INSTITUTE FOR SYSTEMS ENGINEERING
AND INFORMATICS

SER DIVISION

Support Activities for the Directorate-General 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

Lessons Learned from Emergencies after Accidents in the Federal Republic of Germany Involving Dangerous Substances

JOINT RESEARCH CENTRE

COMMISSION OF THE EUROPEAN COMMUNITIES

SP-I.91.23

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Edited by
G. Drogaris

Including the
"Study of site response to accidents in the Federal Republic of Germany"
G. Müller, A. Miles, E. Moch
Rheinish-Westfällischer TUV

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ABSTRACT

The Community Documentation Centre on Industrial Risk (CDCIR) with this publication continues the review of the national appraoches to emergency planning (see also the CDCIR publication on "Lessons learnt from emergencies after accidents in the United Kingdom involving dangerous substances", CDCIR ref. N°:625-UKb3-I.3, EUR 13322 EN (1990)).

This publication is based on a study performed by the Rheinisch-Westfälischer TÜV on "Off-site response to accidents in the Federal Republic of Germany". An overview of the emergency response organization in the FRG based mainly on presentations during Conferences on Emergency Planning for Industrial Hazards and on Communicating with the Public about Major Accident Hazards, organized by the CEC in Varese in 1987 and 1989, respectively, has also been included.

Preface

The Community Documentation Centre on Industrial Risk (CDCIR) with this publication continues the review of the national approaches to emergency planning (see also the CDCIR publication on "Lessons learnt from emergencies after accidents in the United Kingdom involving dangerous substances", CDCIR ref. N°: 625-UKb3-I.3, EUR 13322 EN (1990)).

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Similar studies have already been initiated (France) or are planned for other Member Countries and are going to be performed by various local contractors.

With reference to the TÜV study a copy of a blanc data collection form has been added. Only point 7 (description of accident/emergency/disaster) and point 10 (conclusions drawn) for the 12 accidents reviewed have been included in this publication.

The general conclusions drawn reinforce the need for:
a) a systematic collection of response reports, lest valuable information and experience might not get lost;
b) a structured dissemination of experience gained and lessons learnt from handling emergencies to all interested parties.

July 1991 G. Drogaris

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"Study of off-site response to accidents in the Federal Republic of Germany"

Rheinisch-Westfälischer TÜV, October 1990

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PART 1

OVERVIEW OF THE EMERGENCY RESPONSE ORGANIZATION FOR ACCIDENTS INVOLVING DANGEROUS CHEMICALS IN THE FEDERAL REPUBLIC OF GERMANY

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1. INTRODUCTION

The study of off-site response to accidents in the FRG, performed by the Rheinisch-Westfälischer TÜV, shows that no single detailed description of the emergency response organization in the FRG is possible; each state (Land) has its own legislation for this issue (see e.g. [21]). However, there are general guidelines at the federal government level, setting minimum requirements and defining the philosophy of the emergency response organization [1].

For a complete presentation of the study of off-site response to accidents in the FRG it was felt necessary to present an overview of the emergency response organization in this country. This review is mainly based on presentations during a Seminar on Emergency Planning for Industrial Hazards [25] and Conferences on Emergency Planning for Industrial Hazards [2] and on Communicating with the Public about Major Accident Hazards [3], organized by the CEC in Varese in 1987 and 1989, respectively, as well as during OECD Workshops. Consequently, the situation up to the middle of 1990 is reflected in the following.

The prevailing safety concept for handling dangerous substances in the FRG based on article 2 of the German Constitutional Law (Grund Gesetz) requires that such installations should not create according to the available knowledge any risk to the public [4,16]. The residual risk due to lack of knowledge has to be borne by the community as a general social weight (sozialadäquate Lasten) [16]. Consequently, whenever dangerous substances are employed, their substitution by innocuous or at least less harmful ones [1,5] is demanded. If this is impossible, a hazard analysis has to be performed according to the requirements of the Regulation of Major Industrial Accidents (Allgemeine Verwaltungsvorschrift zur Störfallverordnung - Regulation applying the SEVESO-Directive in the FRG). Based on this analysis a comprehensive, inte-

grated three-stage safety concept has to be developed which consists of [1]:

Stage 1: measures in the installation which assure the safe containment of dangerous substances and the prevention of inadmissible operating conditions;

Stage 2: measures designed to limit the effects of fire, explosion or release of chemicals which might occur as the result of a major accident;

Stage 3: measures taken off-site to protect the surroundings and limit the effects of harmful substances, heat radiation or consequences of an explosion on the objects to be protected.

The first two stages are the basic requirements for on-site emergency planning; the third one for off-site emergency planning. Density of installations handling hazardous substances in the FRG as shown in Figure 1 underlines the importance of off-site emergency planning for a substantial part of this country.

A brief presentation of available aids for on-site emergency planning and the evolution under the influence of the SEVESO-Directive of the general guidance for off-site emergency planning and for risk communication to the public will be briefly presented. A few considerations will be included on the important aspects of interphase between on-iste and off-site emergency plans and of exercises and auditing of emergency plans.

2. ON-SITE SAFETY PRECAUTIONS

On-site safety precautions have to be designed to prevent major accidents to occur or, if they do occur, to mitigate their consequences. Basic requirements for safety precautions are included in [1]:

- state regulations, e.g. the Commercial Activity Act (Gewerbeordnung) and the regulations issued under it, the Federal Emission Control Act and its Regulation, the Chemical Act, the Dangerous Machinery Act, etc.;
- guidelines made by the employer's liability insurance associations (accident prevention stipulations);
- trade associations (e.g. DIN, Vdt, VDI, VDE) guidelines;
- internal company regulations and guidelines.

Major chemical companies had Hazard Protection Plans (on-site emergency plans) drawn up even before application of the Regulation on Major Industrial Accidents [6]. According to the requirements of this regulation, new Hazard Protention Plans that have to be drawn up or existing ones that have to be adjusted, must cover all potential on-site hazards (e.g. fire, explosion, accident) and off-site hazards (e.g. malfunctions in neighbouring plants, collisions) must name on-site safety facilities and must specify special behavioural measures for the plant staff in the event of an emergency [6,15].
Hazard minimization by proper design, instrumentation and control systems, maintenance and training of the personnel are the principal requirements of the Regulation of Major Industrial Accidents [15,16]. However, plans have also to be made for mitigation of the consequences of accidents especially if the potential of a public hazard (hazard for the life or the health of persons outside the establishment or material, social or environmental damage outside the establishment) exists.

The Hazard Protection Plan should normally have a dual function:

a) enable senior staff of the plant to react promptly in the event of an emergency;
b) be used for plant staff training and drills.

Ideally, the Hazard Protection Plan should be drawn up by the person responsible for the plant in cooperation with the Fire Protection and Occupational Safety departments and must be updated whenever necessary. A typical Hazard Protection Plan consists of two parts [6]: an organizational section (giving a list of actions describing the behaviour to be adopted in the event of emergencies) and an informa-

tional one (giving an overview of the plant - process description, block flow diagrams, building plans -, the associated hazards - hazardous substances, hazardous areas, sources of hazards - and the safety equipment and systems). Big complexes may have various Hazard Protection Plans for various installations in the same site; then an overall Hazard Protection Plan of the works is required for coordinating notification/alarming process and decisions/actions affecting several managerial areas.

It is recognized by the industry that properly drawing up plans enhances plant safety [6].

Plant operators are also involved in emergency planning since the plant committees (Betriebsräte) should endorse the on-site emergency and alarm plans [18].

Furthermore, the safety reports shall be made available on request and accident notification shall be communicated without any delay to them [18].

3. OFF-SITE SAFETY PRECAUTIONS

Location of the industry and keeping of separation zones between industrial and residential areas are essential steps for off-site safety [1,7]. Further emergency plans specifying alarm paths and behaviour instructions have to be developed [1]. The importance of careful on-site and off-site emergency plans and a clear definition of responsibilities in the case of emergency is underlined in the general guidelines.

Originally, emergency response and contingency plans were based on lessons learnt from previous events, which were mainly natural disasters (floods, large fires, avalanches, earthquakes, etc.) [8]. These plans were mainly aiming to provide aid for combating disasters, rescue and care of the population and selection and training of suitable rescue personnel. The same process has been also initially followed for industrial accidents, i.e. updating emergency plans according to aftermath of serious accidents. Specific disaster management planning was first undertaken to cover radiation hazards with the introduction of nuclear power. Major accidents in the chemical industry, in conjunction with the fact that process industry is rather developed in the high population density FRG, led the Federal Office for the Environment in Berlin in 1981 to have a study performed by the Rheinisch-Westfälischer TÜV. Interviews of plants, authorities and competent associations and literature review were used to evaluate [8,17]:

- structure and content of disaster response plans;
- characterisation of hazard potential;
- cooperation between plant operators and authorities;
- organisations involved, equipment and aids available;
- section strategies (situation evaluation, public alerting, traffic control, evacuation, assistance);
- instructions and decision-making aids to emergency planners and disaster services;.

The legal framework for off-site emergency planning and response is based on [8,20]:

a) the Disaster Response Act (Katastrophenschutz-Gesetz) and the associated regulation on a federal and state (Länder) level;
b) the Federal Anti-Pollution Act;
c) the Incidents Ordinance (12th BIm SchV) and the Regulations on Major Industrial Accidents.

This legal framework offers a substantial prerequisite for an effective emergency planning; however, the development of specific emergency plans is highly influenced by the persons involved in it and the local peculiarities (especially organisational level and availability of equipment). Using the general principles of emergency planning, specific emergency plans have to be developed taking into account the characteristics of the hazard sources, the vulnerability of the objects to be protected, the population density and distribution, traffic routes and infrastructure, orographic and prevailing meteorological conditions. Specific emergency plans can be developed based on the dynamic prinicple (only general preplanning relying on a high flexibility and the capacity of decision making of the emergency management centres) or on a very detailed preplanning or any variation in between these two extremes [17].

