

Editorial Note

The following account of the Spanish Campsite Disaster is published without references.

Short Communication

SPANISH CAMP SITE DISASTER

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Introduction

On Tuesday the 11 July 1978 an unprecedented disaster occurred in Spain, at the location shown in Fig. 1. A tanker carrying liquefied petroleum gas had exploded killing over 200 people instantly, and many were beyond recognition. A further 120 men, women and children had suffered very severe burns. In the United Kingdom many similar vehicles constantly use our roads and rail links. Their construction is like those in Spain and they transport



Fig. 1.

similar materials. British and Spanish regulations governing the transportation of LPG materials are also similar. Could such a disaster occur in this Country? What could we learn from the Spanish holocaust? These were the pressing issues which the author was asked by his Chief Officer to evaluate at first hand in San Carlos de la Rapita.

At the time of the author's arrival, which was just before 10.00 hours on Thursday 13 July (44 hours after the incident), it was quite obvious that difficulty would be experienced in trying to get the information required from the Los Alfraques camp site in any unofficial capacity. A strong Police contingent was present and the general public were kept at considerable distance from the site: photographs could only be taken by permit holders and the main road past the camp site was still open to traffic, which had to keep moving. It was therefore proved necessary to approach the Spanish Police in an official capacity as a fire officer. However, once identification was established and the purpose of the visit explained, full access to the site and permission to take photographs was readily given.

The scene

Without over-reacting in any way, this is one of the most terrible tragedies anyone could have possibly witnessed. Whole families had died a most horrible death within minutes; row after row of tents, caravans and camping trailers were completely burned out. One could virtually see what each family had been doing seconds before the explosion. In one case a camping kitchen was still intact with food in the pan on the stove. There were about 500 people on the camp site at the time of the explosion within the tent area and on the beach. Some of the caravans were only about 10 metres from the main road. As has been said, about 200 people, men, women and children, were killed instantly and a further 120 badly burned. Five days later 12 orphaned children were too badly burned and still too shocked to give any clue as to their identity.

It is not uncommon in the United Kingdom to have camp sites on the side of main roads with such heavy vehicles passing within a few meters of camping areas. The Los Alfraques Camp was heavily congested with both tents and caravans and appeared to be very overcrowded by United Kingdom standards. It is not thought however that such overcrowding occurs in the United Kingdom on similar sites.

There had been little or no blast damage to the camp site itself; the blast appeared to go in an upward and windward direction. A close study of the blast damage revealed a very interesting feature. About 75 metres from the seat of the explosion in one direction, a single storey building of substantial construction, which was used as a discotheque, was completely demolished causing the death of four people. In the opposite direction a motorcycle was still standing on its footrest only about 20 metres from the blast area, but completely burned out.

LPG products

Propylene, the product involved in the Los Alfaques disaster, is one of a family of industrial gases conveniently transported in liquid form, where a very large volume can be stored, by compression or refrigeration or a combination of both, in a relatively small space. Propane, butane, or a mixture of both commonly known as Calor Gas, Bottogas, Gaz, etc., are familiar examples. When a pressure vessel containing one of these liquid gases ruptures, the liquid gushes out, vaporises and being heavier than air forms a blanket along the ground. The liquid LPG in vaporising increases in volume about 250 times and when mixed with between 3 and 4% of air, creates a fireball effect when a source of ignition is applied. It should also be made clear that vaporisation of the liquid depends very much on the ambient temperature when exposed to the atmosphere. For instance, if liquid butane were to leak from a container at 0°C then very little vaporisation would occur. But on the other hand (as happened in Spain when the temperature at the time was 28°C) if the ambient temperature is high then vaporisation takes place very quickly indeed. The boiling point of other LPG gases does vary slightly, usually resulting in more rapid vaporisation.

The supposed cause

According to the recent Court findings, the various causes of the tragic accident have been identified as:

- the road vehicle was without a pressure relief valve,
- the road vehicle was over-loaded,
- corrosion had taken place in the high tensile steel tank due to carrying ammonia,
- the high ambient temperature,
- the road vehicle was without a current pressure test certificate.

The results of the Court decision have brought to light extremely dangerous practices which have been followed for a long time. With regard to the tanker, this had been manufactured in 1973 without safety valves as a special model, with a theoretical volume of 45000 l and a real volume of 44416 l. However, the vehicle lacked an official pressure test certificate and also lacked 'plating' — i.e. specification of the official maximum capacity of the vehicle relative to the product being transported.

'T' steel tankers manufactured by the Mississippi Company of America, which were identical to the Spanish tanker involved, were in the past hydraulically tested to 25 bar, with a working pressure of 17 bar; the pressure relief mechanism to operate at 14 bar. The body of the tank is of 8 mm and the ends of 6 mm thick tempered steel.

