mentioned substances, many other substances have been detected either in the air or in water samples. For instance: cyclopentadiene (the 'diels-alder' product of cyclopentadiene with itself), C9 fractions and solvents like alkylbenzenes.

This part is focused on the main components.

Besides that, there were several chemicals in storage or in installations on the company grounds in the vicinity of the accident scene, such as BF₃, ammonia, hydrogen and acetylene. These chemicals were put in a safe place by the fire brigade.

Actual harm

To man

Three fireman of the works fire brigade, who were in the vicinity of the exploding reactor, died. They were burned. Seven employees and one fireman of the works fire brigade were injured and were taken to a hospital.

In a later stage of the accident, there was no plume rise any more and the wind direction changed. Then smoke and NO_x were emitted and people suffered irritation of the bronchial tubes.

In the city where the accident happened no evacuation order was given; some people went to the emergency shelter (a school) at their own discretion. Most of these people lived within a radius of approximately 600 metres. Because of an incorrect (not official) message on the local radio, several people went to the wrong location. This location (a sports hall) was mentioned in the disaster plan, but was not chosen as the

emergency shelter as it was located too close to the scene of the accident. In a residential area of an adjacent municipality (near the scene of the accident, on the other side of the river) an evacuation order was given, advised by the Dangerous Substances officer of the regional fire service. In this area, approximately 25 people were temporarily evacuated.

To the environment

Burnt material came down north of the disaster area. A toxicologic evaluation for the area in the wind direction had to be made. Grass and soil samples were taken to determine the extent of the deposition of the more coarse particles in the nearby environment. Also the effect of the fire-extinguishing water on the surface water and the wastewater purification plant had to be analyzed.

The factory yard was polluted by the discharged chemicals.

It was provisionally advised:

- To keep the cows inside in a particular area;
- Not to use vegetables out of private gardens.

Later on it was decided that consumption of vegetables out of private gardens was allowed, but only after thorough washing.

To the economy

The traffic on the provincial road was guided to other directions.

The reactor and several tanks, an overground pipeline as well as the office building were severely destroyed. The production of synthetic resin was closed down. The company had to pay a fine of 220,000 Dutch guilders.

Houses and a furniture showroom in the vicinity were damaged (e.g. windows were cracked).

Damage to the property of the municipality was estimated at approximately 400,000 Dutch guilders.

The loss of property of the company was estimated at 10 million Dutch guilders. The production was stopped. At the moment of writing this report, the production has still not been started. The loss of income has been estimated at 1 million guilders a month.

Potential harm

As long as the fire goes along with plume rise, there is no exposure nor soil contamination. The situation changes when the plume rise stops or when inversion layers are present. In this event the plume turns back. It depends on the height of the inversion layer if concentrations that can affect the health and environment, can still occur.

To the neighbourhood

Fragments of the reactor and pipelines were blown away and were found in the gardens in the neighbourhood. Windows in nearby houses were cracked.

There was some concern about the presence of BF₃ at the company grounds and the possibility that something might happen. This caused some confusion with the disaster staff. The fire brigade, however, had cleared the BF₃ to a safe place.

To the environment

The factory yard is close to the river Amstel. Polluted fire-extinguishing water might flow into the river. To prevent this, it was initially decided to let the fire burn out. Later on, it turned out that the fire-extinguishing water could be directed to the

wastewater treatment facilities of the plant which protected the river from polluted water.

In a later stage, extinguishing attacks were performed.

To adjacent chemical production facilities

After the fire there were deformed tanks, heated tanks and there were doubts about the technical condition of the emission control system. The extraction system was shut down, which means that chemical substances may have been released to other places of the factory yard (which has not been established). At the same factory yard, distillation of coal tar products takes place. After inspection it turned out that these facilities were hardly damaged. The production was resumed the day after.

Emergency action

Alarm procedure and emergency actions

Time	Action
09.30	Works fire brigade called out by process security
09.53	Explosion of cyclopentadiene gas
09.55	Alarm via fire alarm system to Regional Alarm Centre in Amsterdam. Regional Alarm Centre called out fire brigade from the city where the chemical plant is situated as well as fire brigades from several other municipalities
09.55	Alarm to alarm centre of police and ambulance services
10.00	Fire brigade, police and first ambulance on the scene
10.05	The mayor gave a 'Disaster Statement'
10.10	Regional Environmental Inspectorate (RIMH) warned by the plant management
10.24	The municipal disaster staff received news from the accident scene, they were advised to warn the public to close doors and windows and stay inside. The disaster staff contacted the local radio
10.45	RIMH requested RIVM to come to the accident scene and take measurements
10.45	Communication Command Vehicle of the Central Ambulance Station on the scene
10.52	Preparations for a possible evacuation were started
11.15	Two Communication Command vehicles of the fire brigade on the scene, one of the vehicles was later transported to the city hall, where the municipal disaster staff were present
11.30	The fire brigade reported to the disaster staff that the adjacent vessels were safe
11.45	Signal 'Fire under control' ¹⁾
12.01	Regional commander of the fire brigade present at the Municipal Disaster staff
12.15	Regional Inspectorate of the Environment present at the Municipal Disaster staff
12.15	Two measurement vehicles of the RIVM on the scene
12.45	25 inhabitants of a residential area in an adjacent municipality were evacuated
13.00	A press-conference was held
13.00	People were advised not to eat vegetables out of gardens in the vicinity of the accident
14.00	The evacuated people were told they can safely return to their homes
19.30	A new fire started, caused by a boil-over, the signal 'fire under control' was still valid
20.46	The news about the boil-over reached the municipal disaster staff
23.18	The fire was extinguished

¹⁾ The fire burnt still fiercely, but the danger for spreading did no longer exist.

Services that came into action at the location of the accident

- The works fire brigade;
- The municipal fire brigade;
- Police;
- Ambulance service;
- Municipal disaster staff;
- Information department of the city of Amsterdam;
- The Regional Inspectorate for the Environment (*RIMH*);
- Health Inspectorate;
- The Purification Board (*Zuiveringschap*);
- National Institute of Public Health and Environmental Protection (*RIVM*);
- The Labour Inspectorate.

Works Fire Brigade

The works fire brigade was informed at 9.30. As the internal cooling of the reactor functioned unsatisfactorily, the works fire brigade expected that the gas under high pressure would escape via the safety valve and bursting disc. This happened, but the reactor ruptured as well and an explosion followed. At that time the fire alarm system was activated.

The Municipal and Regional Fire Services

The municipal fire brigade was on the scene at 10 o'clock. They started to extinguish a fire on a nearby road and encircled the fire by water cannons (full-scale cooling). They also cleared away other dangerous substances near the scene of the accident. The municipal fire service was assisted by several fire services from nearby municipalities and by the regional fire service. The efforts of the fire services were coordinated by the alarm centre of the regional fire service. At first the fire brigade decided to let the fire burn in a controlled way. After a change in the wind direction (wind speed about 1 m/s) and the knowledge of the total amount of flammable products, they started to extinguish the fire by attacking it with large amounts of water and foam. This first attempt did not succeed. They continued with the full-scale cooling. A second extinguishing attempt was made with foam. This attempt succeeded. Later (in the evening) the fire started again because of a 'boil-over'. The fire brigade was prepared for this to happen. They had everything still under control.

Some measurements were taken in the direct area near the accident scene by the Chemical Advice Service of the fire service of Amsterdam.

