

Paris, Tuesday 30 October 2001

Press Release

**EXPLOSION AT THE AZF FACTORY IN TOULOUSE:
THE GENERAL INSPECTORATE FOR THE ENVIRONMENT
HANDS OVER ITS REPORT TO YVES COCHET**

On the 24th of September 2001, Yves COCHET, Minister for Regional Development and the Environment, set up an urgent enquiry by the Inspection générale de l'environnement /General Inspectorate for the Environment on the explosion that occurred on the AZF industrial site in Toulouse. At the time Yves COCHET expressed the wish that an initial report should be handed over to him within a month.

This report, which has just been handed over to the Minister, presents a precise review of the administrative operating conditions at the AZF factory, the checks carried out by the Inspectorate of Classified Installations, the conditions relating to urban development around the site and information about ammonium nitrate.

On the basis of this initial report, which was drawn up within a short period of time, further expert reports will be commissioned, in particular regarding the origin of the accident and the means of prevention implemented by the operator.

The report also made a number of general recommendations aimed at improving policy on industrial risk management in the following fields: regulations governing ammonium nitrate, numbers employed by the Inspectorate of Classified Installations, critical examination of hazard studies, management of urban development in the vicinity of at-risk industries, improvement in the information and participation of the public, testing of emergency plans.

The complete report (3 Volumes: the report itself and its two volumes of annexes) is available on request in the form of a CD-Rom from the Inspection générale de l'environnement (*Tel = 01 42 19 13 40, fax = 01 42 19 13 45, e-mail annick.rousselet@environnement.gouv.fr or armelle.dif@environnement.gouv.fr*) and the text of the report will very shortly be accessible on the Ministry for Regional Development and the Environment's internet site at the URL address (<http://www.environnement.gouv.fr/infoprat/Publications/publi-ige.htm>)

On the 29th of October 2001, Yves COCHET also submitted to the Council of European Ministers for the Environment a memorandum about the explosion in Toulouse which put forward seven recommendations for Community Measures for improving the prevention of industrial risks at European level:

- to set up an enquiry into the adaptation of the scope of the SEVESO 2 Directive in order to strengthen the provisions applicable to factories that present a risk associated with the presence of ammonium nitrates.
- to set up an enquiry into the possibility of reducing the danger posed by ammonium nitrate-based fertilisers through the technical specifications applicable to these products.
- to strengthen the exchange of information between Member States about the risks associated with ammonium nitrates (fertilisers and industrial forms).
- to re-launch an enquiry into the measures to be adopted to prevent the risk of major accidents in ports and marshalling yards.
- to strengthen the exchange of information between Member States about the coexistence of at-risk activities alongside other economic activities, dwellings and thoroughfares.
- to set up an enquiry into a greater harmonisation of the methods and means of monitoring and controlling at-risk establishments by the public authorities.
- to strengthen cooperation between research and specialist bodies within the European Union.

The memorandum will also be accessible shortly on the Ministry for Regional Development and the Environment's internet site.

In order to receive a copy of the report here and now by e-mail – in pdf format, please contact the press department on 01 42 19 10 56.

REPORT OF THE GENERAL
INSPECTORATE FOR THE ENVIRONMENT

24 October 2001

Affair no. IGE/01/034

**Accident on the 21st of September 2001 at a
factory belonging to the Grande Paroisse Company in Toulouse**

Produced jointly with the Explosives Inspectorate and with help from the INERIS

by

François BARTHELEMY

General Mining Engineer

and

Henri HORNUS

Chief Civil Engineer

Jacques ROUSSOT

Controller General of the Armed
Forces (2s)

Members of the General Inspectorate for the Environment

and

Jean-Paul HUFSCMITT

Engineer in Chief of Munitions
Explosives Inspectorate

Jean-François RAFFOUX

Scientific Director of the INERIS

Ministry for Regional Development and the Environment

French Republic

MINISTRY FOR REGIONAL
DEVELOPMENT AND THE
ENVIRONMENT

Paris, 24 October 2001

GENERAL INSPECTORATE FOR THE ENVIRONMENT
Head of Department

**Note for
the Minister for Regional Development and
the Environment**

Subject: The Grande Paroisse Company's factory in Toulouse
Affair No. IGE/01/034

By telephone request on Saturday 22nd September, confirmed by letter dated 24th September, you asked that, as a result of the accident on the 21st which devastated the Grande Paroisse company's factory in Toulouse and caused numerous victims both on and off site, the IGE as a matter of urgency set up a commission of enquiry. You asked for the report to be submitted to you within a month.

Francois Barthélemy, who led the enquiry, arrived on site on the 24th of September. On the 1st of October the Explosives Inspectorate agreed to make available to us its pyrotechnic expertise (through J.P. Hufschmidt) and, at the same time, I seconded two other members of the IGE to the Commission (Messrs. H. Hornus and J. Roussot). The INERIS contributed its technical expertise to the Commission.

The Commission worked on four lines of enquiry:

- the hazards of ammonium nitrate in its various uses and the safety regulations that are desirable,
- the means of the Inspectorate of Classified Installations in Toulouse and the methods with regard to hazard studies,
- the procedures for informing the public of the hazards associated with the site and the implementation of the provisions regarding urban development around the site,
- a few initial general thoughts on the measures that would allow a comparison between the position of SEVESO sites that have urban development in the vicinity.

The Commission was anxious to comply with the time limits that you set us and did not for example carry out any local consultation. The investigations undertaken by the INERIS have not yet been completed. The Commission brought its work to a close yesterday based on the data that were available to it. The precise cause of the accident has not yet been established,

but a detailed analysis of the potential risks of ammonium nitrate has been undertaken. The INERIS is continuing its investigations. The Institute is thereby seeking to specify the exact nature of the products stored.

I am sending their report to you and also to the DPPR and propose to you a plan of distribution. Volume II of the report, comprising the bulkiest annexes, will be sent to you at the end of the week, because of the time taken to get them reproduced. It is intended that this report should be made public after you have had time to study it.

Technical investigations are in progress in addition to the judicial enquiry opened by the Prosecutor. The INERIS is working in particular along two lines of enquiry:

- the exact nature of the products stored,
- the origin of these products.

On the 28th of September the Government announced its intention to improve information to the general public and to reform the regulations around at-risk industrial sites. The legal enacting terms are still in the process of being drawn up. The Commission's proposals are focused on the approach and the contents.

The strengthening of hazard studies (in particular accident scenarios, the fact of taking into account possible defects in safety systems, domino effect) and therefore the strengthening of safety levels (increased back-up, double confinement of toxic substances, division of explosive substances into smaller amounts), proposed by the Commission, will in the first instance require substantial efforts on the part of manufacturers. In this context, the lessons regarding the management of neighbouring production plants must be learned; the traditional safety approach among explosives manufacturers, that is intended to protect the exterior and workers (which amongst other things largely relies on division into smaller amounts) has shown its usefulness in the face of a serious external accident.

The Commission also recommends a greater homogenization of hazard analyses which must come about through international comparisons and through a more precise national technical statutory framework. The Commission stresses the need to strengthen the technical support both to the DPPR and to the different DRIRE. The government has already announced a strengthening of the resources of the INERIS towards 2002. This is a first stage.

Moreover, the Inspectorate of Classified Installations will have to strengthen its monitoring procedures.

The Commission proposes increasing the amount of information available to the public, including information about existing installations, in two directions: the PPI (intervention plan) and in particular the level of risk and the size of the exposed populations.

The IGE is at your disposal to complete this analysis in a few months time when the expert reports are available. The supplementary enquiry could relate both to Toulouse and similar sites.

J L Laurent

Head of Department

Report on the Grande Paroisse company's factory in Toulouse

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- 2 - Note from the Head of the Inspectorate General of the Environment dated 1st October 2001
- 3 - Map of the South of Toulouse to a scale of 1/25000
- 4 - Plan of the Grande Paroisse factory to a scale of 1/2000
- 5 - Aerial photographs of the site
- 6 - Map showing the areas covered by the PIG and the PPI

List of related documents appearing in Volume 2

- A : Opinion of the INERIS on the Grande Paroisse factory's SGS Safety manual.
- B : Note on the Braqueville site and the gravel-pits
- C : Description of building 221
- D : Chronology of 21st September
- E : Account of the interviews with employees from Grande Paroisse and the other companies operating on the site
- F : Analysis of the damage observed in Toulouse after the accident on the 21st of September
- G : Report of the Midi Pyrénées Observatory at the Université Paul Sabatié
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- I : Inspection report for the SNPE and Tolochimie sites

- J : INERIS note on ammonium nitrate
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- N : Data sheet on the Grande Paroisse ammonium nitrate

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- P : Views of the Communes of Toulouse, Ramonville St Agnes and Pechbusque on the extension project.
- Q : Conclusion of the committee of enquiry into the application for an extension
- R : Minutes of the Meeting of the Departmental Hygiene Council on 28th September 2000.
- S : Prefectoral order of 18th October 2000 and extract from the technical specifications.
- T : Opinion of the INERIS on the town planning controls around 3 chemical sites in Toulouse.

- U : Note from the Prefecture dated 26th March 1979
- V : Minutes of meeting on 23rd June 1988
- W : Order dated 21st August 1989 defining the PIG
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- AA: Brochure for informing the public as part of the PPI
- AB: 2001 timetable for POI exercises.
- AC: Minutes of the SPPPI meetings on the 4th and 11th October 1999.
- AD: Letter from the Mayor of Toulouse to the Prefect dated 21st May 2001 and reply from the Prefect to the Mayor of Toulouse dated 20th June 2001.
- AE: Letter from the Mayor of Toulouse to the Commission dated 17th October 2001

General Inspectorate for the Environment

REPORT

**to the Minister for Regional Development
and the Environment
on the accident that occurred at the Grande Paroisse
company factory in TOULOUSE on 21st September 2001**

By letter dated 24th September 2001, the Minister for Regional Development and the Environment asked the General Inspectorate for the Environment to carry out an urgent enquiry following the accident on the 21st of September 2001 at the Toulouse factory of the Grande Paroisse company. A copy of this letter is to be found in Annex 1. The purpose of this Commission was to try to establish the technical, organisational and human causes, analyse the means of prevention employed by the operator and the checks carried out by the Inspectorate of Classified Installations and the adequacy of the measures aimed at limiting the consequences of such an accident (possibility of domino effect, urban development controls, internal and external emergency plans, informing of the public).

For this Commission, the Head of the Inspectorate General for the Environment appointed François BARTHELEMY, General Mining Engineer, Henri HORNUS, Chief Civil Engineer, Jacques ROUSSOT, Controller General of the Armed Forces (2s) and sought expert help in the form of Jean-Paul HUFSCMITT, Engineer in Chief of Munitions, a member of the Explosives Inspectorate (Annexe 2). This Commission received help from the INERIS which was coordinated by M. Jean-François RAFFOUX, Scientific Director. The Commission began its work on-site on the 24th of September 2001.

The Commission of Enquiry was anxious to comply with the time limit of one month that had been set for it and to report on the information that was available to it by the end of this period. Specialist technical enquiries, in particular by the INERIS, are still in progress. We were not able to meet all the many people whom it would have been desirable to hear from. Moreover, because of the extent of the disaster, a judicial enquiry has been launched and judicial experts have been appointed. Part of the operator's technical documentation has therefore been seized by the legal authorities. So far it has not been possible to establish the precise cause of the accident and so this aspect has not been tackled in this report.

Attached to the present report are to be found a number of annexes (numbered 1, 2, etc.) and, in a second volume, documents to which this report makes reference (related documents numbered A, B, C etc.).

Part One

1 The chemical factories in the South of Toulouse

In the XVII^o century, there was a an explosives factory on the île de Tounis which was then obliged to relocate towards the South after a series of accidental explosions (1781, 1816, 1840), in order to be able to carry on benefiting from the energy provided by the river, whilst at the same time moving it further away from the growing city. Between 1914 and 1918, the national explosives factory underwent an exceptional period of growth, spreading along the left bank of the Garonne and swallowing up land as far as the Southern limit of the Commune of Toulouse.