It is also understood that the tanker was used for carrying ammonia on occasions, and when this occurred the pressure relief valve was blanked off. It has also been revealed that when ammonia is carried in 'T' steel tanks, corro-

sion is more apparent and cracking of the main body of the tank is more likely.

Tests on British tankers of the same construction and manufacture, have revealed some small cracks in the body of tanks but not to any serious degree. All such tankers of the American design have been taken out of service for hydraulic testing, the test period has been reduced from 10 years to 5 years and the testing pressure has been raised to 34 bar. During the rest of their serviceable life they will only be carrying butane.

The incident

The loading operation of the tanker involved finished at 12.05 hours on 11 July. The tanker was loaded to its maximum, without leaving sufficient free volume in its interior; the equipment used for loading lacked a flow meter, did not possess an automatic shut-off valve, and also lacked a system which would eliminate the possible excess of fluid in the system. As a result, over-loading could only be identified at the weighbridge at the exit of the refinery, and could only be remedied by the decision of the vehicle driver demanding the release of the excess.

At about 12.30 hours, the vehicle was weighed at the refinery exit and registered a weight by load of 23470 kg. The theoretical maximum load was 19350 kg and the calculated maximum load was 19099 kg. According to the records, the vehicle was plated as being able to carry a maximum load of 22000 kg — regardless of the product carried. At 12.35 hours, the vehicle left the refinery on a hot summer's day.

Whilst passing through the village of San Carlos de la Rapita, followed by another vehicle, it was noticed rather surprisingly that the tanker increased its road speed appreciably and passed through the village at an abnormal high speed — bearing in mind the type of load carried and the experience of the driver. A short distance off the village limits, the vehicle exploded.

It was concluded by the Court that the vehicle exploded as a result of over pressure causing the liquid to escape in such a quantity and ignited by outside means thereby causing the explosion (a boiling liquid expanding vapour explosion). The official document registered the number of deaths as 210, although 40 bodies have never been found. As a result of this Court decision, the following fines have been imposed (subject to appeal) on 6 persons, the Technical Director and another employee of the transport company, Cisternas Reunidas S.A., and 4 Directors of Enpetrol — present sentences between 6 months and one day and 6 years, and a total fine of 1200 million pesetas plus 3 million pesetas Court costs; on the two companies involved, Cisternas Reunidas S.A., and Enpetrol, a further fine of 1200 million pesetas to cover third party costs. Should these moneys not be deposited within 30 days, confiscation of personal/company effects will be effected to a value of the fine.

It must be realised at the outset that most of the people in the immediate

vicinity were killed and therefore the opinions of witnesses varied. The most reliable witness appeared to be a young man who worked in the camp shop. At 14.29 hours on Tuesday 11 July he was serving a customer in the shop when he heard a minor explosion which he thought had occurred on the site. Realising that something was wrong he went outside to investigate, walked to his car, which was parked on a nearby car park, and was about to drive through the camp site when a second, far more violent explosion occurred. On seeing the huge fireball and experiencing the effect of the heat, he fled in fear of his life into the sea. The time lapse between the two explosions is estimated to be about three minutes. Many witnesses talked of two explosions but suggested that they may have been much closer together than that. A study of the extent of the spread of the gas cloud showed that it certainly was not possible for both explosions to have occurred simultaneously. The reconstructed scene of the accident is depicted in Fig. 2.

Some comparisons with the United Kingdom

The prime question is of course: could a similar explosion happen in the United Kingdom? Without any prevarication the answer must be 'yes'. Tankers in the United Kingdom are of similar construction; a 10 mm steel shell with welded joints carrying up to 20 tons of product. Tankers leave many depots regularly throughout the day and proceed along all types of roads and through City Centres with no imposition of special restrictions.

The regulations which govern the transportation of highly flammable materials in Spain take the form of an agreement signed in 1957— 'Accord Européen relatif au transport international des marchandises dangereuses par route' — commonly known in Europe as ADR Rules. The regulations cover labelling, packaging and conveyance of dangerous goods carried freely across Europe.

Although British tankers are constructed to British standard 1500 or 1515, the regulations governing the loading, transportation and delivery of LPG at present taken the form of a voluntary agreement between the companies involved. The agreement, which forms part of the 'Transport and Drivers Manual', does not impose any restrictions concerning the class of roads which should be used.

The tanker in Spain was en route to the Valencia area travelling on the N340 thus avoiding the Motorway and the £7 toll; tankers are advised to use the Motorway but it is not compulsory. However, it has recently been announced in Spain, following this tragedy, that all vehicles carrying hazardous materials must use roads which avoid highly populated areas in the summer and at holiday periods. It is important to consider whether such a restriction would be reasonable in the United Kingdom, although it is inevitable that tankers carrying hazardous materials will at times have to use minor roads passing through populated areas to load and deliver LPG products to specific addresses.