Police

The police blocked an adjacent road and cordoned off the emergency site. In one part of the city they warned the population to stay inside and close doors and windows. The police were also involved in the emergency shelter for evacuated people, employees of the company and their relatives. At first the police were the only representatives of the emergency response services in the emergency shelter.

Ambulance Service

The Ambulance Alarm Centre sent several ambulances to the accident scene. A communication command vehicle of the Alarm Centre was also sent to the accident scene. A trauma team was also warned. This trauma team never arrived at the place of the accident.

Municipal Disaster Staff

At approximately 10 o'clock the municipal disaster staff was operational. The mayor gave a 'Disaster Statement'. In the first moments the disaster staff could not do much because they did not receive enough information from the accident scene. They contacted the local radio and gave them a message in order to warn the public. They

started to make preparations for a possible evacuation. Later on they decided that evacuation was not necessary. At 12 o'clock the regional commander of the fire brigade joined the disaster staff. From that moment on, the disaster staff had much more information about the accident. At 1 o'clock the disaster staff gave the first press conference. When the disaster staff found out that they did not have the capacity to handle all the press questions they also contacted the Information Department of Amsterdam and asked for assistance.

Regional Inspectorate of the Environment

The Regional Inspectorate of the Environment gave (amongst others) advice to the competent authorities on health and environmental aspects. The actual measurements of the nature of the pollutants and the extent of the area that might become polluted was executed by the National Institute for Public Health and Environmental Protection (RIVM).

National Institute of Public Health and Environmental Protection (RIVM)

The Environmental Incidents and Environmental Medicine unit of the RIVM arrived within two hours after the explosion. They did a great amount of measurements of air quality in the vicinity. These measurements showed that there was hardly any exposure of the neighbouring population. Samples of the soil and burnt material were taken and examined. On the basis of the results of the samples of burnt material, it was advised that one farmer should have his meadows cleaned up. A few days after the accident, air quality measurements were taken near the place of the accident. Concentrations of volatile substances were measured, which resulted in advice to clean up the accident scene as soon as possible.

Purification Board (*Zuiveringsschap*)

The Purification Board took care of the protection of the river by installing screens and pumping polluted water by means of a piston.

Preparedness

The plant has been evaluated on safety aspects. An occupational safety report (AVR) had been made. The possibility of such an accident had been considered, which appears from the action of the works fire brigade. This brigade had expected the gas would escape through the safety valve and bursting disc. The company had made a contingency plan which was updated in 1991.

The city where the accident took place had a disaster plan. The warning and alarm procedures in this plan were used in order to activate the municipal disaster staff. The municipal disaster staff had never practised the plan. The contents of the disaster plan, as well as the contents of the contingency plan, were not generally known by the municipal officials or by the employees of the company.

The need for a disaster control plan, concerning an accident at the company where the accident took place, had been investigated approximately ten years before. Because the chance of an accident was considered to be very low, the decision was then made that a disaster control plan would not be necessary. This decision has not been reconsidered any further.

Information for the public

The disaster staff contacted the local radio to inform the public. As the disaster staff did not have much information at first, they could not give much information to the press. At approximately 10.30 the disaster staff warned the public through the local

radio that they had to close doors and windows and had to stay inside. In a part of the city this news was also announced through loudspeakers in police cars.

At 11 o'clock the disaster staff appointed an emergency shelter (a school) for victims. Although there were no orders for evacuations, some people decided to go to the school. In the first few hours there was, however, no one who could inform the people in the shelter about the developments of the accident. Later the vice-mayor informed the people at the shelter. Because incorrect information was given on the local radio, several people went to the wrong location. This wrong message was based on the interpretation of news reporters and was not based on actual facts. As a result of this message, some people went to the wrong location, which caused some confusion.

Although the informing of the press had to be handled by the municipal disaster staff, in the first few hours they did not have much information themselves because the communication with the accident scene and other authorities did not work very well. Partly, this was caused by lack of facilities, and the disaster staff did not know that it was possible to use the national emergency phone system. Later the communication improved.

At 1 o'clock the disaster staff organized the first press conference. There was much attention from the media about the accident. A television crew of CNN just happened to be in the neighbourhood (for a different report) which resulted in a world-wide coverage of the accident. This increased the attention from the press even more. The disaster staff decided that they did not have the capacity for answering all the questions of the press. The Information Department of Amsterdam was asked to give assistance in this matter.

Perceptions

- Problems in communication lead to unnecessary anxiety in the wide surrounding areas. The municipal executive staff was unable to obtain a good impression of the situation because of lack of information. This is partially attributed to the fact that there was no 'command disaster area'. As a result there were only informal contacts between emergency services at the spot of the accident [7]. The lack of information at the disaster staff is also a natural consequence of the fact that for certain information (such as results of measurements) it takes some time before this information can be available;
- With respect to the communication between emergency services: some of the professional terminology like the term 'fire under control' caused great disorder to other emergency services and led to communication faults [6];
- The emergency shelter for anxious inhabitants did not function satisfactorily because of the following facts:
 - Various groups of people were all together at the same location such as residents of houses nearby and families of workers and (possible) victims;
 - There was lack of professional assistance at the reception centre;
 - There was lack of good communication connections [1, 2, 6];
- Informing the public is an important task of the municipal executive staff, but with respect to health and environmental issues the province has the co-ordinating role. This should be recognized.
For smaller municipalities the communication task can go beyond their available capacities [1];
- The communication between services at the accident scene did not function satisfactorily. The three emergency response services (fire brigade, police and ambulance services) did not have the same (or compatible) communication means. This was partly caused by the fact that communication through the air cannot be used for certain confidential information. For this kind of information,

- messengers were used. A special communication channel for the three emergency response organizations should be made available [13];
- The reorganization of the police (in which the police force will join in 25 police regions) will have positive consequences for the emergency response. With these new regions it will be easier for the police force to use the available facilities in each region [13];
 - During the accident the fire brigade had to pay a lot of attention to the repression of the fire. This brings to mind if it would not be better to let the police handle the co-ordinating tasks between the emergency response services [13].

Lessons learned

- Municipalities should have a disaster plan that contains the tasks and responsibilities of organizations involved. This plan should be the basis for exercises of the disaster staff. The disaster plan's function is to handle the preparation and management of a disaster effectively. It should not be a goal on its own, but have sufficient methodical preparation to fight the accidents [2];
- If an accident has intermunicipal involvements, it is stressed that municipalities should make agreements in advance about who takes care of the co-ordination in that event [2];
- Emergency exercises in which emergency services and the management staff of responsible authorities take part, should be held more often [2];
- This accident has proved that not only Seveso plants can lead to serious industrial risks. Municipalities should make a thorough inventory of the risks in their area and also look at potentially unsafe situations. This includes stationary installations as well as transport of hazardous materials [2];
- Safety measures taken by the plant management should correspond with the measures taken by the municipality. Consultation on a regular basis between plant management, municipality and emergency services is essential in order to set up arrangements that should be kept alert and well-trained [2];
- The disaster plan was not up to date:
 - The facilities of the municipal executive staff were inadequate;
 - The facilities for informing the press were inadequate;
 - There was no knowledge about available communication means such as the use of the mosaic channel on the cable television (= all channels shown together on the screen at one time) and the national emergency network;
 - Preparation of evacuation actions needs improvement [1];
- Smaller communities should take the initiative to give information to the public in a co-ordinated, centralized and efficient way. In the event that the information needs to go beyond the available capabilities of a municipality, the information task should be delegated. This should be recognized and provisions should be made beforehand [1];
- With respect to the **environmental and health** aspects of the accident the province should have co-ordinated and controlled the activities of the services involved from the beginning [3];
- The Regional Environmental Inspectorate has established the need for:
 - An internal procedure for acting under emergency circumstances;
 - An internal communication procedure;
 - A procedure for informing external organisations;
 - A data system with data on factories with special risks [3];
- The fact that the fire brigade decided to let the fire burn out, in order to limit the amount of contaminated extinguishing water, had also positive consequences on the exposure of toxic concentrations to the population, cattle and the environment. Most of the chemicals were burnt.

