

KOALAGAS LPG TERMINAL AT BARCELONA

Pipeline Systems

Pipelines for ship discharge

The berth permits the discharge of vessels with a length overall of 210 metres and a maximum draught of 12 metres equivalent to 40 ft.

The berth has an arm for discharging LPG linked to an 8" diameter pipeline for the liquid phase, and a 4" diameter pipeline for the vapour phase.

The pipe runs from the berth to the terminal along a raised pipeway shared with other Companies in the port area.

LPG is pumped from the ship to the storage spheres with the vessel's pumps.

The distance from the jetty to the LPG storage is about 500 metres.

Pipelines for loading and discharging trucks and railcars

Loading and discharging of trucks takes place on two certified weighbridges. Connecting and disconnecting is carried out by the drivers themselves under the supervision of the automatic control system. Two trucks can be loaded or discharged at the same time.

The pumping station for loading tank trucks is near the storage area. It is equipped with two pumps and a compressor with unit rates of 100 cubic metres per hour. These two pumps are installed in parallel and are connected via manifolds to the spheres and the loading arms so that each unit may pump from any of the spheres and send product to any truck loading arm, re-circulate product in the same sphere or transfer from one sphere to the other.

Fire-fighting system

A buried ring main of a 10" diameter extruded steel pipe coated with polyethylene runs all around the Terminal, and is fed by three pumps with a capacity of 500 cubic metres per hour each at 10 atmospheres. The pressure is guaranteed via a jockey pump with a flow rate of 40 cubic metres per hour at 12 atmospheres. The reserve of fresh water amounts to 10,000 cubic metres.

Seven strategically located hydrants equipped with fixed monitors are connected to the ring main, covering all the areas at risk.

In the loading area there is an automatic fire-fighting system equipped with water sprinklers.

In the area where vessels discharge, fire protection systems have been installed, consisting mainly of extinguishers, water hydrants with monitors and escape routes protected with hydro shields.

Instrumentation and supervision

The spheres have flanges in the top with incoming pipes for filling, for instrumentation and for inspection. The instrumentation and safety devices are duplicated as a preventative measure in the event of a malfunction in any one of them:

- Two safety valves for each sphere capable of venting 100% of the contents in the event of an emergency and installed so that should either valve fail, the other would come into operation.
- Two isolating valves in each of the pipelines for filling or emptying the spheres, two level indicators with high or low level alarms, and a switch sensor for each sphere that comes into operation in the event of excessively high or excessively low levels and closes incoming / outgoing product valves.
- Two pressure indicators with high pressure alarms, and three temperature indicators situated at various levels in the sphere.

Emptying and draining the spheres is carried out from below.

Moreover, the Terminal is fully automated by means of a distributed control system which functions in real time. The control and supervision system of the installation's equipment is connected to the management information system via Ethernet network. In this way both the administration and the operation systems are

exchanging data and information constantly.

Loading orders arrive into the system via modem, so that the Terminal customers are able to check in real time their stock level, daily movements and the status of loading orders.

As stated above, verification of the quantities loaded or discharged into/from trucks take place when the vehicle is on the weighbridge.

Product valves and fire-fighting valves are activated automatically and are operated by the control system. Further, the supervision system controls all the alarms that might be activated by the gas or fire detectors, interrupting all current operations and starting up the automatic fire-fighting system.

