MEASUREMENTS REGULATION OF THE NATIONAL NATURAL GAS SYSTEM

IMPORTANT NOTE: The English translation is not binding. In the event of discrepancies between the Greek and English version, the Greek text prevails

GOVERNMENT GAZETTE OF THE HELLENIC REPUBLIC
SECOND ISSUE **Issue Number 584**

May 6, 2010

DECISIONS

Number Δ1/Α/7754
Measurements Regulation of the National Natural Gas System.

THE DEPUTY MINISTER OF ENVIRONMENT, ENERGY AND CLIMATIC CHANGE

Having regarded to:

1. Article 90 of the Law Code for the Government and the Governmental Bodies, validated by article one of the presidential decree 64/2005, “Law encoding for the Government and the Governmental Bodies” (Government Gazette A 98).
2. The presidential decree 381/1989 “Organization of the Ministry of Industry, Energy and Technology” (Government Gazette A 16), as revised, in conjunction with the presidential decree 27/1996 “Merger of the Ministries of Tourism, Industry, Energy and Technology and Commerce in the Ministry of Development” (Government Gazette A 19), as revised, with the presidential decree 185/2009 “Reorganization of the Ministry of Finance, merger of the Ministry of Economy and Finance and Merchant Marine, Aegean and Island Administration and renaming thereof to “Ministry of Economy, Competition and Maritime”, conversion of the Ministry of Macedonia-Thrace to General Secretariat of Macedonia-Thrace and General Secretariat of Aegean and Island Politics”, and the presidential decree 189/2009 “Definition and re-distribution of authorities in Ministries” (Government Gazette A 221).
3. The Fin. decision 52167/21.12.2009 issued by the Prime Minister and the Minister of Environment, Energy and Climatic Change, concerning the “Assignment of duties to the Minister of Environment, Energy and Climatic Change, the Undersecretaries of Environment, Energy and Climatic Change” (Government Gazette A 2514).

4. The provisions of Directive 2003/55/EC “Concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC (EU L176/57/15.07.2003).
5. The provisions of the law 3428/2005 “Liberization of the Natural Gas Market” (Government Gazette A 313/27.12.2005), as in effect, and particularly the provision of paragraph 3 of article 9 thereof.
6. The provisions of the law 2773/1999 “Liberalization of the electricity market – Regulation of energy policy issues and other provisions” (Government Gazette A 286).
7. The Concurrent Opinion number 143/2010 of the Regulatory Authority of Energy with regards to the Measurements Regulation of National Natural Gas (ESFA), which was forwarded by means of the Document number O-40939/9.4.2010 and
8. The fact that the provisions of the present decision do not entail any expense against the National Budget, we decide:

ARTICLE ONE

This decision establishes the Measurements Regulation of the National Natural Gas System, the content of which is as follows:

MEASUREMENTS REGULATION OF THE NATIONAL NATURAL GAS SYSTEM

TABLE OF CONTENTS

NNGTS Measurements Regulation

Article 1
Definitions-Objective

Definitions

The terms used in the Measurements Regulation of the National Natural Gas System shall have the meaning attributed to them by article 2 of the Law 3428/2005 (Government Gazette A’ 313) (Law), and the following terms shall have the following meaning:

Measurement Equipment: The measurement and analysis instruments used by the Operator for determining the quantity and quality analysis of Natural Gas or LNG that is delivered to or received by the NNGTS.

Day: Time period starting from 8 a.m. of one calendar day and ending on 8 a.m. of the next calendar day.

N.G. Quantities Allocation: The amount of N.G. allocated by the Operator to Transmission Users to an Entry point or Exit Point in accordance with the allocation procedure described in the Network Code for the regulation of NNGTS.

Latent Natural Gas Quantities: quantities that refer to Corrections of Measured Values due to equipment calibration and / or uncorrected values.

Entry Point Delivery Transmission Capacity: The maximum Quantity of Natural Gas that can be delivered at an Entry Point per Day (MWh/Day).

Exit Point Off-Take Transmission Capacity: The maximum quantity of Natural Gas that can be received from an Exit Point per Day (MWh/Day).

Measurements and Tests: Procedures and methods for sampling, analysis, calculation and measurement of Natural Gas quantities to the premises of the NNGTS as well as the procedures for calibration and testing of Measuring Equipment.

Metering Station: The installation of metering or metering/ regulating where the Natural Gas is delivered or off-taken from Transmission Users at the NNGTS Entry or Exit Points respectively.

Measured Value: The volume, pressure, temperature, gross calorific value, or another value or characteristic related to the Natural Gas delivered at an Entry Point, received from an Exit Point or stored into Storage Facility or into the LNG delivered at the LNG facility.

Month: Time period starting at 8 am on the first day of a calendar month and ending at 8 am of the first day of the next calendar month.

Flow: The Natural Gas quantity flowing through a Point of the NNGTS per hour (MWh/hour).

Natural Gas Quality Specifications: The quality specifications of the Natural Gas transported through the NNGS, as defined in Annex [I] of the Network Code.

Entry Point: The entrance of measuring installation through which the Natural Gas is injected to the Transmission System**.**

LNG Entry Point: The Entry Point through which the re-gasified LNG is delivered to the Transmission System from the LNG facility.

Exit Point: The output of each metering installation through which the Natural Gas is injected from the NNGTS to a Connected System or to a Natural Gas Extraction Installation.

GIIGNL: Groupe International des Importateurs de Gaz Naturel Liquefie (International Group of Liquified Natural Gas Importers).

NBS: National Bureau of Standards (USA).

N.C. (Normal Conditions): Normal Conditions of pressure and temperature at the NNGTS and LNG facilities are 1,01325bar and $0^{o}C$ respectively.

Objective

The Measurements Regulations include:

- The procedures of measurement and certification of Natural Gas quantities and their energy content,
- The procedures and methods that are followed for the control and calibration of the metering equipment and the related standards of accuracy in summary,
- The terms and conditions under which the volume, the gross calorific value, the quantity and/or any other characteristic of the Natural Gas that is delivered to an Entry Point or received at an Exit Point from the Users, are specified in case of a failure or inability to provide measurements from the metering equipment,
- Procedures and conditions for resolving disputes between the Operator and Users, on issues related to quantity measurements, calculations of Calorific Value and the quality of the off-taken and / or delivered Gas,
- Keeping records and all relevant detail (e.g., the type and specifications of individual instruments of the metering equipment).

MEASUREMENT EQUIPMENT

Article 2

Measurement Equipment - Metering Line

The Measurement Equipment includes all instrumentation and analysis methods used by the Operator for determining the quantity and quality analysis of Natural Gas delivered to an Entry Point and off-taken at an Exit Point of the NNGTS.

The Metering flow consists of the Measurement Equipment so as to carry out flow measurement (uncorrected mass or volume flow) and at any case quality analysis input of Natural Gas (recommendation) for the energy calculation.

Article 3

Certificates and Testing of Measurement Equipment – Operator Responsibilities

1. Each new item of Measurement Equipment is submitted to the prescribed accuracy tests and functionality tests, as provided in Article 8 of this Measurements Regulation.
2. Instruments of Measurement Equipment, which are out of order due to damage, are certified again before reconnecting to use. Certification of Equipment is verified by a Protocol signed by competent staff of DESFA.

3. The Operator carries out regular checks on the Measurement Equipment at intervals defined in Table I.

4. Each audit of the Measurement Equipment is conducted by the Operator or an authorized representative. Users (who have a legitimate interest under the Transportation Contract that they carried out) are entitled to be present in the inspection of the Measurement Equipment on request by written application. Users can report to the Operator comments on the inspection of Measurement Equipment. Users in no case have the right to intervene in the Measurement Equipment in any way.

5. If the measurement equipment meets the specifications in Tables III, IV and V of this Measurements Regulation, the Operator shall issue the corresponding certificate of inspection specified in Table I. The inspection certificate shall be notified to Users.

6. Users within five (5) days of a notification as above will submit to the Operator any objections to the correctness of the certificate, for consideration under the dispute resolution terms of this Measurements Regulation.

7. Each user, in addition to regular checks, can request in writing from the Operator to inspect Measurement Equipment at each metering station at Entry or Exit Points that is included in the Transportation Contract. The audit is conducted by the Operator after timely written notice to the User requested the check, who is entitled to attend. If the check reveals that the Equipment operates within predetermined limits of accuracy, the User who requested the check will be debited with the cost of check, otherwise the cost of the equipment check debit the Operator.

The Operator is responsible for procurement, installation, testing, maintenance, inspection and certifying compliance of Measurement Equipment to the specifications listed in Tables III, IV and V of this Measurements Regulation.

Article 4

Operator's Obligation for Restoration of Measurement Equipment

The Operator shall directly regulate, repair or replace any instrument or other item of Measurement Equipment that was destroyed or damaged or has stopped to function, so that the Measurement Equipment is compatible with the above specifications listed in Tables III, IV and V of this Measurements Regulation.

Article 5

Accuracy and Uncertainty of Metering

According to this article, the measured values (pressure, differential pressure, temperature, flow (volume flow), gross calorific value, energy, etc.) are acceptable if the indications of the measurements are within the permissible limits of error of the measured value, according to the study of the uncertainty or data accuracy of the metering equipment that have been announced by the manufacturing company. If the indications of measurements are outside the permissible limits of error, the measured value is adjusted as stated in Article 9 "Adaptation of Measured Value."

The uncertainty studies are reviewed and modified by replacing part of the existing equipment or by adding new metering equipment or by radically revising the international standards that are set out in the calculation methodology. In the Annex 2 of this Regulation the accuracy allowable limits for measurement equipment are set, derived from relative studies of uncertainty. The review of the study or studies of uncertainty does not coincide to a change for which a modification / revision of the Measurements Regulation is required. The Operator is obliged to publish online, in a special area on its website, the current values of permissible limits of uncertainty (when reviewed), and to inform relevant Users when changes occur.

Article 6
Support Measurement Equipment Storage

The measured and calculated (qualitatively and quantitatively) values from the Measurement Equipment are stored in an electronic format, in supporting storage equipment. Such storage units are either the supervising PC or the volume correctors (PTZ) in the metering station. The generated files are stored in the Support Metering Equipment at least until the signing of the respective monthly protocol. The files are stored in the Support Measurement Equipment for at least forty days.

MEASUREMENTS
Article 7
Measured Values – Measurement Units

In the metering stations of the NNGTS Entry and Exit Points, measurements are taken continuously for values related to delivered and received, respectively, volume of gas (mass, volume, density, pressure, differential pressure, temperature), and sample measurements and / or value analyses relating to qualitative characteristics of gas are taken periodically. Where this is not applicable, data related to quality of the gas is taken from neighboring metering stations of the NNGTS. Criteria of the methodology for the use of qualitative characteristics of the gas from neighboring metering stations, is the direction of

gas flow in the Network and the inclusion of data from a simulation of the network. The relevant information will be published online and in a special area on the Operator's website. On Table IV all the measured or calculated values are listed and there is a pairing of measurement instruments (custody transfer), international standards, measurement accuracy and measurement units of those values.
Definitions of the measurement units are referred to the relevant international standards, at L.3428/2005 (Government Gazette 313/27.12.2005).
For every metering station of Entry / Exit Point at least daily and monthly measurements are taken. Where possible, measurements that refer to gas specifications (composition) can be taken more frequently.

Article 8
Functionality Tests – Accuracy Tests

The Measurement Equipment is submitted to functionality tests and accuracy tests.
Functionality tests are all those checks that are carried out by the personnel of the Operator at regular intervals, leading to the satisfactory operation of the Measurement Equipment and of the general support equipment of metering stations.
Alarms that are received in the Supervisory Control and Data Acquisition (SCADA) of the Operator and are due to abnormal conditions of the Measurement Equipment and / or metering station are the reason of doing (but not exclusively) exceptional checks of functionality.
Accuracy Tests are the tests carried out by qualified personnel of the Operator after informing the involved Users at regular intervals, as stipulated in the Measurements Regulation or in the manufacturers' instructions.
Accuracy Tests are performed occasionally after a failure or suspected failure of Measurement Equipment. Users are entitled to be present at the Accuracy Tests of Measurement Equipment.
The details of the reports of all examinations and tests are held by the Operator for the period specified in Article 11 of this Regulation.
At the Annex 2 and in related tables, which are included in the text of the Measurements Regulation and are published updated at intervals on the internet, on the Operator's website, include all items of Measurement Equipment of metering stations of the NNGTS. Among other things, a sort of metering stations at Entry and Exit Points is done, and the expected accuracy for the energy measurement at each station is stated, as estimated by studies of uncertainty, taking into account the details of the installation and the registered permissible limits of individual instruments (total probable error). In Annex 1 of this Regulation, the methodology of such calculations is stated. The total uncertainties of the Measurement Equipment in conjunction with the uncertainty of reference standards (working) set the thresholds above

Measurement Equipment, which will be performed after the Accuracy Test. Each case uncertainty values are listed in the Tables in Annex 2 and the limits of accuracy of individual instruments in Table IV of the Regulation. The referred values of uncertainty are valid for volume flow rates greater than 5% of the maximum allowable flow. The maximum allowable flow is the upper limit of the operating range of the Meter, to which the Meter operates indefinitely without deterioration of the stated uncertainty.