Actions

- Plants that come under the Seveso Directive should have a company contingency plan. Municipalities should have a municipal disaster control plan for every emergency which could possibly happen in their district. A large number of municipalities consider this a complex matter. The Home Secretary has made it possible for the municipality to take part in a workshop. The objective of these workshops is to pass on relevant knowledge and experience in setting up municipal disaster control plans and to create a network for support on this matter;
- The brochure in which the role of the State Health Inspectorate is described, regarding (environmental) incidents, has been changed and updated. The results of the evaluation of the role and actions of the Regional Inspectorate for the Environment have been incorporated in this new brochure.

Sources

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7 Lessons Learned, Conclusions and Recommendations

In the previous chapter, several lessons learned following a specific accident have been given. Some of these lessons were specifically related to a type of accident or to the organizations involved. These lessons will not be repeated here. Other lessons also had a more general character. These lessons can be grouped into several categories. These categories are worked out in this chapter. The lessons will be accompanied by conclusions and recommendations. These lessons, conclusions, and recommendations are usually based on information from several accidents or accident exercises.

Awareness

The attention given to (major) accidents, the cause and consequences of accidents, is increasing. Disasters and major accidents receive a lot of attention from the press and the public. The social acceptance of (the consequences of) emergencies is decreasing. Damage to people and the environment and nuisance to third parties raise critical questions by several pressure groups and (political) parties. This increase in attention requires more effort from the emergency response organizations, authorities and research institutions regarding information collection, status reports, investigations into the impact of accidents, risk analysis, evaluations, etc.

Not only the increasing attention by the press and the public concerning accidents, but also the reorganization of the emergency response, which has officially been completed only recently, increased the awareness of emergency response organizations and the (local) authorities. The high awareness increases the pressure on the emergency response organizations and the local authorities regarding their internal emergency response organizations, co-operation and communication with other organizations and the preparedness for emergencies as a whole. This increase in attention and pressure, however, does not (in most municipalities) lead to more attention, effort and budget for preparedness for (the emergency response of) major accidents or disasters; the attitude is often, 'Accidents usually happen somewhere else'.

Preparedness

Preparedness activities of local authorities are mainly focused on the disaster plans and disaster control plans. All municipalities are obliged to have a municipal disaster plan. This obligation is stated in the Disaster Control Act of 1985. The development of disaster plans has taken a long while, but at this moment nearly all municipalities have a disaster plan. The availability of a disaster plan has become a political issue, but the real value of the plan forms a point of discussion. A direct link between the availability of a disaster plan and the success of emergency response activities has not been established. The possession of a plan itself is not a guarantee for a successful emergency response organization. The disaster plan is nothing more than a tool which has to alleviate the tasks of the disaster staff. This plan can only be useful if the following points are taken into consideration:

- The plan is a guideline, not an obligatory prescription of procedures;
- The plan has to be updated on a regular basis.
Since the disaster plan contains a compilation of all organizations which can be involved and how they can be reached, this information is quickly outdated;
- The contents of the plan have to be known by all organizations involved. The plan has to be accompanied by regular exercises of the organizations mentioned in the plan.

The introduction of disaster control plans is even more difficult than that of disaster plans. Many municipalities do not see the need for disaster control plans in their municipality or do not have enough capacity to make the plans. The current disaster control plans are very much focused on accident scenarios. This mainly concerns scenarios regarding accidents involving dangerous substances at fixed installations. Although the law holds a very broad description of accident scenarios which require a disaster control plan¹⁾, disaster control plans are primarily made for installations and companies which fall under the 'Seveso Directive'. For scenarios of other types of emergencies such as major floods, storms, long-lasting disturbances in the energy supply, water supply or telecommunications, disaster control plans are only seldom made. Some of these scenarios do not fit very well with the 'definition' of a disaster. This resulted in a currently ongoing discussion about the definition of a disaster, as it has been stated in the Disaster Control Act. With the revision of the Disaster Control Act, this definition might be adapted.

The focus on scenarios in the current disaster control plans can decrease the practical value of these plans. The chance that an accident will be the same as the scenario in the plan is very small. It is therefore important that the planning and organization of the emergency response will not only be prepared for the scenario studies, but will be flexible. The flexibility of the plans can be increased by an approach focused on the tasks which have to be carried out during emergencies and the available capacities of the emergency response services, on regulations and agreements for assistance from services in other regions and on communication and control structures of the emergency response. These plans are not (and do not have to) be as detailed as the scenario-based plans. The plans should be a guideline for the disaster staff. In this way the plans can be made more flexible, usable, easier to develop and can be a basis for emergency response exercises.

The value of plans, however, is not to be overestimated. Plans cannot work on their own. The organizations have to do the job and therefore have to be trained properly. This is also important for the non-uniformed emergency response organizations. For the uniformed services, emergency response is part of their job; exercises are a structural part of their activities. Other services and organizations, such as the mayor and his disaster staff, have not been trained on a regular basis. As a result of recent accidents (e.g. case no. 7) initiatives for exercises at the policy level are taken. For an effective (and more or less consistent) functioning of municipal disaster staffs, a (national) training programme should be further stimulated. The available disaster (control) plans should be incorporated in the training. Municipalities often need to be convinced of the need for emergency response exercises on all levels.

In some of the past accidents, one can see that the use of disaster (control) plans is closely connected to the 'Disaster Statement' given by the mayor. Although a 'Disaster Statement' is not absolutely necessary for the use of a disaster (control) plan, if no 'Disaster Statement' is given, the plans will most times not be used. The use of the plans is therefore dependent on the interpretation the mayor gives to the situation and the definition of a disaster. This means that the plans will be used in only very rare situations. The usefulness of the plans would, however, improve if they would also be used during less severe accidents. By using the plans (only as a guideline!), the contents of the plans will become familiar to the emergency response workers. After using or consulting the plan, its usefulness can be evaluated and the plan can be improved (if necessary).

¹⁾ Disaster control plans are required for all emergencies of which the place and nature can be foreseen.

The knowledge and experience in treating chemical victims is very limited in the Dutch medical field; therefore medical treatment protocols for chemical victims should be developed as soon as possible. A uniform triage method for chemical victims should be developed also. The current triage method is only focused on mechanical accidents.

Organization and co-ordination

The basic principle for emergency response in the Netherlands is the bottom-up principle. Scaling up of activities leads to the upgrading of the controlling and co-ordinating levels. The regulations, agreements and need for the scaling-up of the organization differs from municipality to municipality and from region to region.

Basically the principle of scaling up is a good principle. It also has, however, a few less positive consequences. Scaling-up leads to more organizations being involved, which leads to more co-ordination and communication. Although the different levels all know their own tasks and responsibilities, they also have to know what the tasks and information needs of the other levels and co-ordination centres are. This is very complicated matter, especially in emergency circumstances when one has to work under time pressure. The more co-ordination centres, levels or VIP's who have to be informed, the more complicated it becomes. It is therefore important that the number of people, organizations or co-ordination teams will be kept as low as possible. This means strict co-ordination procedures and good information channels to those teams and workers who are operational and those who do not have to be involved in the emergency response activities (immediately).

