

Observers' Report

Major Accidents

Fire at the chemical industries in Memmingen, Germany



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Swedish Rescue Services Agency

Major Accidents

Fire at the chemical industries in Memmingen, Germany

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Title Fire in the Chemical Plant in Memmingen, Germany. January, 1997. Observers' contribution.		
Résumé A fire broke out at a chemical plant in Memmingen, Germany on 23 rd January, 1997. The building, which was devastated by the fire, accommodated two chemical industries and a vacant warehouse. By confining the fire the rescue services were able to save one of the industries. The rest of the building was completely destroyed by the fire. The company had an abundance of flammable and toxic chemicals that contaminated the water that was used to extinguish the fire as well as giving rise to toxic combustion gases. The inhabitants of Memmingen were requested, via the radio and vehicles equipped with loudspeakers, to remain indoors and to keep all doors and windows closed. The extinguishing water became extremely alkaline and dissipated into the ground as well as into surface water and the drainage system. As yet, no ill effects following the diffusion into surface water and the drainage system have been observed. An investigation into the environmental effects of the fire is to be undertaken, the results of which will be unknown at the time this report will be published. Four firemen received caustic burns from the contaminated extinguishing water and a further nine firemen and policemen developed coughs, chest pains and sore throats as a result of exposure to the combustion gases. Approximately 250 people underwent medical examinations and received prophylactic treatment in the form of cortisone inhalation. The majority of the people examined were, however, rescue service personnel who had been ordered to undergo an examination.		
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Introduction

The Swedish Rescue Services Agency shall, in accordance with instructions, co-ordinate community operations within the area of population protection and rescue services, supervise the development of risks within the field of operations and work to ensure that measures are taken to protect the population and to prevent accidents.

Moreover, the Swedish Rescue Services Agency shall plan that a competent follow-up of a limited number of major or interesting accidents be carried out. The objective behind this follow-up is that any feedback gleaned from such experience will improve efficiency in the protection of the population and also that of the rescue services.

A fire broke out at a chemical industry in Memmingen, Germany at 2.30 a.m. on 23rd January, 1997. A delegation from Sweden, comprising two representatives from the Swedish Rescue Services Agency and one representative from the Swedish National Board of Health and Welfare, visited Memmingen on 23rd - 26th January, 1997 in order to study the fire and its consequences.

The delegation consisted of the following persons:

at the request of the Swedish Rescue Services Agency:

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This report has been compounded jointly by the Swedish Rescue Services Agency and the Swedish National Board of Health and Welfare.

Memmingen is situated 110 kilometres west of Munich and has a population of some 40,000 inhabitants of whom approximately 5,000 are resident in central Memmingen.

The observers began their assignment at 12.45 a.m. on Friday, 24th January by visiting the scene of the accident. This involved a brief tour and examination of the site. The fire had been extinguished and there were only a few firemen remaining to keep watch. During the course of Friday, 24th and Saturday, 25th January several people holding command positions were interviewed. In addition, the fire station, the Red Cross ambulance depot, the hospital and the accident site were visited.

All the people spoken to were extremely accommodating and provided the observers with detailed information.

Organisations concerned with fire and rescue resources

The fire brigade and rescue services

In Sweden, rescue services are organised under one authority. In Germany, however, two authorities divide these services, i.e. the fire brigade ("Feuerwehr"), which deals only with fires and fire prevention, and the rescue services ("Rettungsdienst"), which deals with other accidents, e.g. traffic accidents and chemical accidents. The organisation of these authorities can vary from one town to another. In some places, both may be housed in the same building, in others, they may be combined into one organisation.

On the whole, the fire brigade is made up of voluntary personnel ("Freiwillige feuerwehr"), the closest Swedish equivalent being the part-time brigades. Full-time personnel ("Berufsfeuerwehr") are only to be found in the larger cities.

There are 560 firemen in the Municipality of Memmingen, of which 165 are stationed in the urban area. The fire brigade and the rescue services are located in the same building.

In addition to the fire brigade and rescue services mentioned above, there are other organisations that may be involved in major accidents. "Technisches Hilfswerk" (THW) is a voluntary organisation which can be likened to a compromise between the former Swedish Civil Defence and the Construction and Repair Emergency Organisation (BRB). THW assists in providing lighting, generators and the supply of fuel, food, etc. "Katastrophenschutz" is an organisation which corresponds to the former Swedish Civil Defence and has, for example, additional resources for liaison and command.

In Memmingen, the "Katastrophenschutz" is located in the same building as the fire brigade and the rescue services.

The large number of volunteers within all the organisations involved in rescue services in proportion to the population density of Germany means that an enormous amount of personnel and material resources are available at short notice.

Medical Care

In Memmingen, there is one hospital, Klinikum Memmingen, which caters for both the town and the municipality. The hospital has a total of 564 beds comprising 220 for surgery, 187 for medical care, 92 for gynaecological and obstetrical care, and 65 for paediatric intensive care. With the exception of neurosurgery, there are facilities for most fields of medicine.

There is a modern radiology clinic at the hospital as well as facilities for computer tomography, such as magnetic X-ray equipment.