Article 9
Adjustment of Measured Values

1. In a case where, after checking, the accuracy of Measurement Equipment in a metering station of Entry or Exit Point is off the allowable limits of error, the value of the corresponding Measured Values, as measured, will be adjusted using software, whose algorithms are based on international standards (Table V), so as to minimize the error of the equivalent measurement of Measurement Equipment.
2. In the case that the Paragraph 1 of this Article is in forced, the incorrected Measured Values for the entire period during which it is proved that the accuracy of the Measurement Equipment was off the permissible limits, the incorrected values are replaced by corrected values.
3. If the date of the period described in Paragraph 2 of this Article is not verified with certainty, it will be treated as such of the first day of the second half of the period between the date of last inspection of Measurement Equipment, in which the User or Users who have access to the corresponding Entry or Exit Point participated, and, or the date of the last acceptable measurement, or the date of the last acceptable protocol, or the date of the last recorded accuracy test. Criterion for the selection will be the starting date in which the time it takes to adjust the measurements that are outside the permissible limits is the lowest.

Article 10
Lack of Reliable Data

In a case of failure to achieve a reliable measurement or where there is an occasional disruption of the Measurement Equipment in metering station of an Entry or Exit Point, the Operator may take an estimation of the quantity of the Natural Gas that is delivered or off-taken through this Measurement Equipment, after a short consultation with the Users, for whom this point is an Entry or Exit Point in accordance with the applicable Transportation Contract. For this calculation, in particular, reliable measurements of the Measurement Equipment are used for this specific Entry or Exit Point under similar conditions during respective periods in the past. Otherwise, solutions are used considering the time immediately preceding or following of the breakdown in order of priority, utilizing:

- Available values for which the measurement is possible
- Measured values of neighboring working Metering Stations (e.g. Composition and compressibility)
- Consumption data from any Third Party metering system (e.g. Power Plants)
- The production volume of Power Plants in conjunction with the technical characteristics of the Power Plant Unit.

Article 11
Compliance of Information Record

The Operator shall keep records of all information relating to measurements of Measurement Equipment for at least two (2) years period after the merger.
The Operator shall also keep records of all testing and calibration information relating to Measurement Equipment for at least five (5) years period after the merger.

Article 12
User Access to Measurement Equipment

1. Any User or an authorized representative, who has a legitimate interest, has access to the Measurement Equipment of each metering station at the Entry or Exit Point in which he has booked Transmission Capacity by submitting a request in writing to the Operator, *at least 3 working days before the desired date of visit*. In this application, the User must indicate the desired date of the visit, the estimated duration of the visit, the number of visitors, and the reason why applying for this visit.
2. The Operator may reject, within two working days from the date of the request of the User, if it is considered that there are reasons that render the visit impossible at the date specified in the User's request. In this case, in consultation with the User, the Operator provides a new visit date. *The Operator must fix a new date, which is no time later than 10 days from the date of the initial User request*.
3. The visit of the User will be under the supervision and guidance of qualified Operator’s personnel. The User shall take all necessary precautions to prevent damage to equipment and shall comply with instruction and guidance of the staff of the Operator.
4. The User is solely responsible for the staff and their representatives involved in the visit. Operator’s Personnel is entitled to refuse entry or request a withdrawal from the area of Measurement Equipment for

all or part of the visitors, if it is considered that there is a danger for the safety of persons or equipment located in this area.

Article 13
Measurement Management

1. The Measured Values collected by the Measurement Equipment and managed by the Measurements Management System (MMS), where available. Note that the MMS is not normally available at Type B Exit Points.

The classification of the NNGTS Exit Points metering stations in Type A and Type B is done with the criterion laid down in Article 25 of this Regulation and shall be in accordance with Tables VI and VII which are published, updated online, in a special area in the Operator's website. The Operator has the obligation to inform users when changes occur.

An MMS installed in a NNGTS Entry or Exit Point typically performs the following functions (where available):

- Shall sum the quantities (energy, volume or mass) of all measured flows.
- Checks and transfers the appropriate qualitative analysis of the chemical composition to the flow computer.
- Calculates the required protocols for quantity (in operating conditions and reference conditions) and produces reports on a daily (hourly resolution) and monthly (daily resolution) level.
- Stores the measured and calculated (qualitatively and quantitatively) data to files to at least the signature of the respective monthly protocols.
- Ensures the integrity of these files and records any change in them.
- Provides a secure access mechanism to the possibility of changing parameters in a metering station.
- Communicates with the Supervisory Control and Data Manager (SCADA) transferring measurement data and conditions or receives commands predicted by the basic design of the Supervisory Control and Data and the basic design of the NNGTS metering stations.

The files produced by the MMS are used in the production of the protocols untreated or after conversion to the required reference units by these reporting as appropriate. Where conversion is required, benchmarks are done according to standard ISO6976 and the definitions of measurement units.

2. The reliable operation of the MMS is checked periodically or when required by the User, with the responsibility of the Operator and the presence of the User or a representative. Facts are checked indicatively:

- The proper recording and management of measured values
- The accuracy of calculated values
- The completeness and accuracy of generated reports

3. Every User is entitled to receive copies of measurements reports for each Point at which off-takes or delivers Natural Gas, according to the Transportation Contract. The procedure of copies is done by qualified Operator's personnel that take all necessary measures to prevent damage to the equipment and measurements record.

Article 14
Measurement Protocols

The Measurement Values obtained from the Measurement Equipment at each metering station Entry or Exit Point are used to compile Measurement protocols. Where the Measurements Management System is unavailable or it is damaged, these protocols are compiled by the indications or the reports of the Measurement Equipment.

Measurement protocols are compiled by the Operator for each metering station Entry and Exit point. Users who use this specified Point may be present in the procedure of compiling protocols. Based on Measurement Protocols, quantities and qualities of Natural Gas that is delivered at an Entry Point or off-taken at an Exit Point of the NNGTS are specified. In each Exit Point, the Quantity is the sum of quantities of the individual Metering Stations, while the qualitative characteristics relate to the average qualitative characteristics of the individual Metering Stations.

Details on the format, content and syntax of the Protocols of Entry or Exit Points and the Latent NG Quantities Protocol are specified in Annex 3 to this Regulation.

Article 15
N.G. Quantities Certificate

15.1 *Protocols Compilation*.

1. Monthly Protocols of metering station of Entry Point is compiled each month by the Operator and notified to Users for which the specific Entry Point is a declared Entry Point, which is an Entry Point with Booked Transmission Capacity by the User, no later than the fifth (5) day of each calendar month and until the 12^{th} hour (12:00).
2. Monthly Protocols and Latent NG Quantities Protocol of a metering station Exit Point is prepared monthly by the Operator and is notified to users for which the given Exit Point is a declared Exit Point,

which is an Entry Point with Booked Transmission Capacity by the User no later than the fifth (5) day of each calendar month until the 12th hour (12:00).

3. In case of any disagreement by the Users referring to the content of the Measurement Protocol, the dispute resolution procedure provided in Article 15.2 is activated and the Protocol is seen as provisional until the final settlement.

4. For any difference on the measured NG values, the User or the Operator, who consider themselves wronged, shall inform the other Parties, who have a legitimate interest in the relative Point. The objection that may bear any of the foregoing shall not relieve him or other Parties from their obligations under the NNGTS Network Code and Transportation Contracts concluded.

5. Absence of User or Users who have access to a specific Entry or Exit Point during the compiling procedure of a Measurement Protocol or Latent NG Quantities Protocol relating to the Point is not a reason to delay issuance or non-acceptance of these protocols.

6. Any revisions to the Certification of Quantities, occurred through implementation of paragraphs (3) and (4) of this Article, shall affect only the values that were calculated based on revised values of those Protocols. In this case the liquidation of all values will be revised at the end of each calendar Month and will be repaid with the next invoice.

15.2 Dispute Resolution- Consultant

1. If disagreements arise on measurements of the metering station Entry or Exit Point, User(s) who have Booked Transmission Capacity at this Point and the Operator undertake every effort to amicably settle disputes in accordance with the provisions of the NNGTS Network Code and the concluded Transportation Contract. If the process of amicable dispute settlement is not completed within thirty (30) days after the call for amicable settlement, then the parties may agree to resolve issues that arise in measurement matters, with appointment of a Consultant .

2. The procedure of appointing an expert is as follows:

a. The User who wants the appointment of a Consultant announces its intention to the Operator, giving details of the issue that needs to be resolved by the Expert.

b. The Operator shall notify its intention or the intention User, as above, for the appointment of a Consultant, to Users who have Booked Transmission Capacity at the Entry or Exit Point at which there is a disagreement.

The aforementioned Users meet with the Operator to agree on the issue that needs resolution and to the person who will be appointed as a Consultant.

c. If within twenty one (21) Days after the service of initial disclosure, the User and the Operator have failed to agree on a person to be appointed as an Expert, immediately refer the matter to

NETHERLANDS METROLOGY INSTITUTE (NMI), from which a competent Consultant will be appointed. Contact details of the institute are the following:

Nederlands Meetinstituut
Postbus 394
3300 AJ Dordrecht (NL)
Hugo de Grootplein −1
BG Dordrecht
Tel:+31 78 332332
Fax +31 78 332309

d. If it is jointly agreed, with the responsibility of the Operator, the appointment is immediately known to the Consultant and he is asked to confirm within seven (7) Days of receipt of the notification, whether he is willing and able to accept the appointment, under conditions which should be in accordance with the terms of paragraph 4e below. If the Operator does not disclose the Consultant appointed, within fourteen (14) Days from the deadline referred to in paragraph 4c, any of Users who have Booked Transmission Capacity at the Entry or Exit Point on which there is dispute, may serve a notice of appointment to the Consultant, with notification to other parties (including the Operator).

e. If the Consultant is unwilling or unable to accept the appointment or has not confirmed its acceptance within twenty one (21) days after notification, then, unless the User and the Operator agree to appoint another expert, the matter may be referred by either party to NETHERLANDS METROLOGY INSTITUTE (NMI) that will be asked to make a new appointment and the procedure will be repeated until an expert will accept his nomination.

f. Users and Operator must work together to agree on the person that will be appointed as the Consultant and, further, to negotiate and agree the terms and the execution of the agreement of appointing the Consultant, which will be signed by the parties.

g. It is forbidden to be appointed as a Consultant a person that:

(i) Has not been qualified by education and experience to issue an opinion on that matter, and / or
(ii) at the time of his appointment (or within three (3) years before him), the same or a relative up to the second degree inclusive, is a board member, officer or employee of a User or the Operator or a Related Company, and / or
(iii) at the time of his appointment, the same or up to the second degree inclusive, is employed directly or indirectly as a Consultant of User or the Operator or a Related Company.

3. The remuneration of the Consultant will be agreed by the Users and the Operator and will be paid by the party (the User or Users requesting the appointment of the Consultant or the Operator) which will be proved to the Expert report that is wrong. In the event that two or more parties are proved that they are wrong, then the remuneration of the Consultant will be paid equally by them.

4. In the contracts of appointing the Consultant the following shall be taken under consideration:

a. All information, data and documents disclosed or delivered by the Operator and / or the User or Users to the Consultant, as a result of or in connection with his appointment, shall be deemed confidential and the Expert must return them to the party which had produced them when the procedure ends. The Consultant may disclose any of the above information, data or documents to his employees or Related Companies, which have the same obligations as the Consultant and in a case of manipulation they are liable to the injured party entirely.

b. The procedure before the Expert is as follows:

(i) The Consultant shall invite the parties to a meeting, not later than fourteen (14) days after his appointment, putting all the issues that require clarification and the procedural rules to be applied, which should be in accordance with the terms of this Article,

(ii) the parties will be able to provide data and information and to submit their claims to the Consultant,

(iii) The parties are obliged to provide data, information and submit their claims as soon as possible and in any event within forty five (45) days from the appointment of the Consultant. The Consultant will not take into account data, information and claims submitted after the deadline of forty-five (45) days, unless they were in response to specific requests by the Consultant,

(iv) any party involved will bear the expenses required for the administration of all data, information and arguments will be given by it, as well as all costs and expenses of all witnesses and persons appointed by it,

(v) All communications between the parties and the Consultant must be in writing and copies shall be given to other parties. No meeting between the Consultant and any of the parties will take place if not all parties will be called on time, at least two (2) days in advance, to attend at this meeting,

(vi) the decision of Consultants should be in writing, detailed and fully justified and should be issued within three (3) months after his appointment, unless otherwise agreed by the involved parties.

c. If the Consultant does not issue his decision within the time limits set out above, any of the parties, with a statement, may set a period not exceeding thirty (30) days, within which the Consultant must issue its decision, otherwise he ceases to have any responsibility and obligation to return the received reward. The decision of the Consultant, which may be issued after the expiry of the above thirty (30) days period, will have no power or authority.

d. The Consultant shall not be considered arbitrator, but he will issue the necessary decision as a Consultant and the provisions on arbitration would not apply to him, to his decision, or the procedure required for the publication of his decision.

e. The Consultant's decision will be final and binding on the parties, which are not bound by the decision of the Consultant, just in the case they wanted to be judged by the Arbitration, considering that the decision was the product of fraud or substantial error as a matter of the facts, otherwise the Consultant's decision is an irrefutable presumption for who's judged by it.