A difficulty in the co-ordination and scaling-up procedures are the differences in the territories and capacities of the regions. Since the start of the reorganization process of emergency response, the fire brigade has been organized by regions. The ambulance services are also organized by regions and a reorganization of the police is taking place. The police will be organized into 25 police regions. These regions are, however, not the same as the fire brigade and ambulance regions which are smaller and have other boundaries. The co-operation between the three operational emergency response services (and so the emergency response as a whole) would benefit from consistent (emergency response) regions. The regions of the size (and capacity) of the police region would be better equipped for the emergency response during large-scale disasters. The importance of a region with high capacities has been proven recently (case no. 8, Appendix).

If the reorganization of the police leads to consistent emergency response regions, it would make sense that municipalities located in the same region should make agreements on co-operation and assistance, as the operational emergency response services are also organized on a regional level. Many municipalities do not have the capacity to handle their tasks regarding emergency response on their own. The small scale of Dutch municipalities also results in the fact that major accidents will most likely also have consequences for the neighbouring municipalities. Co-ordination between disaster staffs of the municipalities is then very important. Some of the accidents described in the previous chapter show that this co-ordination has not always worked properly. Co-operation of municipalities in one region would therefore be a logic step; this can also mean the forming of one regional disaster staff instead of several municipal disaster staffs. In the present situation, when the consequences of the accident go beyond the territory of one municipality, municipalities have to co-ordinate their activities. They will then appoint a co-ordinating mayor and co-ordination can be handled by the Queen's Commissioner. Every municipality, however, can keep its own disaster staff and co-ordination centre.

Communication

A subject closely related to organization and co-ordination is communication. The different co-ordination levels can only function properly when they have access to the right communication channels and can actually obtain the necessary information for their decisions.

The process of communication can take place in different ways. In emergency situations the **managerial level** is confronted with problems for which no standard solutions exist. This means that these people have to discuss, within the time constraints, which approach will probably be most successful. This type of communication will be mainly verbal. The managerial level also has to be aware that higher authorities, authorities in the vicinity of the disaster and organizations that might become involved in the consequences and control of the emergency later on, should be informed at an early stage about the state of affairs. This avoids unnecessary inquiries. This information could be distributed mainly in writing.

On the **operational level** communication takes place (or should take place) within and between emergency response organizations (internal and external communication). The internal as well as the external communication is principally verbal, but the effectiveness of these communication patterns is under discussion. The communication between emergency response organizations on operational aspects is especially an issue of concern.

After almost every accident, the communication is criticized. This can also be seen in the accidents described in chapter 6. Communication is one of the most difficult aspects of the emergency response. This usually leads to new investments in communication means and technical equipment, so that more than one type of communication channel is available; if one channel fails, one can use another channel. Good communication is not only dependent on the technical equipment but also seeks to obtain knowledge of the informational needs of other organizations: when and where is communication necessary? However, the organizations involved, especially the operational services, who receive most of the information in the first moments after the accident, are occupied with repressive actions. This is not the best moment to remember that someone else might need some information.

Another aspect to be taken into account is that the organizations involved can vary from professional to volunteer organizations. But also professional organizations may be professional in their day-to-day job, but not with respect to the special demands in an emergency situation.

The first step to improve the communication is to develop a structure for the information exchange demand. The informational need of the different parties has to be investigated and formalized. For hospitals, for example, it is also very important to know the nature and the concentration of the chemicals involved. In order to control the communication structure, it is advisable that every organization appoints one person (or section) who checks if all information needed by others has been sent and that all information necessary has been received. This person has to have close contact to the co-ordinating teams such as the commander at the accident scene or the municipal disaster staff. Once the information exchange is structured and the appropriate communication means under varying circumstances are selected, it is important to practise the communication procedures.

Exercises

Communications and co-ordination work better when the people involved know each other better and know each other's task and capabilities. This applies to the co-ordinating team (e.g. the municipal disaster staff) itself as well as to the other organizations which have to co-ordinate or have to be co-ordinated. Exercises improve the familiarity with the organization, the tasks and information needs. This also stresses the importance of regular exercises. Exercises, which not only focus on

repressive actions, but also incorporate co-ordination activities, decision making and advice from experts, research institutions and inspectorates. These exercises have to be based on the developed procedures, plans and the above mentioned communication procedures. Knowledge of the procedures is essential for the success of exercises.

Information for the public

The increasing attention given to accidents resulted in an increasing need for information. The press is very quickly informed of the occurrence of an accident. News about an accident is on radio or television before an official statement can be given by the authorities. This raises several additional problems for the emergency response organizations. The operational services as well as the disaster staff will be cornered by the press, higher officials who want to be informed, and worried residents. It is therefore very essential that the information given to the press, the public and other people involved, is co-ordinated as fast as possible. The disaster staff has to establish an information point from which all information has to be given. In order to prevent different and conflicting messages, this will be made known to the public. It is also very important that the work of the operational services is not disturbed by the press or other (curious) people. The early news on radio or television evokes so-called 'disaster tourism'. This requires, for example, more effort from the police to keep the public away.

The information tasks of the municipality can easily outgrow the capacity of the municipal services. This has to be recognized by the authorities. Agreements and procedures for assistance, extra facilities, etc. have to be made in advance.

Although a distinction has to be made between information for the public (residents or employees) and the press, the information given to the press also has an effect on the necessary information given to the public. If the information for the press is not clear or conflicting messages are broadcasted on radio or television, a lot of questions will be raised by the public. The media can also be used in order to inform the public. A national campaign has already been organized in which people are told what to do when an emergency happens¹⁾. The role of the media is very important in this. The agreements between the media and the local authorities have to be very clear. The media also have to recognize their important role and have to make a distinction between rumours, facts and orders given by the authorities.

Although the national campaign on the use of the emergency siren has had a very wide reach, the effect on the behaviour of people when they actually hear the siren has not been investigated. No experience of situations where the siren has been used is available in the Netherlands. Further investigations into the behaviour of the public should be made. In this context, the reach of the news given through loudspeakers on police cars or by orders given through radio messages should be investigated. This is not only important regarding the order to stay inside and close doors or windows, but also regarding evacuation orders. Little experience with large-scale evacuations is available in the Netherlands. How will the public respond and how fast can an evacuation be accomplished (dependent on the scale of the area and the number of people)? Lessons have to be learned here from international experiences.

Evaluation of accidents

Evaluation of accidents is receiving more and more attention. This is a result of the increasing awareness of the public and the organizations involved. The larger the

¹⁾ When the emergency siren is sounded, people have to go inside, close doors and windows, and listen to the (local) radio for further instructions.

accidents (and the attention given to it by the press) the more articles giving evaluation appear in the press and professional literature. Things that went wrong or things that functioned very well cannot be emphasized enough.

Several organizations, such as the Labour Inspectorate, the Fire Service Inspectorate, research institutions, local authorities and the emergency response organizations involved, evaluate (certain aspects of) accidents.

The evaluation of the accidents by the involved emergency response organizations themselves is usually not wide-spread. Very important lessons can sometimes only be learned from (confidential) internal reports. These lessons often lead to solutions which help to avoid repetition of certain 'mistakes', or to useful tips to make the emergency response work easier. These lessons deserve to be made public to a wider audience. An international project like this 'Lessons Learned' project is a very good opportunity to compile all these lessons.