The hospital has an appropriate contingency plan for both internal and external emergencies. Drills are carried out annually in co-operation with the fire brigade, the rescue services and the Police. The anaesthesia clinic is responsible for "Notarzt" assignments.

Ambulance medical care

The Bavarian Red Cross, the Knights of the Order of Malta and the Knights of the Hospital of St. John of Jerusalem run ambulance medical care in Memmingen. In total, four ambulances are fully equipped and manned by qualified doctors, so-called "Notarztwagen" (NAW), six ambulances are fully equipped and manned by qualified ambulance medics, so-called "Rettungswagen" (RTW) and twelve ambulances are manned by lesser qualified ambulance medics, so-called "Krankenwagen" (KTW).

"Organisatorischen Einsatzleiter Rettungsdienst" (ORGeL), i.e. director of medical rescue operations (medical care and ambulance medical care), is a post that has existed in Memmingen for just over a year. The director of medical rescue operations is always an experienced ambulance medic from the Red Cross and is in command of all medical and rescue service personnel. ORGeL has, at his disposal, his own rescue vehicle with driver and is always alerted when three or more ambulances have been called out to the same accident site.

Description of the buildings and materials

Location

The chemical industries are situated in the middle of Memmingen. The buildings were constructed at the beginning of the century and were then outside the town. Gradually, as the town grew in size, residential housing has more or less surrounded the plant. The nearest residence is situated only 25 metres from the perimeter. The residential housing comprises detached and semidetached houses. A lot of through-traffic uses the street outside the plant and there is a railway line (not electrified) that runs along the eastern boundary. There is a timber yard situated approximately 75 metres to the south.

The ground in front of and behind the industries is asphalted as is about 25 % of the ground along the sides. The remainder of the ground is covered in gravel. The ground is quite level and there are no water catchment areas in the vicinity.



Fig. 1: The location of the industries (middle of the photograph) in relation to residential housing.

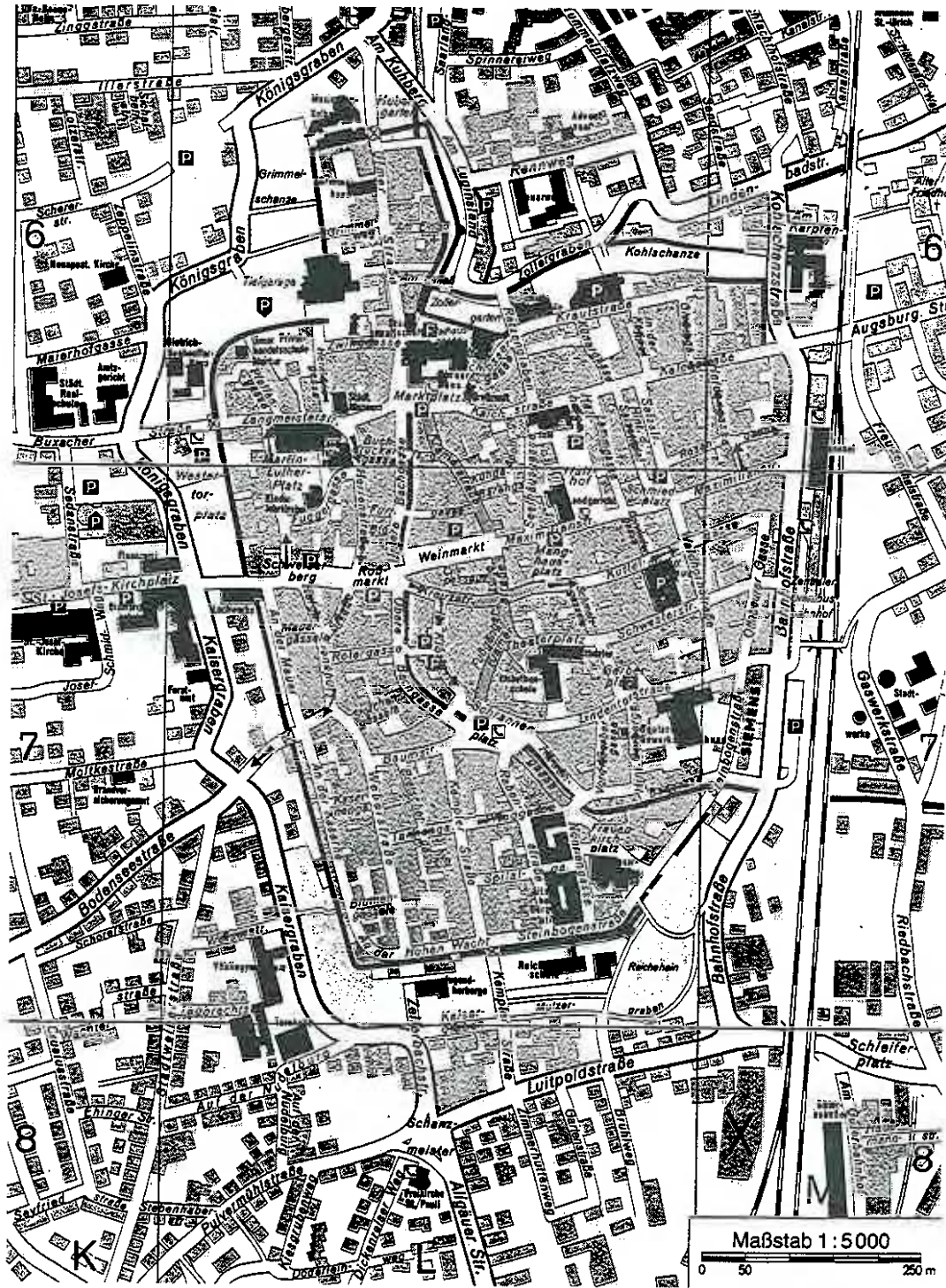


Fig. 2: Map of central Memmingen. The site of the accident is marked with an X in the lower right corner.