5. Regardless the procedure described above, the parties must continue comply, at all times, with their contractual obligations, irrespective to the nature of the dispute and even though the dispute has been referred for resolution in accordance with the provisions of this Article.

MEASUREMENT RULES AND STANDARDS

Article 16

Measurement Standards

The Measurement Standards listed in Tables IV and V of this Regulation shall include:

1. the methodology for measuring the volume or mass of the Gas with fixed composition, pressure and temperature by a specific meter
2. the dimensions, the construction and installation methods and the operating conditions of the Measurement Equipment.
3. the methodology and calculations required for determining the volume and the Heating Value of the measured Natural Gas
4. the range and accuracy of each measurement and the calibration of the meters
5. methodology followed for the required testing of every element of Measurement Equipment

Article 17

Analysis Standards (Gas Quality)

The analysis Standards listed in Tables IV and V of this Regulation provide the procedure of analyzing a sample of Natural Gas using the principle of gas chromatography. Specifically define the method of sampling of Natural Gas, the measurement methods, the components of the test sample, the required characteristics, the measurement range for each component, the accuracy of measurement, the processing of measurement results and traceability analysis.

The analysis of Natural Gas sample with the principle of gas chromatography concerns the components nitrogen, carbon dioxide, saturated hydrocarbons up to six numbers of carbons. If required the determination of sulfur compounds is defined using a separate gas chromatograph. Also a Natural Gas can also contain other ingredients such as oxygen, methanol, hydrocarbons with larger number of carbons, water, etc. in such small quantities that do not affect the accuracy of the method.

Article 18
Sampling Standards

The ISO 10715 standard provides guidelines for the collection, preservation and management of representative samples of Natural Gas streaming. It also provides guidance on the sampling strategy, the position of a sample sensor and the design of sampling equipment.

MEASUREMENTS - CORRECTIONS CALCULATIONS

Article 19
Measurement Instruments

The measurement instruments has an important role in the functioning of the systems integrated into gas transmission network. Values such as pressure, temperature and gas flow are important parameters in the procedures carried out across the network.
These values are measured by special instruments, which are installed in metering stations and other points at NNGTS. These measured values are utilized by the operation, planning and control, on time and effectively, either locally or even with the Telemetry System. More details of measurement instruments of NNGTS are listed in Annex 4.

Article 20
Measurements & Calculations

20.1 Measurement of volumetric flow
This measurement includes the continuous metering of the gas passing through a cross section of the pipeline flow for a given period.

20.2 Measurement of velocity
This measurement includes the determination of gas velocity at a particular point on the section of the pipeline flow. It is used to determine the variation of the flow. The volume meters determine the point at which the average flow rate is calculated.

20.3 Measurement of mass

The measurement is carried by the following methods: (a) by determining the Coriolis force, (b) by determining the volumetric flow and density, (c) by determining the volumetric flow, pressure and temperature, (d) weighed (discontinuous process).

20.4 Calculation of Gross Calorific Value

It is done by determining the quantitative analysis of gas samples from the chromatogram analyzer of Gas chromatography according to the procedure described in Article 22.1 of this Regulation.

When the chromatogram represents all components of the sample, the results are normalized, assuming that the fraction of the total area of each peak is the same as the percentage of component in the sample.

20.5 Calculation of Energy

The calculation of the gas energy (MWh) is done, based on the calculated Gross Calorific Value of gas and its volume.

Article 21
Correction Methods

These methods can compensate for systematic errors for meters associated with flow computers. This is achieved using the calibration certificates of meters in similar circumstances to those in service.

Article 22
Calculation Methods

22.1 Gas Chromatograph

The gas chromatograph determines the gas composition. The gas components are defined:

- Methane C_1
- Ethane C_2
- Propane C_3
- Iso-butane $i-C_4$
- Normal butane $n-C_4$

- Iso-pentane $i-C_5$
- Normal pentane $n-C_5$
- Hexane and heavier hydrocarbons C_6+
- Nitrogen N_2
- Carbon dioxide CO_2

In each analysis, the gas chromatograph performs the following calculations, in accordance with ISO 6976 (Tables IV and V):

- Gross Calorific Value at reference conditions
- Relative density
- Wobbe index
- Density at reference conditions

The chromatograph periodically carries out a calibration gas analysis, either automatically or manually. The response factors for each component are tested between two successive calibration analyses. Variations of these should be within limits specified by international standard ISO 6974 (Tables IV and V).

22.2 Flow Computers and Supervisors Computers- PTZ Correctors

22.2.1 Flow Computers and Supervisors Computers

The volume calculation of delivered and received Natural Gas at Entry or Exit point, respectively; of NNGTS takes place on flow computers of the respective metering stations. A flow computer corresponds to each metering device (metering line) at Metering Stations of NNGTS.

The flow computers are designed to calculate the energy flow and the gas volume, taking into consideration the signals from the corresponding meter of metering line, transmission temperature instruments, pressure, differential pressure and the complete chemical analysis (by the supervising computer). More specifically, the following calculations take place at flow computers:

- Calculation of the mass of flowing gas (Kg) and the mass flow rate (Kg / h)
- Calculation of the volume of flowing gas (m^3) and the volume flow rate (m^3/ h) at pressure and temperature of metering line (turbine meters, ultrasonic, rotary meters and orifice meters).
- Calculation of the volume of flowing gas (m^3) and the volume flow rate (m^3 / h), after error curve application of the corresponding meter (turbine, ultrasonic) at pressure and temperature of the metering line.
- Calculation of the volume of flowing gas (Nm^3) and the volume flow rate (Nm^3 / h) at normal pressure and temperature conditions (reference conditions).

- Calculation of the compressibility of the gas in accordance with ISO 12213 (Table V) for the temperature and pressure of metering line and the composition that was detected by the chromatograph.
- Calculation of the energy of flowing gas (MWh) and the flow of energy (MWh / h), based on the estimated Gross Calorific Value of gas and the volume of flowing gas.

All data generated by computers are the real flow data for invoicing, which are stored and processed by the supervisor computer.

In metering stations can be installed two identical supervisor computers, for 100% redundancy. The supervisor computers control the flow computers and chromatograph computers.

All these calculation results are stored in respective data loggers in flow computer. Pressure, temperature, differential pressure, compressibility as well as other real time data is updated continuously in order to allow the calculation of average flow made by the supervisor computer.

The main role of each flow computer is to collect gas flow data from the associated meters in the metering lines or transmitters, and calculates the volumetric flow and energy flow at reference conditions. The supervisor computer integrates the instantaneous flow rates on hourly, daily and total summaries, takes the analysis of Natural Gas by gas chromatography and calculates the averages of above thermodynamic properties of gas on an hourly and daily basis.

Also the following applies:

(i) The last obtained analysis is acceptable if it fulfills the criteria set in supervisor computer and a chromatograph is under normal condition.

(ii) The gas analysis is determined by priority procedure for each point. When needed, the priority procedure is agreed with the users at regular intervals.

(iii)The supervisor computer calculates the averages of the analysis at least on a daily basis.

22.2.2 PTZ Correctors

In some Exit Points Type B (see Article 25) there is only PTZ corrector instead of flow and supervisor computer. The PTZ corrector calculates and stores the hourly, daily and monthly volume flow rates (Nm^3). The Operator calculates the energy using the average Gross Calorific Value. The necessary data are taken from the same or a nearby Exit Point, which carries a Chromatograph and Measurement Management System. The calculation of energy becomes on a daily basis.

22.3 Method for calculating volume at reference condition of turbine, ultrasonic and rotary meters type metering lines

The measurement of the gas flow by the meters can be done at operating pressure and temperature. To provide a common reference, this measurement is reduced to reference conditions. This calculation is done by using the PTZ method, which uses the following formula to convert the measured volume at reference conditions:

$$V_b = V_m \cdot \frac{P_m}{P_b} \cdot \frac{\mathrm{T}_b}{\mathrm{T}_m} \cdot \frac{Z_b}{Z_m}$$

Where:

P: the gas pressure,

T: the absolute gas temperature,

V: the gas volume,

m: the measured condition,

b: the reference condition,

The compressibility factor Z depends on the gas composition, the pressure P and temperature T. When using PTZ correctors, it is considered that the gas composition is constant (Z_b constant) and therefore Z_m is calculated on actual condition Pm, Tm. The remaining values are obtained from the corrector by direct measurement (V_m, P_m, T_m). Thus the corrected volume V_b is calculated.

In this case the chemical composition data, the Gross Calorific Value and the relative density are obtained from the same or a nearby Exit Point that carries a Chromatograph and Measurement Management System. These qualities characteristics concern the averages of the preceding quarter and coming in the first fifteen-days of each quarter.

The method PTZ for calculating corrected volume can be implemented either with PTZ corrector or with flow computer using pressure and temperature transmitters.

22.4 Method for calculating volume at reference conditions of orifice meter type metering line

This method relies on measuring the differential pressure that develops before and after the orifice meter, the fluid characteristics and the conditions under which the meter is used. The data of design, installation and use of the orifice meter are determined in accordance with ISO 5167 (Tables IV and V). From data such as pressure P, temperature T, density of the fluid ρ, differential pressure DP, the mass flow Q_m that passing in time unit through the orifice can be calculated. Then using the mass flow Q_m and the gas density p, the volume flow is calculated at operating conditions (actual) Q, while the normal volume flow or the volume flow Q_n at reference conditions is calculated using the density at reference conditions ρ_n. These densities are measured directly by density meters or calculated in accordance with ISO 6976 (Tables IV and V) using the chemical composition (ρ_n calculation), the pressure, the temperature and the compressibility of gas (ρ calculation).

22.5 Method for calculating volume at reference conditions of mass meter type metering line

In this case, the mass flow is first determined and then using the density at reference conditions, the volume flow is determined at reference conditions.

MEASUREMENTS PROCEDURES

Article 23

Metering Equipment of Stations of NNGTS

The metering equipment of the stations NNGTS comprises of the main equipment for measuring volumetric flow and energy and the supportive equipment for measuring static pressure, differential pressure and temperature at the metering line.

The metering equipment of NNGTS stations is divided into three categories:

1. turbine or rotary or ultrasonic meter type with supportive equipment: pressure and temperature transmitters or pressure and temperature sensors embedded in PTZ correctors
2. orifice meter type with supportive equipment: transmitters of static pressure, differential pressure, temperature and density meters (if applicable)
3. mass meter type without supportive equipment

In all types of metering equipment, the calculation of Gross Calorific Value per unit of gas volume and relative density is a function of the gas composition taken from the gas chromatograph.

The metering equipment stations of NNGTS is described in the attached tables in Annex 2 for each station of NNGTS, as well as the corresponding total probable errors of individual supporting instruments and the total uncertainty in energy. More information about the accuracy of instruments and all equipment is listed in Uncertainty Studies in Article 5 of this Regulation.

Article 24

Purpose of Measurement Procedures

The actions, the reports and the necessary management of measurements at every Entry or Exit Point, are the subject of measurement procedures.

Specifically:

The User may deliver Natural Gas to the Operator for Transmission through NNGTS to the following Entry Points:

- At Metering Border Station (MSS) at Serres in Sidirokastro which is connected upstream to the natural gas transit system of Bulgaria.

- At Metering Station of Agia Triada which is connected to the LNG gasification facility of LNG of NNGTS.
- At Metering Station of Kipi which is connected upstream to the NG Transmission System of Turkey.

The quality specifications for every Entry and Exit point and the conditions of delivery and off-take are defined in Annex C of the NNGTS Network Code and Annex 2 of this Regulation.

The description of the metering stations and the design and operation specifications are listed in Annex 2.