Evaluation of accidents by other specialized organizations (such as the Labour Inspectorate and the Fire Service Inspectorate) is most times focused on one specific aspect of the accident, such as the cause of the accident, preventive measures or emergency response actions during the emergency. The long-term consequences of accidents and the control procedures which can be taken in order to limit long-term effects, do not receive much attention. Accident analysis should incorporate all aspects of an accident, including the evaluation of risks for the population, cattle and environment during and long after the accident. This report, however, is also an example of focusing on one single aspect: this study was limited to the evaluation of the emergency response after major accidents involving dangerous substances. Therefore the lessons in this report are limited to lessons regarding emergency response.

Lessons regarding emergency response cannot only be learned from major accidents involving dangerous substances, but also from other types of accidents and from smaller accidents. It is therefore recommended that a network be set up which accumulates and publishes essential information, lessons, good ideas, new approaches, solutions to problems, etc. regarding all sorts of accidents. This organization or network can analyze the accident through comparison. The lessons from these accident analyses will then lead to comparative results. From time to time, the network/organization can compile the results and distribute these among all organizations involved in emergency response. This can be an effective way to improve the preparedness and emergency response.

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Appendix

Appendix 1 Compilation of Project Team and Steering Committee

Project team

The project team was formed by the following employees in the Department of Industrial Safety of TNO:

- Mr. P. van Beek;
- Mrs. I. Heidebrink;
- Mrs. T. Wiersma.

Steering Committee

The following organizations were represented in the Steering Committee:

- Ministry of Housing, Physical Planning and the Environment:
 - Mr. L.A.C. de Bruijn;

- Ministry for Employment and Social Security:
 - Mr. J.I.H. Oh;

- Ministry for Home Affairs, Directorate Fire Services:
 - Mr. P.P.H. Swinkels;

- Ministry for Home Affairs, Directorate Police:
 - Mr. W.M. van Andel;

- Ministry of Transport and Public Works:
 - Mr. H.A.M. Grol;

- Ministry of Welfare, Health and Culture:
 - Mr. J. de Boer;

- National Institute for Public Health and Environmental Protection (RIVM):
 - Mr. F.J.J. Brinkmann;

- Regional Assistance Service Rotterdam-Rijnmond:
 - Mr. A.M. Alblas;

- Central Environmental Conservation Service Rijnmond (DCMR):
 - Mr. E.F. Blokker;

- Association of Dutch Chemical Industries (VNCI):
 - Mr. Verhoef.

We would also like to thank the all organizations involved in the selected accidents, which supplied information on the accidents and emergency response. For reasons of confidentiality these people and organizations will remain anonymous.

Appendix 2 Empty Standard Data Collection Form

Case no.:

1. General description

Date, time of event¹⁾ :
Time of alarm :
Place²⁾ :
Type of activity³⁾ :
Type of accident⁴⁾ :

Substances involved⁵⁾

Substance no. 1:

Chemical name :
UN-number :
State :
Concentration :
CAS number :
Hazard class :
Hazchem code :

- 1) The moment that the accident leads to external effects.
- 2) Factory yard, road, vicinity to neighbourhood and waterways.
- 3) Production, store, transport, loading/unloading, maintenance, etc.
- 4) Release, fire, explosion.
- 5) Raw material, final product, catalysts, formed products etc.

2. Actual harm

... To man, environment and to the economy.

3. Potential harm

... To man, environment and to the economy.

4. Emergency action

Alarm procedure and emergency actions

- ... Containing a chronological compilation of actions taken;
- ... A compilation of all emergency response teams which came into action, and a short description of their activities.

5. Preparedness

... A compilation of preparatory actions taken by the organizations involved such as disaster plans, exercises and the availability of emergency response units (works fire brigade, etc.).

6. Information for the public

... Description of the way information has been given to the public, the role of the press in this. This includes information prior to the event, during and after the accident.

7. Perceptions

... A compilation of remarks, conclusions, perceptions, made by individual people involved.

8. Lessons learned

... Lessons learned by organizations involved, reviewed by the project team and the steering committee.

9. Actions

... Actions taken by organizations in order to improve their emergency response (usually results of lessons learned).

10. Sources

... A compilation of all available sources, reports, publications, proceedings, etc. Confidential information will be excluded from this list.

Appendix 3 Case no. 8: Cargo aeroplane crashes on two apartment buildings

General Description

Date, time of event¹⁾ : 4 October 1992, 18.36.
Time of alarm : 18.36.
Place²⁾ : Residential area of Amsterdam.
Type of activity³⁾ : Air transport.
Type of accident⁴⁾ : A Boeing 747 cargo aeroplane lost a motor and crashed on two apartment buildings. This caused a heavy fire.

Substances involved⁵⁾

Substance no. 1:

Chemical name : Kerosine.
UN-number : UN-1223.
State : Liquid.
Concentration : 100%.

Actual harm

To man

There was a lot of confusion about the number of casualties. The first estimation of casualties was 250 people. This number was based on the number of destroyed apartments and the number of residents. Eventually this number turned out to be much lower. The final official number was 48 casualties, this included 43 citizens and 5 crew members.

12 injured people were taken to hospital by ambulances. Several other (slightly) injured were taken to hospital by private means.

To buildings and environment

27 apartments were completely destroyed, another 53 were burnt out. 580 apartments could not be used. Later it was decided that the two apartment buildings should be destroyed completely. For the homeless people new apartments had to be found. Financial support, as well as psychological support, was given to many victims.

The top layer of a surface of 300 by 400 metres had to be removed as this contained the last remains of the aeroplane and the apartment building. Part of the ground was polluted with kerosine. The main reason for the removal of this layer, however, was more for psychologic reasons (people could not be continually faced with the consequences) than for environmental reasons.

The European Community gave 2.3 million Dutch guilders from an emergency fund. A special emergency fund was raised by the Red Cross. The aeroplane company had also money available from its emergency fund. The Ministry of Welfare, Health and Cultural Affairs had money available for psychological care of the people after the accident.

-
- 1) The moment that the accident leads to external effects.
2) Factory yard, road, vicinity of neighbourhood and waterways.
3) Production, store, transport, loading/unloading, maintenance, etc.
4) Release, fire, explosion.
5) Raw material, final product, catalysts, formed products, etc.

Potential harm

After the accident there was some danger of explosions, because of possible gas leaks from the apartments. After a short while the gas supply was disconnected.

There was danger that the buildings would collapse. Because of this, safety measures had to be taken. This caused some delay in the rescue and salvage activities.