In 1924, the ONIA (Office National de l'industrie de l'azote/National Nitrogen Industry Board) was created, as a result of which the production of nitrogenous fertilisers was separated off from the explosives department. The ONIA then became APC then CDF Chime-AZF, SCGP and since 1991 Grande Paroisse which now forms part of ATOCHEM and therefore part of the TOTAL FINA ELF Group.

SNPE was created by a law of 8 March 1971, which transformed part of the Explosives Department, a branch of the Ministry of Defence, into a national company. The manufacture of gunpowder on the Toulouse site was halted in 1973 and since that time SNPE's activities on the site have been directed towards chemicals. Tolochimie was set up in 1961, formed part of the Rhône Poulenc Group and, since 1996, has been incorporated within the SNPE Group.

1.1 – The Grande Paroisse (formerly AZF) factory

The Grande Paroisse company's factory is situated on a 70 ha site to the south of Toulouse about 3 km from the centre of the city, on the left bank of the Garonne. It employs 470 people.

The factory produced fertilisers and a variety of chemical products. From natural gas, the factory produced ammonia (1150 t/d) then nitric acid (820 t/d), urea (1,200 t/d) and ammonium nitrate. The production of ammonium nitrate consisted of 850 t/d of granules for fertilisers, 400 t/d of granules for industrial use (mainly for the manufacture of explosive "fioul" nitrate used in quarries and civil engineering) and nitrogenous solutions (1,000 t/d).

The factory also produced various other chemicals: melamine (70 t/d for the manufacture of resins), formalin, chlorinated derivatives, adhesives and resins and hardeners.

The factory stored considerable amounts of hazardous substances, the maximum permitted values being:

- ammonia: a tank containing 5,000 t, a 1,000 t sphere in cryogenic form and 315 t stored under pressure.
- chlorine: 2 x 56 t tankers
- ammonium nitrates: 15,000 t in bulk, 15,000 t in sacks and 1,200 t of hot solution.

On the 21st of September, on the Southern area of the site there were also 4 tankers of chlorine and 20 tankers of ammonia. In Annexe 4 is to be found a plan of the factory locating the various workshops and storage facilities.

1.2 – SNPE

SNPE is located on a 38 hectare site to the South of the île d'Empalot. Its Northern limit is the railway line from Toulouse to Auch and Bayonne. There is a branch line serving the SNPE site, which nowadays is skirted by the ring road. To the West, are to be found the installations of the Grande Paroisse chemical complex and the Southern exit of the Route Nationale 20. To the East, the site is dominated by the sparsely populated slopes of Pech David which form the right bank of the Garonne. The site has the general form of a triangle, two sides of which are formed by branches of the river.

The SNPE therefore faces the Grande Paroisse site, and is only separated from it by the lower branch of the Garonne. This means that the SNPE installations closest to the accident that occurred on the 21st of September, are at a distance of 500 metres from the origin of the explosion, and those furthest away at a distance of 1,000 metres.

The Toulouse factory employs 469 people, and has a turnover of some 100 millions of euros. Its production is mainly geared towards the space, defence, specialist chemicals and pharmaceutical industries.

1.3 Tolochimie and Isochem

Situated at the Southern end of the site, between the disused plots of the former Braqueville national explosives factory and those of the gravel-pits, the firm TOLOCHIMIE occupies an area of 10 hectares. It relies on SNPE for its basic supplies, especially a pipeline for circulating dissolved phosgene.

TOLOCHIMIE produces speciality chemical intermediaries, mainly for agricultural use. This company employs 110 people, and has a turnover of 25 million euros.

The ISOICHEM factory is installed on the SNPE site, in a block which came into service in 1998. It is therefore completely incorporated within the prevention and protection system of the Empalot factory. ISOICHEM principally consists of a recent production unit for pharmaceutical active ingredients and intermediaries. It employs 38 people.

1.4 Other installations

To the South of the Grande Paroisse factory are to be found the sites of the former Braqueville national explosives factory occupying an area of 70 ha and the gravel-pits occupying 37 ha in which there remain thousands of tonnes of gunpowder residues. A note is to be found in Annexe B.

Also enclosed are:

- Annexe 3 : a map to a scale of 1/25,000
- Annexe 4 : a plan of the Grande Paroisse factory to a scale of 1/2000
- Annexe 5 : aerial photos of the site
- Annexe A : opinion of the INERIS on the SGS safety manual of the Grande Paroisse factory.
- Annexe B : note about the Braqueville site and the gravel-pits.

Part Two

2 The explosion on 21st September 2001

2.1 Building 221 222

The explosion on 21st September 2001 occurred in a “downgraded ammonium nitrates” store, building 221 222 (see plan of the factory in Annexe 4 and the INERIS note in Annexe C) which was authorised for 500 t and contained between 300 and 400 t of product on the day of the explosion.. The “downgraded” products came principally from the ammonium nitrate production and packaging workshops for producing fertilisers or industrial ammonium nitrate; the downgrading could be linked to irregularities in the particle size and also to the composition of the products. These products were then sent to other factories in Fenouillet or Bordeaux for re-use in the manufacture of complex fertilisers.

This building was adjacent to the sack-filling building, 123 124 125, where combustible products were stored.

This group of buildings was not fitted with a fire detection system. Work to bring the infrastructure of the building up to the required level had been undertaken over the last few years.

Building 221 222 did not have any nitrogen oxide detectors and in a note dated 6th June 2001 about the retention of water for fire fighting sent by Grande Paroisse to the DRIRE (pursuant to the authorisation order dated 18th October 2000) it was listed under the heading “improvement”: : “The presence of NOx detectors would help to reduce the time taken to raise the alarm and consequently the time taken to put any fires out and the amounts of water used to do so.” Such devices were present on other larger storage facilities on the site. This situation was consistent with the fact that whilst the risk from fire was contemplated on this type of storage facility, the risk of explosion was considered by the operator to be negligible (see Part Three).

The running of building 221 222 was supervised by Grande Paroisse’s dispatch department and sub-contracted to outside firms. Handling operations in this building were carried out by personnel from a sub-contracting company called TMG who also carried out the handling of nitrates in sacks and on pallets.

2.2 The explosion of 21st September

The day before the explosion, 15 to 20 t of ammonitrate containing an additive that had been manufactured and was at the qualification stage were brought into this building. On the morning of the explosion, products resulting from the packing of ammonitrates and from the manufacturing workshops were brought into this room. The last product having been brought in less than half an hour before the explosion was a skip coming from another storage area.

A Grande Paroisse employee had left the sack-filling building 5 minutes before and had not noticed anything out of the ordinary. Investigations are in progress to find out the nature of the products stored. The explosion occurred at 10.17 am., in building 221. It caused the death of 30 people, 22 inside the factory and 8 outside. 2,500 were injured, 30 of them seriously and one of whom died last week. The explosion took place 3 km from the centre of Toulouse (see chronology of 21st September in Annexe D and interviews with the personnel in Annexe E).

At this point in time it is not known what caused the explosion. In order for ammonium nitrate to explode, even when it is sensitized by the presence of certain products (for example combustible substances) it requires a source of energy, the nature of which is still not known.

An analysis of the consequences of this explosion: the distortion of the various structures, damage to the buildings, broken windows, leads us to estimate that the power of this explosion was comparable to that of 20 to 40 tonnes of TNT (reference explosive in pyrotechnical calculations) which means that between 40 and 80 tonnes of ammonium nitrate would have detonated. (see in Annexe F). In Annexe G will be found a report on seismological data and in Annexe H a report on air pollution.

2.3 Effects of the explosion in the factory – Domino effect

In the field of industrial risks, by “domino” effect is meant the risk that one accident (mainly a fire or explosion) may result in another accident in one or more neighbouring installations.

The explosion produced a crater measuring about forty metres in diameter and 7 m in depth in relation to the natural ground. It caused considerable destruction throughout the Northern part of the site.

Regrettably 22 people were killed on the Grande Paroisse factory site.

The Northern part of the Grande Paroisse factory site was devastated by the explosion. This led to the destruction of a number of tanks containing ammonium nitrate and pollution of the Garonne as well as nitric acid leaks. The tank containing a hot solution of 95% ammonium

nitrate was damaged but without leading to a leak. The explosion did not spread to other ammonium nitrate storage facilities in this area.

By great good fortune, there was no domino effect beyond. The pressurized ammonium storage facilities 300 m away from the explosion were relatively protected by a building which underwent serious damage itself but which acted as a screen. The liquid ammonia storage facility located more than 600 m from the explosion did not suffer direct damage. The building housing the chlorine storage facility at a distance of 500 m suffered damage but the tankers inside were not affected.

The tankers holding these same products (4 chlorine tankers and 20 ammonia tankers) located to the South of the site at a distance of over 400 m, were protected by certain buildings whose structure withstood the shockwave.

The consequences of the explosion in terms of human loss of life and injury could have been much more serious if a storage facility housing toxic products had been seriously damaged or if a tanker of chlorine or ammonia had been located near the area where the explosion occurred and had been damaged. The effects of the cloud would have been all the more life-threatening since the explosion had blown out the windows over a large area around the site.

2.4 Effect on the neighbouring SNPE and Tolochimie installations

SNPE suffered considerable damage to its general installations and regrettably a number of its personnel were victims, including one person killed.

However, no technical installation was damaged, and no leak occurred. The installations immediately benefited from their automatic safety systems coming into effect and the personnel took the scheduled precautionary measures. Since then, the installations have been in the process of being assessed.

The “utilities” were soon reconnected, in particular the electricity supply needed for the essential technical devices was switched back on the first night. At present, work is in progress to clear the rubble and debris and to make everything safe on a permanent basis.

The fact that, in this case, there was no domino effect, was not the result of chance, but in our opinion, to a way of going about things that stems from the precautions applicable to powders and explosives. This involves three principles: dividing them up into small amounts, the erection of partitions and the overabundance of safety devices/systems.

For example the phosgene stored on the site is divided up into tanks containing smaller amounts, which are installed underground and confined. These were able to withstand a major force such as the one on the 21st of September. On certain installations there were walls providing protection against internal deflagrations, which, in the case in point, provided protection against the external shockwave.

It should also be noted that the double-walled phosgene pipeline crosses the lower branch of the Garonne on an earthquake-resistant passageway and that the safety device protecting it from vibrations operated correctly on the 21st of September.

Finally, if only to record our findings from an overall inspection of the SNPE site (see Annexe I), the principle of the systematic confinement of hazardous products, a principle laid down by the DRIRE, certainly proved decisive in ensuring the satisfactory behaviour of the installations.

Being a long way from the explosion, TOLOCHIMIE did not suffer any damage other than a few broken windows.

ISOCHEM, which was fairly close to the source of the explosion suffered external damage and it lost some of the metal coverings that formed its façade. However, it would appear that its technical installations were not damaged at all.

The absence of any “domino” effect can be explained by:

- the distance which lessens the side effects of an accident,
- the small amount of products stored or in the course of preparation, which enabled them to be kept within better protected areas (this is only possible with speciality chemicals or pharmaceuticals).

2.5 Effects outside the site

The amount of material damage outside the site was considerable. Some neighbouring buildings were destroyed and further away very many were damaged, and windows were broken at a distance of several kilometres from the place where the explosion occurred (see Annexe F).

2.6 Crisis management

Our terms of reference did not cover crisis management. However, in order to carry out our task we began our work in Toulouse on the 24th of September 2001. At this point in time, all

the resources of both the authorities and the operator were mobilised in order to tackle the immediate consequences of the disaster.

After the explosion, the management team at the factory found itself in a very weakened state, for a number of reasons: it had been profoundly shocked by the number of victims within the factory (22 people died), the offices and technical documents had been ravaged, the usual technical resources were no longer available with the result that all operations became difficult. In the first few days after the explosion, the local management team did not receive the support that the Parisian departments or the other factories in the group could and should have provided to the Toulouse factory. The central administration of the MATE had to intervene with the group.