Guidelines for a uniform emergency planning were also developed in this study. Efficient specific emergency plans must be [17]:

a) simple and clear;
b) unambiguous;
c) complete (not necessarily foreseeing all details but keeping the balance between giving adequate information on all potential implications and leaving adequate flexibility for facing unforeseen developments).

Emergency plans shall be drawn [17,19]:

a) considering the organisational level, the alerting and intervention capabilities, availability of equipment and rescue/intervention personnel;
b) trying to achieve a good cooperation between authorities and manufacturers (exchange of information, alerting, mutual assistance);
c) analysing the hazards of accidents and their potential consequences;
d) establishing necessary intervention means and actions (alerting of intervention teams, estimation and verification of consequences, risk communication to the public, alternative plans for traffic, public protection, medical treatment, evacuation, etc.).

In general, emergency plans should be applicale for accidents in fixed installations and transportation of dangerous substances [17].
Emergency plans must adequately cover all phases of an accident development such as [20]:

a) the quick identification of the endangered area;
b) warning of public and closure of the endangered area;
c) verification of the extent of consequences of the accident;
d) care for injured persons;
e) evacuation (if necessary - see also point 4 below);
f) decontamination/cleaning of the affected area.

Disaster Response Acts contain also examples of contents of emergency plans [21].

In some states (Länder) such as, for example, in Baden-Württemberg, the industry bears at least partially the cost of equipment and works necessary for implementation of emergency plans [19].

4. EXAMPLE OF SPECIFIC OFF-SITE EMERGENCY PLANT (Störfallverordnung)

On this basis local Fire Brigade, Rescue Services and Civil Defence drew up emergency plans for each administrative district [6]. As an example, the specimen plan that has been introduced by the President of the Cologne regional administration as a guideline for drawing up Emergency Plans for this administrative district is briefly described hereafter [6]:
The Emergency Plans are kept by the competent distric disaster prevention authority (e.g. Town Clerk, District Clerk) and contain information required for implementing measures to protect the public in the event of a catastrophe. Emergency Plans are only intended for use in conjunction with the general disaster protection plan of the authorities and the alarm plan of the operator. The Emergency Plans are updated annually by the district disaster prevention authority.

The Emergency Plan is compiled in the form of checklists and consists of five sections:
1) Description of the object.
2) Reporting and alarm-raising paths.
3) Immediate actions in the event of an emergency:
   - 3.1 establishing the type of hazard
   - 3.2 establishing the endangered area
   - 3.3 measuring the gas concentration
   - 3.4 warning and informing the public.
4) Follow-up actions.
5) Appendices.

These items cover the essential elements of what is known as the Leverkusen Model. Nearly 25% of the total German production of chemical substances is located in the industrial region of Cologne [9,13,20]. Preventive evacuation of large areas has to be carefully studied and planned because of the difficulties in implementation (requirements in transportation means and personnel, settling down of evacuated, etc.) [8,9].
The DIN data sheets (DIN 52900 - given in Attachment 1) that have to be filled in by the manufacturers have been very helpful for the authorities in evaluating dangers caused by substances and preparations as well as in the choice of preventive measures.

5. MAJOR ACCIDENT NOTIFICATION

Manufacturers are obliged to alert the authorities in the case of major accidents by the Law of Fire Protection, the Law on Contingency Planning and the Regulation on Major Accidents [9]. There are also regulations at state level defining accident notification oblications and the content of the notification (see e.g. [22] for North Rhenania Westphalia). Installations falling under the SEVESO-Directive require a uniform incident notification system by means of the standard form shown in Attachment 2. In part D of this form, manufacturers are required to classify the abnormal event. According to this classification, actions are to be taken and various groups (see Attachment 3 for the definition of these groups) are to be alerted as follows [9,20]:

Step 1: Signifies an internal irregularity, for example a minor release of toxic gas, a small fire or a failure in the control system which causes an abnormal situation.
Action: The firefighting forces, the police and the local authorities are alarmed. No alert is given to the public and no measures are to be taken off-site.

Step 2: Signifies an internal danger with the possibility of a threat to the internal staff, but not for the public or the environment. Examples are a runaway reaction, overheating of a pressure vessel or a small release of toxic substances.
Action: Besides the fire brigades and the police on duty, the heads of their regional offices are informed and go into a stand-by position (silent alarm). In the case of disturbing signals from the site, e.g. a fume column, smell, noise from explosions, but no real danger occurs, the public would be informed.

Step 3: Is announced if the danger spreads off-site. An impact of the public or the environment is likely. Examples are the release of a toxic cloud which leaves the limits of the installation, or a major fire which spreads toxic fumes throughout the neighbourhood.
Action: Additional alarm groups (groups III-V, referring to Attachment 3) are informed and go into a stand-by position. The Emergency Operation Centre (EOC) and the Technical Field Headquarters (TFH), which are uniformly organized under the German Law on Contingency Planning, are activated to a stand-by posi-

tion. Some public emergency forces take action in response to the accident. The common public is informed by radio; the public which is directly endangered is instructed by radio and patrol cars with loudspeakers.

Step 4: Is the catastrophic level. The accident is no longer controlled by the on-site forces; there is a severe danger for the public or the environment.

Action: The accident is classified as a disaster. The EOC and TFH is fully operable and takes over the guidance of all response forces. All groups, including group VI and VII if necessary, are alarmed. The informing of the public takes place with standardized radio messages in a broad manner. Directly affected people are also instructed through patrol cars with loudspeakers.

If appropriate, an evacuation is preplanned for each particular site. The decision to evacuate or not is supported by a decision flowsheet [9,10].

The system has run in the centres of the chemical industry in the FRG for over ten years. It works sufficiently well. The main problem in the start-off phase was the organization of reliable information channels between the operator and the fire brigades. In the industrial region of Cologne there are uniform treaties between the Cologne Fire Department and all hazardous installations of the Seveso-type. Within these treaties, the above-mentioned notification system is fixed and direct telephone lines to the central fireguard are switched on [9]. Combination of serens, radio and patrol cars with loudspeakers is used to inform and alert the public [20]. Serens neither do identify the source of hazard nor the area affected and create an extensive wave of telephone calls to police and firebrigade which can block telephone lines. On the other hand, serens are very useful during night for waking up the public, who then should look for more precise instructions through the radio. Patrol cars with loudspeakers are effective both for waking up and giving precise instructions to the public.

6. RISK COMMUNICATION TO THE PUBLIC

An effective implementation of emergency plans requires that the public that might be affected in the case of a major accident is informed on the nature of the danger and the proper behaviour according to the requirements of article 8 of the SEVESO-Directive (as has been modified after the 2nd amendment of this Directive). Especially in the FRG after the catastrophic accidents in Bhopal, Tschernobyl and Sandoz, there is an increased pressure from the public for getting more information on the various major accident hazards and the emergency plans [24].

In the FRG the public is supposed to be informed already before licensing for operation is granted to an installation. According to the Federal Immission Control Act the manufacturer is obliged to present to the local authorities a number of documents (see Attachment 4) [11]. The application is made known to the public by the local authorities through announcement in its official journal and in daily newspapers. Any citizen has the right to review all the documents required for the application for licensing except those concerning business or trade secrets.

If judicial remedies are exhausted it may take years until a final decision on an application is taken. Hence, the operators deplore this fact as a barrier to investment [11]. The authorities receive on the average every three to five years notification due to modifications of installations or processing materials; consequently, the latest information on the actual hazard potential is made available to the public every three to five years.

Modification of the regulations implementing the SEVESO-Directive in the FRG in order to include the requirements of risk communication to the public, as has been set out in article 8 of the Directive after its second amendment, was planned for 1990. Some manufacturers expressed reservations considering that communication to the public of potential dangers from installations could be taken as contradictory to the requirement of the Federal Immission Control Act according to which licensing is granted to an installation provided that it creates no danger to the public [12].

Before 1990, local authorities within the framework of off-site emergency response preparedness distributed to the public leaflets with

instructions for the proper behaviour in the case of an emergency. An example of such a leaflet and the accompanying letter, both translated in English, is given as Attachment 5 |111|. A copy of the original leaflet, distributed in the area of the city of Cologne, is also given as Attachment 6. The states (Länder) would prefer that the manufacturers themselves fulfil the obligation to inform the public on potential dangers in consultation with the responsible authorities |111|.

7. EMERGENCY PLAN EXERCISES AND AUDITING [13]

Should an emergency escalate to step 3 or 4 (see paragraph 5) and the units of the Disaster Prevention Service must be alerted or brought in, an Emergency Operation Centre is created (EOC or Katastrophenschutzleitung - KSL). This operation staff group consists of officers of the professional fire brigade together with the directors of various city offices such as the Health Office or the Press Office. It also includes members of state agencies such as the police and military services and (if necessary) members of private companies. Depending on the situation at the site of the emergency, one or several Technical Field Headquarters (TFH or Technische Einsatzleitung - TEL) are established. They consist of an officer of the professional fire brigade together with a small operation staff and they direct the units that have been put under their command.

In order to assess the effectiveness of emergency plans, every city has to perform exercises mostly in cooperation with the industry, which also covers partially the cost of such exercises [19]; in the state (Land) of North-Rhine-Westphalia they must carry out a disaster prevention exercise at least twice a year. These exercises must be directed to specific local risk factors, should enable a realistic simulation of a disaster and also the testing of disaster prevention measures. They should include the following procedures:

1) notification of the management and units of the Disaster Prevention Service and other agencies;
2) communication between the EOCs, the subordinate TFHs, the supervisory authority and other state agencies and (if necessary) private companies;
3) situation assessment and decision making by the operation staff;
4) the execution of measures such as warning, evacuating and assisting large numbers of injured people.

Three types of exercise can be performed depending on the specific aim:

- alarm exercise;
- staff exercise;
- complete exercise.