Architectonic description

At present, the building accommodates two chemical industries and a vacant warehouse. The total floor area is approximately 7,500 m² comprising: the chemicals company Biochema schwaben, using around 1,500 m² of floor area; the vacant warehouse with around 4,000 m² of floor area; and the chemicals company Purga chemie, using around 2,000 m² of floor area. The two chemical industries are situated on either end of the building and separated by the warehouse.

The premises accommodating Biochema are on three levels. In addition to the workshop itself, which is situated on the ground floor, there are also basement and first floor areas that are used as storage space. All other parts of the building are at ground level.

Each section (the two chemical industries and the warehouse) is separated by fire resistant partitioning and is classed in accordance with EI-60. The outer walls are built of brick and concrete. The supporting structures, horizontal, vertical and framework stabilising arrangements are made of unprotected steel and wood. The roof structure comprises wooden roof ridges and covered with tarred roofing felt. Some sections of the vacant warehouse have corrugated sheet metal roofing.

There is a fire resistant room, used as a chemical store, located in Biochema's premises along the east wall of the building.

On the west side of the building there is a covered loading dock. The superstructure is constructed entirely of wood and covered in tarred roofing felt. The superstructure connects the industrial premises with an adjacent building leased by Purga chemie.

Business Activity / Chemicals

Both chemical industries manufacture cleaning agents and disinfectants, mainly for agricultural use. Together, the companies employ some 30 workers.

The manufacturing process involves mixing various chemicals used to produce the desired product. The following is a list of the chemicals found at the two companies.

Biochema schwaben:

Isopropanol	Unknown quantity, probably several m ²
Ethanol	Unknown quantity, probably several m ²
Acetone	Unknown quantity, probably several m ²
Nitric acid	Unknown quantity, probably several hundred litres
Organic compounds of tin	1-3 tons, stored in fireproof room
Bronopol	1-5 tons, stored in fireproof room
Chlorine acetamide	1-8 tons, stored in fireproof room
1.2 dibrombutane and 2.4 dicyanobutane	2-10 tons, stored in fireproof room

It may be assumed that hundreds of kilos of those chemicals stored in the fireproof room would also have been placed out on the factory floor.

Purga chemie:

Phosphoric acid	Unknown quantity
Potassium hydroxide	Unknown quantity
Potassium silicate	Unknown quantity
Chlorine bleaching agent	Unknown quantity
Surface-active agents	Unknown quantity

There is a tank containing propane (volume 2.5 m²) situated along the outside of the west wall.