Emergency action

Alarm procedure and emergency actions

Time	Action
<i>Sunday, 4 October 1992</i>	
18.27	First report of the aeroplane to the Air Control Centre of Schiphol Airport, report of loss of engine
18.29	Alarm to Coastguard Centre by people who saw that the plane had lost an engine, the Coastguard contacted Schiphol
18.33	Schiphol warned the alarm centres of the fire brigade, ambulance service and police that an aeroplane was in trouble and asked them to be alert.
18.36	The plane crashed into two adjacent blocks of apartments
18.36	Alarm to the alarm centres of the police, fire brigade and ambulance services
18.37	Turn out of fire brigade, ambulance service, police
18.40	Fire brigade on the scene
18.45	The Red Cross and the Regional Voluntary Assistance Service were alarmed by the alarm centre of the fire brigade
18.48	First ambulance on the scene
18.51	The mayor gave a 'Disaster Statement'
19.02	Several crossings and a nearby situated motorway were blocked off in order to keep the road clear for the emergency services and to keep the public away
19.14	Several hospitals in Amsterdam had activated their emergency reception plan
19.21	An emergency injury unit (<i>gewondennest</i>) was set up at the accident scene
19.27	Trauma team and SIGMA team on the scene
20.00	Municipal Co-ordination Centre activated
20.31	Second SIGMA team on the scene
21.00	Signal 'Fire under control'
21.15	Ambulances from other regions were sent back to their own stations
21.30	A press conference was held in the Municipal Co-ordination Centre
22.30	The mayor, the chief of the police and the fire brigade paid a visit to the accident scene
23.00	A press conference was held in the Municipal Co-ordination Centre
23.30	A central emergency shelter was appointed (a sports centre in the vicinity of the accident); until that time several emergency shelters were activated in the area. The night-shelter was at two different locations (marine barracks and a school)
24.00	The mayor, the chief of the police and the fire brigade held a press conference in the Municipal Co-ordination Centre

- The National Co-ordination Centre was activated on 4 October;
- People were asked to report missing relatives to the City Council.

Monday, 5 October 1992

- Salvage activities were started;
- 8 dead bodies were found;
- 200 people were present in the night shelters;
- Press conferences were held;
- The Queen, several ministers and the Queen's Commissioner paid a visit to the accident scene;
- Several international authorities asked for information;
- Preparations for re-housing of the victims were started
- There were no more flights above the accident scene.

Tuesday, 6 October 1992

- 15 dead bodies were found;
- 177 people were present in the night shelters;
- The police took over the task of the District City Council regarding the registration of missing persons;
- Press conferences were held;
- Three lists of 'missing persons' were made by the police:
 - list one: with people who were found;
 - list two: people who were missing and lived in the disaster area;
 - list three: people who were missing and lived outside the disaster area;
- All apartments which could safely be entered were searched, no casualties were found;
- Many people responded to the request to report missing persons;
- The salvage procedures were changed in order to speed up the process.

Wednesday, 7 October 1992

- 39 dead bodies were found;
- 229 people were present in the night shelters;
- The disaster staff asked for advice from experts who were active after the Lockerbie disaster;
- The 'black box' of the aeroplane was found.

Thursday, 8 October 1992

- 50 files on dead bodies were made. As in certain cases only parts of bodies were found, the term 'files' was used instead of dead bodies. The salvage operations were completed;
- Two experts (a pathologist and a police officer) who were active at the Lockerbie disaster visited the accident scene and the disaster staff;
- 184 people were present in the night shelters;
- Almost all the homeless people were offered a new house;
- A pass controlling system was introduced at the central emergency shelter. This was necessary as some people who were not victims of the disaster tried to benefit from shelter facilities.

Friday, 9 October 1992

- The first lists with casualties were made public:
 - list one contained identified casualties: 9 persons;
 - list two contained missing persons who were in the vicinity of the apartment buildings at the time of the accident: 48 persons;
 - list three contained missing persons who did not live in the vicinity of the apartment buildings: 63 persons;
- Victims originating from the Dutch Antilles were moved from the central emergency shelter to a hotel by the Antilles Government.

Saturday, 10 October 1992

- The three lists were several times updated as a result of new information;
- 122 people were still at the central emergency shelter.

Sunday, 11 October 1992

- A memorial service was organized by the Municipal Authorities, several organizations (representing different nationalities) co-operated in this organization

12 October and following days

- The people in the emergency shelter were taken to a hotel, the emergency shelter was not used any more at night. The activities for shelter and psychological assistance were slowly reduced. Psychological assistance remained necessary for a long while;
- An advice and information centre was established in the neighbourhood of the accident scene. Legal assistance was also given here;
- Air traffic was restored, the expansion plans of the airport are temporarily postponed;
- There were some difficulties in distinguishing between people who were really affected by the disaster and those who tried to benefit from the special attention and facilities given to the victims;
- Several illegal residents lived in the damaged apartments; this caused some problems with registering the victims. The illegal victims were promised that their illegal status would not have any consequential significance. Later they were promised that they would be made legal. This resulted in many new illegal 'victims'.

27 October 1992

- The 'Disaster Statement' was withdrawn.

Services that came into action

- The municipal and regional fire brigade;
- The fire brigade of the airport;
- Police;
- Ambulance service;
- Trauma Team of the National Organization of Trauma Teams;
- The Red Cross (two medical teams, two SIGMA Teams);
- Local health authorities;
- The Salvation Army;
- Disaster Identification Team;
- Municipal Co-ordination Centre;
- The District City Council;
- National Co-ordination Centre;
- Two experts from the Lockerbie disaster;
- The Municipal Housing department
- The Municipal Social Services department;
- The Municipal Department of External Affairs;
- The Municipal Department of Public Order and Safety;
- The Municipal Department of Administrative Legal Affairs;
- The Municipal Department of supervision on building construction;
- The Municipal Population Registration Office;
- The Municipal Department for Insurance Matters;
- The Association of Insurance Companies.

Fire Brigade

The fire brigade started extinguishing the fire. Because the heat was too high, they

could not come very close at first and enter the building. The fire brigade of the airport assisted with two crash tenders. With the help of the crash tender of the fire brigade of the airport, the fire could be extinguished relatively early. The signal 'Fire under control' was given at 9 o'clock. The fire brigade did searches for victims in the parts of the building which had not collapsed, and searched for victims and remaining parts of the aeroplane in the ponds in the vicinity of the accident. The fire brigade worked on the salvage operation after the fire had been extinguished. The Communication Command Vehicle of the fire brigade was placed at the scene. From this vehicle the communication between the fire brigade, police and ambulance alarm centre was co-ordinated. A great amount of material was brought into action. One hour after the crash approximately 300 firemen were active at the accident scene. Besides fire fighters, a doctor, two psychologists and several officers were present to take care of the personnel. The salvage operations were carried out by two salvage teams. Voluntary members of the Regional Voluntary Assistance Service, an organization in the Amsterdam region, which will be operational during disasters, also assisted at the salvage operations.

The regional commander of the fire brigade (and his assistant) were present in the Municipal Co-ordination Centre. They worked in two shifts.

Police

The police had to block several crossings and roads in order to give way to the emergency response services and to keep the public away. Because of the rush of many so-called 'disaster tourists' the police were very busy maintaining public order and safety. They had to enclose and guard the accident scene and the entrances to the apartment buildings after robberies from the apartments had been reported. In the first hours after the crash approximately 500 policemen were operational at the accident scene and in the vicinity.

The chief of the police was present in the Municipal Co-ordination Centre.

Disaster Identification Team

The Disaster Identification Team, a police team which falls under the authority of the Ministry of Justice, took care of the identification of the casualties. They held supervision at the salvage operations which were carried out by the fire brigade. They established a special identification centre at the airport.

Health Authorities, Ambulance Services, Trauma Team, Hospitals

The Central Ambulance Station co-ordinated the activities of the ambulance services. They had stationed a Communication Command Vehicle at the scene of the accident. The medical assistance was co-ordinated from this point. Many ambulance services, ambulance services from other regions, offered their assistance after they had heard the news of the crash on the radio or television. Also other people such as general practitioners, first aid volunteers, etc. offered assistance. This asked for a lot of co-ordination. The local hospitals and a special burns unit were warned by the alarm centre. The alarm centre used the ambulance assistance plan. The hospitals activated the emergency reception plans. A trauma team of the National Organization of Trauma Teams was warned. The ambulance personnel established an emergency injured unit near the place of the accident.