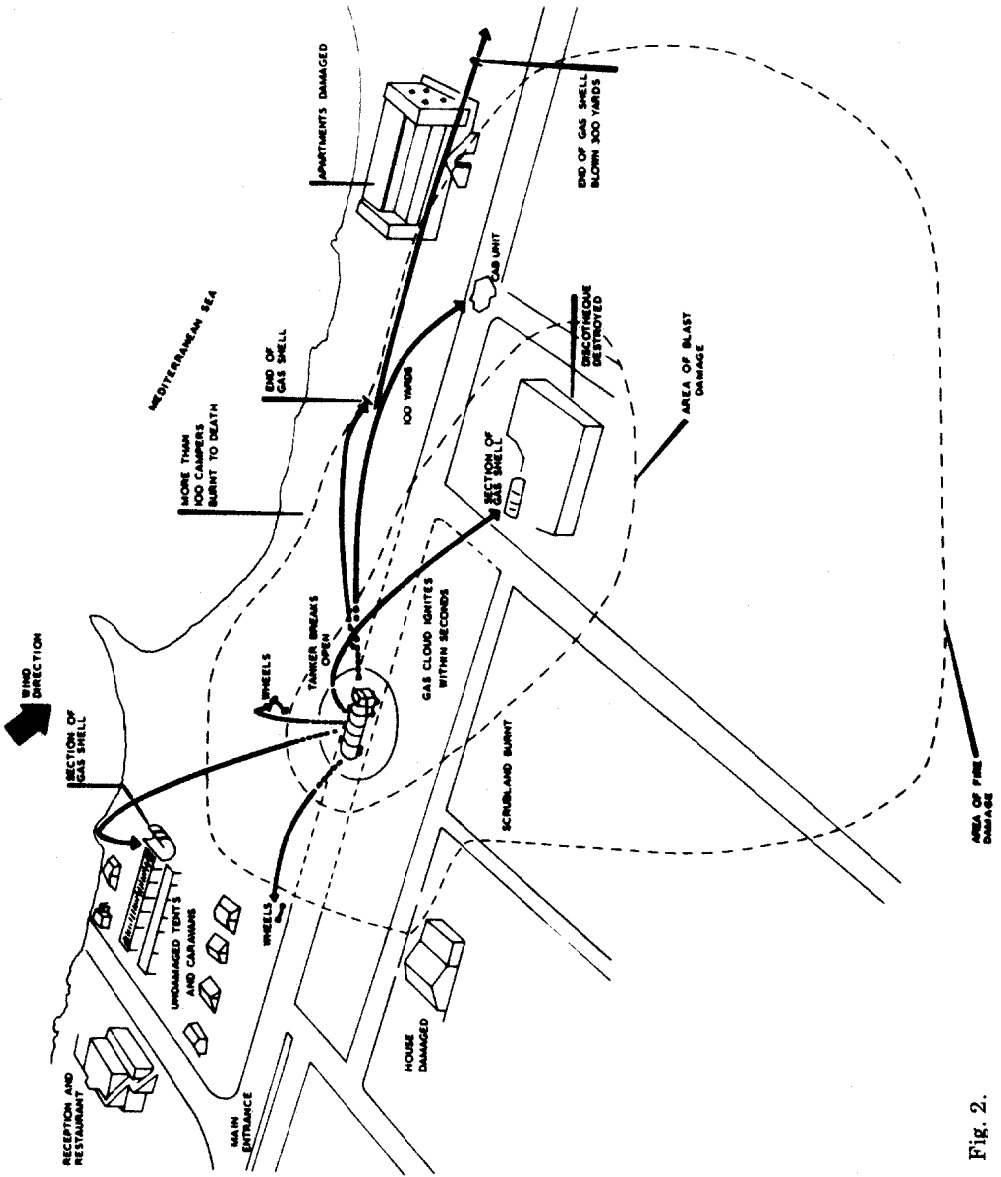


Fig. 2.

Examining the tanker involved, and those of similar construction, it became obvious to the author that 10 mm steel welded jointed vehicles should be more adequately protected against impact. He could not help feeling that, had a tanker of similar construction been involved in a several vehicle accident on a motorway, a comparable rupture could take place and with similar consequences. In addition to this the delivery pipe-work under the main body of the Spanish tanker also seemed very vulnerable to mechanical damage. If during an accident this pipe-work was damaged, liquid could flow from a 100 mm pipe causing a very swift large loss of the contents.