Article 25
Metering Stations Exit Points

The Metering Stations at Exit Points of NNGTS are classified to "Exit Points Type A" and "Exit Points Type B". This distinction concerns only the period during which it is possible the user to be informed on the actual measurements. (Type A information the next day, Type B at a later time)

Until 13:00 each day, the Operator gathers information about the Natural Gas Quantity that delivers and the Users off-take at metering stations of Exit Points in the previous day. These values are indicative in order to inform the Users about the NG Quantities Allocation.

Every working day, the users are informed about the Natural Gas Quantity, that they off-take by the Operator during the previous day at the Exit Point, if they booked Transmission Capacity at this point.

CALIBRATION
Article 26
Calibration equipment

Table III reports the calibration equipment of metering equipment with respective accuracies of the instrumentation. The accuracy of a standard instrument must be at least three times better than that under calibration.

Depending on the measured value under calibration, calibration equipment is categorized into static pressure, differential pressure, temperature equipment etc.

Annex 5 of this Regulation the main standards (working standards) are reporting of static pressure, of differential pressure and of temperature used in general and specifically for calibration of the metering equipment of NNGTS metering stations.

Article 27
Calibration frequency of metering equipment

The metering equipment is undergone at accuracy tests at regular intervals.

The procedures for calibration of metering equipment are referred in Table II in relation with the individual equipment.

The calibration procedure includes both the accuracy test of metering equipment and its adjustment compared with the standard reference equipment (working standard) used by the Operator, who is called the calibration equipment and is registered in Table III.

During the calibrations of metering equipment of Entry or Exit Point Metering Station of NNGTS the Operator invites and entitles the Users who have booked transmission capacity at this point to attend. The results of calibrations are registered into relative forms.

The frequency of calibrations performed by personnel of the Operator is specified by the Operator CALIBRATION ANNUAL PROGRAM, which is reported to Users in time (every December of the previous year).

For each component installation of the metering equipment of entry or exit point metering station of NNGTS, the provisions of Article 3 of this Regulation are followed.

The recalibration frequency of metering equipment to specific metrological laboratories in Greece or abroad is performed in accordance with Table I and respective certificate of calibration is issued.

Article 28
Calibration procedures of metering equipment

These procedures concern the periodical calibrations and checks of the metering equipment of the National Transmission System and its individual instrumentation (70/19 bar) of NNGTS (Table II)

The objective of the procedures is the existence of an integrated method of calibrations execution and of control in all entry / exit points metering stations that will result in safe and reliable operation of metering equipment of NNGTS.

28.1 Two Turbine meter metering lines calibration and Flow Computer check.

This procedure includes:

- Calibration of pressure and temperature transmitters using the respective Working Standards (Table III)

- Check of flow computers using pulse generator (Table III), preset parameters check and the calculation of the correction factor check using standard software.

28.2 Turbine meters in Series check.

This procedure includes:

- Turbine meters check with in series connection metering lines for a given time and volume flow and pressure conditions
- preset parameters check on the calibration characteristics of turbine meters on flow computers

28.3 Two Ultrasonic meter metering lines calibration

This procedure includes:

- calibration of pressure and temperature transmitters using the respective working standards (Table III)
- preset parameters and the calculation of the correction factor check on flow computers using standard software.

28.4 Orifice meter metering line calibration

This procedure includes:

- calibration of pressure, differential pressure and temperature transmitters using the respective working standards (Table III)
- preset parameters and the calculation of the correction factor check, volume and energy flow rate on flow computer using standard software (Table III).

Note: The above process can include density meter check.

28.5 Orifice meter check

This procedure includes:

- visual inspection of the orifice meter according to international standard ISO 5167 (Table V) and check of the internal diameter using micrometer (Table III)
- preset parameters of the orifice meter calibration check on flow computer.

28.6 Gas Chromatograph Calibration

This procedure includes:

- response factors check resulting from consecutive analysis of the calibration gas based on the international standard ISO 6974 (Table V)
- concentrations check resulting from consecutive analysis of the standard gas (Table III)

- calculation check of Gross Calorific Value of natural gas from the chromatograph based on the international standard ISO 6976 (Table V) and check of the certified composition of standard gas on chromatograph.

28.7 Dew Point Analyzer check

This procedure concerns the dew point analyzer check with device based on the chilled mirror principle (Chandler Dew Point Tester-Table III).

Article 29
Special area in the Operator web site -Changes and Revisions

In a special area of the website, the Operator will publish the standards, the type, the specifications and the brief description of the instruments and the rest equipment and any other detail provided in the present Regulation.

The Operator is obliged to update and publish on the internet in this specific area of its website each change of standard, instrument type or equipment and accuracy standard or procedure for testing and calibration of metering equipment. Such changes are required when the policy of the Operator, international standards and in forced legislation are changed or revised. The Operator shall notify involved Users of any such change.

TABLES

TABLE I. Metering Equipment Inspection

s/n	METERING INSTRUMENTS (GAS METERS)	FREQUENCY OF INSPECTION	INSPECTION CERTIFICATE
1	TURBINE	5 years or whenever judged necessary after periodic check	Certificate of accredited laboratory or national metrological institute
2	ULTRASONIC	5 years or whenever judged necessary after periodic check	Certificate of accredited laboratory or national metrological institute
3	ORIFICE	Whenever judged necessary after a check conducted at least once per year.	Inspection from specialized laboratory or the manufacturer
4	MASS	Every 2 years	Inspection from specialized laboratory or the manufacturer
5	ROTARY POSITIVE DISPLACEMENT	8 years or whenever judged necessary after periodic inspection	Certificate of accredited laboratory or national metrological institute

TABLE II. Metering Equipment Calibration Procedures

s/n	PROCEDURES	SECONDARY INSTRUMENTS OF METERING & ANALYSIS
1	Calibration of 2 metering lines with turbine meter and flow computer check	Temperature Transmitters, Pressure Transmitters, Flow Computers
2	Turbine Meters check in series	Turbine Meters, Flow Computers
3	Calibration of 2 metering lines with ultrasonic meter	Temperature Transmitters, Pressure Transmitters, Flow Computers
4	Calibration of metering line with orifice meter	Temperature Transmitters, Pressure Transmitters, Differential Pressure Transmitters, Density Meters, Flow Computers
5	Orifice meter check	Orifice Meter, Flow Computers
6	Check of Water Dew Point Analyzer	Water Dew Point Analyzer
7	Check of Hydrocarbon Dew Point Analyzer	Hydrocarbon Dew Point Analyzer
8	Calibration of Gas Chromatograph	Gas Chromatograph

TABLE III. Calibration Equipment Standards

s/n	Variables for calibration	Wording Reference Devices (Standard)	Accuracy	Use
1	STATIC PRESSURE – DIFF. PRESSURE	Gauge dead weight with ball	±0,015%	Generation of Differential Pressure
2		Gauge of standard masses with double piston (nominal conversion coefficient 0,5 Mpa/kg)	±0,015%	Generation of Differential and Static Pressure
3		Gas pressure controller	±0,008%	Generation – Indication of Static Pressure
4		Barometer	±0,10%	Indication of Barometric Pressure
5	TEMPERATURE	High precision Thermometer (digital)	±0,014% + 0,014°C	Indication of Temperature (portable instrument)
6		Mercury thermometer	±0,1 °C	Indication of Temperature
7		Temperature bath	±0,1 °C	Generation of Temperature using a high precision Thermometer for Temperature Indication
8	-	Digital communication device with Hart protocol	-	Digital Communication with Static Pressure, Diff. Pressure, Temperature Transmitters
9	VOLUMETRIC FLOW RATE	Pulse Generator		Pulse Generation for Flow Computer's Check
10	WATER DEW POINT	Water Dew Point Test Instrument (Chandler)	±2 °C	Water Dew Point Determination
11	GROSS CALORIFIC VALUE - GAS COMPOSITION	Standard Gas	±0,1%	Standard Gas Mixture for Gas Chromatograph Calibration
12	DIAMETER	Micrometer	<±2 μm	Orifice Meter Diameter Measurement

Note: The above Table provides information on the accuracy range of the working standards used by the Operator in calibrations. Table III and every revision is published in a special area on the Operator's website. Revision of Table III is not a change that requires a revision of Measurements Regulation.

TABLE IV. Custody Transfer Instruments - Accuracy (Measurements) Standards - Procedures, Methods

FISCAL INSTRUMENTS	ACCURACY	ACCURACY STANDARDS (MEASUREMENTS)	MEASURED VALUES (UNITS)	CALCULATED FIGURES (UNITS)	METHODS
Coriolis Meters	±0,7%	ISO 10790 AGA 11	MASS (Kg)	CORRECTED VOLUME (Nm^3)	MEASUREMENT
Turbine Meters	±0.5%	ISO 9951 EN 12261 AGA 7	UNCORRECTED VOLUME (m^3)		
Turbine Meters (for use at metering stations with maximum capacity up to 6000 MWh / day)	±1%	ISO 9951 EN 12261 AGA 7			
Ultrasonic Meters	± 0,7%	AGA 9 ISO 9951			
Orifice Meters	±0,5% (discharge coefficient)	ISO 5167 AGA 3			
Positive Displacement Meters with lobes	±0,5%	EN 12480			
Density Meters	±0,2%	ISO 6976-AGA 8	DENSITY (Kg/m^3)		
Pressure Transmitters	±0,15%	EA 10/17, EN 837-1, EN 837-2, EN 837-3	PRESSURE (bar)		
Pressure Sensors at PTZ	±0,3%	EA 10/17, EN 837-1, EN 837-2, EN 837-3	PRESSURE (bar)		
Diff. Pressure Transmitters	±0,15%	EA 10/17, EN 837-1, EN 837-2, EN 837-4	DIFFERENTIAL PRESSURE (mbar)		
Temperature Transmitters	±0,14%	EA 10/11	TEMPERATURE (^oC)		
Temperature Sensors at PTZ	±0,3%	EA 10/11	TEMPERATURE (^oC)		
Gas Chromatographs	±0,2% (Gross Calorific Value)	ISO 6974 ISO 6976	GAS COMPOSITION AT $C_XH_Y,C0_2,N_2$ (%mole)	GROSS CALORIFIC VALUE (MWH/Nm^3)	
Oxygen Analysers - Gas Chromatographs	±50%		OXYGEN (%mole)	QUANTITY & QUALITY GAS ANALYSIS	ANALYSIS
Gas Chromatographs	±4%	ISO 19739	RSH,H_2S (mg/m^3)		
Water Dew Point Analysers	±2	ASTM/D 1142	H_2O DEW POINT ^oC (at 38,2 bar)		

Hydrocarbon Dew Point Analysers	±1	ASTM/D 1142	H/C DEW POINT ^{o}C (at line pres. [bar])		
-	-	ISO 10715	-	-	SAMPLING

Note: The Standards are referred to currently in force publications and may be revised or supplemented by the issuing international organizations.

TABLE V. Standards in force for the NNGTS Measurements Regulation

Measurement of Gas Volume – Mass – Energy	ISO 9951	:	Measurement of Gas flow in closed conduits – Turbine meters
	EN 12261	:	Gas Meters-Turbine gas Meters
	EN 12480	:	Gas Meters-Rotary displacements gas meters
	ISO 5167	:	Measurement of fluid flow by means of pressure differential devices inserted in circular - cross section conduits running full – Orifice plates
	ISO 5168	:	Measurement of fluid flow – Evaluation of uncertainties
	ISO 6976	:	Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition
	ISO 10790	:	Measurement of Gas flow in closed conduits – Guidelines to the selection, installation and use of Coriolis meters (mass flow, density, and volume flow measurements)
	ISO 12213	:	Natural gas – Calculation of Compression Factor
	AGA 3	:	Orifice Metering of Natural Gas
	AGA 7	:	Measurement of Gas by Turbine Meters
	AGA 8	:	Compressibility Factor of Natural Gas and Related Hydrocarbon Gases
	AGA 9	:	Measurement of Gas by Multipath Ultrasonic Meters
	AGA 11	:	Measurement of Gas by Coriolis Meter
	GUM	:	Guide Uncertainty of Measurement
	EN 1776	:	Gas supply – Natural gas measuring stations – Functional requirements
Analysis / Gas Quality	ISO 6974	:	Determination of composition with defined uncertainty by gas chromatography
	ISO 14111	:	Natural gas – Guidelines to traceability in analysis
	ISO 19739	:	Natural gas – Determination of sulphur compounds using gas chromatography
	ISO 6326	:	Natural gas – Determination of sulphur compounds
	ISO 6141	:	Gas analysis - Requirements for certificates for calibration gases and gas mixtures
	ISO 6142	:	Gas analysis – Preparation of calibration gas mixtures – Gravimetric method
	ISO 6143	:	Gas analysis – Comparison methods for determining and checking the calibration gas mixtures' composition
	ISO 6327	:	Gas analysis – Determination of the water dew point of natural gas – Cooled surface condensation hygrometers
Sampling	ISO 10715	:	Natural gas – Sampling guidelines

Note: The Standards are referred to currently in force publications and may be revised or supplemented by the issuing international organizations.