In view of the presence on the site of substantial amounts of hazardous substances under conditions which were no longer the normal ones obtaining, the authorities asked the operator to make them safe and then to remove them from the site. However, the operator would have liked the authorities to indicate to him in detail what needed to be done, and this presented a risk of a confusion of roles. It is necessary to stress the need to respect – as far as possible – the roles of the various parties involved. The operator must take the necessary steps to ensure that the site is safe, including after an accident. The authorities must assess these steps, relying where necessary on expert opinion, but they must not take over the operator's role.

In the Annexe will be found:

- C : Description of building 221
- D : Chronology of the events of 21st September
- E : Report on the interviews with the employees of Grande Paroisse and the firms operating on the site
- F : Analysis of the damage observed in Toulouse after the accident on the 21st of September
- G : Report from the Midi Pyrénées Observatory of the Paul Sabatié University (which explains how a single explosion can be heard at a certain distance as two “bangs”)
- H : the results of air quality measurements carried out by ORAMIP (Observatoire régional de l'air en Midi-Pyrénées/Midi-Pyrénées regional air observatory)
- I : Inspection report on the SNPE and Tolochimie sites.

Part Three

3 Ammonium nitrate

3.1 The dangers of ammonium nitrate

Ammonium nitrate (NH_4NO_3) presents risks of more or less rapid combustion (because of its composition this product may be consumed in the absence of oxygen) with toxic gases given off (nitrogen oxides). It also presents risks of explosion which are complex and which vary a great deal according to whether it is mixed with a small proportion of inert product or on the contrary with combustible products or catalysts influencing its decomposition. This results in a great deal of confusion which often allows manufacturers to state that these products do not present any risk of explosion, but only a risk of combustion (see in Annexe M an extract from the Council for Classified Installations report dated 15th March 2001 and in Annexe N the data sheet on ammonitrates drawn up by Grande Paroisse).

The Commission considers that ammonium nitrate must be regarded as an explosive substance since, under certain conditions where it is mixed with combustible compounds or catalysts and with a fairly strong source of energy or in the event of confinement, it may detonate.

This risk is relatively small since it requires a fairly strong source of energy to cause a detonation so that usually the product is consumed more or less quickly. Whilst this risk is small, it is somewhat unpredictable since it varies greatly according to the properties of the product and its degree of pollution.

This was tragically illustrated by the OPPAU accident (Germany) in 1921. This factory manufactured a fertiliser composed of a mixture of ammonium nitrate and sulphate. The product regularly solidified and explosive charges were used (20,000 explosive charges were used to break up the mass), but the explosive charges on the 21st September 1921 caused a violent explosion leaving 561 people dead. An enquiry showed that the composition of the mixture had been modified shortly before the accident. In Annexe K will be found a list of accidents involving ammonium nitrate drawn up by the BARPI (bureau d'analyse des risques et pollutions accidentels /Industrial Pollution and Risk Analysis Bureau).

Chemically pure ammonium nitrate contains 35% nitrogen and ammonium nitrate is characterised by the nitrogen content which for fertilisers is the sought after component. So we find industrial ammonium nitrate, mainly used for the manufacture of "fioul" nitrate, which has a nitrogen content of 34.6% that is to say nearly 99% nitrate, and straightforward fertilisers with a 33.5% nitrogen content, that is to say over 95% nitrate.

3.2 Regulations on ammonium nitrate

In Annexe J will be found a note from the INERIS about the regulations on ammonium nitrate in various European countries.

The difficulty of clearly defining the risks associated with ammonium nitrate is reflected in the initial version of the SEVESO Directive of 24th June 1982 by the following classification: ammonium nitrate 5,000 t pursuant to article 5 (notification with hazard study) accompanied by the following note: “insofar as its state confers on this substance properties liable to create a risk of major accident”.

In 1987, an amendment to this Directive made the following distinction:

- ammonium nitrate in which the nitrogen content due to ammonium nitrate is greater than 28% by weight: threshold of 2,500 t and solutions in which the concentration of ammonium nitrate is greater than 90% by weight
- ammonium nitrate in the form of fertilisers in accordance with Directive 80/876 in which the nitrogen content due to ammonium nitrate is greater than 28%.

In the SEVESO II Directive Annexe I are to be found the following substances with the thresholds pursuant to the provisions of article 9 (referred to as “high” thresholds) and articles 6 and 7 (“low” thresholds) of the Directive:

	“low” thresholds	“high” thresholds
Ammonium nitrate in accordance with the fertilisers Directive	1,250 t	5,000 t
Other ammonium nitrate	350 t	2,500 t
Explosive substances (risk phrase R2)	50 t	200 t

The thresholds for ammonium nitrate are set out in the list of classified installations, headings 1330 and 1331 but without adopting the threshold of 28%.

This comparison shows that the classification has been made on the assumption that the risk of explosion with ammonium nitrate was negligible and only taking into account the risk of combustion with nitrogen oxides being given off.

At its meeting on the 28th of March 2001, the Explosive Substances Committee drew attention to the hazards of certain NK (nitrogen potassium) fertilisers containing more than 90%

ammonium nitrate that is to say 31.5% of nitrogen with chlorides in the form of potassium chloride. (see opinion in Annexe L).

3.3 Proposals

Under these conditions it would be desirable to review the regulations on ammonium nitrate.

1 – The regulations on nitrogenous fertilisers should limit the maximum nitrogen content to a value of between 28 and 31.5% (80 to 90% ammonium nitrate), which would reduce the risk of explosion and the risk of use as explosive.

2 – For nitrogenous fertilisers with less than 31.5% nitrogen (90% ammonium nitrate) rules similar to those which are in force in Germany and the Netherlands should be adopted:

rules on the composition

rules on the storage in packed form away from production sites

limits on the amounts per cell and establishment of safety distances in view of the risk of detonation

4 – A standard should be introduced to define precisely what constitutes industrial ammonium nitrate. Research work should be carried out to determine the regulations to be applied to this product.

5 – Products which do not conform to the regulations in the manufacture of nitrogenous fertilisers or industrial ammonium nitrate and contaminated products should be treated as explosives, which involves special rules to protect workers and people living nearby.

At European level this means amending the 80/876 Directive on Fertilisers and adapting the thresholds of the SEVESO II Directive.

Without waiting for the amendments to the European regulations proposed above, steps should be taken to begin making the corresponding amendments to French regulations:

- To have the corresponding hazard studies updated (bearing in mind the risks of a domino effect in production factories between facilities storing ammonium nitrate and facilities storing ammonia)**

- To lay down new technical rules on facilities storing ammonium nitrate**

- **To amend the list of classified installations in accordance with the previous guidelines**

These provisions will involve substantial modifications to these kinds of installation, both at production and storage level, especially fertiliser plants, of which there are a very large number.

In the following annexes will be found:

J - INERIS note on ammonium nitrate.

K - BARPI note on fires and explosions involving nitrates.

L - Recommendation of the CSE (Explosive Substances Committee).

M - Report of the CSIC dated 15th March 2001.

N - Grande Paroisse data sheet on ammonium nitrate.

Part Four

4 Regulations on installations

In this part we will examine the present regulations aimed at ensuring the safety of installations then in the following part we will take into account the risks outside the industrial site.

4.1 General provisions

The Grande Paroisse factory in Toulouse, the SNPE, Tolochimie and Isochem are subject to the legislation on classified installations for the protection of the environment under the authorisation regime.

This legislation is set out in the law of 19th July 1976 which became Part I of Book V of the Environment Code (articles 511-1 et seq.). According to the terms of article L.512-1 of the Environment Code, [the following] “shall be subject to prefectoral authorisation: installations which present serious hazards or disadvantages for the interests referred to in article L.511-1”, that is to say installations which “may present hazards or disadvantages either for the comfort of the neighbourhood, or for health, safety, public health...”.

These installations are set out in a list of classified installations drawn up by decree in Council of State. This decree makes the installations subject either to authorisation or to declaration depending on the seriousness of the hazards or disadvantages that may arise out of their operations (L 511-2).

It is added in L 512-1 that “authorisation may only be granted if these hazards or disadvantages can be prevented by the measures specified in the prefectoral order”. This means that there is a sort of balance between the risks covered by the authorisation to operate and the measures which are recommended and which it is incumbent on the operating company to implement.

The decree of 21st September 1977 specifies the procedures to be applied. The technical regulations are laid down in numerous texts.

The SEVESO I Directive of 24th June 1982 required operators to carry out hazard studies for installations that presented the risk of major accidents. It also required them to organise inspections, and to inform the public what to do in the event of accidents. The SEVESO II Directive of 9th December 1996 also requires those responsible to set up a safety management system and to carry out a periodic re-examination of the hazard studies every 5 years. It also requires them to set up emergency plans and to control urban development.

The provisions of the SEVESO II Directive were transposed into French law within the framework of the legislation on classified installations by a decree of 20th March 2000 amending the decree of 21st September 1977 and a ministerial order of 10th May 2000.

4.2 Regulations governing the Grande Paroisse factory in Toulouse

The factory was previously regulated by a prefectoral order of 12th February 1996 supplemented by an order of 9th September 1998 following a major ammonia leak (see below) and an order of 30th May 2000 specifically concerned with aerorefrigerants (legionellosis risk).

In 1999, the company lodged a request to extend the production capacity for ammonia, urea and nitric acid, without extending the storage capacity. Consequently, the public enquiry file gave information about the risks regarding the workshops that were to be extended but not on the other workshops nor on the storage facilities. This situation is formally correct but it nevertheless poses a problem with regard to informing the public.

In the complete file was to be found a scenario involving a leak of synthetic gas leading, under certain conditions, to a 1% lethal risk within a radius of 212 m and a significant risk of irreversible effects within a radius of 1,086 m. The file recorded that these values remain within the limits laid down in the PIG and PPI respectively. These values were not validated by a third party expert and we will come back to them in the section on hazard studies.

The non-technical summary of the hazard study (Annexe O) was particularly succinct and concluded with the words "Bearing in mind the safety measures taken when the capacity was extended, the safety of the site will be improved." That was true but gives no idea of the level of risk posed by the factory.

The extension project was examined by the SPPPI's risks and information committees (see below) on the 4th and 11th of October 1999 (report in Annexe AC). Questions were asked about the risks posed by an aircraft crashing or pollution, but they do not seem to have mentioned the risk of major accidents connected with leaks of ammonia or chlorine in the storage facilities. The draft non-technical summary of the application file was examined and was the subject of a few corrections; the document remains very weak on the hazard study.

In the file submitted to the enquiry the detailed drawings and lists of products were withdrawn at the request of the operator as being confidential, which is formally acceptable.

The application was put before a public enquiry that lasted from the 3rd April to the 4th of May 2000 with a commission of enquiry consisting of three members who, amongst other things, held a public meeting bringing together about thirty people. At the end of the enquiry the commission gave a favourable opinion (conclusions in Annexe Q).

The town and parish councils for the communes concerned gave their verdicts (opinions in Annexe P):

- Pechbusque and Ramonville St Agne were against the project;
- Toulouse was in favour, although it expressed reservations about the effectiveness of the sirens and the extent to which flooding had been taken into account.

The services concerned made various comments and the DRIRE drew up a report dated the 8th and 12th of September 2000 which was examined with the draft order by the Departmental Council of Health on the 28th of September 2000 (report in Annexe R).

The order of 18th October 2000, which authorises this extension, comprises 14 pages, including 9 pages of dense tables listing the authorised installations. Article 2 of the order called for various studies, including a hazard study on the ammonia circuits (Annexe S).

Attached to the order was a complete set of technical requirements (42 pages) repeating and bringing up to date all the provisions applicable to the factory. This way of going about things requires a great deal of work for the inspectorate, but it has the advantage of giving both the operator and the inspector a single document in which all the provisions are brought together. It avoids the superimposition of a number of orders which one sometimes encounters with certain older installations.

