

## Release then flash of LPG at tank truck loading point in a refinery

April 23<sup>rd</sup> 2004

Germany

Flash  
Refinery  
Loading point  
LPG  
Connector  
Threading  
Victim  
Periodic checks

### THE INSTALLATIONS CONCERNED

The tanker truck loading point in a refinery was involved. The photo opposite gives a view of the type of installation.

On the site concerned, during loading, the tanker is connected to the loading point by an articulated arm. The transfer is made as a rain, the liquid phase being transferred via tee bottom valve....



Photo LFU – Baden Wurttemberg - Germany

Example of LPG loading point

### THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

#### The event :

At 7h30, when the loading had commenced and when 15t of product had already been transferred, the unexpected separation of two parts of the tank / connecting arm occurred. A release of LPG followed and this caught fire provoking a flash which engulfed the driver. The explosive force of the separation was such that the extremity of the arm was projected towards the cladding of the loading point, which provoked the activation of the stop valve and halted the arrival of product from the refinery. The flash burned the feed hose from the bottom valve of the tank, and this valve closed, preventing leakage from the truck.



Photo - LFU – Baden Wurttemberg – Germany

Example of connection arm –tank

#### The consequences :

The driver, burned by the flash, died a few days later of his injuries. The incident led to the release of roughly 10 kg of LPG (volume estimated at 20 l).

## European scale of industrial accidents

Using the scoring rules of the 18 parameters on the scale formalised in February 1994 by the Committee of Competent Authorities of the Member States in the application of the 'SEVESO' directive, the accident can be characterised by the following 4 indices, taking into account the available information..

Dangerous materials released		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The parameters comprising these indices and the corresponding method of scoring can be found at the following address: [www.aria.ecologie.gouv.fr](http://www.aria.ecologie.gouv.fr)

Level 1 for the quantities of dangerous substances released represents the release of 20 litres of LPG (parameter: Q1).

Level 2 for human and social consequences represents the death of the driver (parameter: H3).

## THE ORIGIN, THE CAUSES AND THE CIRCUMSTANCES OF THE ACCIDENT

### Equipment failure:

Investigations following the accident showed that the cause of the release of the LPG lay in the failure of a bolted connection between the feed arm and the tank. A detailed examination brought to light that the bolted connection, of the ACME 3 ¼" type was heavily worn, the profile of the threading of the bolting ring was in fact reduced to a triangular profile from excessive wear. The other part of the connector in the tank was also very badly worn and showed a conical form. Consequently the connection between the two parts was extremely unstable. Thus, even vibration or slight movement would have been sufficient to provoke the failure of the equipment.



*Examples of worn bolted connections : connector at tank end and bolting ring.*

### Anomalies in practices:

Marks due to impacts from hammer blows intended to ensure tight connection were clearly visible on the "ears" of the bolting ring. This practice is actually current while presenting harmful effects such as abnormal wear on the thread due to excessive tightening of the connection – or even leading to the ring taking on an oval shape

Close to the loading point, a tightening spanner was found on the ground, which tends to exclude the hypothesis that the driver concerned on the day of the accident had used a hammer to tighten the connection.

## THE MEASURES TAKEN

This event resulted in immediate action being taken as regards LPG activity in the region concerned of Baden-Württemberg. A vast control programme was immediately set up. The objective was to identify all connections likely to show faults. All the LPG "distributors" were checked as well as installations holding stores of more than 15 t. Reservoirs subject to more frequent filling or where a greater possibility of wear of the connectors existed were also included in the programme. Road tankers were also checked, even if the transport company concerned was not located in the region.

Bearing in mind the generic aspect of the problem encountered, information was provided to a large number of bodies, authorities and various organisations. Thus the authorities in the region responsible for water pollution and for mechanical security were alerted as well as the German professional LPG union (DVFG), the Federal Environment Agency (UBA), the office in charge of the recording of accidents (ZEMA), the federal union of transporters and storage agents (BSL), the body in charge of technical controls (VdTÜV), the union of petroleum industries (MWV). Local inspection authorities around the region concerned (Drire Alsace, KCB-Basel Landschaft, Sicherheitsinspektorat Basel-Stadt) were also warned.

The accident enters the field of German technical regulations TR 402 covering the handling of gas under pressure and in particular the chapter concerning the filling of installations. Paragraph 8.2 of this text refers to tests of handling of this equipment, one of the important points in the check consists of the visual examination of the external surfaces and, as far as possible, the internal surfaces.

Inspectors of the sites received instructions to complete a programme of checking immediately. A list of visual indications to check was provided for them, the aim being to check the existence of potential risk.

The threading was to be checked in taking into account its profile, anomalies presented (flattened areas, spot corrosion, broken threads). Furthermore, the state of the ears on the tightening rings was to be checked for evidence of possible tightening by "hammering".

During the checking campaign and during exchanges with the LPG professional union in the United Kingdom, a new method of testing was developed. The use of testing rings allowed for rapid and simple testing of the degree of wear of the two parts of the connector. As an example, if the ring made one turn, the connector is in a good condition, failing that, it is considered as worn. On the ring used at the time of the accident, four turns could be made.



Initially, in the framework of the checking campaign, no clear criteria were stated. It was necessary therefore to be confident in the competence of the inspectors on the sites. The results were as follows:

- ✓ in no case was there serious wear on the site end of the ACME connector,
- ✓ in a few isolated cases, slight wear was visible : the operators replaced the parts as a precaution
- ✓ In a few cases, signs of hammering were visible on the threaded ring, even if the thread itself presented no particular anomalies.

It is clear that these results did not reflect the true situation prior to the accident: indeed several operators having heard about the checks had already changed their connectors as a precautionary measure

## THE LESSONS LEARNED

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On the basis of this event, the elements to be derived from experience are relatively simple:

- ✓ Ensure that the use of a hammer for tightening connections is clearly forbidden, this having been a common practice.
- ✓ Proceed to check regularly, either visually or with test equipment.
- ✓ Importance of the process of exchange of experience as follows:
  - × Seek out the causes,
  - × Determine the measures to be taken and the follow-up
  - × Communicate the causes, measures and follow-up as widely as possible throughout the field of activity concerned but also to the national authorities and international bodies
  - × Trace the information received

Indeed, during its investigation, the attention of the authorities of Baden-Wurtemberg was drawn to the fact that a similar event had occurred in the United Kingdom. This had led the operator of the site concerned to prepare an "Alert file" which was distributed throughout the group (file dated 08.12.2000). One can thus wonder if a wider distribution of this file might not have prevented the accident in 2004.

To conclude, the LPG Union in the United Kingdom, published a technical memorandum (n°81) devoted to the ACME bolted connections, dated April 2005. Furthermore, the group implicated in the accident in the United Kingdom in 2000 made a further publication of their "Alert file" at the end of 2004.