TABLE VI. EXIT POINTS NNGTS

EXIT POINT	STATIONS	LOCATION	TYPE [1]
KERATSINI (PPC)	M – KERATSINI	KERATSINI	A
LAVRIO (PPC)	M – LAVRIO	LAVRIO	A
KOMOTINI (PPC)	M/R PPC KOMOTINI	KOMOTINI	A
VFL	M - VFL	CHALKERO / NEA KARVALI	B
THESSALONIKI	M/R EAST THESS□LONIKI	THESSALONIKI	A
	M/R NORTH THESSALONIKI	DIAVATA THESSALONIKI	A
KATERINI	M/R KATERINI	KATERINI	B
KILKIS	M/R KILKIS	DRIMOS	B
PLATY	M/R PLATY	PLATY IMATHIA	A
ELPE	M/R EKO	DIAVATA THESSALONIKI	B
SALFA	SALFA I [7]	ANO LIOSIA	A
	SALFA II [7]	AN□HOUSA	A
ΑΘΗΝΑ	M/R EAST ATHENS	PALLINI	A
	M/R NORTH ATHENS	ANO LIOSSIA	A
	M/P WEST ATHENS	SCHISTOS	A
MOTOR OIL	M MOTOR OIL	AG. THEODOROI	A
THRIASSIO	M/R THRIASSIO	ASPROPYRGOS	A
SPATA	M/R MARKOPOULO	MARKOPOULO	B
HERONAS	M – HERONAS [6]	THIVA	B
ADG	M - ADG	ANTIKYRA VIOTIA	A
ENERGIAKI THESS. (ELPE)	M/R ENERGIAKI THESSALONIKI [2]	ENERGIAKI THESSALONIKI	B
ALEXANDROUPOLI	M/R ALEXANDROUPOLI	ALEXANDROUPOLI	A
KOMOTINI	M/R KOMOTINI	KOMOTINI	B
DRAMA	M/R DRAMA	FOTOLIVOS	B
KAVALA	M/R KAVALA	PETROPIGI	B
XANTHI	M/R XANTHI	XANTHI	B
SERRES	M/R SERRES	MITROUSI	B
LARISSA	M/R NORTH LARISSA	NORTH LARISSA	A
	M/R SOUTH LARISSA	SOUTH LARISSA	A
VIPE LARISSA	M/R VIPE LARISSA [6]	VIPE LARISSA	B
KOKKINA	M/R KOKKINA [5]	KOKKINA	B
VOLOS	M/R VOLOS	VOLOS	A
KARDITSA	M/R KARDITSA [3]	KARDITSA	B
TRIKALA	M/R TRIKALA [3]	TRIKALA	B
INOFYTA	M/R INOFYTA	INOFYTA VIOTIA	A
LAMIA	R LAMIA [3],[4]	LAMIA	B

TABLE VII. FUTURE STATIONS NNGTS

s/n	STATION
1	M/R KOSMIO
2	ELPE - DIAVATA
3	M/R LAMIA
4	M/R THIVA
5	M HERON II
6	M/R THISVI

(1) Distinction of Stations into Types A / B referred to in Article 25

(2) The Metering Station is under construction. Currently the measurements are taken from a metering station which does not belong to DESFA. There is daily information via fax.

(3) These Stations serve as temporary (Annex 2) with future standards of building new stations (case of M/R LAMIA)

(4) Point of delivery from Regulating Station R-Lamia. The measurements are registered by the sum of the Industrial Consumers at the Medium Pressure network.

(5) There is a Scada link that provides daily indicative information.

(6) There is a satellite Scada link (GPRS) which is not uninterrupted.

(7) At SALFA I and II there are not metering stations owned by DESFA and the measurement is made through gas meters.

ANNEX 1

ACCURACY AND UNCERTAINTY OF MEASUREMENT

1. Definitions − Calculations

The Accuracy and the Uncertainty of measurements are defined in the following way:

The Accuracy of measurement is defined as the proximity of result of measurement and the acceptable common reference value of measured value. The term «Accuracy» is referred to the uncertainty.

The Uncertainty is the quantitative expression of measurement system capability to attribute the value of measured variable close to real value as possible.

In ISO 5168 standard the Accuracy defined as "an estimation that characterizes the range of values inside which the real value exists".

The real value constitutes the ideal value which is supposed that it exists and which could be known provided that all sources of errors were eliminated.

The Accuracy is distinguished in random and systematic.

Random error of measurement is defined as the deviation of random measurement from the average value of measured value. Random errors are those that give the variance of observations in repeated measurements that become under the same seemingly conditions.

Systematic error of measurement is defined as the deviation of measurements average value from the real value. Systematic errors are those that are imported by imperfections in the measurement instruments, the calibration or the technique that is followed for the measurement. The systematic errors are characterized by the attribute they tend to a specific direction.

Consequently for small random error (small deviation) the accuracy of measurement is considered that it is high, while for big random error (big deviation) the accuracy of measurement is considered that it is low.

The random Uncertainty, e_R, of measurement result is defined as $\pm t_{\sigma}$, where σ is the standard deviation of measurement and t is the statistical value that corresponds in the selected probability. For determining of the t value using the statistical method «Student's t test» and is equal to about 2 for 95% confidence level. Therefore, the random uncertainty is given by the following formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}} \qquad (1)$$

Where:

N is the number of measurements

$\bar{x}$ is the average value of individual measurements of a variable

x_i is the value of a variable measurement (measured value), e.g Pressure P, Temperature T, Energy E etc.

The systematic Uncertainty, e_s (bias), is defined as the upper limit of systematic error.

Therefore the total Uncertainty of measurement U is calculated according to international standard ISO 5168 (Table V) by the formula U= $\sqrt{(e_R)^2 + (e_s)^2}$ (2) and expresses the range (values range) in which the real value of the measured variable is possibly to lie with 95% confidence level.

2. Individual uncertainties of the metering system

This article lists the individual uncertainties of measured value that contribute to overall measurement uncertainty of Energy of each metering system.

The uncertainty studies are categorized according to structure calculations of measured values depending on the meter type as detailed below:

A. Uncertainty on the Energy measurement with turbine meter or ultrasonic meter system.

- Uncertainty on volume measurement
- Uncertainty on pressure measurement
- Uncertainty on temperature measurement
- Uncertainty on compressibility factor calculation and accuracy of mathematical approach calculations.
- Uncertainty on Gross Calorific Value measurement (GCV)

B. Uncertainty on the energy measurement with orifice meter system

- Uncertainty on differential pressure measurement
- Uncertainty on pressure measurement
- Uncertainty on temperature measurement
- Uncertainty on orifice meter diameter
- Uncertainty on metering pipeline diameter

- Uncertainty on the ratio of orifice meter diameter to pipeline diameter
- Uncertainty on the discharge coefficient
- Uncertainty on the expansibility factor
- Uncertainty on density measurement (and at reference conditions)
- Uncertainty on Gross Calorific Value (GCV) measurement

The total uncertainty U of the system concerning the energy measurement is calculated from above equations (1) and (2) according to the relative uncertainty study of the manufacturer or of the authorized for this purpose Agency.

In both two cases of measurements systems the relevant standards referred to this Regulation are used in conjunction

ANNEX 2

DESCRIPTION-TECHNICAL SPECIFICATIONS OF STATIONS

ENTRY POINTS

Below is cited a general description of design - operation of metering stations of all Entry Points.

1. General description of design – operation of Metering Station M-Ag. Triada

The station consists of three metering lines with details listed below in a table. The priority function of the metering lines is determined by two PLCs (duty and stand by) where the operator predetermines the priority function of lines.

During normal operation of the station, metering lines operate (in order of priority) No 1 or / and No 2 (main metering lines), while the metering line No 3 (backup metering line) is under standby mode.

To ensure the normal functioning of equipment and uninterruptible supply of NNGTS, the metering line No 2 is operated in parallel with the metering line No 1 where the liquefied LNG supply requirements exceed the upper limit flow of the metering line No 1. In this case the flow will be shared automatically between the two metering lines. In case the requirements for liquefied LNG exceed the upper limit flow of both metering lines, the third metering line is also in parallel operation. If the flow is reduced, metering lines No 3, No 2 are isolated automatically in the reverse order controlled by the PLC.

In case of emergency operating conditions of the Ag. Triada Metering Station (eg increased differential pressure in filters) all three metering lines operate and the restoring of normal function is done only by a specialist staff transition at the station.

The metering lines No 2 and No 3 are put at manually mode operation, during maintenance of the station metering lines.

The quality parameters are monitoring continuously by using in series gas chromatographs with the system.

The gas composition is then transferred to the measurements management system MMS (supervisors computers), who use it, along with indications of pressure and temperature from the pressure and temperature transmitters to calculate the current gas compressibility.

Aforementioned are transferred to flow computers also, which use them to convert the pulses received from the flow meters to rates of energy, mass and volume flow.

Under normal operating conditions (full functionality) the station operates without the presence of staff, as it is monitored by the Supervisory Control and Data acquisition System (SCADA).

The operation of the station is possible via the control panel of the station, by personnel of the Operator, where it is not possible (for technical reasons) supervision and the remote control of station by the Supervisory Control and Data acquisition (SCADA) of NNGTS or in exceptional circumstances or when that is judged by the Operator as the best operational solution.

2. General description of design – operation of Border Metering Station Sidirokastro

The Border Metering Station at Sidirokastro, Serres, near Greek-Bulgarian Boarder, measure and regulate the flow of imported Natural Gas. The equipment of the station includes filters, meters, chromatographs and other analyzers, heat exchangers and boilers, regulators, regulating valves as well as control systems for the operation of these facilities. The flow is measured by five parallel metering lines with a 16´´ diameter orifice meter. In the Border Metering Station at Sidirokastro there is a bypass of all station with an Ultrasonic meter and a Turbine meter installed in series, flow computers and Measurement System Management (MMS).

The equipment of bypass includes filter and regulating valve as well as manual isolation valves. The bypass pipeline will be used only in case of emergency or general maintenance work.

3. General description of design – operation of Metering Station Kipi

It is consist of three metering lines with a combination of turbine meter and ultrasonic meter in series for each metering line and use of duty and stand by chromatographs and Measurement Management System (MMS).

In addition there is a by pass of all the station with Ultrasonic meter and Chromatograph (at 70% capacity of the station), to be used only in case of emergency or general maintenance work.

EXIT POINTS

Below is a general description of design - operation of Metering Station (M) or Metering/Regulating (M / R) stations of all exit points

1. General description of design - operation of orifice type stations with ultrasonic meter for start-up (Station M-Lavrion and M / R Komotini)

The station is consisted of a section with parallel filters, separators with condensate collector, part of parallel lines (three in M / R KOMOTINI and four in M-LAVRIO) each with fully equipped orifice meter, a system of "start up" with two parallel lines with ultrasonic meters (dual ultrasonic meters), a gas outlet isolation valve and by-pass valve which does not permit or allow the passage of gas when the section is starting or not in operation respectively, as well as intermediate and exterior collectors.

In M / R Komotini, after the metering system, there is a pressure regulating device in a series consisting of two regulating lines, equipped with a heat exchanger each. Also there is a container with three boilers and two metering - regulating lines of fuel gas for boilers supply.

The basic design characteristics are listed below in table.

Quality characteristics of Natural Gas as Gross Calorific Value, the composition and dew points of water and hydrocarbons are measured continuously by two gas chromatographs, an oxygen analyzer, a water dew point analyzer, a hydrocarbon dew point analyzer and are also recorded.

The recorded composition of the Natural gas and the quality parameters are transferred to supervisors computers and used with other digital data from temperature and pressure transmitters, for compressibility calculation.

The above gas composition is also transferred to the flow measurement, and used with other digital data from temperature transmitters, pressure and differential pressure from their respective (orifice meters or ultrasonic meters) flow computers for flow and energy calculation.

All functions of the station are monitored by a central control station via a computerized system (duty and stand by) and programmable logic controllers (duty and stand by) so that the presence of staff at the station is not necessary under normal conditions. The operation of the station is possible via the control panel of the station or locally, by staff of the Operator, in cases that supervision and the remote control of station by the Supervisory Control and Data acquisition (SCADA) of NNGTS is not possible or in exceptional circumstances or when that is judged by the Operator as the best functional solution.

2. General description of design - operation of ultrasonic meter type station (M-HERONAS)

Installation of two meter lines with ultrasonic meter, respective flow computers and Measurement Management System (MMS). They are also predicted installation of chromatograph and third stand by meter line (with ultrasonic meter- flow computer), connected with Supervisory Control System and Data Acquisition of DESFA. The chemical composition for the Superior calorific value and Energy calculation is done using data by Operator from adjacent to entry or exit point metering station gas chromatograph .