Section 6 of the annexe to the prefectural order was concerned with the general provisions on safety and the following sections with the special provisions regarding the various workshops, in particular section 10 was concerned with the ammonium nitrate storage facilities. These specifications were concerned with the bulk storage of ammonitrates in building I 4 and the storage of liquid ammonium nitrate.

4.3 Regulations governing the SNPE factory

The position of SNPE is currently governed by prefectural order no. 182 of 26th November 1997, issued after evidence had been taken from all parties concerned, inter alia a public enquiry and listening to the views of the municipal authorities. This order repeals that of 30th

July 1992, which goes to show that the updating of this fundamental document was carried out within the statutory time limit.

Moreover, a supplementary order, dealing with the industrial pharmacy workshop and preparing for Isochem to come into operation, was issued on 9th November 1998 under the number 189.

The order of 1997 was in the process of being revised and this revision was already well under way.

Order no. 182 records 58 nomenclature headings, including 11 AS, 34 A and 13 D. The draft revision thereof lists 98, including 8 AS, 48 A and 42 D (where A = authorisation, S = obligations, D = declaration). One can thus note a refinement both of the regulations and of the knowledge of the installations, and at the same time a reduction in the variety of the most hazardous installations. Article 2 of this same document gives the manufacturer notice to install a unit for treating liquid and gaseous effluent which is to be brought into service by the 31st December 1999.

As regards specifications, the details are to be found in the annexes to the same order, bearing in mind that the timetable for their implementation is the subject of article 3. If these specifications are compared with those in the new prefectural order that is now in the process of being drawn up, it can be seen that there are additions that take into account statutory developments in terms of safety management or further elements with a view to getting the newly built effluent treatment unit under way.

These technical specifications also lay down the timetable for drawing up the hazard studies for the coming five years.

In addition to this central order there are particular orders relating to supplementary points, namely:

one dated 9th November 1998 on the constitution of financial guarantees (no. 188),
one dated 7th June 1999 giving notice to improve the effluent (no. 154),
one dated 30th May 2000 on the prevention of legionellosis (no. 54)

4.4 Regulations governing the Tolochimie and Isochem factories

1) TOLOCHIMIE is currently subject to a prefectural authorisation order no. 186 dated 12th August 1999. It comprises 29 headings including 7 AS, 15 A and 7 D. It requires financial guarantees to be set up for three installations (hydrogenation, phosgenation, nitric acid) and

lays down a timetable for implementing the technical specifications. Amongst these, is the care devoted to the double confinement of phosgene (§ 9.3.3)

2) Until the Grande Paroisse accident, the activities of ISOICHEM were regulated by prefectural order no. 69 of 8th June 2000. This order comprises 36 headings including 21 A, 15 D but no AS. The special technical specifications are concerned with chlorine, phosgene, radioactive substances and the risk of legionellosis. They do not mention hazard studies.

A reading of the prefectural orders relating to the various installations shows that a work of quality is thus performed and maintained by consultation between the manufacturer and the DRIRE, and that the State duly exercises its power to police classified installations. The details of this monitoring process are analysed further on in the report.

4.5 Hazard studies

Article 5 of the decree of 21st September 1977 requires that authorisation application files shall include: "a study setting out the hazards that the installation may present in the event of an accident and proving the measures taken to reduce the probability and effects thereof, established at the applicant's responsibility..." (art. 3 – 5^o). After the publication of the SEVESO Directive in 1982, a circular dated 28th December 1983 specified the conditions for carrying out hazard studies.

The first hazard studies on the high-risk industrial installations in the South of Toulouse were carried out in 1982 and 1983. They were concerned with the refrigerated storage of 5,000 t of ammonia by CDF Chimie AZF, the phosgene pipeline between SNPE and Tolochimie and the phosgene storage facilities of Tolochimie.

Several other studies have been carried out subsequently by the manufacturers operating in the South of Toulouse. These studies were made with varying assumptions as to the accident scenarios, risk criteria taken into account and weather conditions. On certain points, these studies anticipated safety improvements such as putting the Grande Paroisse chlorine storage facility in double confinement, which was in fact implemented a few years afterwards.

For certain studies, the operator had adopted 50% lethal concentrations and for others 1% lethal concentrations before instructions were given at the beginning of the '90s. One wonders whether there may not have been in this choice an understandable concern not to set hazard distances that could not have been transcribed into the urban development regulations.

This position is certainly quite understandable, but by doing this the Inspectorate of Classified Installations was taking upon itself responsibilities which are not within its remit.

These hazard studies served as a basis for various assessments made by the DRIR (which became DRIRE after 1991) for determining the perimeter of an urban development control area (PIG) and the perimeter of the special intervention plan (PPI). (see below).

After the first series of hazard studies carried out between 1982 and 1990, the DRIRE asked for these studies to be brought up to date, and these updates were carried out between 1992 and 1999.

For the Grande Paroisse factory the list of hazard studies is as follows:

Product	Activity	1 st edition	latest revision
Site	General document	2001	
Ammonia	Use	1986	1996
Ammonia	Cryogenic storage	1983	1993
Ammonia	Synthesis	1984	1994
Chlorine	Confined discharge	1987	1997
Ammonitrates	Bulk storage	1990	1995
Methanol	Storage	1996	
Formaldehyde	Storage and manufacture	1997	
Phenol	Storage	1997	
Chlorinated products	Storage	1998	

As regards ammonium nitrate storage facilities, a hazard study was carried out in 1990 and supplemented in 1995. This study concerned building I 4 where there was a store that could reach 15,000 t of bulk fertiliser with a 33.5% nitrogen content. This study came to the conclusion that the ammonium nitrate could only be detonated by the effect of a fairly powerful pyrotechnic detonator and therefore this was not taken into account.

For the Grande Paroisse factory the worst case scenario is the instantaneous rupture of a chlorine tanker (outside the discharge room) which gives distances of more than 2,500 m for the threshold of lethal effects and more than 5,000 m for the threshold of irreversible effects. For the rupture of an ammonia pipeline the distances are 600 m and 2,500 m respectively. We will come back to these figures in the analysis of the situation with regard to urban development.

SNPE, for its part, has published and updated the following hazard study:

Phosgene storage	latest revision	1998
Chlorine	ditto	1999
Phosgene cylinders	ditto	1999
Phosgene manufacture	ditto	2000
Phosgene use	ditto	1995
Ammonia discharge	ditto	2000
Storage of toxic substances	ditto	1997
Floods	ditto	1999
General site study	in progress	

The Commission examined the first five studies, their assumptions and their conclusions:

For chlorine, for example, a leak of 200 kg for 15 seconds leads to an exclusion zone Z1 with a radius of 470 metres and an intervention zone Z2 with a radius of 940 metres (version ED/1 November 1999).

For the manufacture of phosgene, the scenario of a leak of 46 kg for 5 seconds gives a Z1 zone of 450 metres and a Z2 zone of 1,250 metres. (version ED4 January 2000).

For ammonia, the assumption of the rupture of a valve in the bottom of a tanker would lead to a Z1 of 100 metres and a Z2 of 600 .

This kind of conclusion is obviously to be taken into account when examining the question of urban development around industrial sites. This point was moreover the subject of correspondence from the DRIRE to which the SNPE replied on 9th November 1999 summarizing its assumptions and the consequences that can be drawn from them for Z1 and Z2.

In our opinion, these studies have been carried out carefully, but the relevance of the scenarios adopted is open to question, inasmuch as they deal more with what one could call major incidents rather than accidents in the common sense of the term. This situation led the DRIRE to ask the INERIS for a study to define the areas where measures to control urban development should be taken.

The study that the INERIS had been asked to produce was in progress. A document, the text of which will be found in Annexe T, has been drawn up for this task. This document indicates for certain scenarios, the lethal effects thresholds (LC 1) and the irreversible effects thresholds, under unfavourable weather conditions. The distances mentioned therein are much greater than those that had been adopted for the definition of the PIG and PPI.

4.6 Supervision by the Inspectorate of Classified Installations

Over the last few years, the Inspectorate of Classified Installations has made regular supervisory inspections of the Grande Paroisse factory:

- 4th February 1998 : storage and discharge of methanol
- 21st October 1998 : prevention of accidental instances of water pollution, and discharge of ammonia
- 17th November 1998 : chlorine
- 2nd December 1999 : chlorine, storage of ammonia
- 5th April 2000 : discharges into the atmosphere, aqueous discharges
- 26th October 2000 : ammonia storage, POI
- 17th May 2001 : hazard study, safety management system

After each of these visits, a letter was sent to the operator setting out the Inspectorate's comments. Many other letters were exchanged between the Inspectorate and the operator concerning inter alia the application of the SEVESO II Directive and the extension order of 18th October 2000.

On the 27th of March 1998, 10 t of ammonia was discharged through the chimney over a period of one and a half hours giving rise to numerous complaints. The Inspectorate of Classified Installations examined the causes of this discharge and proposed a prefectural order requiring the operator to take various measures, in particular a hazard study on the ammonia distribution chain on the site. This order was issued on the 9th of September 1998. Moreover a report was sent to the prosecutor for failure to comply with certain safety rules laid down by the prefectural order of 10th February 1996 authorising the factory.

Updating the specifications for the factory when the extension was authorised in 2000 constituted a substantial task for the Inspectorate of Classified Installations.

Supervision of the Grande Paroisse company's factory, as with the other factories in the South of Toulouse, was carried out diligently, by applying the directives of the central administration in a relevant manner.

Whilst the storage facility where the explosion occurred had not been inspected recently by the Inspector of Classified Installations, this was down to the fact that the inspections carried out had been focused, as was quite normal, on those installations deemed to be the most hazardous, which in the case of Grande Paroisse meant the storage facilities for toxic products (chlorine and ammonia) and the implementation of the new provisions of the SEVESO II Directive. The complex problem of assessing the risks posed by ammonium nitrate has been examined earlier in this report, but that is not the responsibility of the local services. Responsibility correctly lies with Community or national decisions.

4.7 Organisation of the Inspectorate for Classified Installations and resources

The Inspectors of Classified Installations have carried out their work with a great deal of care, but it should be stressed that the present situation where they are obliged to make choices within establishments referred to as priorities by the SEVESO Directive, by prioritizing storage facilities holding toxic products over other installations, is not satisfactory.

The Inspectorate's resources need to be strengthened not only to improve the supervision of priority establishments, but also to supervise other establishments.

For a number of years now the supervision of classified installations has been concentrated on the most hazardous installations. A circular dated 12th July 2000 set out the priority establishments (establishments classified by the SEVESO Directive as high threshold and principal establishments responsible for substantial instances of pollution, totalling around 1,300 establishments).

It will be necessary to review assessments of the resources needed to supervise these establishments, taking into account the fact that the same establishment may comprise many installations and that this fact needs to be borne in mind when counting the number of installations covered by the SEVESO II Directive in the same establishment.

Out of the 65,000 establishments classified as subject to authorisation, those establishments as-defined above constitute the number one priority. Greater attention needs to be paid also to installations which do not present such substantial risks, but for which an absence of supervision is not acceptable, since they do involve the risk of accidents (see the case of silos) or risks to public health. This second level of priority could cover several thousand establishments which ought to be the subject of regular inspections: SEVESO low threshold installations, silos, installations covered by the 96/61 Directive of 24th September 1996 on the integrated prevention and reduction of pollution.

Whilst it is natural to make the supervisory effort proportional to the extent of the risk or pollution posed by different classified installations, it is not acceptable to carry out virtually no supervision of classified installations that come into the categories of subject to authorisation but non-priority or installations subject to declaration.

The Inspectorate of Classified Installations needs to be strengthened in a regular manner by a plan aimed at giving it the necessary resources over a period of 5 or 6 years, which would involve doubling the number of people it employs. The Commission has noted the recent Government decision to proceed, from 2002 with a strengthening in relation to the 2002 PLF which follows the strengthening already decided upon, but confirms the need for a doubling in relation to the authorised numbers resulting from the Finance Law for 2001. It stresses the need for a plan stretching over a number of years which enables the recruitment, training and integration of reinforcements to be programmed.