Any combination of these exercise types is also possible. The alarm exercise is intended for verifying the time interval between alarming and the "ready for action" state. A staff exercise is only performed by the operation staff while the units at the disaster scene are simu-

lated. During a complete exercise the EOCs, TFHs and all units perform the exercise in a simulated emergency situation.
Staff exercises are most frequently performed. Alarm exercises for the 4500 assistants of the Disaster Prevention Service in Cologne only take place once every 3 years. Complete exercises are only performed approximately once every 5 years due to the extensive preparations necessary.

The main conclusions of the exercises carried out that are also supported by the experience gained from accidents [14] are:

- The notification of leading staff memebers and units of the Disaster Prevention Service must be done by sirens or by using a collect call for radio receivers; alarm by telephone requires too much time and is less effective.
- Plans must also be made for employing units with only 50% of their personnel.
- Radio communications networks are often overloaded or even jammed during the early stages of an emergency. They are also frequently used by reporters. Mobile telephones or use of private telephone lines with secret telephone numbers so that they cannot be blocked by calls from the public are necessary for EOCs and TFHs.
- Since TFHs are overloaded, especially during the early stages of an emergency, it may take 45 minutes or more before EOC receives a first detailed report. Therefore, EOC should have their own scouts that can report from the scene of the emergency. Direct video camera transmission, even from a helicopter, into the control centre has proven to be very efficient.
- Management groups can only work efficiently if they are kept as small as possible. The positions and tasks within the group must be defined beforehand to allow for proper preparation and practicing. Every position must be occupied by two persons to enable shift work during longer duration emergencies.
- Good cooperation within management groups and between management groups and private chemical companies is essential. Exchange of staff members with members of the factory management as liaison officers has proven to be very effective.
- Chemical companies are very cooperative in exercises simulating transport accidents inside or in the direct vicinity of the factory area, but reluctant to simulate an accident in a production or storage area.
- Special attention has to be paid to factories located on the boundary between neighbouring cities since, in addition, coordina-

tion and cooperation of the management groups is required. Single planning and protection responsibility of the city where the larger potential is located is the preferred alternative. Tasks, information exchange and responsibilities must be defined precisely in advance.

- Use of loudspeaker-equipped vehicles for alerting the public has extensively been tested in the Cologne area and the results have been used as a basis for planning. Eighty-four fire brigade vehicles, which are either permanently occupied or which can be employed immediately, were equipped with loudspeakers, cassette tape decks and prerecorded cassette tapes. However, the success of a combined alarm using sirens, radio broadcoast and loudspeaker vehicles is not known as this combination has not yet been tested. Such an exercise would require a large amount of participation from the general public.

8. CONCLUSION

Emergency planning in the FRG is based on the experience gained from accidents. Regular exercises and close cooperation with chemical companies are used to improve the emergency response preparedness, especially in centres with a high concentration of industrial activities. In rural areas, however, emergency plans may be still inadequate and disaster control teams may be ill-equipped and inadequately trained [11].

There are several problems of legal and technical nature which can be observed in practice regarding emergency plans [11] and more work is required to provide frank and comprehensive information to the public on potential dangers [1,11,12].

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24. W.R. Dombrowsky, "Gefahrenplanung und Öffentlichkeit", in: Theorie und Praxis der Gefahrenabwehrplanung bei gefährlichen Industrieanlagen nach der Störfall-Verordnung, Umweltsbundesamt, Texte 15/88, Berlin (1987).
25. "Theorie und Praxis der Gefahrenabwehrplanung bei gefährlichen Industrieanlagen nach der Störfall-Verordnung", Seminar in Berlin, 26-27 Oktober 1987, Umweltbundesamt Texte 15/88, Berlin (1987).

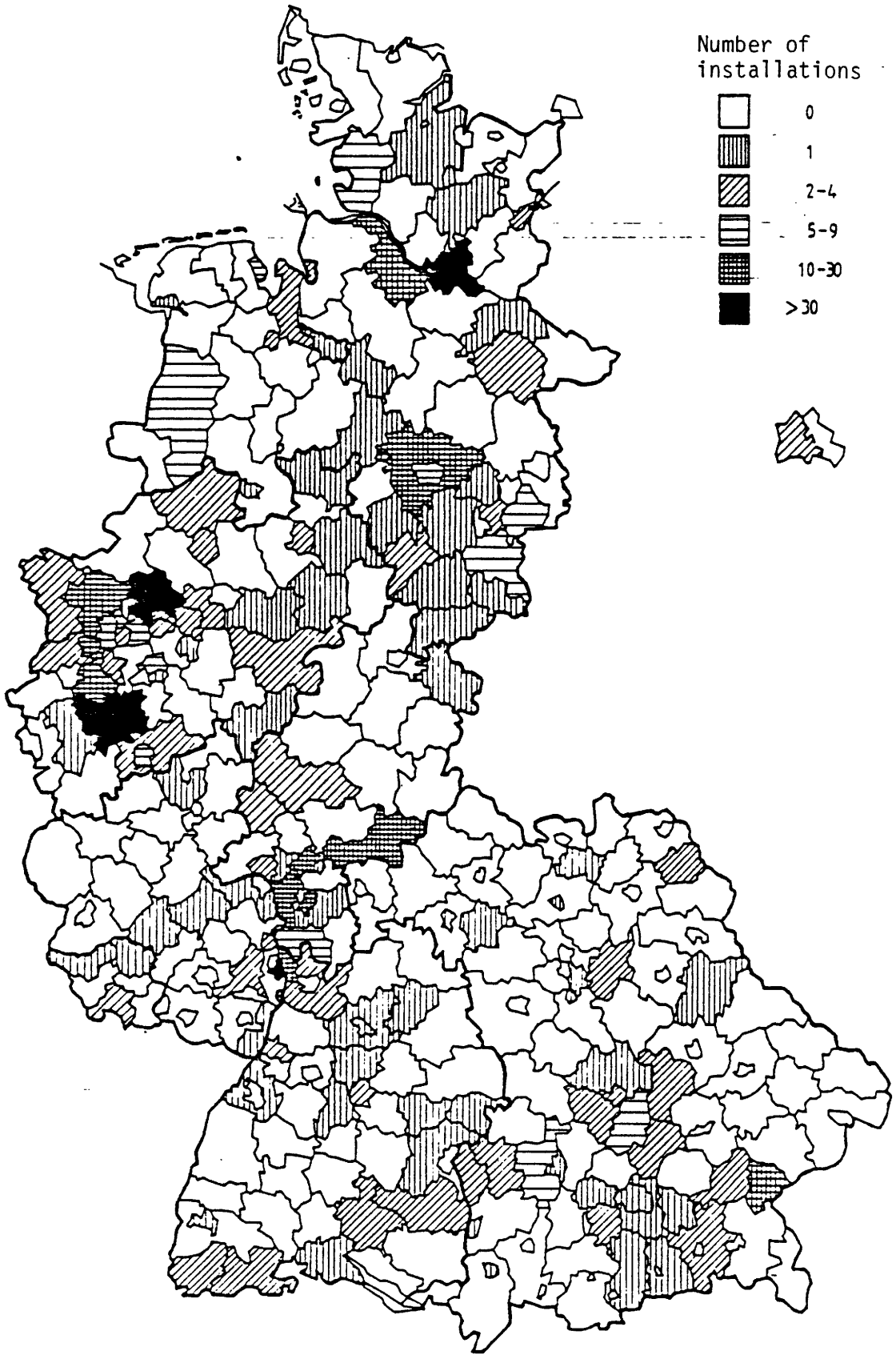


Fig.1: Density of installations covered by the requirements of the SEVESO-Directive (82/501/EEC) in the FRG in 1987. Sources [9,23].

ATTACHMENT 1

Date:

DIN safety data sheet

Division:				
Commercial product name:				
1.1	Chemical characterization:			
1.2	Form:	1.3	Colour:	1.4 Odour:
2.	**Physical data and safety data**			Tested in accordance with:
2.1	Change in physical state			°C °C
2.2	Density	(°C)		g/cm^3
	Bulk density			kg/m
2.3	Vapour pressure	(°C)		mbar
		(°C)		mbar
2.4	Viscosity	(°C)		
2.5	Solubility in water	(°C)		g/l
	in	(°C)		g/l
2.6	pH value (at g/l H_2O)	(°C)		
2.7	Flash point			°C
2.8	Ignition temperature			°C
2.9	Explosion limits	Lower:	Upper:	
2.10	Thermal decomposition			
2.11	Hazardous decomposition products			
2.12	Hazardous reactions			
2.13	Further information			
3.	**Transport**	GGVSee/IMDG code:	UN No.:	ICAO/IATA-DGR:
		GGVE/GGVS:	RID/ADR:	ADNR:
		Other information:		
4.	**Regulations**			

Commercial product name

5. Protective measures, storage and handling

5.1 Technical protective measures

5.2 Personal protective equipment — Respiratory protection: — Eye protection: — Hand Protection: — Other:

5.3 Industrial hygiene

5.4 Protection against fire and explosion

5.5 Disposal

6. Measures in case of accidents and fires

6.1 After spillage/leakage/gas leakage

6.2 Extinguishing media Suitable:

Not to be used:

6.3 First aid

6.4 Further information

7. Information on toxicity

8. Information on ecological effects

9. Further information

ATTACHMENT 2 (Source [9,10])

PRELIMINARY NOTIFICATION OF A MAJOR ACCIDENT

Installation:
Substance:
Amount:

Date:
Time:

Wind:
- direction:
- speed:

Office of reception:
Message received at:

A Classification

1. On-site
2. Off-site

B Character

1. leakage
2. runaway reaction
3. fire
4. explosion

C Effect off-site

1. Smell molestation
   - 1.1 not excluded
   - 1.2 expected
   - 1.3 no longer expected
2. Danger for life and health through gas clouds
   - 2.1 not excluded
   - 2.2 expected
   - 2.3 not expected
3. Danger of an explosion
   - 3.1 not excluded
   - 3.2 expected
   - 3.3 not expected
   - 3.4 no longer expected

D Notification - expected reactions

1. Preliminary notification - no reactions necessary
2. Notification - reactions not expected
3. Notification - reactions necessary
4. Notification - full reactions necessary

ATTACHMENT 3 (Source [9,10])

Different groups to be alarmed in a major accident

PROFESSIONAL GROUPS	SPECIAL GROUPS
Group I - authorities - public services - private fire brigades	Group IV - operator of hazardous installations
Group II - rescue forces - medical services - water/electricity supply	Group V - persons or facilities which need special protection

VOLUNTEER GROUPS
Group III - transport enterprises - civil engineering enterprises etc.
Group VI - scientists - engineers - experts
Group VII - information services

ATTACHMENT 4

Documents which shall be presented and published
(extract from the Fourth Ordinance Implementing the Federal Immission Control Act) Source [111].