3. General description of design - operation of Stations with Turbine meter, flow computer, MMS and chromatograph (e.g. M-Keratsini, M-VFL, City Gates)

The description of these stations is similar to the Station M-Ag. Triada with the observation that the metering stations at the exit points that supply medium-pressure networks have pressure regulator at each metering line and fitted with gas heater.

4. General description of design - operation of Stations with Turbine meter, flow computer and chromatograph without MMS (e.g. EKO)

The description of the stations is similar to the Station of M-Ag. Triada with the observation that there is no Measurement Management System (MMS) and there may be pressure regulator in each metering line.

5. General description of design - operation of Stations with Turbine meter or/and rotary meter, with PTZ corrector without MMS and without chromatograph (e.g. M-Markopoulo, M-A VIPE Larissa, M-Kokkina, Temporary stations).

The description of the stations is similar to the M-Ag. Triada Station with the observation that the PTZ corrector replaces the flow computer, pressure and temperature transmitters, there is no MMS, and chemical composition is made by the Operator to calculate the Gross Calorific Value and Energy using data from a nearby gas chromatograph metering station of entry or exit point. Preset values of gas quality that have been entered to the PTZ corrector are taken into account for calculating the compressibility,

Note: At this Appendix the Technical Descriptions will be added only for those stations concerned on each contract.

The Operator shall publish on the site or on e-information system technical characteristics of the entry and exit points their total capacity as well as available capacity.

AGIA TRIADA U-3020	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 °C / +50 °C
MINIMUM / MAXIMUM INLET PRESSURE	38,4 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	37,9 barg / 66,4 barg
MINIMUM / MAXIMUM INLET TEMPERATURE	+ 3°C / + 19°C
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+ 3°C / + 19°C
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	519554 Nm^3/h
METERING SKID DESIGN CAPACITY	278640 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	3
NUMBER OF INSTALLED CHROMATOGRAPHS	2
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G4000
METERS DIAMETER	400mm
METERING SKID DIAMETER	400mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

Two (2) metering skids can be in operation, while the third one can be in standby mode.

SIDIROKASTRO U-2010	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.3 & B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	47,75 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +40 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+6 ºC / +40 ºC
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	662200 Nm^3/h
METERING SKID DESIGN CAPACITY	218500 Nm^3/h
STATION BYPASS METERING SKID CAPACITY	300000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	▪ Five (5) Orifice meters, and ▪ One (1) Ultrasonic meter and one (1) Turbine meter for the station bypass metering skid
NUMBER OF INSTALLED METERING SKIDS	5
NUMBER OF INSTALLED CHROMATOGRAPHS	3
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, ΔP=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	-
METERS DIAMETER	220 mm
METERING SKID DIAMETER	400 mm
BYPASS METERING SKID DIAMETER	300 mm
FLOW STRAIGHTENER DESIGN	-

Note:

Three (3) metering skids can be in operation, while the remaining two (2) ones can be in standby mode. The station bypass metering skid is activated only in extraordinary situations and includes one (1) ultrasonic meter and (1) turbine meter connected serially.

KIPI U-3900	
DESIGN DETAILS	
DESIGN CODE	EN 1776
DESIGN PRESSURE	80 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	50 barg / 75 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	856164 Nm^3/h
METERING SKID DESIGN CAPACITY	551750 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	▪ Three (3) Turbine meters, ▪ Three (3) Ultrasonic meters, and ▪ One (1) Ultrasonic meter for the station bypass metering skid
NUMBER OF INSTALLED METERING SKIDS	3
NUMBER OF INSTALLED CHROMATOGRAPHS	3
METERING EQUIPMENT TOTAL PROBABLE ERROR	P=±0,07%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,32%
INSTALLATION DETAILS	
TURBINE METERS CAPACITY	G-10000
METERS DIAMETER	500 mm
METERING SKID DIAMETER	500 mm
BYPASS METERING SKID DIAMETER	750 mm
FLOW STRAIGHTENER DESIGN	ISO 5167

Note:

Two (2) metering skids can be in operation, while the third one can be in standby mode. Each metering skid includes one (1) turbine meter for invoicing purposes and (1) ultrasonic meter for checking purposes. The station bypass metering skid is activated only in extraordinary situations and includes one (1) ultrasonic meter and one (1) chromatograph. The station bypass metering skid capacity is equal to 70% of the station design capacity.

LAVRIO U-3430	
DESIGN DETAILS	
DESIGN CODE	ASME VIII Div.1
DESIGN PRESSURE	40 barg
DESIGN TEMPERATURE	-10 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	26,5 barg / 37,5 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	25 barg / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+3 ºC / +26 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +26 ºC
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	240000 Nm^3/h
METERING SKID DESIGN CAPACITY	80000 Nm^3/h
ULTRASONIC METERING SKID DESIGN CAPACITY	19000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	▪ Four (4) Orifice meters ▪ Two (2) Ultrasonic meters
NUMBER OF INSTALLED METERING SKIDS	4+2
NUMBER OF INSTALLED CHROMATOGRAPHS	2
METERING EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, ΔP=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	-
METERS DIAMETER	150 mm
METERING SKID DIAMETER	250 mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Z3433

Note:

Three (3) Orifice metering skids can be in operation, while the fourth one can be in standby mode. One (1) Ultrasonic metering skid can be in operation, while the second one can be in standby mode.

PPC KOMOTINI U-3570	
DESIGN DETAILS	
DESIGN CODE	ASME VIII Div.1
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	40 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	28 barg / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +26 ºC
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	108000 Nm^3/h
METERING SKID DESIGN CAPACITY	54000 Nm^3/h
ULTRASONIC METERING SKID DESIGN CAPACITY	20000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	▪ Three (3) Orifice meters ▪ Two (2) Ultrasonic meters
NUMBER OF INSTALLED METERING SKIDS	3+2
NUMBER OF INSTALLED CHROMATOGRAPHS	2
METERING EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, ΔP=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	-
METERS DIAMETER	115 mm
METERING SKID DIAMETER	200 mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Z3573

Note:
Two (2) Orifice metering skids can be in operation, while the third one can be in standby mode. One (1) Ultrasonic metering skid can be in operation, while the second one can be in standby mode.

KERATSINI U-3090	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	40 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	18 barg / 18,2 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	17,6 barg / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+3 ºC/ -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC/ -
OPERATING PRESSURE	17,6 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	102153 Nm^3/h
METERING SKID DESIGN CAPACITY	102153 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	2
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G4000
METERS DIAMETER	400 mm
METERING SKID DIAMETER	400 mm
FLOW STRAIGHTENER DESIGN	-

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

HERONAS U-6020	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-29 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	25,5 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	25 barg / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+5 ºC / +24 ºC
OPERATING PRESSURE	45 barg
OPERATING TEMPERATURE	+10ºC
DESIGN CAPACITY	40000 Nm^3/h
METERING SKID DESIGN CAPACITY	40000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Ultrasonic meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^oC
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	2500 m^3/h
METERS DIAMETER	200 mm
METERING SKID DIAMETER	200 mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

TRIKALA TM3-B	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	20000 Nm^3/h
METERING SKID DESIGN CAPACITY	20000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	1+(1)
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,3%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 1000
METERS DIAMETER	150 mm
METERING SKID DIAMETER	150 mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one with similar meter type prediction will be in standby mode.

KAVALA TM4-A	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	10000 Nm^3/h
METERING SKID DESIGN CAPACITY	10000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	1+(1)
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,3%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 400
METERS DIAMETER	150 mm
METERING SKID DIAMETER	150 mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one with similar meter type prediction will be in standby mode.

KARDITSA TM3-A	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	20000 Nm^3/h
METERING SKID DESIGN CAPACITY	20000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	1+(1)
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,3%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 1000
METERS DIAMETER	150 mm
METERING SKID DIAMETER	150 mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one with similar meter type prediction will be in standby mode.

KOMOTINI TM3-C	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	20000 Nm^3/h
METERING SKID DESIGN CAPACITY	20000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	1+(1)
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,3%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 1000
METERS DIAMETER	150 mm
METERING SKID DIAMETER	150 mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one with similar meter type prediction will be in standby mode.

MARKOPOULO TM2	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	7,6 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	9600 Nm^3/h
METERING SKID DESIGN CAPACITY	9600 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter & Rotary meter
NUMBER OF INSTALLED METERING SKIDS	1+1
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,3%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 1000 , G 160 (Rotary)
METERS DIAMETER	150 mm
METERING SKID DIAMETER	150 mm
FLOW STRAIGHTENER DESIGN	-

ATHENS NORTH U-2910	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	32,1 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	-3 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +7 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	110219 Nm^3/h
METERING SKID DESIGN CAPACITY	110219 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G4000
METERS DIAMETER	400mm
METERING SKID DIAMETER	400mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

THRIASSIO U-2960	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	36,5 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	-3 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	50705 Nm^3/h
METERING SKID DESIGN CAPACITY	50705 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	250mm
METERING SKID DIAMETER	250mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

<u>Note</u>:

One (1) metering skid can be in operation, while the second one can be in standby mode.

ATHENS EAST U-2940	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	40 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	27,6 barg / 37,7 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	-2 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +11 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	110219 Nm^3/h
METERING SKID DESIGN CAPACITY	110219 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G4000
METERS DIAMETER	400mm
METERING SKID DIAMETER	400mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

<u>Note</u>:

One (1) metering skid can be in operation, while the second one can be in standby mode.

ASPROPYRGOS U-2970	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	30 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	-3 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	28,9 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	100150 Nm^3/h
METERING SKID DESIGN CAPACITY	100150 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^oC
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	300mm
METERING SKID DIAMETER	300mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

1. One (1) metering skid can be in operation, while the second one can be in standby mode.
2. The Metering Station is isolated with Nitrogen under pressure.

ATHENS WEST U-2990	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	26,8 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	-4 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	110213 Nm^3/h
METERING SKID DESIGN CAPACITY	110213 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^oC
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G4000
METERS DIAMETER	400mm
METERING SKID DIAMETER	400mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

INOFYTA U-2880	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	36,3 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +7 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	26508 Nm^3/h
METERING SKID DESIGN CAPACITY	26508 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

VFL U-2170	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	33,2 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	32,7 barg / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+7 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	24309 Nm^3/h
METERING SKID DESIGN CAPACITY	24309 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G650
METERS DIAMETER	150mm
METERING SKID DIAMETER	150mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

THESSALONIKI NORTH U-2240	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35,6 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	72527 Nm^3/h
METERING SKID DESIGN CAPACITY	72527 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	300mm
METERING SKID DIAMETER	300mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

THESSALONIKI EAST U-2220	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	34,2 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +7 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	72527 Nm^3/h
METERING SKID DESIGN CAPACITY	72527 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	300mm
METERING SKID DIAMETER	300mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

PLATY U-2410	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	43,8 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+10 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +7 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	21488 Nm^3/h
METERING SKID DESIGN CAPACITY	21488 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

EKO U-2250	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	39 barg / 55 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+4 ºC / +18 ºC
OPERATING PRESSURE	34,5 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	18027 Nm^3/h
METERING SKID DESIGN CAPACITY	18027 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G400
METERS DIAMETER	150mm
METERING SKID DIAMETER	150mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

LARISSA NORTH U-2520	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	45,4 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+8 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	25910 Nm^3/h
METERING SKID DESIGN CAPACITY	25910 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

LARISSA SOUTH U-2530	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	45,4 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+7 ºC / +24 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / +7 ºC
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	25910 Nm^3/h
METERING SKID DESIGN CAPACITY	25910 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

<u>Note</u>:

One (1) metering skid can be in operation, while the second one can be in standby mode.

VOLOS U-2680	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-15 ºC / +50 ºC
MINIMUM / MAXIMUM INLET PRESSURE	45,3 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	+3 ºC / -
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	51643 Nm^3/h
METERING SKID DESIGN CAPACITY	51643 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,47%
INSTALLATION DETAILS	
METERS CAPACITY	G1600
METERS DIAMETER	250mm
METERING SKID DIAMETER	250mm
FLOW STRAIGHTENER DESIGN	ISO 5167 Type C, bundle of 19 tubes

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

VIPE LARISSA U-2515	
DESIGN DETAILS	
DEIGN CODE	EN 1776
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +60 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	10000 Nm^3/h
METERING SKID DESIGN CAPACITY	10000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,25%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 400
METERS DIAMETER	150 mm
METERING SKID DIAMETER	-
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

KOKKINA U-2670	
DESIGN DETAILS	
DEIGN CODE	EN 1776
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +60 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	10000 Nm^3/h
METERING SKID DESIGN CAPACITY	10000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,25%, T=±0,3^{o}C
ENERGY UNCERTAINTY (by calculations)	±1,15%
INSTALLATION DETAILS	
METERS CAPACITY	G 400
METERS DIAMETER	150 mm
METERING SKID DIAMETER	-
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

LAMIA TM5-R	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	41 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg / 37,7 barg
MINIMUM / MAXIMUM INLET TEMPERATURE	+7 ºC / -
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	90000 Nm^3/h
SKID DESIGN CAPACITY	90000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	-
NUMBER OF INSTALLED METERING SKIDS	-
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	-
ENERGY UNCERTAINTY (by calculations)	-
INSTALLATION DETAILS	
METERS CAPACITY	-
METERS DIAMETER	-
METERING SKID DIAMETER	-
FLOW STRAIGHTENER DESIGN	-

Note:

One (1) regulating skid can be in operation, while the second one can be in standby mode.