At 21.15 it was clear that there would not be many injured people; most of the ambulances were sent back to their post. Two ambulances were held on stand-by. The hospitals were also warned that there would not be many more injured people. The emergency plans of the hospitals were not necessary any more.

The head of the local health authorities was present at the Municipal Co-ordination Centre for advice and to report the medical news to the mayor. The health authorities had to prepare an aftercare plan for mental and psychological support to the victims and relatives.

Red Cross

Two medical teams and two SIGMA teams (rapid medical intervention teams) of the Red Cross were activated. The first SIGMA team was present at the accident scene at 19.30. This team examined the injured people and gave first aid in the emergency injury unit. The second SIGMA team was present at 20.31. At 22.15 the SIGMA teams went to the central emergency shelter. The injury unit was no longer necessary because there were not many injured people. The SIGMA teams and the medical teams gave assistance in the emergency shelter regarding mental support. They also gave assistance during the memorial service.

Specially selected persons of the medical teams of the Red Cross assisted the Disaster Identification Team of the police with the identification of the casualties. They had to wash and take care of the (parts of) bodies, which had to be identified.

Salvation Army

Approximately 600 volunteers and employees of the Salvation Army were present during the whole emergency response and aftercare phase. The Salvation Army gave mental support to victims and relatives of victims. They supplied coffee, soup, food, etc. to emergency response workers and to victims in the emergency shelter.

Municipal Co-ordination Centre

Most members of the Municipal Disaster staff were present at the Municipal Co-ordination Centre (in the City Hall) at approximately 20.00 hours. The following persons (or their representatives) were permanently present at the meetings of the Municipal Co-ordination Centre: the mayor, the chief of the police, the regional commander of the fire brigade, the head of the local health authorities, the head of Department of External Affairs and the head of the Department for Public Order and Safety. Heads of several municipal services were also present at the meetings if it became necessary. Minutes were drawn up of all meetings. A logbook of all activities of the Municipal Co-ordination Centre was made.

The Disaster staff visited the accident scene regularly. Besides the co-ordination of the activities regarding the emergency response the disaster staff had to deal with several other matters more or less related to the accident. In the first few hours after the accident, the Municipal Co-ordination Centre did not have much contact with the accident scene. At that time all operational decisions were taken at the accident scene. The disaster staff tried to get a complete picture of the scale and consequences of the disaster and started to organize the emergency response services. Later the disaster staff had more control of the matters. All information was given from the Municipal Co-ordination Centre.

A special committee was established which organized the memorial service. Several municipal services as well as other organizations representing the different nationalities of the victims took part in this committee.

District City Council

A few years ago the city of Amsterdam was divided into several city districts with their own councils. On the first day the task of the council regarding the emergency response was not very clear. Their task had not been described in the disaster plan. At first the council was not present in the Municipal Disaster staff. Later the council took over the organization and co-ordination of the central emergency shelter of the

police. They also took care of informing the public. This was done immediately after the accident as well as during a long time after the accident (when the emergency shelter had been disbanded).

National Co-ordination Centre

The National Co-ordination Centre at the Ministry for Home Affairs co-ordinated the activities of the Ministries of Transport and Public Works, Home Affairs, Foreign Affairs, Justice, and Welfare, Health and Cultural Affairs. They consulted the Municipal Disaster staff on matters concerning the shelter of victims and relatives of casualties. They also assisted with the international contacts.

Two experts of the Lockerbie disaster

The experts were asked for advice by the municipal disaster staff. They wanted an answer to the question about the possible number of casualties that were burnt and incinerated completely. The experts judged that at the most 10% of all casualties could have been completely incinerated. They also advised the disaster staff to remove the top layer of the ground where the aeroplane had crashed.

Municipal Department of External Affairs

The Municipal Department of External Affairs took care of the information given to the press and the public. All information was given by the information centre of the Municipal Co-ordination Centre. The Information centre also hired several translators. These translators were necessary in order to provide information to several foreign journalists. A special information telephone number was opened for information to questions of residents and relatives of the afflicted apartments.

Municipal Department of Public Order and Safety and the Department of Administrative Legal Affairs

The chief of the Municipal section of Public Order and Safety co-ordinated the activities of the Municipal Disaster staff. The chief informed new members of the disaster staff about their tasks. The section of General Administrative and Juridical Affairs took care of the organization and logistic affairs regarding the Municipal Co-ordination Centre.

Municipal departments

Several municipal services had to come into action in order to solve some of the particular problems related to the accident. The Municipal Department of Supervision on Building Construction had to control the two apartment buildings in order to check the safety of the buildings and to give permission to start the salvage operation. As many people were made homeless because of the accident crash, the Municipal Housing Department and the Municipal Social Services Department had to take care of these people. They had to provide new houses, give them financial support, etc. The Municipal Housing Department had up to 20 employees working on the effects of the plane crash. One of its offices was especially assigned for the victims of the plane crash. They worked closely together with the housing corporations. The Municipal Social Service Department was responsible for the material aid to the victims, they also played a role in the organization and assistance in the central emergency shelter. The Municipal Population Registration Office had to provide information on the number of residents, which information played an important role in the estimation of the number of deaths. When it appeared later that a significant number of illegal residents were victims of the accident, these illegals were offered the opportunity to register themselves. The victims were promised that they would be made legal. This caused a rush of illegals towards the registration office.

Association of insurance companies

The insurance companies worked together in dealing with the damage claims after the aeroplane crash. The Association of Insurance Companies provided uniform information to the victims. They were present in the emergency shelter where people could ask questions and could handle their claims.

Preparedness

The city had a disaster plan. The plan has been used to alert all municipal officials. There has been some confusion about the use of the disaster plan. The minister of Transport and Waterways stated only a few hours after the accident that the disaster plan worked satisfactorily. Weeks later the regional commander of the fire brigade stated that the disaster plan had never been used.

The regional commander of the fire brigade also stated that the staff of the fire brigade was not properly prepared. Therefore they had to improvise at some points. This had, however, no harmful effect on the functioning of the fire brigade and the emergency control.

The city of Amsterdam has the largest force of emergency response personnel who have to deal with extraordinary situations regularly. This means that they have a very well prepared emergency response network. A similar accident in smaller municipalities would have made the emergency response much more complicated.

The city of Amsterdam has a special emergency container with telephones, hot lines, communication equipment, etc. which can be transported to the accident scene. With this equipment the telephone network can be expanded.

The Council of the relevant city district was not familiar with the procedures of the disaster control plan. They did not know that a representative of their council had to be at the Municipal Co-ordination Centre.