The transportation of hazardous materials on our roads is a very complex matter and the author is aware that the problem has been given serious consideration for a number of years, but impact protection to the outside of road tankers carrying LPG remains, in his mind, a matter for urgent consideration.

The United Kingdom safety record

It is understood that up to 300 pressurised gas tankers are travelling regularly on British roads, but information from one of the larger companies suggests that this could be an underestimate of the true position. They carry mainly highly flammable petroleum related gases i.e. propane, butane, (or a mixture of both), chlorine and propylene, although it should be stated that most of the LPG transported in the South of England is by sea, underground pipeline or by rail. Pressure vessels on road tankers are said to be strong and representatives from the United Kingdom industry have expressed surprise at the suggestion that any of their specially constructed tankers could rupture so completely without being subject to violent impact.

In support of their optimism, there was an incident which occurred at Ferry Hill, County Durham, about six years ago, where a rail tanker of similar construction, carrying approximately 30000 litres of LPG, was dragged for half a mile on its side, crashed into a pile of rails and suffered only superficial dents. However, a further incident occurred in 1974 in Aberdeen where a BOC road tanker carrying 16000 litres of butane was involved in a road accident caused by icy roads. The main valve group ruptured on impact and liquid butane flowed out. It was fortunate on this occasion that the temperature was at freezing point (boiling point of butane 0°C) and therefore very little vaporisation of the butane occurred. However the limited amount of vapour that was present was ignited by a car which was involved in the accident.

If we are to compare this incident with the one in Spain, it is quite obvious that, had the temperature been much higher, vaporisation would have taken place more quickly, the gas cloud would have been much larger and when ignition occurred the consequences may have been far more serious. Significantly, the fact that the tanker had no external impact protection contributed to the cause of the rupture.

Although during last year alone, British tankers carrying LPG products have travelled over 30 million miles on British roads with no loss of life, our record is not altogether perfect. Incidents have occurred where LPG has leaked from tankers and formed gas clouds of limited size, but fortunately due to varying circumstances (including the very swift attendance of the emergency services) the consequences have not been so disastrous as the one in Spain.

Other lessons to be learned

During the course of the author's investigations, one important organisational point arose. During the afternoon of Thursday 13 July he visited the mortuary in Tortosa, about 15 miles from San Carlos de la Rapita. There he saw at first hand the difficulties of coping with 100 very badly burned bodies. The German Police (most of the victims were thought to be German) had taken registration numbers of vehicles involved in the fire together with the engine and chassis numbers in a bid to trace the families involved. It is understood that there were many nationalities on the site at the time.

A German forensic team, whose specific task it was to try and identify bodies, found this task to be extremely difficult. All the victims who had suffered fatal burns had been moved very soon after the explosion into an area away from the camp site and laid out on a pathway ready for removal to the mortuary. Because they were moved from their camping area without any form of labelling, it was impossible to trace them back to the site where they were staying. If these bodies had been labelled in some way before removal, they could have been identified with their car registration number and relatives could have been informed almost immediately.

Unfortunately some relatives had to wait up to two weeks to see if people who were thought to be in San Carlos de la Rapita returned home. If a local authority in the United Kingdom is ever faced with a massive death toll where bodies are burned beyond recognition and scattered over a wide area, it is imperative that a labelling system should be used in order to identify at least the places from where the bodies had been recovered. A numbering system on each body with a sketch plan would suffice.

Whilst appreciating the difficulties involved in dealing with such an unprecedented disaster, a very controversial issue arose concerning the treatment of the badly burned survivors. The immediate and natural human impulse was to utilise the very limited intensive care facilities to help those who were most badly burned. However, with hindsight it would appear that, had these limited resources been used to help those whose burns were less severe (say less than 75%), more lives may well have been saved. A sobering and very agonising thought.

Conclusions

If we in the United Kingdom are to do as much as possible to avoid a similar disaster it will be important to ensure that the tankers which carry LPG

products are more adequately protected against impact than they are at present.

In addition to the points raised about tanker construction and legislative control, if we are to prepare for a similar disaster in the United Kingdom (and the possibility cannot be ruled out), the Spanish experience:

- (a) drew attention to the safest routing of such vehicles;
- (b) highlighted the added danger of camp sites being situated near to the roadside with their immense ignition potential, raising the question as to whether the road over which LPG products are transported should be restricted during holiday seasons;
- (c) proved the need for a reliable system to help identification of bodies;
- (d) raised the controversial issue of the allocation of limited intensive care facilities.

Any preventive steps which are taken will only be truly effective if backed by legislation rather than voluntary agreement. Obviously any such legislation should be valid across Europe and not simply an internal measure in the United Kingdom.