Safety facilities

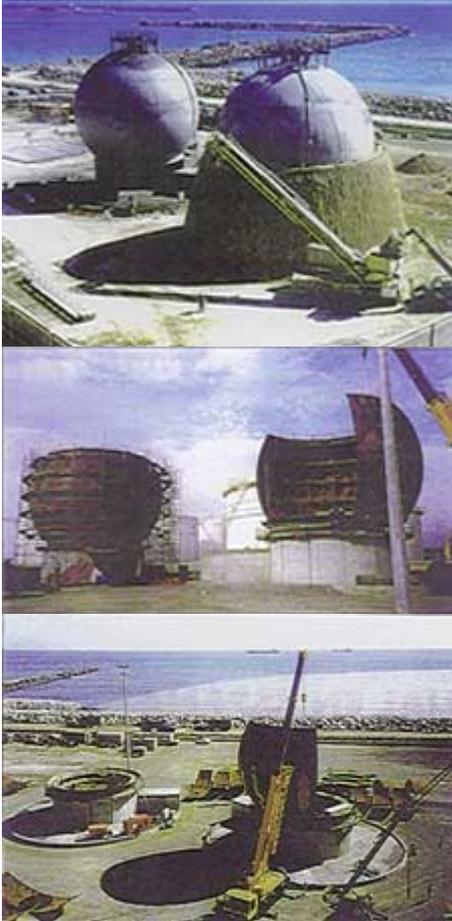
Safety facilities have been installed in conformity with the Spanish regulations dated December 1st 1964 "Safety instructions for installations for loading LPG", the Royal Order no. 2085 / 1994 approving the regulations for petroleum installations, and the Technical Instruction ITC-MIE-APQ001 "Storage of inflammable liquids and fuels". Consequently, the facilities and the installations have been located respecting the distances foreseen by these regulations and the plant has been provided with a fire-fighting network. In the event of any inconsistency in the law, the most favourable solutions from the safety point of view have been adopted.

The KOALAGAS installation has gas and fire detectors located strategically in the areas of greatest risk. These detectors are connected directly to an independent panel and to the general supervision system, in the control room. Gas detectors have pre-alarm and alarm settings which provoke, as do the fire detectors, the activation of the fire-fighting system in the loading area, stop the pumps and other equipment and give a general alarm, thus triggering the internal emergency plan.

Both the marine arms and the truck loading and unloading arms are equipped with a breakaway system that prevents the release of gas in the event of an accidental break in connection resulting from an unexpected movement of the vessel or of the truck, in such a way as to close off the gas immediately by means of an automatic valve.

Finally, the terminal has an anti-intruder system with closed-circuit television and video recording connected up to the alarm centre.





KOALAGAS was constituted in December 1997 as a joint-venture between CAPESA (currently DECAL ESPAÑA) and PRIMAGAZ DISTRIBUCION. The main aim of the company is the storage of LPG in Spain.

Immediately after constitution, the necessary permits for the construction of an independently-owned Terminal, strategically located in the port of Barcelona, were applied for. It was to be available for the use of any of the operators competing in the sector.

The whole project foresaw six spheres of a geometric capacity of 2,000 cubic metres each, for the storage of propane and butane. The forecast investment was in excess of 2.500 million Pesetas (Figure 1 gives a graphic presentation of the whole project).

figure 1: initial project

In the first phase two spheres were built and thus the initial capacity put into service amounts to 4.000 cubic metres with an investment cost of 1.000 million Pesetas.

In addition to the area dedicated to storage, the Terminal has:

- a marine facility for the discharge of vessels, and
- a loading/discharge areas for trucks and railcars (the latter is in the project phase).

Construction work began in May 1998 with earth-moving and the preparation of the foundations of the spheres.

Geotechnical Studies / Foundations

Geotechnical studies were carried out on the basis of three exploratory drillings down to 46 metres, six continuous rotational drillings with the extraction of continuous cores down to 25 metres and seven dynamic penetrometer tests to observe the resistance of the subsurface material. SPT tests were made around the drillings and, from the clayey strata, fresh samples of material were extracted.

On the basis of the results of the various tests, the foundations were designed using piles of a suitable length driven into the stratum of consolidated sand located under the infill materials. Each sphere rests on 63 piles of the CPI-8 type, with a diameter of 650 millimetres and 9 metres deep. Each sphere rests on 63 piles of the CPI-8 type, with a diameter of 650 millimetres and 9 metres long. The piles were tested ultrasonically in order to check that they had been properly constructed and in addition, bearing tests were made up to 150% of the load normally required. The load bearing requirements were calculated on the basis of the weight of the tanks filled with water (for the purposes of the tests) and above all of the weight of the sand that constitutes the Texsol(r), which results in a weight 3 times greater than spheres without this protection.