In order to improve the effectiveness of the supervision work carried out by the authorities, this strengthening should be accompanied by the establishment of closer links between the Inspectorate of Classified Installations and the Factory Inspectorate.

The following will be found in the various Annexes:

- O – Extract from the non-technical summary of the file put to the enquiry in 2000 (summary of the hazard study)
- P - Views of the Communes of Toulouse, Ramonville St Agne and Pechbusque on the extension project.
- Q - Conclusion of the Committee of Enquiry on the application to build an extension
- R - Minutes of the meeting of the Departmental Health Council on 28th September 2000.
- S - Prefectoral order of 18th October 2000 and extract from the technical specifications.
- T - Opinion of the INERIS on the control of urban development around the 3 Toulouse chemical sites.

Part Five

5 Industrial risks in an urban environment

5.1 Historical review

The relationship between Toulouse and its Southern chemical complex has been dogged by a series of serious accidents that have triggered the need to relocate the hazardous activities towards the South. However, in the course of time, urban development has spread out to reach the site of these hazardous activities.

Since the middle of the last century, urban development around the chemical factories (the ONIA and the National Explosives Factory) has grown considerably. At that time, there was scarcely anything, in the vicinity of these sites, apart from the Marchant Psychiatric Hospital. Since, in addition to the transfers of sites from the Explosives Factory to the ONIA, some of the main developments have been as follows:

- Agreement in June 1949 to hire the Recebedou estate, at Portet sur Garonne to the Public Office for Cheap Housing. This estate was later sold in 1966 to the Council Housing Office for the City of Toulouse.
- Disposal in 1954 of the Bordelongue camp, in order to set up there the Adult Occupational Training Centre.
- Disposal between 1954 and 1956 of sites on the île du Ramier, in order to set up the Chemical Engineering Institute, national education housing and university residence there.
- Disposal in 1964 of the land situated between the Route Nationale 20 and the present "Braqueville Explosives Factory", in order to set up an industrial zone there.
- Disposal in 1968 of the Clairfont camp at Portet sur Garonne, to the Ministry for Justice.
- Disposal in 1972 of the Chapitre storage depot site, in order to set up an industrial zone there. A few years before, at the request of the City of Toulouse, it had been envisaged to transfer this storage facility onto the gravel-pit site, but this project was abandoned, since the disposal costs, which would have been payable by the City, were too high.
- Sale in 1974 of the ANS estate housing.

Since the '80s, urban development has continued Southwards on either side of the "Seveso" perimeter of the chemical complex. (see in Annexe U a note from the Prefecture dated 26th of March 1979).

The clearly stated desire to break the accident-relocation-urban development cycle therefore didn't appear until late in the day with the publication of the "Seveso" Directive in 1982: to strengthen the safety precautions for hazardous activities, to modify urban development in the vicinity of the site and to prepare neighbouring activities and inhabitants for the possibility of an accident.

After the publication of the so-called SEVESO Directive of 24th June 1982, the operators of the installations covered by the Directive were required to produce hazard studies. These studies showed that certain accidents could have serious consequences beyond the confines of industrial sites. With this in mind, in the law of 22nd July 1987 provisions were laid down aimed at:

- controlling urban development in areas exposed to risks arising out of classified installations that are to be set up on a new site (new art.7.1 et seq. of the law of 1976 which became articles L 515-8 et seq. of the Environment Code. This article relates in particular to installations subject to the SEVESO Directive).
- drawing up special intervention plans (PPI) for certain installations. The Decree of 8 May 1988 gave a list of these which includes in particular the installations covered by the above-mentioned article 7.1.

These provisions made it possible to create public utility obligations indemnified by the operator. In practice the number of cases to which these provisions have applied has been extremely small.

For existing installations, and also for new installations set up on existing sites (which in practice is much more often the case) the town planning obligations procedure created by PIG (General Interest Project), and therefore not-indemnified, has been adopted. These procedures were laid down by articles L 121-12 and R 121-13 of the Town Planning Code and the Circular of 24th November 1986. The Ministry of Equipment department responsible for town planning did not wish to extend the scope of indemnified obligations because town planning obligations are free. The manufacturers, from their point of view, obviously did not want to find themselves having to make indemnity payments.

5.2 Definition of the protection perimeters

This process was carried out globally by the DRIR for the whole of the Southern chemical complex: SNPE, Tolochimie and SCGP (Grande Paroisse). These factories are in fact interdependent both in their operation and in their danger zones. A whole series of safety studies have therefore been carried out by these firms, with the identification of accident scenarios and the definition of hazard criteria being validated by the DRIR. These studies led the DRIR to order the installation of safety equipment (in particular the double confinement of the largest amounts of toxic products undergoing processing) costing in the region of 150 M.F. then, in 1988, to initiate urban development control procedures (pursuant to the law of 22nd July 1987) in the form of a General Interest Project (PIG establishing a perimeter inside which urban development is strictly regulated) and procedures for protecting inhabitants by means of a Special Intervention Plan (PPI).

The risks taken into consideration were: toxic emissions of ammonia, chlorine or phosgene. The risk of ammonitrate explosion, as indicated earlier, was not envisaged.

The accident scenarios adopted in the studies were ruptures in pipelines lasting 10 minutes. The risks connected with the presence of tankers containing these products parked on the site were not taken into consideration. Three scenarios of major importance encompass all the others for the purposes of defining the protection perimeter: ammonia at SCGP, chlorine at SNPE and phosgene at Tolochimie.

Between 1983 and 1989, the method of assessing the risk to the urban environment was in the process of being drawn up and furthermore, the studies of this site contributed towards specifying the doctrine (cf. guide to the control of urban development around high-risk industrial sites – Ministry of the Environment 1991). The studies and the protection perimeters (1989 PIG and PPI) do not therefore correspond with the later recommendations of the Ministry of the Environment.

The criterion of toxicity adopted for the PIG perimeter is the limit from which, under the conditions of the scenario, irreversible effects begin to appear (i.e. perimeter marking the limit between reversible – irreversible effects or ZOLERI). In practice, no doubt because of the absence of technical data, different criteria have been adopted. These criteria are homogeneous between factories for the same product, but are not so from one product to another: start of the appearance of lethal consequences for ammonia, ZOLERI for chlorine, and 50% lethal concentration for people affected (CL50) for phosgene. The use of the ZOLERI criterion for phosgene would have caused the limiting distance for this product to go from 900 m to over 2,000 m. The same holds true for the criteria adopted for the PPI perimeter

which is defined as the limit where people begin to experience a general feeling of being unwell.

Curiously, and at variance with the contents of the 1989 PIG, a letter of June 2001 from the Prefect to the Mayor of Toulouse (Annexe AD) presents the limit of the PPI as that where irreversible effects on man appear and the limit of the PIG as corresponding to a 50% mortality risk for people who are directly exposed.

5.3 Implementation of the PIG

It was at the end of 1988 that the DRIR took the first steps with the Prefect, other administrative authorities, and elected representatives to set up a protective perimeter by means of a PIG. It would appear that a PIG was the only procedure envisaged whereas a “notification” type of approach leading to a POS revision and possibly an early taking into account was possible. It may well be that the DRIR put a priority on effectiveness, but this was to the detriment of open debate. The DRIR therefore held a series of consultations, provided explanations and sent various letters to its partners. It does not appear that any explanations of a more precise nature than those appearing in the PIG and PPI (zone of irreversible effects and zone in which people feel unwell) were given or requested.

The existence of road building schemes coming within the perimeter of the PIG gave rise to various letters: to the North the project to widen the Toulouse bypass and its link-up to the A64 motorway; to the South the departmental project to bypass the built-up area. Only the latter (which has not yet been built) has been slightly modified, but will still penetrate within the perimeter of the PIG. In fact, at the end of this debate, the DRIR accepted the argument put forward by the DDE that since these projects would help to keep the traffic flowing more easily, they would improve the safety of the road users. It is surprising that the substantial increase in traffic (over 100,000 vehicles/day in 2000) and the possibility of traffic jams at peak periods were not raised as issues even though they could easily be foreseen and duly made their appearance a few years after the widened bypass came into service. Moreover, traffic on the RN 20, which serves the industrial site and passes through the danger zone for a distance of nearly 1,500 m, has continued to grow in line with the development of commercial and small-scale activities that it has opened up.

The Ministry for the Armed Forces also expressed a number of reservations about this project which considerably reduced the value of the land formerly occupied by the old explosives factory ; however no further action was taken about these reservations, especially since the land is subject to flooding. The project was well received by the Mayor of Toulouse who immediately put it into effect. The Commune of Vieille Toulouse was up in arms about the

impossibility of setting up a leisure area from which it hoped to receive a certain amount in the way of taxes.

The PIG project was put at the disposal of the public by prefectural order of 21st August 1989 (Annexe W), described as a project of general interest by prefectural order of 9th October 1989 (Annexe X) and notified to the Mayors concerned by letter dated 17th October 1989.

The establishment of the perimeter of the PIG anticipated the double confinement of sensitive points which became effective, as provided for, in 1992.

5.3.1 Provisions of the PIG

Town planning restrictions are concerned with future developments, existing structures and public highways:

- New developments are limited to companies and institutions “with a chemical culture”.
- For existing installations (activities, dwellings), the PIG states “each construction should be left with the possibility of extending in line with the normal development of the existing activity” and specifies that ‘measured’ extensions will be allowed or that ‘the potential for the company or institution to grow normally forms part of the existing situation’.
- As regards road infrastructures, the PIG opens the possibility of accompanying the normal development of the area with new projects “that unquestionably demonstrate an overall improvement in the conditions of safety”

Generally speaking, the regulations in the PIG appear not unduly restrictive and leave the field fairly open for town planning documents which give concrete application to the PIG.

The protective perimeter has not been modified since 1989. The DRIRE has regularly and successfully refuted the arguments of residents or elected representatives calling for it to be reduced on the grounds of improving the safety of the site (for example building plot in the rue Jean Bart). On the other hand, some of the manufacturers’ safety studies have been based on the 1989 methods and criteria and have not taken into account the more recent directives of the DPPR. Other studies that have taken into account the new criteria have confined themselves to noting that their marginal consequences did not extend beyond the 1989 perimeters. The circular of 24 June 1992 from the Ministry of the Environment to the Prefects on the control of urban development did not, it appears, give rise to any repercussions or any reply in Haute Garonne.

5.3.2 The translation of the PIG into the POS

95% of the protection zone is situated in the Commune of Toulouse. We did not examine in detail the case of the other Communes which included the zone in their POS.

Since 1990, the Toulouse POS takes into account the PIG. This taking into account is limited to the interior of the protection perimeter. Beyond, for example in the PPI zone, the industrial risk is not taken into account in the definition of the permitted use of spaces and their development criteria.

The limit of the PIG appears, without any adjustment, in the zoning of the various revisions of the POS that have taken place since 1990 (see perimeter in Annexe 6). It constitutes a zoning limit characterised by the letter R inside which are to be found essentially the Uer and NDr zones, the configuration of which has however evolved between 1990 and 2000. The NDr zone, initially limited to the natural spaces along the banks of the Garonne, was extended to all the abandoned land of the former Braqueville explosives factory, but part has been recently re-established as a Uer zone in order to allow an extension of Tolochimie.

The Toulouse city council has come out clearly against any structural strengthening of the chemical complex desired by the CCI by firmly ruling out any increase in the chemical risk in this zone (see Annexe AE). The extension of the NDr zone goes in this direction in fact, even if the protection perimeters around each new installation remain included within the PIG perimeter, the multiplication of scenarios that could be envisaged would have contributed towards an increased probability of an accident. This however has not prevented the extension of Tolochimie nor an increase in capacities and the range of products made by SMPE and SGPC. For all these important files, the Prefecture has been at pains to ensure that the public enquiries are the subject of widespread publicity and information, but as regards the risks, the files investigated confine themselves to stating that the potential additional risks remained within the envelope of the existing risks.

