DESCRIPTION OF THE LNG TERMINAL AND ITS MANAGEMENT

1) INTRODUCTION

The Panigaglia Terminal, owned by GNL Italia, was built between 1967 and 1970 and started operations in 1971. In its original configuration, the plant was designed to receive natural gas from Libya, make it compatible with the lighter gas extracted in Italian gas fields, and feed it into the network. With the termination of imports from Libya, the plant was upgraded to meet the standards for regasification plants and was used for the regasification of LNG of various origins.

In 1980, following the termination of contractual relations with Libya, the plant ran at reduced capacity until 1987, when a decision was made for an initial restructuring of the facility. This restructuring, which lasted from 1987 to 1991, was followed by a second upgrade carried out between 1995 and 1997 in which the two LNG storage tanks were modified, transforming them from single to double containment tanks.

2) DESCRIPTION OF THE TERMINAL

The regasification process at the Panigaglia plant uses "submerged combustion" vaporizers which heat and vaporize the LNG using heat produced by the combustion of part of the Natural Gas produced. This type of heating system is less expensive in terms of investment. However, it is more expensive from an operational perspective than the more common systems that rely on heat exchange between the liquefied gas and sea water. However, the system was adopted because of the specific environmental constraints affecting the stretch of sea where there the plant is located.

The site, which covers 317,300 m², is located in the Bay of Panigaglia, along the coast that links La Spezia with Portovenere and consists of:

- the plant itself, which covers approximately 45,000 m², consisting mainly of two LNG storage tanks, the vaporization plants, the pier for LNG carriers, and auxiliary systems;
- a group of buildings used primarily as offices, maintenance workshops with associated equipment and warehouses;
- green areas subject to environmental requalification following the first restructuring;
- a woodland area, surrounding the facility.

The plant consists of the following sections:

- receiving;
- storage;
- regasification;
- Boil-off Gas (BOG) recovery;
- final gas correction;
- auxiliary systems;
- control and safety systems.

The following are the main operations of the Terminal: Annexes to this chapter show scale drawings of the plant location and layout and a diagram of the pier.

2.1) Receiving

The receiving section consists of the berthing area for LNG carriers, the unloading arms and the transfer line.

The berthing area is located at the end of a 500-metre long pier which, once the relevant checks have been completed, can receive LNG carriers with a capacity of up to 65,000-70,000 m^3 of LNG. The sea surrounding the head of the pier is about 10 metres deep and is used exclusively for the manoeuvring and mooring of LNG carriers. The pier has four mooring posts, each of which is equipped with quick release mooring hooks, and two fenders to protect the ships, which are at equal distances from the unloading arms and have a centre to centre distance of approximately 70 metres.

To transfer the cargo, the right-hand side of the pier is equipped with three unloading arms, two for liquid (12 inches in diameter), each with a nominal maximum flow rate of 2,000 m^3/h, and one, located in the centre, to return the vapour to the ship (8 inches in diameter and a maximum flow rate of 12,000 Nm^3/h). However, the unloading flow rate depends on the production of vapours (Boil-Off Gas) that develop during the unloading operation which are recovered by the specific section for handling boil-off gas.

The vapour is returned to the Ship, as required, by a vapour return blower with a capacity of about 12,000 Nm^3/h.

The LNG from the carrier is transferred to two storage tanks through a 24-inch transfer line that connects the unloading arms to the tanks.

2.2) Storage

The storage section consists of a tank with a geometric capacity of 50,000 m^3 and an operating capacity of approximately 44,000 m^3 and of the submerged pumps for the LNG handling.

The tank is made up of two coaxial, vertical cylindrical containers. The self- supporting inner container is made of 9%Ni steel and is designed to store the LNG while the outer container (added as part of the second restructuring phase) is made of prestressed reinforced concrete and has the dual function of supporting and protecting the insulating material placed around the inner container and, in the event of an emergency, containing any loss of LNG. The tank is, furthermore, installed inside a containment basin.

The LNG is stored in the tanks at a temperature of approximately -160 °C and at a pressure slightly higher than atmospheric pressure (350 mmH_2O rel).

The storage tank is equipped with three submerged pumps, two with a capacity of 500 m^3/h of LNG each, and the third with a capacity of 170 m^3/h of LNG.

2.3) Regasification

The regasification section consists of pumps for handling and pressurising LNG and of the submerged combustion vaporizers.