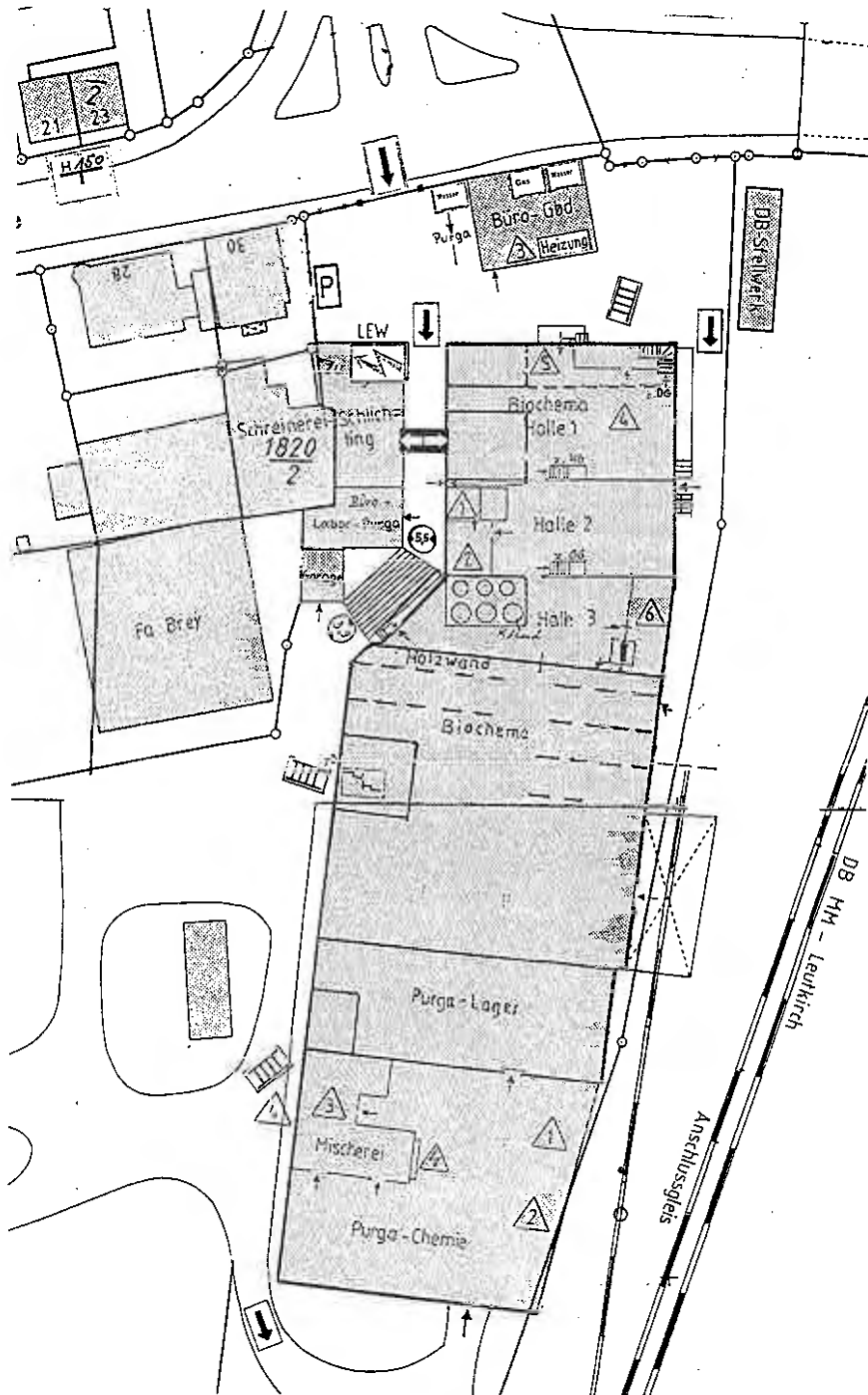


Fig. 3: Plan of the building (part of the fire brigade's operations plan).

Planning prior to a possible accident

The chemical industries were not of the size that would class them as a Seveso plant.

No contingency plans, risk analyses, description of consequences or the like existed at the companies.

Company personnel had been given no special training in fire prevention or information concerning chemicals.

The fire brigade in Memmingen was well acquainted with the companies and had an operations plan with respect to the plant. The operations plan was reviewed as late as June, 1996. Drills, as well as orientation exercises such as operation training, were carried out at the site.

No active systems, such as automatic fire alarms, combustion gas ventilators, etc., existed at the industries.

The extent and development of the accident

Thursday, 23rd January

approx. 2.30 a.m.

A 35-year-old man, who had formerly been employed at Biochema, broke into the premises. He started fires in at least three different places, including the vacant warehouse. The man suffered from pyromania and had been convicted of arson prior to this incident. It is likely that he did not use any kind of inflammable liquid but put combustible materials found in the premises into piles and ignited them. The man was later taken into custody and confessed the following day.

3.03 a.m.

Officers on duty at the police station, which is situated only a few hundred metres from Biochema and Purga chemical industries, saw enormous flames in the sky and immediately alerted the rescue services.

The fire in the Biochema premises and those adjacent was, by this time, fully developed and had burnt through the roof.

3.04 a.m.

A major alert was sounded in the region.

approx. 3.10 a.m.

The first teams from the fire station in Memmingen arrived. Upon their arrival it was seen that the building had been completely engulfed in flames, putting rescue service personnel at great risk. The rescue personnel were well acquainted with the company and were very much aware that they had to deal with both toxic and inflammable chemicals that were mostly kept in steel or plastic drums. At this stage, fire-fighting efforts were carried out from outside the building.

approx. 3.15 a.m.

A command centre was established and connections were gradually established between the command staff the following persons:

Key personnel involved in rescue operations

Head of co-ordinating staff (person from the municipal management team)

Mayor of Memmingen

Director of medical rescue operations

Director of police operations

Command personnel from Katastrophenschutz

Representative from THW
Representative from the Public Health Office
Toxicologist called in from Munich

3.20 a.m.

The operations plan included details of the chemicals kept on the premises as well as a plan of the building. This was used as the basis to decide which operations should be employed in order to stop the fire from spreading.

The fire was to be prevented from spreading into the part of the building in which Purga was located as well as to a "fireproof" storeroom in the Biochema part of the building in which large quantities of toxic chemicals were kept. It was soon realised that the combustion gases were toxic as several firemen, who had not been wearing breathing apparatus, developed breathing difficulties.

3.33 a.m.

More fire-fighting teams arrived and attempts were then made to extinguish the fire.

An explosion occurred in Hall 3 in the Biochema part of the building. In all likelihood it was a 200-litre drum containing inflammable liquid that exploded.

3.36 a.m.

The direction of the wind was established as being SSE with a velocity of 3-4 m/s.
Air temperature was around zero.

3.37 - 6.30 a.m.

The toxic combustion gases were carried by the wind over a residential area. Trains were stopped. No acute cases of poisoning were reported. This was possibly due to the time of day. The majority of the inhabitants of Memmingen were at home asleep with closed windows. The police cordoned off the roads in the vicinity of the fire, covering an area with a diameter of 200 - 500 metres.