The piles have a reinforced concrete base 80 centimetres thick. Each sphere, instead of having the conventional metal leg supports, is supported on a circular wall made of reinforced concrete, with 40 centimetres width and 4 metres height built onto the concrete base.

Storage spheres

Given the particular nature of the support of the spheres on the crown shaped concrete wall instead of on metal supporting legs, the erection of the spheres proved to be unique and innovative as shown in figures 2-3.

The spheres have been protected with an epoxy coating reinforced with fibreglass 2000 microns thick, with a system of cathodic protection by active current to prevent corrosion damage. The distribution of the current is achieved by means of "anodes" situated at four levels for better distribution.

The material used for the construction of the spheres in accordance with the project code of practice CODAP 95, is carbon steel grade A-48 FP. The thickness of the metal sheet varies between 34 and 45 millimetres.

The spheres have been subjected to exhaustive quality checks, including radiographic tests on 100% of the welds, ultrasonic tests, tests with penetrant liquids and hydrostatic tests at 21 atmospheres of pressure.

Currently both spheres contain propane and are also suitable for containing butane.

figures 2 y 3: Spheres installation

Protection with Texsol(r)

The really unique aspect of the KOALAGAS project from a technical viewpoint consists of the built-in protection of the spheres by virtue of Texsol(r), a material which has a finish which is very characteristic. This material, studied for the French Ministry of Defence, consists of a combination of sand and polyester thread in the proportion of 250 kilograms of plastic thread per cubic metre of sand. The minimum thickness of the covering is 60 centimetres and guarantees protection against fire and explosion greater than FR-180. The combination of the two materials, created "in situ", permits the formation of almost vertical strata (in our case 80j) thus obtaining a semi-underground type of storage. Figures 4 and 5 below show some parts of the covering work with Texsol(r).

These applications were developed in France, especially for installations near to urban areas subject to the Directive "Seveso II".

This is the first time that a project of this kind has been implemented in Spain.

figures 4 y 5: Texol material installation

Partecipazione di Technip al progetto del terminale GPL di Koalagas

Technip Iberia ha realizzato, tra il 1998 e il 1999, il progetto esecutivo e i progetti amministrativi e si è occupata della direzione e supervisione del cantiere, sfere escluse, del deposito GPL di Koalagas localizzato sul molo degli infiammabili del Porto di Barcellona. Tale impianto è formato da un'area adibita alla scarica delle navi, un'area di stoccaggio, una per la stazione di pompaggio e una adibita al carico di camion e vagoni cisterna.

La ricezione del prodotto avviene attraverso la scarica delle navi al pontile di attracco sul quale sono ubicati il braccio di carico marino e l'inizio delle tubazioni di scarica.

Nella zona di stoccaggio sono state collocate, nella prima fase, due sfere, totalmente ricoperte da Texsol. A

tali sfere se ne aggiungeranno, in fase successiva, altre quattro. La capacità totale del deposito risulterà di 10.200 m³ con un coefficiente di riempimento dell'85%.

A lato della zona di stoccaggio si trovano la stazione di pompaggio per camion e vagoni cisterna. In tale area sono installate pompe e compressori con un portata unitaria di 100 m³/ora. L'area di carico dei camion è situata di fronte alla zona di stoccaggio, vicino ai bracci di carico.

Environmental protection

A characteristic which differentiates KOALAGAS from other similar installations is that this is of the type "zero leak" as the whole gas recovery system routes all gas to the spheres in order to avoid flaring gas or releasing it into the atmosphere.

As it is a liquefied gas, there is no water contamination. However, a hydrocarbon API separator has been installed which functions on the principle of density difference with coalescence, for the treatment of runoff rainwater from the truck parking area for possible oil drips or leakage of gas oil.

The works were completed in November 1999, thus adhering to the 18 month timetable fixed for the construction. Figure 6 shows how the Terminal site looked after the first phase of construction. KOALAGAS started operations in December 1999.



figure 6: first phase

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