The LNG extracted from the storage tank by means of the submerged pumps is initially pressurised to approximately 22 bar by the primary pumps (three in operation plus one in reserve) and, subsequently, to about 75 bar by the secondary pumps (three in operation plus one in reserve) and is then sent to the vaporizers. Each pump, both primary and secondary, has a maximum capacity of approximately 250 m^3/h of LNG.

The LNG is regasified using submerged combustion vaporizers (three in operation and one in reserve), each of which has a maximum rated capacity of approximately 250 m^3/h of LNG.
The heat required to vaporize the LNG is produced by the combustion of natural gas (fuel-gas) taken downstream of the vaporizer.

2.4) Boil-Off Gas (BOG) Recovery

The BOG recovery system at the Panigaglia facility consists of three cryogenic compressors, one with a capacity of 2,000 kg/h and two with a capacity of 8,000 kg/h each, the absorption column and related feed pumps. The smaller compressor is used for continuous recovery of the vapours generated by the heat entering the plant during normal operations and outside of unloading periods; the two larger compressors are used for recovery of the BOG produced during unloading. Recovery takes place in the absorption column by condensing the vapours with subcooled LNG.

2.5) Final gas correction

The purpose of correcting the final gas is to maintain the Wobbe Index of the gas sent to the pipeline at less than 52.33 MJ/Sm^3 to meet the quality specifications of the transport network and thus ensure the interchangeability of the regasified LNG with the other natural gases normally transported through the network. Any required corrections are made by adding air or air-enriched nitrogen to keep the oxygen concentration below 0.6% (mole). Non-compliance of the natural gas sent through the network with the quality requirements will automatically block the system.

The final gas correction section consists of two air compression trains and a battery of membrane units that enrich the nitrogen content. Each train is equipped with a screw compressor connected in series with a reciprocating compressor and is capable of compressing air to the pressure of the methane pipeline with a maximum flow rate of 4,300 Nm^3/h.

2.6) Auxiliary systems

The auxiliary systems section includes all of the activities that support the main process and without which the plant could not operate. The most important are: the electrical substation and its transmission lines to supply power and transform electricity at the plant; the fresh water and sea water systems for the dissipation of the heat generated by the compressors; the instrument air systems to operate pneumatic

controls; the station for measuring the quantity and quality of the gas in the methane pipeline and the fire protection system.

2.7) Control and security system

The LNG regasification plant is monitored and remotely controlled from the Control Room using an automatic system. This system is divided into two subsystems:

- Distributed Control System (DCS) whose functions include the acquisition, processing and regulation of the process parameters and the supervision of the plant;
- Programmable logic-based automation and blocking system (PES) which governs the start-up, stopping and blocking of the equipment sequences as well as activating automatic safety procedures in the event of an emergency.

3) PLANT CAPACITY AND THE CRITERIA FOR DETERMINING IT

The regasification capacity of the Panigaglia Terminal is determined by considering the following values:

1. the receiving capacity;
2. the vaporization capacity.

3.1) Receiving Capacity

The plant's receiving capacity, during a month of operation ("reference period", conventionally set at 30 days), is defined by taking into account:

a) the maximum possible number of berthings;
b) the LNG unloading capacity.

3.2) Vaporization Capacity

The parameters to be considered for the definition of the vaporization capacity of the Panigaglia Terminal are the capacities:

- ✓ of the pumping system;
- ✓ of the vaporization system.

The capacity of the pumping system is influenced by the quality of the LNG unloaded and the working pressure of the methane pipeline connected, while the capacity of the vaporization system is determined by the capacity of each of the four submerged-combustion vaporizers.

It follows, therefore, that the vaporization capacity matches the capacity of the vaporization system.

3.3) Plant Regasification Capacity

The plant's regasification capacity is determined by the number of potential berthings at the Terminal and the capacity, expressed as the volume of LNG that can be delivered to the Terminal itself.

Taking into account the duration of the mooring, unloading and unmooring of an LNG Carrier at the pier, which does not allow more than one berthing every three days, the maximum number of possible berthings on an annual basis is equal to one third of the days the Terminal operates in each Thermal Year, rounded down to the nearest integer.

Taking into account the safety operating margins required for a regasification terminal, the facility's structure provides a maximum guaranteed regasification capacity of 17,500 m^3_{liq}/d of LNG.

Therefore, the annual regasification capacity of the terminal is equal to 17,500 m^3_{liq}/d multiplied by the number of days that the Terminal operates in each Thermal Year.