The fire in the Biochema section grew and by this time Hall 1 was in flames. A large number of fire-fighting personnel and appliances were employed in containing the fire as well as extinguishing it. The greatest number of firemen who were actively engaged in fighting the fire at any one time was 150. Enormous amounts of water were used. An initial order to increase water pressure in the municipal hydrant network was given. If this did not suffice then water was to be taken from a river some 600 metres from the scene of the fire. Several water canons were in operation.

A check of hydrogen cyanide, ammonia and chlorine levels was carried out at the scene of the fire. Readings were obtained for hydrogen cyanide and ammonia but not for chlorine. The levels of concentration were under sanitary limits (MAK).

An information centre for the general public and the mass media was established in the town hall in Memmingen. The information given to the mass media instructed the public to remain

indoors and to keep windows and doors closed. The public was also to be informed that no mass evacuation was being considered. The police used loud speaker vehicles to impart the same information to the inhabitants of the central districts of the town.

It was decided that a school, which was situated within the risk zone, should be closed for the day.

The supporting structure of the building and the presence of large quantities of chemicals were two factors that had a bearing on the decision to fight the fire from the outside. Due to the fact that the supporting structures were not protected against fire it was highly probable that the roof would cave in at an early stage in the fire. This would contribute to the combustion gases being ventilated and the chances of holding the limitation lines for the fire increased. The collapsed and combustible roof structures would supply the fire with highly inflammable material at the same time as they would obstruct the jets of water from reaching the fire.

During the course of the fire extinguishing operations four firemen were injured. They were splashed with contaminated extinguishing water, resulting in chemical burns to the legs and feet.

The hospital was instructed to keep all doors and windows closed and to turn off the ventilation system.

6.30 - 7.40 a.m.

Monitoring of toxic gases at a distance further from the fire and following the direction of the wind was carried out. The results were negative.

Smoke emission from the fire diminished whilst fumes rose more quickly. The direction of the wind changed to SW.

An evacuation plan was drawn up. The houses closest to the accident site were evacuated. A nursing home, which was situated in the path of the wind, was contacted by telephone and instructed to close all windows and doors. The headmaster of the school confirmed that the school would be kept closed.

Information was broadcast on the radio.

Both the fire and smoke emission continued to diminish. Fire extinguishing operations progressed to damping-down operations and then supervision. The co-ordinating staff on site returned to their normal work places and continued their work from there.

The decision was made that all personnel who were involved with on-site operations were to undergo medical examinations and prophylactic treatment.

7.40 - 10.40 a.m.

It was announced on the local radio that concerned people could ring to the town hall for information.



Fig. 4: The building in total ruin

The monitoring of toxic gas levels continued at the scene of the fire. The levels had diminished considerably. All gas readings, with the exception of those at the scene of the fire, were negative.

Railway traffic was permitted to pass by the scene of the fire.

It was decided to hold a press conference at 11.30 a.m.

10.40 a.m. - midnight

Keeping a watch on the scene of the fire continued.

The monitoring of toxic gas levels continued. No positive readings were obtained.

The Waterworks lowered the water pressure back to normal.

The fire was considered extinguished at approximately 7.00 p.m.

Rescue operations

Rescue services

Right at the start, when the extent of the fire was realised and which industries were involved, a major alert was initiated. The resources of eleven fire brigades in the region were commandeered. Approximately 175 firemen were involved in fire-fighting operations at the scene of the fire. A further 100 firemen were standing in readiness in connection with the fire.

In order to be able to douse the fire with sufficient water, even the nearest airport fire brigade was called in during the initial stages. Aeroplane crash appliances equipped with powerful water canons were utilised during the greater part of the fire fighting efforts.

The command team, which belongs to the "Katastrophenschutz" on an organisational basis, was immediately alerted. The group had two Volkswagen buses at their disposal which were equipped with tables and communication equipment. The two Volkswagen buses formed the nucleus of a command centre, involving representatives from all concerned organisations and offices, and were located directly adjacent to the scene of the accident. At 6 a.m. the personnel in command positions split up. The incident commander and sections of the command team from "Katastrophenschutz" returned to the fire station in order to engage themselves in more comprehensive management.

Catering for the 350 personnel at the accident site was the responsibility of the THW.

During the night, two other fires broke out, almost simultaneously. One was a fire in a cellar and the other a fire in flat that had spread to an adjoining flat. Some of the firemen who were standing in readiness at the chemical industries as well as firemen who had been alerted from elsewhere were sent to deal with these two fires.

Police

In total, approximately 100 police officers took part in operations involving cordoning off the accident area and imparting information to the general public using loudspeaker vehicles.

Medical care

The director of medical rescue operations and several ambulances were called to the scene of the accident. All the ambulances were manned by "Notarzt" personnel. Initially, when it was feared that there would be a greater release of toxic gases, a "contamination alert" was sounded. This entailed the manning of all ambulances and alerting the personnel in Red Cross aid teams. Moreover, additional personnel from the Knights of the Order of Malta and the Knights of the Hospital of St. John of Jerusalem were alerted. The hospital was informed of the accident at 3.38 a.m.

