

MEASUREMENT OF LNG DELIVERED AND OF GAS REDELIVERED

1) FOREWORD.....	2
2) MEASUREMENT OF THE LNG DELIVERED.....	2
2.1) DETERMINATION OF THE QUANTITY OF LNG DELIVERED	2
2.2) MEASUREMENT SYSTEM FOR THE LNG DELIVERED	3
2.3) MANAGEMENT OF THE UNLOADING OF LNG VOLUMES THAT ARE GREATER THAN EXPECTED VOLUMES.....	4
3) MEASUREMENT OF THE GAS INJECTED INTO THE NETWORK.....	4
3.1) SYSTEM FOR MEASURING THE VOLUME OF GAS INJECTED INTO THE NETWORK	5
3.2) INSTRUMENT CHECKS	6
3.3) CONSUMPTION AND LOSSES.....	6

1) FOREWORD

The quantity of LNG, expressed in cubic metres, considered delivered by the User to the Operator at the Delivery Point and the determination of the volume of gas injected into the network by the Operator at the interconnection with the Snam Rete Gas transport network shall be measured according to the procedures in use at the Terminal, as described below.

2) MEASUREMENT OF THE LNG DELIVERED

2.1) Determination of the Quantity of LNG Delivered

The quantity of LNG in the LNG Carrier's tanks is determined by measuring several parameters, such as:

- a) on board the Carrier, before unloading begins and again after the unloading operation has been completed
 - Volume of LNG in the tanks
 - Temperature of the LNG
 - Pressure of the gas phase in the tanks
- b) in the Terminal, as ascertained by the composition analysis performed by the gas chromatographs, the
 - Density of the unloaded LNG
 - Higher Heating Value of the LNG
 - Wobbe index of the LNG
 - Higher Heating Value of the Vapour
 - Density of the vapour

The volume of LNG and the energy unloaded shall be determined by means of a joint consultation between the ship's Captain (or the first officer as a delegate), a representative of the User, a representative of the Operator, the inspector of the surveying company and, if the Customs so requires, a Customs' representative, taking into account the following two measurements:

- the first measurement shall be taken after mooring, before the unloading arms have been connected to the LNG Carrier, while the unloading manifold valve is still closed, and after the ship's Captain, as required, has sent a notice of readiness to unload the LNG;
- the second measurement shall be taken out immediately after completion of the unloading operation and the manifold valve has been closed.

The difference in value between the two LNG volumes, determined by the aforementioned measurements, net of any quantities of boil-off gas from the ship

released by the ship during the unloading phase, shall be considered the volume of LNG unloaded from the LNG Carrier's tanks.

The parties specified above shall indicate their acceptance by signing the "Assessment Report" showing the quantity - and quality - of LNG unloaded, thus confirming their complete agreement with regard to the values used for all of the aforementioned parameters.

The quantity of LNG unloaded shall be converted into the equivalent amount of energy (expressed in GJ) on the basis of the HHV determined as set out in the "Quality of the LNG Delivered and of the Gas Redelivered" chapter.

2.2) Measurement System for the LNG Delivered

The LNG delivered must be measured - in terms of volume, temperature and pressure - using the following methods.

The volume of LNG must be measured by measuring the height of the LNG in the tanks, making the necessary adjustments to obtain the correct height and then, using the specific calibration tables, calculating the volume of each tank.

The height must be measured at least 15 minutes after the Carrier has completed the mooring and 15 minutes after unloading has been completed.

The adjustments - applied to all level measurement systems - made to obtain the correct height of LNG, must be carried out according to the floating conditions of the Carrier, as follows:

- Trim (forward/aft draft)
- List (heel)

The corrections are individually tabulated for each tank and are expressed in millimetres according to the height of the level and of the meters of forward/aft draft for Trim and the degrees of heeling of List. The millimetres of correction to be made are calculated by interpolating the tabulated values, to determine the real Trim and List values ascertained.

The calibration tables, complete with all of the necessary adjustment tables, must meet ISO standards (in particular ISO 8311-1989 for prismatic membrane tanks and ISO 9091/1-1991 or ISO 9091/2-1992 for spherical tanks). For each LNG Carrier, the User must send the Terminal a certified copy of the tables with data expressed in metric units. Any physical change, distortion or change in volume of the tanks shall require a new calibration which must be certified, approved and delivered as described above. The certification of the calibration of the instruments must be carried out in accordance with the *Ship Approval Procedure*, as defined in the "Methods and procedures for authorising the unloading of LNG Carriers" chapter. Among other things, the procedure specifies that every three years, GNL Italia may request that the calibration certification of the LNG measurement instruments on board the Carrier be updated. The Operator reserves the right to request such documentation at any time deemed appropriate.

During the unloading phase, the User may use the boil-off gas in the carrier's tanks as fuel.

The amount of boil-off gas used during unloading must be measured with instruments that comply with applicable laws. This value is converted into energy using the Higher Heating Value of the Vapour.