The reservations for road infrastructures result from the discussion of 1989 and encroach on the protection zone.

5.3.3 The POS regulations

The POS regulations for these zones set out the specifications for the PIG and they too have evolved appreciably in the course of successive revisions. The concept of measured extension first of all became more rigorous then less so:

1990 : 20% of extra net surface area, but at all events no more than 200 m²

1994 : 20m² of gross extra surface area, once (see in Annexe Y an extract from the POS regulations)

2001 : 20m² of net extra surface area once, but no limitation if the project does not lead to an increase in the numbers of people present in the sector.

In 2001 there was also introduced the possibility of a change of use in existing constructions provided that this did not lead to an increase in the numbers of people present in the sector.

These regulations have not been amended as regards new installations: these remain limited to activities of a chemical culture or similar, subject to authorisation as classified installations and which do not involve any extension of the protective perimeter.

5.3.4 Application of the POS in the PIG protection zone

The majority of town planning measures within the protection zone are concerned with industrial activities. As the site has been developed and modernised, the total surface area built on has gone down as has the number of people present on the site.

Other town planning measures have been very few in number:

- The construction of three small extensions to the Marchand Hospital were authorised between 1995 and 2000 covering a total surface area of 330 m².
- An extension of 50 m² was authorised in 1993 for a dwelling house because the POS allowed a 20% extension.

The establishment of the DARTY Works on the site occurred before 1989 in 1986-1987 in fact, at a time when thinking on the PIG was well advanced. DARTY took over a car repair workshop and only had to obtain a town planning permit for altering the façade. The fact that this new activity would lead to an increase in the number of people present was not therefore examined either for the building licence or for the ERP permit.

We also examined the case of the Bikini, a discotheque on the banks of the Garonne less than 200 m away from the SNPE. A 105 m² extension was authorised in 1992. The authorisation was based on the fact that the extension did not exceed 20% and did not increase the numbers it could cater for. An architect's note certified in fact that the capacity would rise from 500 to 502 people. However, the capacity actually authorised for this establishment was only 300, but its owner indicated that he intended to seek authorisation for the 300 to 700 people

category. The architect then produced for this same project a revised calculation note showing that the maximum numbers it could cater for was going down from 400 to 369. The DRIRE, the Municipal Safety Committee and the DDE voted in favour of this extension. It can be seen therefore how the interpretation of the statutory enacting terms allowed a significant increase in the risk for this establishment which nowadays probably caters for over 500 people instead of 300.

This somewhat confusing situation in the management of POS results from a lack of information among local authorities on the exact extent of the risks and the aims of urban development and control.

5.4 The PPI

The PPI was conceived and put in place at the same time as the PIG (see in Annexe the report of a meeting on 23rd June 1988) and put into law by an order of 30th June 1989. The PPI zone outside the PIG was presented as one where non-confined people present could be exposed to 'a feeling of being unwell' in the event of an accident. However the DRIR did not clarify the meaning of this term nor the method of determining the zone (see perimeter of the PPI in Annexe 6).

The PPI specifies moreover '*It is not possible to completely rule out an accident, however improbable such an event may be. Because of the dramatic consequences which an accident would produce in such a sensitive industry, it is advisable to prepare for such a hypothetical accident*' which creates the need for factories to have Internal Operation Plans, but it also specifies that '*none of the accidents envisaged would give rise to consequences outside the limits of the factory*'. This may have contributed towards the fact that the services entrusted with drawing up the PPI and the local authorities concerned did not really realise the risks incurred.

The PPI is responsible for ensuring that the triggering of the alarm, the traffic and the emergency services are properly organized ; it envisages the possibility of finding itself faced with a substantial number of seriously injured people. It has not been updated to take account of what would be necessary for the people involved in management crisis, telephone access, the resources mobilised, and traffic plans.

5.4.1 Information on the PPI

The job of informing the general public was accomplished by the DRIRE which sent letters to each of the establishments or dwellings situated in the zone (over 20,000 letters). Enclosed with this letter was a brochure briefly describing the risk and the PPI and giving information on what to do in the event of an alarm (moist handkerchief, stay indoors...).

A second information campaign specific to the chemical complex was organised in 1994. A brochure was sent to all occupants of the PPI zone through the SPPPI journal. This brochure explicitly mentioned the presence of ammonitrate, a solid product which, in the event of an accident, could be the source of a fire or explosion. The town councils concerned organised a quite extensive poster campaign in blocks of flats, camp sites and commercial properties. An advertising lorry, organised in liaison with the manufacturers, went round the districts concerned. Finally, people were sent round to explain to the staff of schools. In general, the teachers were particularly sensitive and were anxious to make sure that their schools would be in a position to tackle the risk.

A third information campaign (aimed at all those Communes in the Department exposed to a 'Seveso' risk) was prepared in 2000 within the context of the SPPPI. It was decided that responsibility for circulating the information should be left with the town councils concerned, but there was no follow-up to the initiative, with the result that the brochures arrived safely at all the town halls concerned, except the one in Toulouse (where it appears that there was a misunderstanding regarding the dispatch of the brochures to the town hall). Furthermore, it appears that in those Communes which did in fact receive the brochures, the latter did not reach all the establishments or inhabitants concerned (see the brochure in Annexe AA).

5.4.2 Exercises

Exercises to try out the various parts of the PPI took place between 1991 and 1995:

- On the 30th of October 1991 at the fixed PC in the Prefecture: procedures for summoning the PC and the meeting of the PC, and testing of the telephone and radio links.
- On the 4th of April 1992, deployment of resources in the field: operational PC, testing of radio links, testing of the DDE's mobilisation capacity.
- On the 23rd of October 1992 mobilisation of the operational PC and of the Advanced Medical Care Post in the field, testing of the radio links, operation of the PMA, evacuation by helicopter.

- On the 21st of January 1995, testing of various components of the PPI: Communication cell at the Prefecture, PMA, large fleets of vehicles, hospital major emergency procedures.

This strategy of carrying out partial exercises but ruling out the overall implementation of the plan and any full-scale exercise seems reasonable to us, but it is unfortunate that the strategy was broken off in 1995 and that a programme of exercises that gradually but systematically tested the various elements of the plan and whether they could work successfully together was not drawn up and then regularly put into action.

Since the end of 1999, the implementation of a new exercise has come up against various kinds of procrastination and the difficulty of mobilising services that were already overburdened in other directions. A scenario for an exercise was drawn up by the DRIRE but it had to be postponed time after time. This clearly shows that awareness of the risk became blunted over the years and that carrying out exercises needs to be an explicit and essential aspect of the PPI.

Moreover there was an internal operation plan for the Grande Paroisse factory which had been updated in March 2001 and was the subject of internal exercises and exercises in liaison with the fire and emergency services (see annexe AB).

The PPI lays down that *“through the medium of the public services, local authorities, businesses, and teaching establishments shall be informed: special safety instructions, adapted to the different groups and environments, shall be drawn up by the heads or people in charge of the various organisations”*. Compliance with this specification has not been organised and verified strictly enough by the public services. The teaching establishments gave the matter their attention as did the DDE fleet which regularly carried out exercises.

5.5 Revision of the urban development control zones

As mentioned earlier in this report in connection with hazard studies, the DRIRE had asked the INERIS to carry out a study, which was in progress. It is not possible to say what conclusions it might have come to in terms of a revision of the PIG. Provisional results show that it would have been necessary to envisage a substantial extension of the town planning control zones with the aim not only of limiting building within an area of over 2 km, but also of taking certain measures within an appreciably bigger area.

At the present time, within the PIG zone, there are over 1000 people, and 16,000 within the PPI zone. The new PIG zone would have been required to cover an area in which there are several tens of thousands of people, which shows the unrealistic nature of such a measure. Calling into question the protection zones would very probably have caused enormous local difficulties, by highlighting the incompatibility of the co-existence of a major heavy chemical complex alongside a heavily-populated dense urban environment, which could not have been resolved at local level.

5.6 Informing the public about the risks

There is a permanent secretariat for the prevention of industrial problems (SPPPI) which was formed in 1990 for the urban area of Toulouse. The SPPPI includes over 300 members representing State administrations, territorial authorities, universities, associations and manufacturers. It includes various committees on water, air and waste, hazards and communication. The day-to-day running of the secretariat is provided by the DRIRE. The project to extend the Grande Paroisse factory was examined by the risks and communication committees on the 4th and 11th of October 1999. A copy of the minutes of these meetings will be found in Annexe AC. It is to be regretted that at these meetings no information was given, nor does it appear that such information was requested, on the risks posed by the factory. Only a question about the risk connected with aircraft crashing was raised.

The following items are to be found in the various Annexes:

5 – Aerial photographs of the site

6 – Map showing the areas covered by the PIG and PPI

U – Note from the Prefecture dated 26th March 1979

V – Minutes of a meeting on 23rd June 1988

W – Order dated 21 August 1989 defining the PIG

X – Order dated 9 October 1989 qualifying the PIG

Y – Extract from 1994 POS regulations

Z – Town planning developments between 1975 and 1990

AA – Brochure containing information for the public within the context of the PPI

AB - 2001 timetable of POI exercises.

AC – Minutes of the SPPPI's meetings on 4th and 11th October 1999.

AD - Letter from the Mayor of Toulouse to the Prefect dated 21st May 2001 and the reply from the Prefect to the Mayor of Toulouse dated 20th June 2001.

AE - Letter from the Mayor of Toulouse to the Commission dated 17 October 2001

Part Six

6 Proposals on the management of major industrial risks in an urban environment

A brief analysis of the explosion that occurred on the 21st of September 2001 at the Grande Paroisse company's factory in Toulouse leads us to make a number of proposals to improve the safety of large industrial sites presenting major risks that are situated in an urban area.

It should be stressed that the action of the Inspectorate of Classified Installations has up to now been implicitly guided by the idea that, by [taking] safety measures within the installations, the risks outside the site could be reduced to a very low level so that safety measures were sufficient without calling into question either urban development around industrial sites or the existence of the factories.

It is therefore necessary that a national policy and precise procedures on assessing areas of risk, zoning and urban restrictions be put in place in order to define a process for resolving situations of incompatibility, of which Toulouse is far from being the only example in France.

The definition of affected areas from hazard studies should be more transparent and distinct from the definition of the consequences which are drawn from them on the urban plan, with the DRIRE and the DDE being entrusted respectively at local level with the implementation of these two aspects of State policy.

It is recommended that the MATE should draw up a precise short-dated timetable for specifying the methodology and systematically revise, in a homogeneous manner, the perimeters of the affected zones in accordance with the rules that it lays down.

6.1 General knowledge of the risks – expert reports

The Toulouse explosion shows the need to improve our knowledge of risks, All technical risk prevention, town planning control and crisis management measures rely on an in-depth knowledge of the risks. In particular, the problems raised by ammonium nitrate show the need to strengthen the resources, in terms of feedback, of the Bureau d'analyse des risques et pollutions industrielles (BARPI)/Industrial Pollution and Risk Analysis Bureau, which exists within the DPPR and is located in Lyon, to record serious incidents or small accidents which may be the forerunners of more serious ones.

The senior staff at the Ministry of the Environment, at national level, and the Inspectorate of Classified Installations, at local level, need to have a solid technical support along the lines of that which exists between the Nuclear Safety Authority and the IPSN. The resources of the INERIS and the IPSN need to be strengthened and their cooperation organised. Credits should be provided for this purpose in the MATE's budget, in return for a significant increase in the taxes paid by the most hazardous ICPE, which [at present] are modest beside those paid by nuclear installations.

6.2 Knowledge of the risks – hazard studies

In each establishment, it is necessary to improve the quality of the hazard studies and their homogeneity between different industrial sites. As a means towards achieving this, the MATE needs to lay down rules on what kinds of accident scenario to take into account, on external threats, on methods of hazard analyses and on the criteria for defining the effects on people.