Scene of the accident

All available ambulances were directed to the scene of the accident. During the operations, three NAWs, three RTWs and four KTWs were employed. In addition, three other ambulances were redirected to two other fires. At 3.58 a.m. it was announced that the casualty assembly point, that is to say the Red Cross premises which had been decided upon due to their close proximity to the scene of the accident, was ready to receive the injured. The ambulances, which initially had been located at the command centre, were redirected so that there would always be one ambulance to the west, one to the east and one to the north of the accident site. Furthermore, there would always be at least one ambulance at the command centre. Medical personnel, other than ambulance medics and the "Notarzt" personnel, who manned the ambulances, were not at the accident site.

One injured person was transported to the casualty assembly point by ambulance, two to Klinikum Memmingen and two received ambulant treatment in the form of cortisone inhalation.

Casualty assembly point / Red Cross premises

A casualty assembly point was established in a large room at the premises of the Red Cross. The Red Cross ambulance station was also located in this building. There were camp beds, blankets, etc. in the room. Two Red Cross doctors were on duty in the casualty assembly point as well as night on fifty Red Cross assistants. Hot soup, coffee, tea, etc. were served at the assembly point. A doctor examined all casualties who were taken there after which they received cortisone inhalation treatment. In total, 234 people underwent treatment. Most of these received prophylactic treatment. 171 of those treated were rescue service personnel who were ordered to have check-ups before finishing work.

Hospital

After the hospital had received the alarm the catastrophe command team convened. It was decided that the hospital should be prepared to receive a large number of casualties. Doctors who were on-call and other key personnel were called in. The casualty department was reorganised in order to receive a large number of injured, stations were established to designate the levels of priority and certain wards were vacated. In actual fact, the hospital did not receive a large number of casualties. During the course of the night, only eight people suffering from smoke inhalation at other fires and four firemen with chemical burns from contaminated extinguishing water were taken to the hospital. Around fifty people were examined during the course of the night and the following day in connection with injuries, possibly related to the fire. The majority of these received prophylactic treatment in the form of cortisone inhalation and were later sent home.

Results of the injuries

Seven firemen were injured in connection with extinguishing operations. Four of these were effected by contaminated extinguishing water that caused chemical burns. Two of these firemen, who were standing next to a loading ramp, had their thighs and lower legs splashed with water that was running from the building. One fireman got contaminated extinguishing water in his boot and another was splashed in the face. Judging by the appearance of the injuries, there seemed to be a concentration of alkaline substances that had contaminated the water. One fireman sustained an allergic reaction when he came into contact with the

disinfectant used on his protective mask. Two others suffered from coughing and sore throats caused by the combustion gases. Seven policemen, who had inhaled smoke, exhibited similar symptoms, i.e. coughing, chest pains and sore throats.

All those affected from breathing in smoke were given cortisone inhalation therapy and were permitted to leave the hospital/ casualty assembly point following the treatment. The fireman who had suffered an allergic reaction received treatment from a doctor on site, after which he returned immediately to work. The firemen who sustained chemical burns received treatment at the hospital. Three of them were allowed home immediately after the treatment but the fourth had to remain in hospital for observation until the following day.

In total, approximately 250 persons received prophylactic treatment in the form of cortisone inhalation sprays.

Warning, information and evacuation

Warning

There was an alarm system for IA (Important Announcement) signals in Memmingen similar to the siren system in Sweden.

The command team decided against using the sirens during the operation as it was considered pointless to alarm the inhabitants of Memmingen unnecessarily. This decision was based, firstly, upon the time of day as most of the inhabitants would have been asleep during the first few hours of the operation and, secondly, had an immediate evacuation been called for, there would probably have been a greater number of casualties due to the uncontrolled movement of people than there would have been from the inhalation of combustion gases.

Instead, it was chosen to make an announcement informing the inhabitants of Memmingen of the accident.

Information

The possibility of broadcasting information via radio and television is similar in both Germany and Sweden. However, there is one exception - the local private radio stations. If these are to be utilised then the command team would have to contact each and every station individually.

The command team at the scene of the accident decided to inform the general public via:

- an announcement on the radio,
- an announcement broadcast via loudspeaker vehicles and
- via the establishment of an information centre at the town hall.

The announcement was broadcast on three national and three local private radio channels. The announcement consisted of a brief description of the events, the advice to remain indoors with closed doors, windows and ventilation ducts, and discouraging immediate evacuation. As a consequence of the positive readings with regard to hydrogen cyanide and ammonia, residents within a one kilometre radius of the scene of the accident were urged not to consume food or drink. The reporters at the local radio stations misinterpreted the information that was submitted and blew up the incident out of all proportion, broadcasting reports of dangerous clouds of toxic gases, etc.

A number of police vehicles equipped with loudspeakers drove continuously around central Memmingen giving out the same information that had been given to the radio stations.

The information centre, which had been established in the town hall, was intended for both the mass media and the general public. It did not, however, prove to be such an asset as the

command team had hope for. Information was infrequent and the media chose to glean details at the scene of the accident instead.

The old people's home and the hospital, which were located in the vicinity of the accident, were contacted via the telephone. They were informed of the incident and told what measures to take (i.e. to close all windows, doors and ventilation ducts). Personnel at these establishments were encouraged not to alarm the patients.