DRAMA U-2140	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	28000 Nm^3/h
METERING SKID DESIGN CAPACITY	28000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

KATERINI U-2340	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	28000 Nm^3/h
METERING SKID DESIGN CAPACITY	28000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	-

<u>Note</u>:

One (1) metering skid can be in operation, while the second one can be in standby mode.

KILKIS U-2260	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	44000 Nm^3/h
METERING SKID DESIGN CAPACITY	44000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1600
METERS DIAMETER	250mm
METERING SKID DIAMETER	250mm
FLOW STRAIGHTENER DESIGN	-

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

SERRES U-2110	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	44000 Nm^3/h
METERING SKID DESIGN CAPACITY	44000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1600
METERS DIAMETER	250mm
METERING SKID DIAMETER	250mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

AdG U- 2820	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	100000 Nm^3/h
METERING SKID DESIGN CAPACITY	100000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	2
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	300mm
METERING SKID DIAMETER	300mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

Motor Oil U-7130	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	100000 Nm^3/h
METERING SKID DESIGN CAPACITY	100000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,5%
INSTALLATION DETAILS	
METERS CAPACITY	G2500
METERS DIAMETER	300mm
METERING SKID DIAMETER	300mm
FLOW STRAIGHTENER DESIGN	-

Note:
One (1) metering skid can be in operation, while the second one can be in standby mode.

XANTHI U-3530	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	70 barg
DESIGN TEMPERATURE	-24 ºC / +80 ºC
MINIMUM / MAXIMUM INLET PRESSURE	35 barg / 66,4 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	9 barg /-
MINIMUM / MAXIMUM INLET TEMPERATURE	+6 ºC / +25 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	16,7 barg
OPERATING TEMPERATURE	-
DESIGN CAPACITY	44000 Nm^3/h
METERING SKID DESIGN CAPACITY	44000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	1
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14°C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1600
METERS DIAMETER	250mm
METERING SKID DIAMETER	250mm
FLOW STRAIGHTENER DESIGN	-

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

ALEXANDROUPOLI U-3630	
DESIGN DETAILS	
DEIGN CODE	ANSI B31.8
DESIGN PRESSURE	80 barg
DESIGN TEMPERATURE	- / -
MINIMUM / MAXIMUM INLET PRESSURE	- / 75 barg
MINIMUM / MAXIMUM OUTLET PRESSURE	- / -
MINIMUM / MAXIMUM INLET TEMPERATURE	+5 ºC / +26 ºC
MINIMUM / MAXIMUM OUTLET TEMPERATURE	-
OPERATING PRESSURE	-
OPERATING TEMPERATURE	-
DESIGN CAPACITY	28000 Nm^3/h
METERING SKID DESIGN CAPACITY	28000 Nm^3/h
METERING INFRASTRUCTURE	
METER TYPE	Turbine meter
NUMBER OF INSTALLED METERING SKIDS	2
NUMBER OF INSTALLED CHROMATOGRAPHS	-
AUXILIARY EQUIPMENT TOTAL PROBABLE ERROR	P=±0,15%, T=±0,14^{o}C
ENERGY UNCERTAINTY (by calculations)	±0,65%
INSTALLATION DETAILS	
METERS CAPACITY	G1000
METERS DIAMETER	200mm
METERING SKID DIAMETER	200mm
FLOW STRAIGHTENER DESIGN	-

Note:

One (1) metering skid can be in operation, while the second one can be in standby mode.

ANNEX 3

PROTOCOLS-FORMS

1. Entry Points Protocols

For each Entry Point Metering Station of NNGTS, the Operator shall prepare not later than the fifth (5) calendar day of each month until the 12th hour (12:00) the following protocols for the quantities of gas received in the immediately preceding month:

1.1 Quantity Monthly Protocol and Measurement Characteristics of NG at Entry Point 9 Form 1)

This protocol includes the following measured variables for each day of the Month:

i. Total delivered volume (V_N) of N.G. expressed in Nm^3
ii. Total delivered energy (E) of N.G. expressed in MWh
iii. Gross Calorific Value (GCV) expressed in MWh/Nm^3
iv. Pressure (P) expressed in bara
v. Delivered temperature (T) expressed in ^oC
vi. Relative density r_d
vii. Wobbe index expressed in MWh/Nm^3
viii. Water Dew Point expressed in ^oC at reference conditions

The Protocol shows the average measured values from (iii) to (viii).
Specialty at Ag.Triada entry point, the measured value (viii) is not measured.

1.2 Quality Monthly Protocol of NG at Entry Point (Form 2)

This protocol includes the percentage molar composition (% mole) of natural gas for hydrocarbons (C_xH_y), carbon dioxide (CO_2), nitrogen (N_2) and oxygen (O_2).

2 Exit Points Protocols

For each Exit Point Metering Station of NNGTS, the Operator shall prepare not later than the fifth (5) calendar day of each month until the 12th hour (12:00) the following protocols:

8.2.1 Quantity Monthly Protocol and Measurement Characteristics of NG at Exit Point M/R (Form 3)

This protocol shows for each metering line of station per Day of the Contractual Month the total delivered volume (V_N) of NG expressed in Nm^3, the total delivered energy (E) of NG expressed in MWh, the pressure expressed in bara and the delivered temperature expressed in ^{o}C. The sum of the delivered volume (V_N) of NG is also referred expressed in Nm^3, and the sum of the delivered energy (E) of NG expressed in MWh, for all metering lines of Metering Station.

8.2.2 <u>Quality Monthly Protocol of NG at Exit Point (Form 4)</u>

This protocol includes the percentage molar composition (% mole) of natural gas for hydrocarbons (CxHy), carbon dioxide (CO_2), nitrogen (N_2) and oxygen (O_2). Also, includes the Gross Calorific Value (GCV) expressed in MWh/Nm3, the relative density rd and the Wobbe index expressed in MWh/Nm3. For the exit points which have no gas chromatograph these data are obtained from nearby entry point or exit point that has a gas chromatograph.

3 Latent quantities of Natural Gas Protocol

1. Latent quantities of Natural Gas mean the Corrections of measured quantities due to equipment calibration and / or incorrect values.
2. Until the fifth (5) calendar day of each month and until the 12th hour (12:00) for each entry and exit point metering station of NNGTS the Operator compile latent quantities of natural gas Protocol (Form 5), which records for each Day of previous month volume (V_N) expressed in Nm3, energy (E) expressed in MWh and Gross Calorific Value (GCV) expressed in MWh/Nm3 of latent quantities of natural gas.

3.1 Protocols Forms

The relevant forms are published by the Operator at the Electronic Information System, or lack to this, at its website

<u>Form 1</u> Quantity Monthly Protocol and Measurement Characteristics of NG at Entry Point M/R

<u>Form 2</u> Quality Monthly Protocol of NG at Entry Point M/R

<u>Form 3</u> Quantity Monthly Protocol and Measurement Characteristics of NG at Exit Point M/R

<u>Form 4</u> Quality Monthly Protocol of NG at Exit Point M/R

<u>Form 5</u> Latent Quantities Protocol

MONTHLY PROTOCOL OF QUANTITY AND N.G. MEASUREMENT CHARACTERISTICS AT ENTRY POINT

DAILY QUANTITY REPORT
Per contract month

Gas month :
printout mode :
Page :

Delivery Point: **METERING STATION**

Contract Day	**Meter Run**							
	Vn (Nm³)	E (MWh)	hs dry (MWh/Nm³)	P (bara)	T (°C)	rd	Wobbe(MWh/Nm³)	H_2O dewpoint(°C)
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

28								
29								
30								
31								
Total / Averages								

DESFA Hellenic Gas Transmission System Operator

MONTHLY PROTOCOL OF N.G. QUALITY COMPOSITION AT ENTRY POINT

DAILY QUALITY REPORT

Gas month :
printout mode :
Page :

Per contract month

DELIVERY POINT: **METERING & REGULATION STATION**

Contract Day	Composition											
	C1 (mol%)	C2 (mol%)	C3 (mol%)	i-C4 (mol%)	n-C4 (mol%)	i-C5 (mol%)	n-C5 (mol%)	neo-C5 (mol%)	C6+ (mol%)	N2 (mol%)	CO2 (mol%)	O2 (mol%)
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Averages												

DESFA
Hellenic Gas Transmission System Operator

Contract Day	Meter Run 1				Meter Run 2				Future Run			
	Vn(Nm³)	E (MWh)	P (bara)	T (°C)	Vn(Nm³)	E (MWh)	P (bara)	T (°C)	Vn [Nm³]	E (MWh)	P [bara]	T [°C]
01	445.074,4	4.985,7	13,60	-0,76	0,0	0,0	13,60	12,26	0,0	0,0	0,00	0,00
02	391.831,9	4.365,4	13,60	-0,48	0,0	0,0	13,58	12,34	0,0	0,0	0,00	0,00
03	416.369,9	4.695,9	13,61	0,24	0,0	0,0	13,54	12,56	0,0	0,0	0,00	0,00
04	399.493,2	4.478,4	13,59	-0,84	0,0	0,0	13,55	12,63	0,0	0,0	0,00	0,00
05	428.658,2	4.777,7	13,60	0,33	0,0	0,0	13,54	12,81	0,0	0,0	0,00	0,00
06	417.163,7	4.665,3	13,60	0,52	0,0	0,0	13,56	12,85	0,0	0,0	0,00	0,00
07	435.415,4	4.918,5	13,60	-0,35	0,0	0,0	13,60	11,43	0,0	0,0	0,00	0,00
08	367.639,9	4.166,8	13,61	0,54	0,0	0,0	13,60	11,38	0,0	0,0	0,00	0,00
09	349.440,9	4.020,3	13,61	-0,76	0,0	0,0	13,60	11,07	0,0	0,0	0,00	0,00
10	380.687,6	4.418,3	13,59	-2,15	0,0	0,0	13,54	11,47	0,0	0,0	0,00	0,00
11	509.021,4	5.870,7	13,59	-0,35	0,0	0,0	13,51	11,84	0,0	0,0	0,00	0,00
12	574.546,1	6.627,7	13,59	0,37	0,0	0,0	13,53	11,46	0,0	0,0	0,00	0,00
13	435.860,3	5.032,9	13,60	0,33	0,0	0,0	13,54	12,09	0,0	0,0	0,00	0,00
14	421.539,0	4.843,0	13,61	0,50	0,0	0,0	13,59	12,48	0,0	0,0	0,00	0,00
15	331.369,9	3.766,6	13,61	1,76	0,0	0,0	13,61	12,43	0,0	0,0	0,00	0,00
16	341.299,8	3.864,5	13,60	1,16	0,0	0,0	13,56	12,87	0,0	0,0	0,00	0,00
17	409.694,9	4.693,4	13,60	1,79	0,0	0,0	13,56	12,75	0,0	0,0	0,00	0,00
18	369.069,6	4.253,6	13,60	1,82	0,0	0,0	13,57	12,68	0,0	0,0	0,00	0,00
19	317.866,0	3.675,6	13,59	0,89	0,0	0,0	13,53	13,28	0,0	0,0	0,00	0,00
20	337.015,0	3.877,9	13,59	1,51	0,0	0,0	13,54	13,50	0,0	0,0	0,00	0,00
21	460.786,1	5.354,2	13,59	1,60	0,0	0,0	13,59	11,75	0,0	0,0	0,00	0,00
22	333.396,2	3.814,3	13,59	0,27	0,0	0,0	13,57	12,64	0,0	0,0	0,00	0,00
23	354.724,8	3.958,9	13,59	2,37	0,0	0,0	13,57	12,59	0,0	0,0	0,00	0,00
24	368.670,8	4.205,8	13,59	1,81	0,0	0,0	13,57	12,04	0,0	0,0	0,00	0,00
25	436.668,9	4.943,2	13,58	0,87	0,0	0,0	13,53	12,02	0,0	0,0	0,00	0,00
26	486.609,5	5.563,2	13,59	1,21	0,0	0,0	13,55	12,42	0,0	0,0	0,00	0,00
27	450.515,2	5.210,8	13,59	1,34	0,0	0,0	13,60	12,40	0,0	0,0	0,00	0,00
28	607.245,4	7.005,2	13,58	0,31	0,0	0,0	13,57	11,57 *	0,0	0,0	0,00	0,00
29	444.015,5	5.041,0	13,60	0,27	0,0	0,0	13,54	11,58	0,0	0,0	0,00	0,00
30	445.490,3	4.972,2	13,60	1,87	0,0	0,0	13,52	11,82	0,0	0,0	0,00	0,00
31	489.524,7	5.582,1	13,60	0,72	0,0	0,0	13,53	11,77	0,0	0,0	0,00	0,00
Totals	12.956.704,5	147.649,1			0,0	0,0			0,0	0,0		