If the measurement system is unavailable, the energy of the Boil-Off gas used by the Carrier during unloading shall be set at 90 GJ for each hour between the measurement operations specified in paragraph 2.1.

The energy used by the Carrier for its own consumption thus determined shall be deducted to determine the volume of LNG unloaded.

The temperature of the LNG inside the Carrier's tanks is measured by temperature sensors. These sensors must be distributed along the entire height of the tanks and at least one must be always immersed in the LNG. The temperature of the LNG in each tank is the arithmetic mean of the values of all of the sensors immersed in the liquid. The temperature of the entire load is obtained by calculating the arithmetic mean of the average temperatures of each tank. The temperature of the vapour is obtained using the same procedure described for measuring the temperature of the LNG, taking the values transmitted by the temperature sensors that are not immersed in the LNG.

The pressure measurement systems measure absolute pressure in bar or mm H₂O. For load calculations, the pressure will be rounded up to 1 mbar or 1 mm H₂O. The relative pressure of the vapour to atmospheric air is calculated using an atmospheric pressure value of 1.01325 bar.

2.3) Management of the Unloading of LNG Volumes that are Greater than Expected Volumes

If a Carrier arrives at the Terminal with a quantity of LNG that is greater than the expected volume to be unloaded (or the Maximum Unloading Capacity, for spot unloading), the Operator shall carry out the appropriate checks to determine the feasibility of completing unloading operations for the cargo that is in excess of the expected volume, taking into consideration the space in the storage tanks and any impact it may have on the LNG delivery schedule.

If this check is positive, the Operator shall notify the affected User by fax that it may complete the unloading operations; otherwise, the Operator shall request the User to stop unloading when the volume of LNG unloaded reaches the scheduled volume (or the Maximum Unloading Capacity for spot unloading).

If it is not possible to stop the unloading operation for safety reasons, the provisions outlined in the "Receiving, storage and regasification of LNG" chapter, paragraph 1.3.1 ("Failure to Comply with the Unloading Window for Reasons not Attributable to the Operator") shall apply or, for spot unloading operations, the provisions of paragraph 2.3.1.

3) MEASUREMENT OF THE GAS INJECTED INTO THE NETWORK

The volume of gas injected into the network for redelivery at the Panigaglia Entry Point to the National Network is determined accordance with the provisions of Article 7(4) of Annex A to Resolution No. 185/05.

Determination of the quantity of gas injected into the networkThe volume of gas injected in the network is determined at the measurement station, owned by GNL Italia, located at the interconnection with the transport network of Snam Rete Gas: this plant is equipped with a specific daily remote metering system that provides hourly details of the metering data it has collected.

GNL Italia, as owner of that measurement station, is responsible for managing and maintaining it as well as for carrying out all other activities related to the measurement process (data acquisition and validation, forwarding to Snam Rete Gas in order to account for the gas injected into the network and archiving for compliance with current tax and administrative laws).

3.1) System for measuring the volume of gas injected into the network

The measurement station consists of two separate lines arranged in parallel, each with its own meter with 10,000 m³/h Q_{max} to measure the maximum expected flow rate of gas in transit. The lines can be configured in series to perform checks.

The making of the measurement lines, the performance of the equipment and the configuration of the system must comply with national and international norms and standards.

The station was built for the following conditions:

- ◆ maximum hourly plant capacity 600,000 Sm³/h
- ◆ operating pressure between 22 and 72 bar

The quantity is determined by means of two meters, one performing "primary measurement" and the other used as "reserve and control measurement (back-up)".

The type and characteristics of the meters installed are as follows:

- ◆ the primary measurement consists of a turbine meter which is constructed, installed and operated in compliance with the UNI 7988 and ISO 9951 standards and the EEC Directive; the meter also bears the "initial verification" stamp and has been tested on the bench at a pressure of 60 bar.
- ◆ the reserve and control measurement (back-up) is performed by means of an ultrasonic meter installed in accordance with the ISO 9951 standard; the meter was tested on the bench at a pressure of 60 bar.

The recommended range of use of the meters is between 10% and 90% of the Q_{max} of the meter; if the volumes exceed the maximum flow rate of a meter, the two measurement lines can be opened simultaneously.

The measurement pressure and temperature are measured by special transmitters, in particular, the pressure is measured at the appropriate socket on the meter body while the temperature sensor is inserted 5 DN downstream.

On each measurement line, near the primary element, there are specific sockets to connect equipment used to carry out on-line checks in parallel with the main measurement system.

3.2) Instrument Checks

Checks on the measurement instruments are performed in accordance with the procedures described in the chapter entitled "Quality of the LNG Delivered and of the Gas Redelivered".

3.3) Consumption and Losses

The quantity of regasified LNG redelivered by the Operator to Snam Rete Gas at the Redelivery Point (expressed in MWh), and that in turn Snam Rete Gas takes delivery of for redelivery to Users, must match the quantity of LNG delivered by the User to the Operator, minus the amount to cover the consumption and losses related to the Regasification Service, and the quantity to cover the consumption related to the transport service, as described in Chapter 9(3.4), above.