Care needs to be taken that these studies are not slanted out of a desire to look in advance for compromises over hazard distances in order to avoid conflicts over the consequences of very serious scenarios, that would be difficult to accept in terms of informing the public or controlling urban development, understandable as such a concern may be. It is found in fact that studies carried out on comparable installations can lead to widely varying results. [For example] whereas the radii of the hazard zones for the risk connected with ammonia at the Grande Paroisse factory in Toulouse were 900 and 1,600 m, for another fertiliser factory, the figures were 4,500 m and 7 km.

These studies should specify the basic assumptions concerning:

- Accident scenarios: taking into account the rupture of tanks, tankers or lorries, ruptures of pipework etc.,
- External threats to be taken into account: earthquakes, floods of centennial or millennial frequency, domino effects connected with neighbouring installations, rupture of large dams, aircraft crashes (this question has often been posed in Toulouse because of the proximity of Blagnac), acts of foul play.
- Taking into account the failure of safety systems. In fact in the field, the Classified Installations Inspectors have difficulties getting operators to install automatic safety devices and then impressing on them not to take these devices into account in the hazard study. This is however logical, but requires some explanation. The safety devices, in particular active devices, are intended to reduce the probability of certain

accidents, but they cannot reduce the risk to zero and it is therefore necessary to continue to take into account accident scenarios if these devices fail to work.

The case of tankers parking in the factories warrants special attention. The explosion that occurred in Toulouse could have had much more serious human consequences if a tanker containing chlorine or ammonia had been parked near the area where the explosion occurred and had been damaged thus causing a toxic cloud.

Hazardous materials stored in tankers on industrial sites must be taken into account in hazard studies and corresponding specifications must be laid down (in particular the location of parking areas). Care must be taken to be consistent in complying with the provisions of the order of 5th June 2001 on the transport of hazardous goods by rail (which is a reworking of an earlier order of 6th December 1996) article 15 of which lays down limits on parking times for wagons loaded with hazardous goods outside classified installations.

International comparisons on accident assumptions and methods of analysis should be developed so as to benefit from experience acquired in neighbouring countries.

It must be possible for a hazard study carried out under the responsibility of the operator to form the subject of a critical analysis by an expert independent of the operator, if so requested by the authorities. The Commission pondered the question of how these studies should be financed: at the present time they are paid for directly by the operator, whereas in the nuclear safety sector they are paid for by the authorities. The INERIS and IPSN should play a major role in these critical analyses.

The definition of the different types of zones according to the levels of risk must be specified. Particular care should be given to harmonising the terminology between hazard studies on classified installations and pyrotechnic safety studies.

Studies of the most significant accident scenarios should be accompanied by precise data on the numbers of people and establishments open to the public affected. In fact, if there are already substantial numbers of people present in the danger areas, those with responsibility for safety cannot contemplate provisions on town planning controls or on emergency plans without having re-examined the possibility of reducing these danger areas. If that is not possible, those responsible for safety must envisage the partial or total closure of the installations.

A great deal of work has been done in these various fields over the last ten years or so by the Service de l'environnement industriel/Industrial Environment Department of the DPPR, but it has been dispersed over a wide number of texts, orders, circulars and notes from the SEI.

This body of information needs to be given a coherent and complete presentation in the form of an order accompanied by a circular.

6.3 Measures to reduce the risks : confinement, breaking up into smaller amounts, operating without stock

Without going into the detail of the technical provisions likely to significantly reduce the risks posed by hazardous installations, we should stress **the importance of double confinement** whenever this is technically and economically possible. Double confinement consists of placing the storage facility (whether fixed or in the form of a tanker) or the installation using a toxic product within a building that is calculated to withstand pressure and neutralise any product released in the event of the tank leaking. Various provisions need to be laid down for completely isolating the building in the event of a leak. By increasing the operating safety of these isolating mechanisms (standby facilities, defence in depth, etc.) to a suitable level, the risk of a toxic discharge can be considerably reduced.

The areas of risk can then be virtually reduced to within the site or at least the areas presenting fatal risks (1% lethal risk). In this case, the areas where measures to control urban development are needed can be kept on a small scale without hindering urban development over larger areas.

Provisions of this type existed on the chlorine storage facilities at Grande Paroisse, but there were unprotected tankers on the site.

In certain cases, in particular for phosgene, a method is also used which consists of producing the **toxic substances and then using them without intermediate storage** or with a very small stock.

Provisions of this type can be used for toxic gases when the amounts are not too great. On the other hand this arrangement would probably be more difficult for factories producing basic chemicals or oil installations where the amounts are generally very large.

For explosive products, stocks need to be broken down into smaller amounts so as to limit the effects of an explosion in one particular stock by making sure that the distances between stocks is sufficient to avoid an explosion being transmitted from one to another.

6.4 New urban and industrial projects

In many cases, faced with irreducible incompatibilities between residual risks and exposed populations, it will be a question of defining and negotiating both a new urban project and a

new industrial project (which generally speaking will involve banning any heavy chemical activities in the vicinity of a dense urban area). This means that the State, local authorities and manufacturers should engage in a far more complex process than the definition of protective areas, a process in which the socio-economic stakes (both in industrial and land terms) are considerable. As regards the State, the Ministries of the Environment, Regional Development, Industry, Equipment, Transport and Housing must therefore prepare themselves in a concerted manner to do so.

With this in mind the MATE needs to ask Prefects to take stock of factories covered by the SEVESO Directive that are located in an urban area on the basis of a number of simple criteria: size of the danger areas (with homogeneous criteria) populations affected in these areas, possibility of reducing the amounts stored and/or confining them. This should make it possible to establish which are the most difficult cases and these will have to be examined as a matter of priority.

For factories where the areas where there is a fatal risk (LC 1: 1% lethal effects threshold) are of substantial proportions and where present urban development amounts to tens of thousands of inhabitants, the relevant authorities need to ask themselves whether the activity should be allowed to carry on - with steps being taken to make it safer, or whether the activity needs to be brought to an end.

For certain activities, like fine chemicals or pharmaceuticals, the amounts stored are relatively small or can be reduced. In this case, it should be possible to develop the technique of double confinement mentioned above to a greater degree than happens at the moment.

The same is not true in the case of some heavy chemicals or oil factories where the amounts that need to be stored (both fixed and mobile) are very considerable. The cost of confinement, where this is possible – and this is not always the case – would be considerable. Some of these industries are not very profitable and it is unlikely that the industrial groups concerned would wish to make very heavy investments in this technique.

In cases such as these, one can no longer reasonably envisage relevant urban development control measures and closure of the factory needs to be envisaged. This possibility exists in the legislation on classified installations by applying the provisions of article L. 514-7 of the Environment Code (art. 15 of the law of 1976) which provides for the possibility of closing, by Decree in Council of State without compensation, any installation which presents hazards such that the measures provided for in this legislation cannot eliminate them.

In general, it will be necessary to allow a time limit of a few years in order to facilitate the transition both in economic and social terms, but it will be necessary to make sure that the time tables announced are in actual fact adhered to.

Transferring factories to sites “in the countryside” is sometimes called for. We should not be under any illusions as to this possibility since attempts to do so could come up against strong opposition, as can be seen in the case of certain waste disposal projects. Furthermore, there is a risk that installing an industrial plant may give rise to urban development in the vicinity. In practice, there will probably be relocations of certain products like ammonia to the countries that produce the raw material as a gas.

In the case of Toulouse, there arises the problem of the possible resumption of activity by SNPE and Tolochimie. If such a resumption is contemplated, it could only take place after a complete review of the safety of the installations, an updating of the hazard studies and a critical analysis by an expert appointed by the authorities.

The possible resumption of activities connected with phosgene would involve a complete review of their design. It will be necessary to limit the amounts of phosgene stored to the very minimum or better still to use the phosgene on-line without any intermediate storage between production and use.

6.5 Informing the public

Article 21 of the law of 22nd July 1987 laid down that “Citizens have the right to be informed about major risks to which they are subjected in certain areas of the country and about the safeguards concerning them”. This wording has the disadvantage of mixing two types of very different information and in practice the accent has been put on information relating to safeguards in the context of PPI.

In the case of installations which have been in existence for many years, it is not a simple matter to give correct information about the risks. There are “institutional” phases of information during public enquiries when the establishment is proposing an extension, as happened in the year 2000 with the Grande Paroisse factory, but the manufacturer does not wish to give information beyond what is required by the regulations, which has the disadvantage of giving what may be very fragmentary information.

Steps should be taken at national level to lay down what information needs to be given during enquiries over plans to extend establishments, bearing in mind not only the size of the modification, but also whether or not quite recent information exists from a previous

enquiry. The hazard study might be allowed to be confined to the proposed extension when a full hazard study has been made available to the public during a previous enquiry less than 5 years earlier for example, whilst at the same time requiring that the non-technical summary should deal with the establishment as a whole.

It should be specified what is expected from the non-technical summary in terms of

safety. It is relatively easy as regards air or water pollution to present the various levels of discharge before and after an extension, and often it can be shown in this way that the extension in production will be accompanied by a fall in the level of pollution. On the other hand, it is more difficult to present in a clear and concise manner the level of risks. In order to do so it will be necessary to be able to find in these summaries at least a map showing the risk zones: 1% lethal risk (LC 1) and risk of irreversible effects, together with the number of people affected for each zone. The effect of the envisaged modification on these zones should be specified.

The composition of the SPPPI should allow an exchange between the various parties:

manufacturers, authorities, elected representatives, associations and scientists in the field of major risks under calm conditions. Pressure should be exerted on these bodies to bring about the necessary dialogue on major industrial risks.

In cases where there is no SPPPI, local information committees would have to be set up for installations covered by the SEVESO Directive (high thresholds) such as exist for basic nuclear installations and waste processing plants.

6.6 Town planning controls around sites which present major industrial risks

In the light of existing hazard studies, in the first instance a quick review of the situation regarding SEVESO establishments should be carried out. An analysis should be made of the population living in the at-risk areas, the number of jobs and the number and capacity of ERP, especially schools or hospitals. It is obvious that when the population in these areas is already very large, measures aimed at limiting any increase in population to the bare minimum scarcely make much sense.

Secondly the scenarios to be taken into account for controlling town planning should be laid down by updating the DPPR documents which go back to 1990 and giving them statutory form. The perimeter of the area that is to appear in the POS should be adapted to take into account any constraints in the application of these texts, in particular the contour of the area may not in general take a straightforward geometric line such as a circle, but must take into account such ins and outs as may be dictated by land ownership.

At present the provisions of articles 515-8 et seq. (former articles 7.1 et seq. of the law of 19th July 1976), which were introduced in 1987 and which make it possible to create public utility obligations, only apply to installations that are to be set up on new sites. In practice, this has considerably limited the scope of this provision, as the majority of new installations, since this date, have been set up on old sites.

It would therefore be desirable to extend the scope of this provision so that it covers not only new installations but also old ones.

These provisions do not allow the owners of existing buildings to be obliged to demolish them, but one could at least, through legislative channels, for the most exposed areas, provide for a right to compulsory purchase or at least a pre-emptive right in favour of the operator so as to gradually reduce settlement in these areas.

It must be stressed that these kinds of measures can only be successfully accomplished if there is a consensus with the local councillors. From this point of view the present procedure of the PIG by which the Prefect imposes constraints on the local councillors which they have not really accepted, then leads to numerous difficulties in applying these measures. An appropriate compensation for the owners should facilitate the taking of such measures, but the cost would certainly not allow it to be used when the area to be protected is too extensive.

Such measures, whose technical detail is complex, could only be taken after an in-depth study carried out in liaison with the Minister with responsibility for Town Planning.