As the news of the incident became known, the number of journalists at the accident site slowly increased. Unfortunately, they had been given inaccurate information by the command team and chose to find out as much information themselves from other rescue personnel and "interested members of the public". Much of this gleaned information was incorrect and led to a lot of misunderstanding and rumours.

At 10.32 a.m. the command team decided to hold a press conference at 11.30 a.m.

Evacuation

The command team decided to evacuate the residential housing situated nearest to the factory (approx. 25 metres) and transported the residents to the casualty assembly point at the Red Cross premises.

Approximately 50 persons fled immediately and made their way to the Red Cross where they were examined by a doctor and received prophylactic treatment.

Diffusion of chemicals

During the course of the fire-fighting operation, chemicals from leaking containers in the building had mixed with large amounts of extinguishing water. A lot of this mixture had run down into the cellar, however, a lot had also run out onto the ground surrounding the building. The ground outside the front, rear and about a quarter of the long sides of the building was asphalted. The remainder of the surrounding ground was covered in gravel. According to reports, the extinguishing water would only spread to the sewage drainage system, though this hardly seemed plausible. The majority of the extinguishing water that ran out onto the asphalt probably flowed into the drains. None of these had been covered. The sewage-treatment plant that would receive the contaminated water was alerted but no damage was reported. The water that ran onto the gravelled areas was absorbed into the ground. There were several pools of water remaining at the scene of the accident the day after the fire. The water in these pools was most definitely alkaline, which is why it may be presumed that the extinguishing water, as a whole, had a high pH value.

There is a likelihood that plant life around the factory would be affected by the contaminated extinguishing water. The risk that subsoil water would be affected was considered minimal. There was no water catchment area in close proximity to the fire.

Air monitoring, with respect to hydrogen cyanide, ammonia and chlorine levels, was carried out in the immediate vicinity of the factory. Positive readings of hydrogen cyanide and ammonia were reported at 5.42 a.m. and 5.51 a.m. respectively. At 6.03 a.m. zero levels of chlorine were reported (it being uncertain whether chlorine or chloride levels were being monitored). The positive readings were the main reason behind an increased cordoning off of the area, recommendations that the public refrain from consuming food or drink within a one kilometre radius of the factory and that certain schools were to remain closed. The monitoring area was extended to a 2-kilometre radius from the scene of the fire. Readings were, however, negative.

It is hardly surprising, when considering the large quantities of chemicals involved, that air samples taken in the vicinity of the factory were found to be contaminated. Samples elsewhere were found to be negative and this was probably due to several factors. The intense heat of the fire undoubtedly caused the clouds of smoke to rise to such an altitude that the area around the factory was too close to be affected. Moreover, it is likely that the wind had a significant diluting effect on contamination levels.

Furthermore, there is to be an investigation to look into the effects that the accident has had on the environment. No results were available at the time when this report was compiled.

Experience

Extinguish or let it burn?

When there is a fire in which a number of chemicals are involved, it is impossible to know which chemical compounds will be found in the combustion gases. It may, however, be possible to form a 'general idea' of the type of compounds that may be formed and their properties. Tactically, it is much easier to deal with a release of significant magnitude if it is known which chemical(s) is/are involved.

At this fire, large amounts of water were used. Part of this extinguishing water, approximately 2,000 litres, accumulated in the cellar. Just as much again ran out into the factory's drainage system and into the ground. Fortunately, there was ground frost, as there had been had been subzero temperatures in Memmingen for a considerable period of time. This meant that less water was absorbed into the ground than would have been the case had the ground not been frozen. We are of the opinion that the majority of the extinguishing water ran into the drains which, according to information received, were connected to a sewage works situated some 5 kilometres from the fire. The sewage works reported that they had had no problems.

What was the long-term damage to the environment and what were the costs for decontamination? The extinguishing water had mixed with leaking chemicals. This, in turn, had lowered the temperature of the combustion gases which, consequently, mixed with the steam causing the combustion gases to become heavier. Had all effort been concentrated on confining the fire to a limited area and letting it burn freely, would the result have been a more complete combustion and a greater thermic climbing power?

The questions are many and expertise is insufficient at the present time.

What would the result have been had foam been used in the extinguishing operation instead of water? The release of chemicals into the air and ground would certainly have been less.

Indication and monitoring of gases

In order to be able to monitor gas concentrations it is necessary to know which gases are to be monitored and to have the equipment to monitor these gases. How do measuring instruments operate when there is a mixture of different gases that are also mixed with hot combustion gases? For example, if it is known that chlorine is present in the fire then a variety of different chlorine compounds would be formed. How would a measuring instrument react if set to monitor pure chlorine gas? How would the hot, wet combustion gases effect the instrument? The next big problem is how the monitoring is to be carried out in large volumes of combustion gases that are rising and drifting away. Monitoring was carried out using a helicopter in this operation. It was soon realised that it was an impossible task. Perhaps the only feasible method would be to wait until the cloud of combustion gases descended to the ground before taking readings.