Art.4 Type and amount of documents

(1) The application shall be supplemented by documents which are required in order to examine the prerequisites to the licencing procedure.

(2) The documents shall contain information on

1. engineering facilities which are necessary for the operation of the installation as well as auxiliary facilities which - due to operational requirements - have to be established and operated in the vicinity,
2. the planned process including necessary data on the identification of the process as well as information of the kind and amount of
   - substances used,
   - intermediate products, by-products and final products,
   - waste substances produced,
3. perceivable secondary reactions and by-products caused by problems in the course of the process,
4. type and extent of emissions which will probably be caused by the installation; type, position and size of emission sources; distribution of emissions over space and time; as well as conditions at the outlets,
5. planned measures on the protection against harmful effects on the environment, especially measures for the reduction of emissions as well as measurements on emissions and immissions,
6. planned measures for the protection of the general public and immediate neighbours against other dangers, considerable disadvantages and considerable nuisance,
7. planned measures in order to reuse residual substances or to dispose waste,
8. planned measures in the field of occupational safety and health.

(2a) Installations which are subject to the Hazardous Incident Ordinance and which are listed in Annex I to the Hazardous Incident Ordinance shall require a safety analysis which meets the requirements of Article 7 of the Hazardous Incident Ordinance. Sentence 1 shall not apply if the licencing authority promises the applicant in writing that the applicant shall be partially or totally discharged from his obligations pursuant to Articles 7 and 9 of the Hazardous Incident Ordinance in accordance with the licence granted pursuant to Article 10 of the Hazardous Incident Ordinance.

(3) In addition to the documents presented in accordance with paragraph 1 the applicant shall present a clear and short description of the layout of the installation and perceivable effects on the general public and the neighbourhood. He shall also present a list of the documents included in the application which marks those documents that include business or trade secrets.

ATTACHMENT 5

Information to the Public (Source III)

EMERGENCY
Emergency

Dear Citizens,

You are living in a city with chemical industry which means that you have to be prepared for incidents in your immediate neighbourhood. In such a case you have to bear in mind certain rules of behaviour and certain measurs to protect yourself. Please keep this leaflet for an emergency in an easily accessible spot.

The Lord Mayor

EMERGENCY EMERGENCY EMERGENCY
EMERGENCY EMERGENCY EMERGENCY

If you hear about an incident in a chemical plant or about an accident with chemical products in your neighbourhood which has an effect on the environment, please, bear in mind the following rules. You will thus help to improve your personal protection and assistance provided for the entire community.

siren	When you hear the siren (howling sound for 1 minute) turn on your radio (Südwestfunk I, II or III, or ARD late-night programme).
loudspeakers	Listen to the announcements made by the fire brigade or the police.
neighbours	Inform your immediae neighbours.
windows	Close windows and doors.
air-conditioning	Shut off your air-conditioning and ventilation systems.
rooms	If possible stay in rooms at the upper floors which are not adjacent to outside walls.
outside	Do not stay outside.
doctor	In case of health problems contact your family doctor or doctors on emergency duty.
site of accident	Do not approach the site of the accident and keep streets and roads free for fire brigades, police, etc.
police	Follow the instructions given by the police.
telephone	Do not block telephone lines to the fire brigade, the police and rescue services asking for information. Call only if your special situation (fire, accident) necessitates their help.
"all clear"	Listen to the "all clear" announcements made over the radio or by the fire brigade or the police.

Published by the office for public relations of the city of Ludwigshafen.

ATTACHMENT 6

DIE STADT KÖLN INFORMIERT

Verhalten bei

Katastrophen

Gaswarnung

Chemie-Unfällen

Wichtige Informationen für Ihre Sicherheit –

bitte aufmerksam lesen und aufbewahren

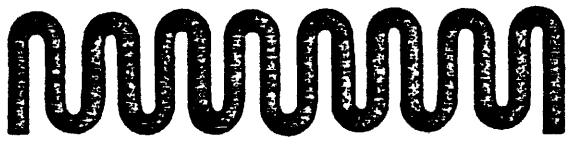
Wie werden Sie unterrichtet?

Bei Katastrophen, größeren Unglücksfällen und Terroranschlägen werden Sie durch geeignete Maßnahmen alarmiert, wie z. B.

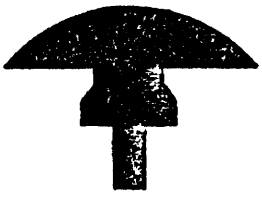
- **Bekanntmachungen in Rundfunk und Fernsehen**
- **durch die im Stadtgebiet installierten Sirenen**
- **durch Lautsprecherdurchsagen der Feuerwehr oder Polizei**

Wesentlich für alle Bürger ist es, die Bedeutung der verschiedenen Sirenensignale zu kennen!

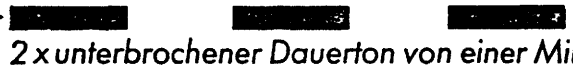
Sirenensignale im Frieden:



1 Minute Heulton

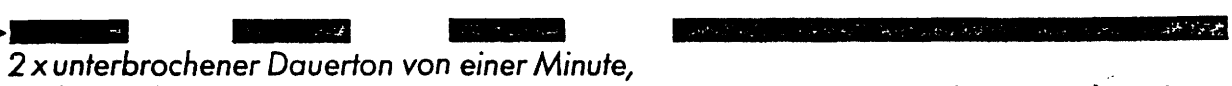


Rundfunkgerät einschalten – auf Durchsagen achten



2 x unterbrochener Dauerton von einer Minute

Feueralarm



2 x unterbrochener Dauerton von einer Minute, nach 12 Sek. Dauerton von einer Minute

Katastrophenalarm

Wenn Sie selbst ein Schadensereignis melden, nennen Sie

- **Ort des Ereignisses**
  (Straße, Hausnummer, Stadtteil)
- **Ereignis**
  (welche Personen oder Sachen sind betroffen, Ausmaß, Ursachen)
- **Ihren Namen**

Wichtige Telefonnummern in Köln:

Feuerwehrruf	112
Rettungsdienste	112
Notarzt	112
Rettungshubschrauber	112 oder 24 24 24
Polizei-Notruf	110

Stadtverwaltung (Information)	221 – 1
Hausarzt	.....
Krankenhaus	.....
Apotheke	.....

Allgemeine Verhaltensregeln

- **Bleiben Sie zu Hause oder am Arbeitsplatz,** und achten Sie auf Lautsprecherdurchsagen von Feuerwehr und Polizei und Rundfunkdurchsagen.
- **Kinder sofort in's Haus rufen!** Dann sind sie unter Aufsicht und können nicht durch Unwissenheit falsch reagieren.
- **Helfen Sie älteren oder behinderten Nachbarn und Straßenpassanten!**
- **Vermeiden Sie, daß die Einsatzkräfte bei Bränden und Unglücksfällen durch Schaulustige behindert werden!**
  Polizei, Feuerwehr und Hilfsorganisationen sind auf freie Straßen angewiesen. Wenn Sie nicht selbst helfen können, bleiben Sie dem Schadensort fern, und blockieren Sie keine Verkehrswege!
- **Telefonleitungen nicht blockieren!**
  Feuerwehr, Polizei und betroffene Unternehmen benötigen jede Telefonleitung zum Einleiten von Hilfs- und Rettungsmaßnahmen; deshalb dort nur im Notfall anrufen!
- **Auch wenn Sie nicht unmittelbar betroffen sind,** können Sie durch Ihr besonnenes Verhalten wirkungsvoll zu einer schnelleren Gefahrenabwehr und Schadensbeseitigung beitragen!

Besondere Verhaltensregeln bei Gaswarnung oder Chemieunglücken

- **Den besten Schutz finden Sie in einem geschlossenen Gebäude!**
  Fenster und Türen schließen, Klimaanlagen abschalten!
  So können Gase ausgeschlossen bleiben und nicht ungehindert in die Wohnung gelangen.
- **Obere Stockwerke aufsuchen!**
  Viele Gase sind schwerer als Luft.
  Deshalb sind höher gelegene Räume im allgemeinen sicherer!
- **Nasse Tücher bereitlegen!**
  Vor Mund und Nase gehalten, können Sie Beeinträchtigungen der Atmung vermindern!
- **Lautsprecherdurchsagen beachten!**
  Feuerwehr und Polizei informieren Sie über erforderliche Verhaltensregeln durch Lautsprecherwagen!
- **Radio einschalten!**
  Meldungen über den Störfall, Verhaltensregeln und Entwarnung werden, soweit notwendig, auch über die regionalen Sender bekanntgegeben!

PART 2

Study of off-site Response to Accidents in the Federal Republic of Gemany

Ordered by the European Atomic Energy Community (Euratom)

Contract no. 3479-88-10 ED ISP D

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Vice President and Chief Technical Officer Dr.-Ing. Siegfried Wiesner

October 1990

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*Note: Only pages 7 (descriptions of accident/emergency/disaster) and 10 (conclusions drawn) are herewith presented.