Information for the public

- Very shortly after the crash, the news of the plane crash on the two apartment buildings was reported on television. Journalists were soon at the scene of the accident. In fact, there were so many journalists that from time to time they hindered the emergency response workers. Although the media were very important for the information supply, they also spread several rumours, which appeared to be not true. The news on the number of casualties differed in different media. There was also a message in which a call for blood donors was asked. There was, however, no request from the health authorities and it was not necessary. The call for blood donors caused a lot of extra work for the hospitals and the Central Ambulance Station;
- The accident received a lot of attention in the press. The first days after the crash the radio and television had continuous broadcasts about the accident;
- Several foreign journalists came to Amsterdam to report the accident. Some of these journalists did not speak any foreign languages. The Municipal Co-ordination Centre had to hire translators in order to provide these journalists with information. These foreign journalists could ask questions through the translators twice a day;
- All information given by the authorities was co-ordinated by the Municipal Co-ordination Centre. At the accident scene, information was also given but there they repeated the news of the Municipal Co-ordination Centre;

- Lists of the names of missing persons were distributed at the emergency shelter. The announcement of the status and the distribution of the lists had been prepared very carefully. The distribution did not result in very emotional scenes. After the distribution the list was shown on national television. The list had been made under high pressure, which resulted in some mistakes in the list;
- The first few hours after the accident the Municipal Co-ordination Centre had very little contact with the accident scene. The media then played an important role in informing the disaster staff. Later, communication between the Municipal Co-ordination Centre and the operational services at the accident scene, was possible through special channels;
- The police, fire brigade and ambulance alarm centre needed a special communication channel where these three services could communicate together. This was arranged by the Communication Command Vehicle of the fire brigade.

Perceptions

- The fact that the plane crashed on an apartment building where people from many different nationalities lived, of which some people stayed in the Netherlands illegally, caused some additional problems. Especially because there were illegals among the victims caused some additional problems regarding the registration of the missing persons and of all victims. The announcement made by the State Secretary of Justice and the police chief that all illegal victims would be legalized caused a lot of extra work and problems for the municipal services. These problems are not likely to appear at other accidents [1];
- The role of the District City Council was not made clear for the other organizations. This and the fact that they were not present in the disaster staff from the beginning had some negative effects on the co-operation between the council and the other organizations [1];
- The fact that the Municipal Service for Housing had no representative in the disaster staff caused some problems for this service [1];
- The division of the responsibilities of the several aspects related to the reception and shelter of the victims as well as the distinction between the day shelter and the night shelter and the distance between these two caused several control and co-ordination problems [1];
- The emergency response needs to be organized on a regional scale. The capacity of single cities, villages, etc. is too small for larger emergencies [14];
- Disaster plans should be made and used differently. The main lines and structures can be anticipated. Details, however, have to be filled in at the moment of the accident [14];
- Registration data on the (number of) residents of the apartments appeared to be incorrect [13];
- Although usually communication between services presents problems, there were no major communication problems in Amsterdam [14];
- The medical emergency plans of the Red Cross should give more attention to mental support, psychological assistance and handling traumas [7];
- The emergency reception plan of the Amsterdam Medical Centre (hospital) and of the hospital of the Amsterdam Free University worked satisfactorily [8];
- The volunteers of the Regional Voluntary Assistance Service of the fire brigade had more problems with handling the traumatic experiences they had suffered than the regular firemen. One of the reasons can be the lack of experience. Although the volunteers did an excellent job, the role of the Regional Voluntary Assistance Service should be reconsidered [3];
- The fire brigade had some criticism on the large number of representatives of every service in the Municipal Co-ordination Centre [3];
- The first evening after the plane crash the commander at the place of the accident was not well-informed about which services were informed and how many workers

- from every service were warned and present. Representatives of services were sometimes hard to recognize (especially those without a uniform) [3];
- The authority of the fire brigade in disaster circumstances is not fully recognized by other emergency response services [3];
 - The meeting room in the communication command vehicle is too small. The space should be expanded with a front extension (tent) or with extra containers [3];
 - The communication between several commanders at the accident scene was not always consistent; this sometimes resulted in differing orders [3];
 - The fire brigade did not have the capacity to keep up a logbook [3];
 - The ambulance assistance was arranged very quickly. This can be seen as a benefit from a large scale Central Ambulance Station [2];
 - The local health authorities were not officially informed about the 'Disaster Statement' of the mayor [2];
 - Many volunteers offered their support at the ambulance alarm centre. Although this support was overwhelming, it asked for extra co-ordination of the Central Ambulance Station. It was not possible to put these volunteers into action in a co-ordinated way, because of a lack of structure and means. The capabilities of the volunteers could not be checked either [2];
 - Communication between the communication command vehicles should be established by using field telephones [2];
 - Too many VIP's were visiting the accident scene and the Municipal co-ordination centre. This hindered the activities [1].
 - The District City Council was not aware that they had to go to the Municipal Co-ordination Centre. Representatives of the council could not be reached by the disaster staff [1].

Lessons Learned

- The municipal disaster staff worked with one team (not with a separate managerial team and an operational team, see section 3.3). This worked very well. The functioning of the disaster staff and the way the media was managed, can function as an example for staffs in the event of future disasters [1];
- Not only the (uniformed) emergency response services but also the other organizations which might be involved in emergency response after large-scale incidents should be prepared for their tasks. Their role and tasks should be made clear [1];
- The aftercare of victims should receive more attention in disaster plans [1];
- The operational personnel of the fire brigade was not familiar enough with the procedures of the (staff of the) fire brigade during large-scale operations. Additional exercises are necessary [3];
- The use of helicopters above the accident scene makes verbal communication impossible. These helicopters should therefore not be used any more [3];
- The emergency injury unit should be established by a SIGMA team. To prevent the injury unit from being in the open air, an inflatable tent could be used [2]. The ambulance alarm centre and the ambulance personnel should be better informed about the role the Trauma team and SIGMA teams can play [4];
- People who come spontaneously to the accident scene in order to help (such as general practitioners and first-aid volunteers) should be received somewhere outside the accident scene. Their availability should be regulated and co-ordinated from this point. They should be made recognizable by other emergency response workers [4]. A general rule in disaster medicine is: it is better to clear a disaster with a handful of experienced professionals than with an army of curious volunteers.

Actions

- To improve the communication between the several officials of the local health authorities, they took action to buy additional means of communication, including more telephone lines, a car telephone, a police radiotelephone and a notebook PC with the ambulance assistance plan and the Casualty Delivery Plan installed [2];
- The disaster plan of the local health authorities will be evaluated. The alarming of some important people of the local health authorities will be improved. An information specialist will also be alarmed. If possible, the Red Cross will also be alarmed by the Central Ambulance Station (they were now warned by the alarm centre of the fire brigade) [2];
- The volunteers of the Red Cross will be trained and better prepared for tasks concerning the reception and mental support of victims. A list will be made with specially selected volunteers who can assist with the identification activities of the Disaster Identification Team. Procedures for the mental support of the volunteers and evaluation will be developed [4];
- Research has been started in order to develop a method with which the need for ambulances and medical support can be predicted at an early stage of an accident. With this method, a balanced response of health services should be obtained. Such a balanced response is essential in order to keep the normal day-to-day health care as optimal as possible and to be prepared for other accidents or disasters.

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European Commission

**EUR 15563 – EC study - Lessons learnt from emergencies after accidents
in the Netherlands involving dangerous substances**

T. Wiersma, J. Heidebrink, P. Van Beek

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This report shows the results of the study performed for The Netherlands on “Lessons Learned From Emergencies After Accidents Involving Dangerous Substances”. Similar projects have been carried out in the United Kingdom, Germany and France and have been extended to cover all other EEC countries. The purpose of these projects is to analyse information and lessons learned from experience during and after emergencies in the EEC countries to encourage a common learning process. The accidents analysed are limited to accidents involving dangerous chemical substances. The analysis mainly focuses on emergency response activities. The cause of the accidents and preventive measures do not fall under the scope of the study. Relevant accidents have been selected by considering both fixed installations and transportation activities. An appendix analyses the Schiphol Airport accident, as the case study is capable to result in useful indications for a better preparation and response to emergencies in general.

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