7 Conclusion

The analysis which we have been able to make, which was accomplished within a very short time, has not enabled us to determine the direct causes of the explosion. In particular we do not have any data enabling us to pass a precise verdict on the means of prevention used by the operator. It should be noted however that the ammonium nitrate storage facilities were not managed directly by the Grande Paroisse company, but by a sub-contractor. We do not have data that would enable us to say whether this fact could have played a role in causing the accident, but the increasing use of sub-contracting in the most hazardous industrial installations poses problems in terms of knowledge of the products and the transmission of information between the operator of the installation and his sub-contractors.

7.1 Regulations on ammonium nitrate

Following the explosion that occurred on the 21st September in Toulouse, the regulations on ammonium nitrate need to be strengthened in order to take into account the risk of this product exploding:

- 1 - The maximum content of nitrogenous fertilisers should very rapidly be limited to a maximum value of between 28 and 31.5% of nitrogen (80 to 90% of ammonium nitrate), which would reduce the risk of explosion and the risk of their use as explosives.
- 2 - For nitrogenous fertilisers containing less than 31.5% nitrogen, technical safety rules similar to those in force in Germany and the Netherlands should be adopted.
- 3 - Industrial ammonium nitrate (which should be treated as an explosive) should be defined precisely by a standard. The technical rules should be defined.
- 4 - Products that are not up to standard in the manufacture of nitrogenous fertilisers or industrial ammonium nitrate as well as contaminated products should be treated as explosives, which involves special rules for the protection of workers and people living nearby.

With this in mind, at European level, Directive 80/876 on fertilisers should be amended and the thresholds of the SEVESO II Directive should be adapted.

Without waiting for the amendments to European regulations proposed above, work must begin on amending the French regulations:

- To have the corresponding hazard studies brought up to date (taking into account the risks of the domino effect in production factories between ammonium nitrate stores

and ammonia stores)

- To lay down new technical rules on ammonium nitrate storage facilities
- To amend the list of classified installations in accordance with the previous guidelines.

7.2 - The Inspectorate of Classified Installations

Supervision of the Grande Paroisse company's factory, and likewise that of the other chemical factories in the South of Toulouse, was carried out diligently and the directives of the central authorities were applied appropriately.

The present situation, in which inspectors are obliged to make choices according to priorities within establishments which are themselves regarded as priorities, and the majority of the installations subject to authorisation are not supervised, is unsatisfactory. The Inspectorate of Classified Installations needs to be strengthened through a plan covering a period of 5 or 6 years aimed at giving it the necessary resources. This would involve doubling the present numbers employed (2001 budget).

7.3 - Knowledge of the risks – Hazard studies

The Toulouse explosion shows the need to improve our knowledge of potential risks. In order to do so, it will be necessary to strengthen the technical support to the authorities on the model of that which exists between the Nuclear Safety Authority and the IPSN. The resources of the INERIS and the IPSN, which are complementary, need to be strengthened.

In order to improve the quality of hazard studies and their homogeneity between various industrial sites, the MATE needs to lay down rules on what sort of accidents to take into account, external threats, the procedures for hazard analyses and the criteria defining the effects on people. The question of tankers parked in factories warrants special attention.

The numbers of people living in the various risk zones must be assessed. This assessment will throw light on the decisions that have to be made.

Hazard studies, which are carried out under the responsibility of the operator, should – at the request of the authorities – be able to be subjected to critical analysis by an expert who is independent of the operator. This would be one of the major roles of the INERIS and the IPSN.

7.4 New urban and industrial projects

The accident that occurred in Toulouse on the 21st of September should lead to a re-examination of the position of many factories that are situated in an urban environment. In the case of factories where areas where there is a fatal risk (LC 1:1% lethal effects threshold) are of substantial dimensions and where present urban development may exceed tens of thousands of inhabitants, the question needs to be asked as to whether the activity should be allowed to carry on, whilst making it more safe, or whether it needs to be brought to an end.

The pursuit of certain activities will only be possible in the long term if, through technical measures, it is possible to reduce the risks to a tolerable level bearing in mind the present level of urban development. In other cases, it will be necessary to contemplate closing the factory, with a delay of a few years to facilitate the transition, whilst ensuring that the timetables announced are in fact complied with.

7.5 Informing the public

The process of informing the public about major industrial risks must be improved. When there are enquiries in connection with proposed extensions, procedures need to be laid down for informing the public about the risks of the establishment as a whole. In particular, the minimum contents of the non-technical summary should be specified. These summaries therefore must contain at least a map showing the risk zones: 1% lethal risk (LC 1) and risk of irreversible effects, specifying for each zone the number of people concerned.

7.6 Urban development controls

The scenarios to be taken into account for controlling town planning should be laid down by updating DPPR documents dating from 1990 and giving them statutory form.

At present the provisions of articles 515-8 et seq. (former articles 7.1 et seq. of the law of 19th July 1976), which were introduced in 1987 and which make it possible to create public utility obligations, only apply to installations that are to be set up on new sites. It would therefore be desirable to extend the scope of this provision so that it covers not only new installations but also old ones.

These provisions do not make it possible to force people to demolish existing buildings, but one could at least, for the most exposed zones, provide for a right of compulsory purchase or at least a pre-emptive right in favour of the operator, at his expense, so as to gradually reduce the numbers of people living in these zones.

7.7 PPI

PPI must contain precise specifications on: their regular revision, information, exercises, preparation for a possible accident in exposed establishments. In particular a system for checking on the existence of special safety instructions for these establishments must be put in place (perhaps in the context of authorisations and inspections connected with the safety of ERP and within the framework of the Factory Inspectorate).

François BARTHELEMY
General Mining Engineer

Jacques ROUSSOT
Controller General of the
Armed Forces (2s)

Henri HORNUS
Chief Civil Engineer

Jean-Paul HUFSCMITT
Engineer in Chief of Munitions
Explosives Inspectorate

Jean-François RAFFOUX
Scientific Director of the INERIS

List of annexes

- 1 - Letter of authority for the Commission dated 24th September 2001
- 2 - Note from the Head of the Inspectorate General of the Environment dated 1st October 2001
- 3 - Map of the South of Toulouse to a scale of 1/25000
- 4 - Plan of the Grande Paroisse factory to a scale of 1/2000
- 5 - Aerial photographs of the site
- 6 - Map showing the areas covered by the PIG and the PPI

List of related documents appearing in Volume 2

- A : Opinion of the INERIS on the Grande Paroisse factory's SGS Safety manual.
- B : Note on the Braqueville site and the gravel-pits
- C : Description of building 221
- D : Chronology of 21st September
- E : Account of the interviews with employees from Grande Paroisse and the other companies operating on the site
- F : Analysis of the damage observed in Toulouse after the accident on the 21st of September
- G : Report of the Midi Pyrénées Observatory at the Université Paul Sabatié
- H : The results of the air quality measurement(s) carried out by the ORAMIP (Regional Air Observatory for the Midi-Pyrénées region)
- I : Inspection report for the SNPE and Tolochimie sites

- J : INERIS note on ammonium nitrate
- K : BARPI note on fires and explosions involving nitrates
- L : Recommendation of the CSE (Explosive Substances Commission).
- M : CSIC report dated 15th March 2001
- N : Data sheet on the Grande Paroisse ammonium nitrate

- O : Extract from the non-technical summary of the file submitted to the enquiry in 2000 (summary of the hazard study)
- P : Views of the Communes of Toulouse, Ramonville St Agnes and Pechbusque on the extension project.
- Q : Conclusion of the committee of enquiry into the application for an extension
- R : Minutes of the Meeting of the Departmental Hygiene Council on 28th September 2000.
- S : Prefectoral order of 18th October 2000 and extract from the technical specifications.

- T : Opinion of the INERIS on the town planning controls around 3 chemical sites in Toulouse.
- U : Note from the Prefecture dated 26th March 1979
- V : Minutes of meeting on 23rd June 1988
- W : Order dated 21st August 1989 defining the PIG
- X : Order of 9th October 1989 qualifying the PIG
- Y : Extract from 2001 POS regulations
- Z : Urban development trends
- AA: Brochure for informing the public as part of the PPI
- AB: 2001 timetable for POI exercises.
- AC: Minutes of the SPPPI meetings on the 4th and 11th October 1999.
- AD: Letter from the Mayor of Toulouse to the Prefect dated 21st May 2001 and reply from the Prefect to the Mayor of Toulouse dated 20th June 2001.
- AE: Letter from the Mayor of Toulouse to the Commission dated 17th October 2001.

List of abbreviations

BARPI	Bureau d'analyse des risques et pollutions industrielles/Industrial Pollution and Risk Analysis Bureau
CSE	Commission des substances explosives/Explosive Substances Committee
ERP	Etablissement recevant du public/Establishment open to the public
IGE	Inspection générale de l'environnement/General Inspectorate for the Environment
IPE	Inspection de l'armement pour les poudres et explosifs/Explosives Inspectorate
MATE	Ministère de l'Aménagement du Territoire et de l'Environnement/Ministry for Regional Development and the Environment
PIG	Projet d'intérêt général/General Interest Project (urban development control area)
POI	Plan d'opération interne/Internal Operation Plan
PPI	Plan particulier d'intervention/Special Intervention Plan
SEI	Service de l'environnement industriel/Industrial Environment Department
SPPPI	Secrétariat permanent pour la prévention des problèmes industriels/Permanent Secretariat for the Prevention of Industrial Problems
ZOLERI	Zone limite entre effets réversibles – irréversibles/Zone (perimeter) marking the limit between reversible – irreversible effects

**The Minister for Regional Development
and the Environment**

Paris, 24th September 2001

**The Minister for Regional Development
and the Environment**

to

**The Head of the Inspectorate General for
the Environment**

Re: Accident that occurred at the premises of Grande Paroisse S.A. in TOULOUSE

Following the accident which devastated the GRANDE PAROISSE S.A. factory in TOULOUSE on the 21st of September 2001 and caused many victims both on-site and off-site, I am asking you, as a matter of urgency, to send a Commission to inspect the circumstances surrounding this accident.

This Commission shall pay particular attention to understanding the origin of the event by investigating all the technical, organisational and human causes, and by analysing the means of prevention used by the operator and the effectiveness of the supervision exerted by the Inspectorate of Classified Installations.

The Commission shall also assess the adequacy of the measures in force to limit the effects of such an accident (possibility of domino effects on the site and in the direction of neighbouring establishments, urban development controls, internal and external emergency plans, information supplied to the public).

It shall issue such recommendations as it sees fit in order to improve the policy on controlling industrial risks on this type of establishment in an urban environment.

The Commission shall, as far as may be necessary, rely on the technical expertise of the INERIS. I would like your report to be handed over to me within one month.

Yves COCHET

20, avenue de Ségur 75302 Paris 07 SP – Telephone: 01 42 19 20 21

Telex Menvir 200312 – Fax: 01 42 19 11 23

Letter of authority for the Commission

1st October 2001

GENERAL INSPECTORATE FOR THE ENVIRONMENT

The Head of the General Inspectorate for the Environment;

Having regard to the decree in Council of State No. 2000-426 of 19th May 2000 and in particular article 2 thereof

Having regard to the interministerial order of 19th May 2000 on the organisation of the Inspectorate General for the Environment;

Having regard to the order of 7th August 2001 on the delegation of signatures to J.L. Laurent and P. Roussel;

Having regard to the verbal request of 22nd September 2001 from the Principal Private Secretary in the name of the Minister

Having regard to the decisions on the 22nd and 24th September 2001

Having regard to the letter ordering a report dated 24th September 2001, signed by the Minister and setting a time limit of one month

Having regard to the agreement of the IPE and the need to reinforce our knowledge

HAS DECIDED THAT:

The expert Commission on the accident at the Grande Paroisse factory in Toulouse, recorded under the number IGE/01/034, shall be entrusted to

- F Barthélemy, coordinator
- H Hornus
- J.P. Hufschmitt, a pyrotechnic expert and member of the IPE
- J Roussot

F Barthélemy shall be responsible for drawing up the report. The INERIS shall give him its assistance

This decision shall have the value of an order to set up a Commission.

Copies to: J.P. Albertini, E. Normant, IPE, INERIS, DPPR

J L Laurent

Head of Department