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1.1 Introduction

The Council Directive of the European Communities of 24 June 1982 on the major-accident hazards of certain industrial activities (82/501/EEC) also known under the designation "Seveso-Directive" obliges the states of the European Community to take precautions

- to prevent major accidents
- to cope with large-scale emergencies
- to provide the means for limiting the consequences of major accidents and finally
- to mitigate an impact on the public.

This obligation is expressed in article 7, No 1 with the words:

The Member States shall set up or appoint the competent authority or authorities who, account being taken of the responsibility of the manufacturer, are responsible for:

- ensuring that an emergency plan is drawn up for action outside the establishment in respect of whose industrial activity notification has been given.
- ... to provide the means for limiting the consequences thereof.

The establishment of an emergency plan demands a wide range of

- laws, regulations and instructions
- clear organizational frameworks to build up a functioning management system and to link up all response groups in a suitable way
- knowledge of appropriate equipment and means
- various experts in the fields of:
  - organization
  - fire-fighting
  - rescue operations
  - medical care
  - communication systems
  - chemistry

- police matters

and so on.

An indispensible tool however, when emergency response plans are to be established, is experience gained with former accidents. Up to now a variety of publications have appeared on the subject of major accidents [1, 2, 3, 4]. These normally present the facts of what happened in a lucid and brief way. But there is throughout a gap in the details given of the countermeasures. It is precisely these, however, which are decisive points of interest when setting up an emergency response plan as well as when a major accident has occurred. The above mentioned tool can be characterized by the term:

"exchange of experience".

There is a real need to list and classify those measures and countermeasures which had to be taken by the authorities and the response groups to cope with specific hazardous situations.

With this in mind, initially 12 cases which occured in the FRG are to be looked at as a first step to closing the gap of information which is urgently needed by organizers of response planning as well as by responders. Living without risks is simply not possible, but good and comprehensive information can support responders in their decision-making in the field of disaster relief an in mitigating and limiting the consequences of hazards.

This study is intended to fill the gap and to promote the exchange of experience particularly with respect to questions such as:

- which dangerous substances have caused a major accident / hazardous situation ?
- which types of impact have arisen off-site ?
- in which way was emergency / accident response prepared ?
- what types of organizations have been assigned ?
- how many men where assigned ?
- what was the personal protective clothing ?
- which vehicles, means, equipment, agents were applied?
- what was the time sequence for the assignment of the response groups ?
- how was the public informed ?
- what lessons can be learned by the specific case ?

1.2 Statutory Bodies involved

To perform this study it was necessary to contact a large number of authorities responsible for questions of disaster response or directly involved in response measures. To achieve acceptance and to avoid problems with local authorities we started by making contact with high-level statutory bodies such as:

- Federal Agency for Civil Defence
- State Ministries of the Interior
- District Governments
- German Association of Fire Brigades.

While working on the different cases we built up personal contacts with the respective statutory bodies at the place of the event. These were:

- Major Disaster Protection Authorities
- Police Headquarters
- Municipal Fire Brigades
- Voluntary Fire Brigades (outside larger towns)
- Work Fire Brigades.

The latter are also statutory bodies. This is based on the acts of the different states in the FRG governing fire brigades, fire protection, disaster response and special services [5]. Under these acts work fire brigades are entitled to perform their tasks with the powers of authorities.

1.3 Sources of Information

Information on major accidents or imminent danger situations which are of interest for this study was gathered from different sources as listed below. In an initial overview we studied publications such as:

- newspapers

  national newspapers e.g
  Die Welt
  Frankfurter Allgemeine Zeitung
  Handelsblatt
  Süddeutsche Zeitung

  regional newspapers according to places where accidents or serious situations occurred and to those editions which reported on the relevant facts

- manuals

  the useful manuals include:
  C.H. Vervalin [4]
  Fire Protection Manual for Hydrocarbon Precessing Plants

  UBA [1]
  Major Accidents Manual

  UBA [3]
  Documentation on Disturbances in Industrial Plants or involving dangerous Substances
  Due for publication in the near furture

- specialist journals

  the most informative and therefore most used journals are:
  Bevölkerungsschutz-Magazin
  Brandhilfe
  brandschutz / Deutsche Feuerwehr-Zeitung
  Brandschutz in Rheinland-Pfalz

Fire International
Gefährliche Ladung
112 Magazin für den Feuerwehr-Mann
Schweizerische Feuerwehr-Zeitung
VFDB, Zeitschrift für Forschung und Technik im Brandschutz
Zivilschutz-Magazin
Zivilverteidigung

- reports
  reports dealing with special major accidents, for example in a particular case the Report of the BASF Work Fire Brigade or reports dealing with different cases such as Report of Hazardous Incident Commission, FRG 19.09.1984.

To study reports, articles and / or brochures only available for examination in archieves we had to contact some institutions at different places. These include:

- Bundesamt für Zivilschutz
  Federal Agency for Civil Defence
- Kathastrophenschutzschule des Bundes
  Federal Disaster Control Academy
- Landesfeuerwehrschule
  Fire Brigade Academy
- Schweizerischer Feuerwehrverband
  Swiss Fire Brigades Association.

The most important and essential sources of information, however, have been the personal contacts with those bodies engaged in the response measures. With these contacts we gathered verbal information as well as insights into assignment reports. In some cases we inspected the place of the event and obtained vivid descriptions by the officer in charge of the case in question. The bodies we contacted were some of those listed in chapter 2: Statutory Bodies involved. In the forms these types of information are marked: P.I. = personal information, point 11, page 13.

1.4 Explanation of Form

The forms used to describe the off-site response measures are designed to ensure a concise, clear and comprehensive survey of all those facts significant for the response measures. The information given on the forms is intended to feed a database. The facts are divided into eleven catagories.

Catagory 1 identifies the case to date by the letter D, indicating a German case, and a number which is made up of the date in reverse order. Later, when the study is continued, the letter D will be replaced by CH for Switzerland or A for Austria.

Catagory 2 includes the date and place of the event, the time of the alarm, the type of activity during which the accident happened and up to three of the hazardous substances involved in the event, either because they were present before the event or they were produced in the course of the event.

The substances are characterized as follows:

- chemical name or names in English
- chemical formula
- chemical abstract service registry number
- identification number, preceded by UN No
- hazard class number, Kemler-number
  the first figure indicates the main danger e.g.:
  2 gases
  3 flammable and combustible liquids
  4 flammable solids
  5 oxidizers
  6 poisons
  8 corrosive agents
  the second and third figures indicate additional dangers. If there is an X before the figures there is a danger in combination with water
- hazchem code
  the hazchem code gives information under the following headings:
  - fire fighting number:

1 = jets
2 = fog
3 = foam
4 = dry agent

- personal protection
  P, R, W, X = full protection
  S, S, T, T, Y, Y, Z, Z = closed-circuit breathing apparatus

- evacuation
  E = consider evacuation

- action to be taken
  P, R, S , T demand for dilution
  W, X, Y, Z demand for containment of released substance or substance plus extinguishing water

- violent reaction
  possible violent reaction is indicated by letter V.

The type of the accident / disaster under review is signified by one or more of the terms in the last box of catagory 2. Imminent danger means in this case: quasi danger, imagined risk. In this case there is no real danger to the public.

Catagory 3 lists the potential hazards of the substance, the situation, the sequence of events, but not the real danger which actually occurred.

Catagory 4 and 5 list the impacts off- and on-site which actually occurred.

Catagory 6 illustrates the accident preparedness based on the requirements of the Hazardous Incident Ordinance, Störfall-Verordnung, and / or on the statutory contingency planning and the precautions of the fire-brigades.

Catagory 7 describes in concise form some facts of the accident which have to be known to understand the description of the countermeasures.

Catagory 8, catagory 9 and catagory 10 present the most important information with respect to the characterisation of this study.

Catagory 8 specifies in detail the assigned personnel, bodies, vehicles, equipment,

means an agents and gives a rough overview of the countermeasures.

Category 9 deals with the care for the public, especially with respect to information.

Category 10 points out what the case, the actions and the result of all responses show. In relation to the remark that every chemical accident can be used to improve the precautions, as mentioned in chapter 1, this category grants the most effective information.

Category 11 finally lists the sources of information for those users of this study who require additional knowledge of the case under review.

1.5 General Comments on Cases

The study contains 12 cases selected with a view to covering a wide range of critical situations, preferably those caused by hazardous substances.

Major criteria in the selection were:

- the range of occurences should represent:
  - release
  - fire
  - explosion
  - environmental pollution
  - imminent danger
- unexpected or very new occurences
- examplary precautions
- new methods of attack
- response measures which are of special interest, and which have been characterised by extreme expenditure of personnel, equipment, means
- assignment of special operational units (e.g. task force, TUIS).

In particular the cases are typified as follows:

release	case no	700409
explosion and fire	cases no	790206
		830215
		860626
major fire	cases no	790206
		791001
		820908
		890518

new method of attack	case no	861223
examplary precaution	case no	850118
epidemic danger	case no	830803
environmental pollution	cases no	791001 830803
assignment of special units	case no	830125
puncture of a presurized gas-tanker	case no	800508
imminent danger	case no	830125.

The cases are described in a way which makes it possibele to collect data simply on the assigned men, vehicles, equipment, the countermeasures, the activities performed, point 8, and point 9 Care for the Public. Particularly attention is drawn to the comparison between advance contingency preparedness and the countermeasures taken in the event, point 10, Conclusions drawn. Finally in each case it is worked out what lessons can be learned from this event. This is in accordance with the basic principle of this study: to offer a reality-based support for all endeavours in establishing emergency response plans, in improving the preplanned countermeasures and / or in finding the appropriate and correct decisions when the event has occurred, and do this by the exchange of experience.