Information to the general public

It is important when dealing with a fire of this sort, in which toxic or health-impairing releases can occur, that information to the public be correctly balanced and issued early on in the course of events. It is just as important that any warning announcements be withdrawn once the danger has passed.

With respect to this particular fire, one of the private radio stations broadcast, on several occasions, an "incisive" warning that was difficult to withdraw later on.

A press conference was called for 11.30 a.m. As the newspapers were to go to press before this time they, naturally, wanted to include this piece of news as an extra article. The journalists, therefore, attempted to gather information beforehand, partly by constantly ringing the command team and partly by acquiring information from other sources. The information obtained in this way proved to be seldom correct. One measure that we considered was to appoint a special press officer (similar to the post in Sweden). The first press conference must be called much earlier so that the command group would be able to give out the information it wished to. The incident commander together with staff unit medical leaders should make an announcement on television and radio so that correct and pertinent information is conveyed to the public. This announcement should be well prepared and intended to prevent the spreading of rumours and other possible actions taken by the public that would be detrimental to the situation. The information should be repeated. This ought to take place through the press officer although the incident commander and staff unit medical leaders should make themselves available at regular intervals so that they are able to answer questions, in particular from television and radio reporters.

It is essential that local radio stations be contacted so that they too can broadcast official announcements without "pepping" them up. This contact must be established before an accident has occurred so that an awareness of 'who's who' exists between the command group and the journalists. It is of equal importance that the command group 'know' journalists from the radio, television and the newspapers.

Emergency care

It is justifiable to carry out medical check-ups on all personnel involved in operations in which they are exposed to smoke containing large amounts of toxic or injurious substances. In Memmingen, a comprehensive prophylaxis involving cortisone inhalation was also administered. This would not have been the case had a similar incident occurred in Sweden. According to Swedish practice, everyone seriously exposed to irritant gases and who exhibits related symptoms is put under observation at hospital for at least 48 hours. This is due to the fact that serious symptoms (i.e. pulmonary oedema) may arise up to 48 hours following exposure to irritant gases. A comparison study would have been of great interest as it would give an indication as to whether or not a prompt prophylaxis would lower the necessity to keep a patient suffering from exposure to irritant gases under observation at hospital.

Organisation – Command – Co-operation

The tactics of the operation were to simultaneously extinguish the fire and to establish fire limitation lines. The large number of firemen engaged in the operation made this possible. However, it is uncertain as to whether all the active personnel were in agreement with respect to guidelines and decisions. Considering the large number of personnel at the accident site and that they belonged to several different organisations, it was difficult to maintain an internal flow of information. If it were ascertained that the flow of information could function well in such a large organisation with so many different parties involved then the Swedish rescue services would have much to learn from their German colleagues.

If a similar accident had occurred in Sweden, the guidelines of a rescue operation would probably have been quite different. Similar resources, used to hold the fire limitation lines and simultaneously extinguish the fire, are difficult to mobilise in Sweden and, in most places, it would probably be considered difficult to hold the limitation lines. Furthermore, it is likely that the internal flow of information would be considered unsatisfactory.

In Memmingen, a common director of medical rescue operations dealing with all medical care, i.e. "Organisatorischen Einsatzleiter Rettungsdienst", has existed on a trial basis for just over a year. He is an experienced ambulance medic from the Red Cross. The director of medical rescue operations holds a purely administrative post, his main task being to distribute and direct ambulances and their crews and also to decide upon which hospitals the injured are to be taken. However, this allocation seemed to be based more upon the quantity of resources rather than upon the quality of resources and specialisations of particular hospitals. It is possible that this is a system that would function in Germany, as ambulance crew and emergency doctors carry out a great deal of medical care administered at the scene of an accident, aided by first-aid personnel from the Red Cross, etc. The greatest drawback with this system is that there is no controlling medical administration. The director of medical rescue operations can never make any medical decisions, it is a matter for each individual doctor to give priority and decide which treatment shall apply. In this case, it is a definite advantage to have a command doctor in charge who can make administrative decisions as well as medical ones. Most towns in Germany do have the system with a "Leitende Notarzt", the German equivalent of the Swedish "ledningsläkare", (i.e. staff unit medical leader), as the director of medical rescue operations.

Conditions

The accident occurred one winter night when the majority of the inhabitants of Memmingen were asleep at home behind closed windows. This was fortunate for the rescue services as it gave them time to plan their strategy with respect to information, evacuation, closing of schools, etc. What would the situation have been like had the accident occurred on a summer day in the rush hour? In all likelihood, the number of casualties would have been considerably greater and it would have been necessary to carry out an organised evacuation.

The construction of the building may be regarded as being both fortunate and unfortunate. That the roof collapsed can have had a positive effect in that the fire was supplied with more fuel and the intensity thus contributed to a more complete combustion of the chemicals. The construction of the roof could also have made the fire more difficult to reach after it had

collapsed. This may have been the reason why more than the usual amount of extinguishing water was used which, in turn, may have increased the diffusion of chemicals.

The factory was not equipped with an automatic fire alarm. Had it been so equipped, then it is highly likely that the fire would not have been so devastating. Perhaps an early alarm system in factories dealing with chemicals would facilitate an operation involving a breathing apparatus team, which would, in turn, lessen the impact on the environment considerably.