1.6 Final Conclusions

As we know from experience, responders often need many hours to cope with what happened or went wrong in the first 20 minutes. To improve the effects of the first responders within the first few minutes after the alarm has been given, it is essential that their decisions and assignments be based on experience gained with hazardous situations in the past, either by themselves or especially by others. This study should be regarded as a first step in providing the responding groups with comprehensive information on:

- how an appropriate emergency preparedness can be established
- which vehicles, equipment and agents have to be kept ready for specific assignments
- how the logistical problems were managed at the scene
- how many personnel were needed to cope with specific situations
- what has to be done in special situations under similar conditions.

In preplanning activities the knowledge gained from earlier response measures will help ensure that the off-site emergency plans and the on-site plans are mutually compatibel.

Initial operations in case of an emergency are determined essentially by the time factor. A collection of response descriptions published in a suitable context will help minimize and mitigate the consequences of any major accident / hazardous situation. It will enable the responders to save time by taking correct decisions after being alerted.

While preparing this study we encountered an increasing acceptance on the part of the bodies we contacted. This was based on the recognition that the results of any endeavours may help to improve precautions and assignment activities. According to the principle that every major hazard / hazardous situation can help to improve the countermeasures, we made excellent contacts for our work. In view of this we can state that this study, seen as a feasibility study, has confirmed the expectation that the large scale collection of response reports can be successfully conducted.

1.7 Recommendations for further Procedure

As we progressed with the study, it became clear to us that the following is important with regard to our further endeavours:

- this study is now under discussion by all bodies concerned with questions of response to hazardous situations. On the one hand, this is based on our personal contacts, on the other on informative events e.g. conferences, discussions, review meetings and / or personal contacts within these bodies.

- the bodies mentioned showed great interest in obtaining the results and in the details of the study, which is to be published as an additional tool for planning or improving precautions and as a basis for decision-making in an actual hazardous situation.

- experts in major accident response management expect that the collection of countermeasure reports will be pursued without delay on a larger scale, and even across national frontiers.

To achieve optimum benefit from this study and from those established in other countries, we recommend the following procedure:

- the reports of countermeasures taken to date, should be published immediately. Publication may be in the form of loose-leaf collection. That would offer the possibility of supplemention and / or to updating the collection subsequently without difficulty. In addition these reports should be stored in a database. In any case, the reports should be made available to all those bodies concerned with response measures.

- the Joint Research Centre should promote the presenting of papers on this subject. The aim has to be to arose interest in this information system on a broad basis, to create acceptance at different levels of the bodies concerned and to promote assistance for further endeavours in this field.

- the study and the establishment of countermeasure reports in relation to actual events should be extended to the five new states of the FRG. Moreover they should cover our neighbouring countries Switzerland and Austria.

In the course of the study we have made exellent contacts in Germany. We are in a position to commence similar activities without delay in particular in Switzerland

and Austria, and also in the United States. We could start with corresponding activities immediately. To maintain our contacts, activities aimed at extending the collection of cases should be initiated at the earliest opportunity.

7. Description of accident / emergency / disaster

Impact on the public	yes	X	no		unobt.

Source of danger: by mistake the connection hose of a tank car carrying chlorohydric acid was connected to a tank containing sodium hydroxide solution

Weather conditions: wind of west

Short description of development of accident:

hydrochlorid acid reacted with sodium hydroxide solution to form chlorine gas which was released

Time sequence for decisions of actions taken:

9.14 alarm

9.16 employment of fire brigade

10.45 all clear

7. Description of accident / emergency / disaster

Impact on the public	yes	X	no		unobt.

Source of danger: presumably short circuit

Weather conditions: temperature -3 °C; slight wind; overcast, fog, wind from the east

Short description of development of accident:

- faulty current cable caused fire
- fire caused dust explosion

Time sequence for decisions of actions taken:

06.02.:	21.27	alarm
	21.30	assignment of 4 engine companies
	21.50	assignment of additional engine companies
	22.15	assignment of 2 fire-fighting boats, water supply by the pumps of the fire-fighting boats and by a high-pressure main
	23.30	assignment of BW bulldozer tanks
07.02.:	17.20	a rescue dog team started search operations
12.04.:	17.00	all clear

7. **Description of accident / emergency disaster**

Impact on the public yes ☐ no ☒ unobt. ☐

Source of danger: presumably welding work

Weather conditions: cloudless, warm, slight wind from southwest

Short description of development of accident:

a tank farm in a port was set on fire after explosion of fuel oil tanks;
a major conflagration followed

Time sequence for decisions of actions taken:

10.41 alarm
10.45 fire brigade turned up on scene
10.50 fire attack
15.41 all clear

7. Description of accident / emergency / disaster

Impact on the public	yes	☐	no	☒	unobt. ☐

Source of danger: pressurised gas tanker

Weather conditions: dry, cloudy, wind from north

Short description of development of accident:

during shunting operations in a marshalling yard two tankers containing vinyl chloride crashed; one tanker was punctured by a buffer; vinyl chloride released and exploded immediately after being ignited by an electric arc of the overhead line

Time sequence for decisions of actions taken:

10.34 operation control center of the fire brigade watched fire and smoke

10.35 one engine company started on sight without an alarm having been sounded

10.40 fire brigade reached scene of conflagration

11.10 fire brigade was informed on the nature of the hazardous good

11.50 all clear

D - 820908

7. Description of accident / emergency / disaster

Impact on the public: yes [X] no [ ] unobt. [ ]

Source of danger: leak in a methanol pipe-line

Weather conditions: easterly wind, wind velocity 3...5 m/sec

Short description of development of accident:

release of methanol due to a leak in a pipe-line and ignition most probably by a short circuit in a cable

Time sequence for decisions of actions taken:

11.28 alarm
11.31 fire attack
11.33 alert stage 4
11.42 alert stage 6
11.45 predisaster warning
11.55 OEC arranged
12.00 EOC manned
13.20 fire under control
15.54 all clear

7. Description of accident / emergency / disaster

Impact on the public	yes	☐	no	☒	unobt. ☐

Source of danger: derailed pressurised gas tank car

Weather conditions: damp and cold, light rain

Short description of development of accident:

a pressurised gas tank car derailed in a marshalling yard during shunting operations; the derailment was caused by inadvertent operation of points

Time sequence for decisions of actions taken:

3.06	alarm
16.00	evacuation
16.40	start of salvage operations
19.40	all clear

D - 830215

7. **Description of accident / emergency disaster**

Impact on the public yes ☐ no ☒ unobt. ☐

Source of danger: explosion of a pump recipient

Weather conditions: overcast, light wind

Short description of development of accident:

- pollution by anorganic salt has caused a thermal decomposition of anthracenedione
- recipient exploded
- released thermooil, diphyl, was set on fire

Time sequence for decisions of actions taken:

3.38 fire attack

9.00 all clear

7. Description of accident / emergency / disaster

Impact on the public yes [X] no [ ] unobt. [ ]

Source of danger: arson

Weather conditions: bright, warm

Short description of development of accident:

- fire in warehouse with cold-storage plant, 6,200 t butter, 3,000 t meat were stored
- extent of fire to entire warehouse and cold storage plant
- damage to ammonia evaporator
- release of molten butter
- disturbance to public

Time sequence for decisions of actions taken:

0.56	alarm
1.01	assignment of 2 engine companies
1.21	assignment of 4 additional engine companies and of 2 fireboats
3.03	fire-fighting operations by 9 engine companies
11.30	fire unter control
	additional fire-fighting operations over a period of 17 days

7. Description of accident / emergency / disaster

Impact on the public: yes [X] no [ ] unobt. [ ]

Source of danger: explosion in the distillation unit of an ethylene plant

Weather conditions: frost, -6 °C

Short description of development of accident:

a release of gas was followed by an explosion of the gas cloud; this caused a major fire

Time sequence for decisions of actions taken:

15.42 alarm
15.47 fire attack
17.10 fire under control
17.28 all clear

7. Description of accident / emergency disaster

Impact on the public	yes	X	no		unobt.

Source of danger: ignition of vapour by static charge

Weather conditions: light north-easterly wind, 30 °C, hot dry weather

Short description of development of accident:

after loading of a tanker with benzene a sample was to be taken; due to incorrect behaviour of the sample-taker benzene vapour ignited causing an explosion and ensuing fire

Time sequence for decisions of actions taken:

14.35 alarm
14.38 fire brigade on scene, fire attack
14.44 cooling of the harbour tanks
14.53 engagement of an firte-fighting boat
17.09 all clear

7. Description of accident / emergency / disaster

Impact on the public: yes [X] no [ ] unobt. [ ]

Source of danger: leaking pressure gas road tanker

Weather conditions: winter weather, temperature around freezing point, light easterly wind, snow-fall

Short description of development of accident:

tanker was about to fill a stationary LPG tank when the connection hose fractured; propane escaped forming a gas cloud covering an area of 500 m^2 with a higth of 1 m

Time sequence for decisions of actions taken:

13.47 alarm

14.06 evacuation of neighbouring houses, turning off of heating facilities, attack with diffuser spray nozzle

15.06 measuring of propane concentration in the air in the village and on an open field

19.00 all clear

7. Description of accident / emergency / disaster

Impact on the public	yes	☐	no	☒	unobt. ☐

Source of danger: release of butane
ignition of gas cloud

Weather conditions: cloud-free, warm, slight wind from eastsoutheast

Short description of development of accident:
during repair work on a pipe containing butane, butane was released and ignited, this escalated into a major fire involving different sorts of hydrocarbons

Time sequence for decisions of actions taken:

8.51	alarm
8.56	fire attack
9.03	call in additional operational units
9.15	establishment of OEC
13.00	all clear

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- stock of a sufficient number of closed-circuit breathing apparatus with full face masks
- wind cone
- better marking of tanks and mains for dangerous materials

Lessons learned:

fire brigade is to be informed very soon of the kind of dangerous substances

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

- external aid had to be called in
  - BW bulldozer tanks
  - rescue dog team

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- extensive actions call for a well equipped mobile command center

Lessons learned:

- in the case of a major and long-term fire an additional water supply from high-pressure mains and / or fireboats are essential

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

- additional water was provided with the aid of fire boats
- additional operational units were to be called in immediately

Need for additional preparedness — yes ☐ — no ☒

Which measures / means:

Lessons learned:

for fire fighting operations in tank farms are to be kept ready:

- sufficient foam
- a number of oil booms

moreover one or more fire-fighting boats should be to call in immediately

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

water supply of the marshalling yard was insufficient to cope with a major fire

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- water supply on the marshalling yard is to be increased
- plans of sewage systems hare to be available
- marshalling yards should be made more accessible

Lessons learned:

technical assistance, e.g. by TUIS, is inevitable in the case of a critical situation with hazardous materials

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

- special disaster response plan enabled effective employment
- availability of a car with gas detection equipment

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- coordination of warning text between fire brigades and police
- detailed description of the storage of dangerous goods with updating

Lessons learned:

- a good cooperation between municipal fire brigade and works fire brigade was based on a joint drill 3 months before
- warning texts must be coordinated between police and fire brigade
- special gas-measure equipment for quick action is to be kept ready

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

this event confirmed the indispensibility of TUIS in particular situations

Need for additional preparedness — yes ☐ no ☒

Which measures / means:

Lessons learned:

the provision of empty tank cars is difficult and time consuming

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

Need for additional preparedness yes [X] no [ ]

Which measures / means:

hydraulic platform for fire figthing puposes in higths exceeding 30 m without need for indoor fire attrack

Lessons learned:

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

- extinguishing water could not be collected
- communication system of response groups was interferred with a foreign transmitter; transmission frequency had to be changed
- capacity of animal carcass utilisation plants was not sufficient
- water supply was supported by the pumps of two fireboats

Need for additional preparedness — yes [X] no [ ]

Which measures / means:

- preventive fire protection of warehouses has to be worked out with respect to
  - fire sectors, party walls, fire doors
  - limitation of fire load
  - smoke-flue pipes, heat removal pipes
  - smoke detectors
- access to warehouses from all sides for fire engines is essential
- provision of facilities to supply waterways, streams, rivers in special cases with oxygen to keep fish alive

Lessons learned:

- alarmregister must include
  - addresses of animal carcass utilisation plants up to greater distances
  - addresses for suction cars and cleaning facilities
  - possibilities for combatting rats or other health hazards
- warehouses are to be equipped with a sufficient number of pillar hydrants and / or ground hydrants
- cleaning companies must be on standby 24 hours

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- setting up of an extinguishing water collection basin
- improved information to the public in case of a dangerous situation
- special letter to inform the public: new edition

Lessons learned:

- in case of an accident an immediate alarm from the company management should be given to the municipal fire brigade
- mutual aid and technical assistance by neighbouring WFs0 was necessary

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

usuable equipment was available such as:

- mobile monitors
- wooden oil booms
- plastic oil booms

Need for additional preparedness yes [X] no [ ]

Which measures / means:

- marking of inland tankers carrying dangerous goods with orange warning plates which display hazard class number and UN - No
- inclusion of the harbour loading and unloading installations in the stationary protective system

Lessons learned:

- staff ist to be trained regularly in the use of stationary fire extinguishing installations
- fire practices supervised by the fire brigade should be performed annually

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

	yes	no
Need for additional preparedness	☐	☒

Which measures / means:

Lessons learned:

expulsion of an explosive gas cloud by spray is very efficient; to avoid injuries to the firefighters full protection suits must be worn

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

- sufficient water supply by a great number of pillar hydrants
- additional water was provided with the aid of fireboats

Need for additional preparedness — yes ☐ — no ☒

Which measures / means:

Lessons learned:

fireboats were temporary on radio set of 2 m-band unattainable. This was caused by the hight of a steel-armed jetty-wall and by the steeltanks which reflected the radio waves

3.1 Appendix 1: Keys

In the forms are used abbreviations or keys for some terms. Some of these are international usual, some are special keys in Germany.

The abbreviations / keys are:

A

AL	trailer ladder
ASB	workers rescue service Arbeiter-Samariter-Bund-Deutschland e.V.

B

BF	professional fire brigade
BLEVE	boiling liquid expanding vapour explosion
BRK	Bavarian Red Cross e.V. Bayrisches Rotes Kreuz e.V.
BW	Ferderal Defence Forces Bundeswehr

C

CVE	confined vapour explosion

D

DB	German Federal Railway Deutsche Bundesbahn
DL	turntable ladder
DLK	turntable ladder with basket
DRK	German Red Cross e.V. Deutsches Rotes Kreuz e.V.

E

ELF	fire fighting conduct car
ELW	mobile command center
EOC	emergency operation center

F

FF	volunteer fire brigade

G

GW	tool and gear carrier
GW-A	breathing apparatus tender

H

HB	Handesblatt

J

JUH	Johanniter rescue service Johanniter-Unfall-Hilfe e.V.

K

Kdow	control unit
KTW	ambulance

L

LB	turntable ladder with stage
LF	fire squad tender

M

MTW	personnel carrier

N

NAW	emergency ambulance
NZZ	Neue Zürcher Zeitung

O

OEC	on-scene emergency center

P

P.I.	personal information
PLF	dry powder tender
P 250	dry powder trailer, 250 kg

R

RTW	ambulance vehicle
RW	emergency tender

S

S	foam-making nozzle
STF	foam agents vehicle
SW	hose carrier

T

THW	technical assistant service Bundesanstalt Technisches Hilfswerk
TLF	pump water tender
TroLF	dry powder tender
TroTLF	dry powder tank tender
TSA	trailers for portable fire pumps
TUIS	Transport Accident Information and Assistance System Transport- Unfall- Informations- und Hilfeleistungs-System

U

UBA	Federal Environmental Agency Umweltbundesamt
unobt.	unobtainable
UVCE	unconfined vapour cloud explosion

V

VFDB	Journal for Research and Technics in Fire Protection Zeitschrift für Forschung und Technik im Brandschutz

W

WAZ	Westdeutsche Allgemeine Zeitung
WF	works fire brigade
WLF	vehicles for fire-fighting purposes
WSP	waterway police

3.2 Appendix 2: Registers

3.2.1 Chronology

Date	Case No	Place
09.04.1970	700409	D - 6750 Kaiserslautern
06.02.1979	790206	D - 2800 Bremen
01.10.1979	791001	D - 4100 Duisburg
08.05.1980	800508	D - 8500 Nürnberg
08.09.1982	820908	D - 5000 Köln
25.01.1983	830125	D - 4200 Oberhausen
15.02.1983	830215	D - 2212 Brunsbüttel
03.08.1983	830803	D - 2000 Hamburg-Wilhelmsburg
18.01.1985	850118	D - 5047 Wesseling
26.06.1986	860626	D - 6800 Mannheim
23.12.1986	861223	D - 6912 Dielheim-Balzfeld
18.05.1989	890518	D - 2000 Hamburg

3.2.2 Places of events, alphabetical

Place	Case No
D - 2800 Bremen	790206
D - 2212 Brunsbüttel	830215
D - 6912 Dielheim-Balzfeld	861223
D - 4100 Duisburg	791001
D - 2000 Hamburg	890518
D - 2000 Hamburg-Wilhelmsburg	830803
D - 6750 Kaiserslautern	700409
D - 5000 Köln	820908
D - 6800 Mannheim	860626
D - 8500 Nürnberg	800508
D - 4200 Oberhausen	830125
D - 5047 Wesseling	850118

3.2.3 Substances involved

3.2.3.1 Arranged alphabetically

Substance	Formula	Case No	Place
Ammonia	NH_3	830803	D - 2000 Hamburg-Wilhelmsburg
Anthracenedione, 1-nitro	$C_{14}H_7NO_4$	830215	D - 2212 Brunsbüttel
Benzene, Light oil, Phenylhydride	C_6H_6	860626	D - 6800 Mannheim
Butane	C_4H_{10}	890518	D - 2000 Hamburg
Chlorine	Cl_2	700409	D - 6750 Kaiserslautern
Crude oil		890518	D - 2000 Hamburg
Diphyl	$C_{12}H_{10}O{\cdot}C_{12}H_{10}$	830215	D - 2212 Brunsbüttel
Ethane	C_2H_6	850118	D - 5047 Wesseling
Ethylene	C_2H_4	850118	D - 5047 Wesseling
Flour		790206	D - 2800 Bremen
Gasoline		890518	D - 2000 Hamburg
Grain		790206	D - 2800 Bremen
Heavy fuel oil		791001	D - 4100 Duisburg
Hydrochloric acid	HCl	700409	D - 6750 Kaiserslautern
Methanol	CH_3OH	820908	D - 5000 Köln
Propane	C_3H_8	861223	D - 6912 Dielheim-Balzfeld

Propylene, Propene, Methylethene	C_3H_6	850118	D - 5047 Wesseling
		830125	D - 4200 Oberhausen
Sodium hydroxide	NaOH	700409	D - 6750 Kaiserslautern
Vinyl chloride	C_2H_3Cl	800508	D - 8500 Nürnberg

3.2.3.2 Arranged according UN No

UN No	Case No	Place
1005	830803	D - 2000 Hamburg-Wilhelmsburg
1011	890518	D - 2000 Hamburg
1017	700409	D - 6700 Kaiserslautern
1035	850118	D - 5047 Wesseling
1077	850118	D - 5047 Wesseling
1077	830125	D - 4200 Oberhausen
1086	800508	D - 8500 Nürnberg
1114	860626	D - 6800 Mannheim
1115	890518	D - 2000 Hamburg
1230	820908	D - 5000 Köln
1267	890518	D - 2000 Hamburg
1789	700409	D - 6750 Kaiserslautern
1823	700409	D - 6750 Kaiserslautern
1962	850118	D - 5047 Wesseling
1978	861223	D - 6912 Dielheim-Balzfeld

3.2.3.3 Arranged according CAS No

CAS No	Substance	Case No	Place
67 - 56 - 1	Methanol	820908	D - 5000 Köln
71 - 43 - 2	Benzene, Light oil, Phenylhydride	860626	D - 6800 Mannheim
74 - 84 - 0	Ethane	850118	D - 5047 Wesseling
74 - 85 - 1	Ethylene	850118	D - 5047 Wesseling
74 - 98 - 6	Propane	861223	D - 6912 Dielheim-Balzfeld
75 - 01 - 4	Vinyl chloride	800508	D - 8500 Nürnberg
82 - 34 - 8	Anthracenedione, 1-nitro	830215	D - 2212 Brunsbüttel
106 - 97 - 8	Butane	890518	D - 2000 Hamburg
115 - 07 - 1	Propylene, Propene, Methylethene	850118	D - 5047 Wesseling
115 - 07 - 1	Propylene, Propene, Methylethene	830125	D - 4200 Oberhausen
1310 - 73 - 2	Sodium hydroxide	700409	D - 6750 Kaiserslautern
7647 - 01 - 0	Hydrochloric acid	700409	D - 6750 Kaiserslautern
7664 - 41 - 7	Ammonia	830803	D - 2000 Hamburg-Wilhelmsburg
7782 - 50 - 5	Chlorine	700409	D - 6750 Kaiserslautern
8002 - 05 - 9	Crude oil	890518	D - 2000 Hamburg
8004 - 13 - 5	Diphyl	830215	D - 2212 Brunsbüttel
8006 - 61 - 9	Gasoline	890518	D - 2000 Hamburg

3.2.3.4 Arranged according total formula

Formula	Substance	CAS No	Case No
CH_3OH	Methanol	67 - 56 - 1	820908
C_2H_3Cl	Vinyl chloride	75 - 01 - 4	800508
C_2H_4	Ethylene	74 - 85 - 1	850118
C_2H_6	Ethane	74 - 84 - 0	850118
C_3H_6	Propylene, Propene, Methylethene	115 - 07 - 1	850118
			830125
C_3H_8	Propane	74 - 98 - 6	861223
C_4H_{10}	Butane	106 - 97 - 8	890518
C_6H_6	Benzene, Light oil, Phenylhydride	71 - 43 - 2	860626
$C_{12}H_{10}O{\cdot}C_{12}H_{10}$	Diphyl	8004 - 13 - 5	830215
$C_{14}H_7NO_4$	Anthracenedione, 1-nitro	82 - 34 - 8	830215
Cl_2	Chlorine	7782 - 50 - 5	700409
HCl	Hydrochloric acid	7647 - 01 - 0	700409
NaOH	Sodium hydroxide	1310 - 73 - 2	700409
NH_3	Ammonia	7664 - 41 - 7	830803

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Bremen

Feuerwehrgesetz
Hamburg

Gesetz über den Brandschutz und die Hilfeleistung der Feuerwehren
Hessen

Niedersächsisches Gesetz über den Brandschutz und die Hilfeleistungen der Feuerwehren
Niedersachsen

Gesetz über den Feuerschutz und die Hilfeleistung bei Unglücksfällen und öffentlichen Notständen
NW

Landesgesetz über den Brandschutz, die Allgemeine Hilfe und den Katastrophenschutz
Rhld.-Pfalz

Gesetz über den Feuerschutz im Saarland
Saar

Gesetz über den Brandschutz und die Hilfeleistungen der Feuerwehren
Schl.-H.

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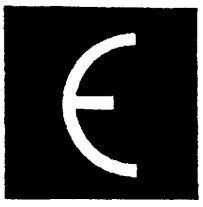

RWTÜV

REPORT OF OFF-SITE RESPONSE MEASURES

1. Identification

Case No.:

2. General Data

Date, time of event :

Time of alarm :

Place :

Type of activity :

- industry ☐
  type of industry
- transport rail ☐ road ☐ others ☐
- storage ☐
- others ☐

Dangerous substances involved:

1. Substance

chemical name (s) :
formula :
CAS No. :
UN No : Hazard class : Hazchem Code:

2. Substance

chemical name (s) :
formula :
CAS No. :
UN No : Hazard class : Hazchem Code:

3. Substance

chemical name (s) :
formula :
CAS No. :
UN No : Hazard class : Hazchem Code:

Type of accident/disaster:

- CVE ☐ - UVCE ☐ - BLEVE ☐
- fire ☐ - release ☐ - leakage ☐
- other catastrophe ☐ - deflagration ☐
- imminent danger ☐

Declaration of major disaster yes ☐ no ☐

D -

3. Potential hazard

for man	**yes**	☐	**no**	☐
	poisoning	☐	distress	☐
	pressure wave	☐	panic	☐
	apparent danger	☐	restriction of traffic	☐
	injuries	☐	fatal injuries	☐
	evacuation	☐	irritations	☐
	burns	☐	shock	☐
for environment	**yes**	☐	**no**	☐
	air pollution	☐	water pollution	☐
	soil pollution	☐	vegetation poisoning	☐
	demage to buildings	☐	... to traffic facilities	☐

4. Actual types of impact off-site

for man	yes	☐	no	☐
	poisoning	☐	distress	☐
	pressure wave	☐	panic	☐
	apparent danger	☐	restriction of traffic	☐
	injuries	☐	fatal injuries	☐
	shock	☐	evacuation	☐
	irritations		burns	☐
	- respiratory	☐		
	- eyes	☐		
	- skin	☐		

for environment	yes	☐	no	☐
	air pollution	☐	water pollution	☐
	soil pollution	☐	vegetation poisoning	☐
	damage to buildings	☐	... to traffic facilities	☐

D -

5. Actual types of impact in-site

for man	**yes**	☐	**no** ☐	**unobt.**	☐
	injuries	☐		fatal injuries	☐
for plant	**yes**	☐	**no** ☐	**unobt.**	☐
	damage to buildings		☐		
	damage to process units		☐		
	damage to storage tanks		☐		
	damage to traffic facilities		☐		
extent of damage				unobt.	☐

6. Accident preparedness

	yes	no	unobt.
	☐	☐	☐
Plant/unit submitted to Hazardous Incident Ordinance	☐	☐	☐
Safety analysis established	☐	☐	☐
General emergency response plan established	☐	☐	☐
Special disaster response plan in force	☐	☐	☐
Early warning system arranged	☐	☐	☐
- reserved telephone line to:	☐		
- radio connection to:	☐		
- fire alarm	☐		

6. Accident preparedness continued

	yes	no	unobt.
Fire brigade			
- special countermeasure plan	☐	☐	☐
- information on dangerous substances	☐	☐	☐
- special response plan according to safety analysis	☐	☐	☐
- assignment instructions	☐	☐	☐
- kind of special equipment according to safety analysis	☐	☐	☐
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
EOC arranged	☐	☐	☐
- alert schedules prepared	☐	☐	☐
- float-charts for decisions established	☐	☐	☐
- disaster manual available	☐	☐	☐
- preliminary estimation of hazardous area (plume spread model)	☐	☐	☐
- plastic overlays	☐	☐	☐
- other precautions:	☐		
Informing the public in advance:	☐	☐	☐
- special letter	☐		
- special page in directory	☐		
- informational meeting	☐		

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7. Description of accident / emergency / disaster

Impact on the public yes ☐ no ☐ unobt. ☐

Source of danger:

Weather conditions:

Short description of development of accident:

Time sequence for decisions of actions taken:

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8. Countermeasures

	yes	no	unobt.
Assignment			
Species of organizations involved			
- professional fire brigade	☐	☐	☐
- works fire brigade	☐	☐	☐
- industrial fire brigade	☐	☐	☐
- police	☐	☐	☐
- civil service / defence service	☐	☐	☐
- voluntary organizations	☐	☐	☐
- medical services	☐	☐	☐
- FF	☐		
-	☐		
-	☐		

Fire brigade

- vehicles: quantity and type (DIN)

- men
- duration of assignment
- helicopter ☐
- fire-fighting boat ☐
- means and agents
  - branch pipes: size (DIN)
    quantity
  - hydro-shield: quantity
  - monitors: quantity
    - foam ☐ heavy ☐ medium ☐ light ☐
    - dry powder ☐ ☐ ☐

8. Countermeasures continued

- assessment of hazardous area:
  - detector tubes ☐
  - explosimeter ☐
  - plume spread modelling ☐
  - plastic overlays ☐
- personal protective clothing:

Police

- men:
- vehicles: quantity:
- kind of activity:

	yes	no
- evacuation procedure	☐	☐
- emergency route	☐	☐
- inner core / outer ring	☐	☐
- equipment		

Civil service / civil defence

	yes	no
- EOC manned	☐	☐
- OEC manned	☐	☐

- kind of activity:
- duration of assignment:

8. Countermeasures continued

Voluntary organizations

- name(s):

- kind of activity:

Medical service(s) involved:

Short description of countermeasures:

Additional remarks:

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9. Care for the public

Actions for information

Warning to the public

- time of warning — unobt. ☐
- warning means
  - long range loudspeakers ☐
  - sirens ☐
  - loudspeaker cars ☐
  - radio ☐
  - telephone hot lines ☐
  - others

	yes	no	unobt.
Information on safe behaviour	☐	☐	☐
Means of information			
- loudspeaker cars	☐	☐	☐
- leaflets	☐	☐	☐
- radio	☐	☐	☐
- telephone hot lines	☐	☐	☐
Evacuation procedure	☐	☐	☐
- selective evacuation	☐	☐	☐
- general evacuation	☐	☐	☐
- approximate number of evacuees			

10. Conclusions drawn

Countermeasures taken compared with contingency preparedness:

Need for additional preparedness yes ☐ no ☐

Which measures / means:

Lessons learned:

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11. Source(s) of information