Contract Day	Future Run				Future Run				Sum of Meters Runs (Totals/Averages)				
	Vn [Nm³]	E (MWh)	P [bara]	T [°C]	Vn [Nm³]	E (MWh)	P [bara]	T [°C]	Vn(Nm³)	E (MJ)	E (MWh)	P (bara)	T (°C)
01	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	445.074,4	17.948.575,7	1.384,9	13,60	-0,76
02	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	391.831,9	15.715.394,4	1.212,6	13,60	-0,48
03	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	416.369,9	16.905.333,2	1.304,4	13,61	0,24
04	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	399.493,2	16.122.095,7	1.244,0	13,59	-0,84
05	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	428.658,2	17.199.683,6	1.327,1	13,60	0,33
06	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	417.163,7	16.795.181,6	1.295,9	13,60	0,52
07	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	435.415,4	17.706.718,2	1.366,3	13,60	-0,35
08	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	367.639,9	15.000.596,1	1.157,5	13,61	0,54
09	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	349.440,9	14.473.209,8	1.116,8	13,61	-0,76
10	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	380.687,6	15.905.972,6	1.227,3	13,59	-2,15
11	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	509.021,4	21.134.498,2	1.630,7	13,59	-0,35
12	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	574.546,1	23.859.768,4	1.841,0	13,59	0,37
13	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	435.860,3	18.118.270,5	1.398,0	13,60	0,33
14	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	421.539,0	17.434.826,9	1.345,3	13,61	0,50
15	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	331.369,9	13.559.908,8	1.046,3	13,61	1,76
16	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	341.299,8	13.912.040,3	1.073,5	13,60	1,16
17	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	409.694,9	16.896.133,6	1.303,7	13,60	1,79
18	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	369.069,6	15.312.935,4	1.181,6	13,60	1,82
19	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	317.866,0	13.232.319,4	1.021,0	13,59	0,89
20	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	337.015,0	13.960.389,2	1.077,2	13,59	1,51
21	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	460.786,1	19.275.221,0	1.487,3	13,59	1,60
22	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	333.396,2	13.731.316,7	1.059,5	13,59	0,27
23	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	354.724,8	14.252.104,8	1.099,7	13,59	2,37
24	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	368.670,8	15.141.021,0	1.168,3	13,59	1,81
25	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	436.668,9	17.795.692,8	1.373,1	13,58	0,87
26	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	486.609,5	20.027.367,4	1.545,3	13,59	1,21
27	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	450.515,2	18.758.842,8	1.447,4	13,59	1,34
28	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	607.245,4	25.218.608,4	1.945,9	13,58	0,31
29	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	444.015,5	18.147.574,5	1.400,3	13,60	0,27
30	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	445.490,3	17.899.888,9	1.381,2	13,60	1,87
31	0,0	0,0	0,00	0,00	0,0	0,0	0,00	0,00	489.524,7	20.095.439,3	1.550,6	13,60	0,72
Totals	0,0	0,0			0,0	0,0			12.956.704,5	531.536.929,2	41.013,7	13,60	0,60

DESFA
Hellenic Gas Transmission System Operator

MONTHLY PROTOCOL OF N.G. QUALITY COMPOSITION AT EXIT POINT

DAILY QUALITY REPORT

Gas month :
printout mode :
Page :

Per contract month

DELIVERY POINT: **METERING & REGULATION STATION**

Contract Day	Composition												hs dry	rd	Wobbe
	C1 (mol%)	C2 (mol%)	C3 (mol%)	i-C4 (mol%)	n-C4 (mol%)	i-C5 (mol%)	n-C5 (mol%)	neo-C5 (mol%)	C6+ (mol%)	N2 (mol%)	CO2 (mol%)	O2 (mol%)	(MWh/Nm³)	-	(MWh/Nm³)
01															
02															
03															
04															
05															
06															
07															
08															
09															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
Averages															

DESFA
Hellenic Gas Transmission System Operator

MONTHLY PROTOCOL OF LATENT QUANTITIES AT ENTRY or EXIT POINT

Point …………….. :………………………………………………………….
Reporting Date :………………………………………………………….
Reporting Period :………………………………………………………….

Day	Station Total			Comments
	V_N Nm^3	GCV MJ/Nm^3	E MWh	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
Total				

The OPERATOR
……………………………

The USERS
……………………………

ANNEX 4

MEASUREMENT INSTRUMENTS – DATA LOGGERS – TOTALISERS

1. Definitions and types of measurement instruments

The term instrumentation means a sensitive electrical or mechanical or pneumatic or digital device for measurement transmission or control of a variable parameter, which is located in NNGTS and connected with the devices and parts of the measurement process. The various types of instruments can be classified depending on the type of measurement carried out. So, according to the type of measurement, instruments are classified to three main categories:

1.1 Indicators

Indicators measure and record the instantaneous value of a parameter associated with the process of actually measurement and it is not necessary to store or record it of either analog or digital form. Such instruments are for example: analog or digital pressure gauge (gauge pressure) the thermometer (temperature gauge), etc.

1.2 Data Loggers

The Data Loggers are used for permanent, total or partial recording of a process variable parameters, for systematic recording of operational data needed to Operator for consideration and further analysis. In essence for analog mode these instruments record on paper surface (classified according to use) the change in operating variable versus time. The recording instruments in digital mode (Digital Data Loggers) record the measurement data, depending on the desired settings in digital memory, from which they can be retrieved with the help of a computer and analyzed with appropriate software. In this way the Operator has the ability to store various operating data for further processing and for future use. These instruments are used in many applications in the management of NNGTS (e.g. measurement data to invoice the gas at entry points).

1.3 Totalisers

The Totalisers who called meters (analog-mechanical or digital) record the total value of the functional variable for a given period during which the instrument or measurement device of a particular parameter was operating. Such Totalisers widely used in NNGTS for example for the recording of the total volume of gas that has passed through a period of time through gas turbine meter or another meter type of metering stations of NNGTS.

The various types of instruments are classified into the following two categories depending on whether they serve invoicing purposes or not:

1.4 Supervisor Instruments

The Supervisor Instruments briefly illustrate the instantaneous value of a parameter to ensure the best possible supervision of NNGTS through the Control and Dispatching Center of Operator, but this value is not used for invoicing purposes of the Users.

1.5 Custody Transfer instruments

Custody Transfer instruments are those instruments of NNGTS used for Custody Transfer purposes in accordance with international standards, procedures and methods as described in Tables IV and V. They are accompanied by certificates of calibration and checked and / or recalibrated either by special metrological laboratories at predetermined time intervals (Table I) or by the staff of the Operator in accordance with the calibration procedures (Article 27, Table II). Such instruments make up the supportive measurement equipment of metering stations of NNGTS such as pressure, differential pressure, temperature transmitters or the primary measurement equipment such as various types of meters (Table IV). Also Custody Transfer instruments include gas chromatographs, and dew point analyzers.

2. Main groups of measurement instruments

In regard to the various groups of measurements instrument classification, they are determined by the parameters taken into account in each measurement processes. Generally the main parameters measured in the case of the National Natural Gas Transmission System are the following:

- Temperature
- Pressure
- Gas flow

Consequently, the main groups of instruments in relation with the abovementioned are:

- Thermometers (Analog or Digital / Transmitters)
- Gauges (Analog or Digital / Transmitters)
- Flow meters (Turbine meters, Rotary meters, etc)

2.1 *Temperature−Thermometers*

2.1.1 Temperature measurement principles

The value or the quantitative value of temperature can not be determined directly. Consequently, the temperature is determined indirectly, based on some characteristic properties of matter, which change as a function of temperature increase or decrease. Such characteristic properties are:

- Length or volume (based on thermal expansion)
- Electrical changes (electrical resistance change)
- Optical properties

In Natural Gas Transmission System the following types of thermometers are widely used either in laboratory or in the process of measurement:

2.1.2 Thermal expansion thermometers − Capillary tube or glass mercury thermometer

Increase in temperature alters the volume of solid, liquid and gaseous matters, so these types of materials expand as a function of temperature increase. This is essentially the basic property the operation of ordinary thermometers with mercury or other liquid is underlying (the liquid expands when the temperature increases).

2.1.3 Electrical resistance thermometer

The electrical resistance thermometers (RTD-Resistant Temperature Detector) operate with a measurable change in resistance of the metal or a semiconductor (Thermistor) as a function of temperature. The metal is platinum, copper or nickel and the semiconductor is metal oxide.
The electrical resistance of the RTD changes as a function of temperature. Circuit similar to a Wheatstone bridge is installed in control systems designed for use in instruments of resistance (RTD). A continuous current at the bridge produces an output voltage which varies with temperature.

2.1.4 Temperature transmitters

The temperature transmitters are used to transmit the temperature to a remote point in relation to the physical point of measurement. The transmission element or connection transmits the temperature of the medium, at some point at a distance and can be the Control and Dispatching Center of NNGTS and / or units and data processing systems and measurement process control of the metering stations. The basic operating principle of a temperature transmitter is to convert the temperature into an electrical signal 4 mA to 20 mA, and to transmit this to the final recipient, who receives the electrical signal and converts it to a temperature indication. The calibration of the transmitter is based on the above scale of the electrical signal.

2.2. Pressure – Pressure measurement instruments

Various instruments are used in NNGTS for pressure measurement either mechanically or digitally. In regard to mechanical pressure measurement, the operating principle is based on mechanical deformation of a component or part of the gauge by imposing the static pressure of a fluid or gaseous medium. This change is converted to measurement upon a pressure calibrated scale through a mechanical index. Measurement instruments with digital display of measurement convert primary value through an electronic process into an indication on a display screen. These instruments can be designed with high accuracy, depend on the application.

2.2.1 Pressure transmitters

The basic operating principle of a pressure transmitter is to convert the measured value of pressure into an electrical signal 4 mA to 20 mA, transmitted to the final recipient which converts it to a pressure indication. The calibration of the transmitter is based on the above scale of the electrical signal. These instruments have the ability of recalibration with special devices (HART Communicator), for higher accuracy and transmission.

The pressure transmitter used for measuring and transmitting the absolute pressure at Metering and Regulating gas stations of National Natural Gas Transmission System uses a piezoresistive silicon sensor, which provides an increased level of accuracy and operation of absolute pressure measurements. The digital technology used ensures a high level of accuracy in the measurement range, as well as communication between the measurement point (field) and the central control and data processing area. The sensor consists of an electrical circuit "Wheatstone bridge » which is made of silicon resistors tipped in a silicon substrate. The process pressure is transmitted through the isolated and full of fluid diaphragm to the sensor element, creating a very slight shift of silica substrate. The resulting low mechanical stress applied to the substrate alters the electrical resistance of the Wheatstone bridge directly proportional to the applied pressure. So a mechanical stress is converting into electrical change of similar size and a signal 4 - 20 mA is transmitting to deliver the measurable value to the final recipients of measurement, with high reliability and accuracy.

2.3 Flow Meters

2.3.1 Turbine meters

The turbine meters are induction meters with wide use in NNGTS. The principle of operation is as follows:

The gas enters the turbine-meter through a flow conditioner, pass through a ring channel and drives the turbine. The contraction of the gas inside the ring channel increases speed of the gas so as to produce more torque to the turbine. The turbine consists of a wheel on which it is implanted wing angle from 30° to 45°. The stream of gas rotates turbine at a speed proportional to the velocity of the gas. The total volume of gas passing through the meter per time unit (rate) is equal to the velocity of the gas multiplied by the surface of the ring channel, and each turn of the turbine corresponds to a fixed volume of gas passing through the meter.

Depending on the ratio of minimum to maximum flow (Qmin / Qmax) that the meters are able to measure, they are divided into three categories:

- Low range, Qmin/Qmax = 1/5
- Medium range, Qmin/Qmax =1/10
- High range, Qmin/Qmax = 1/20

The start up flow is Qmax/100. The acceptable measurement errors of turbine-meters are:

- For Qmin < Q < 0.2Qmax, 2%
- For 0.2Qmax < Q < Qmax, 1%

A more extensive report on this meter is done in the standards EN 12261 and ISO 9951 (Table V).

2.3.2 Rotary meters

Rotary meters are volume meters used primarily to measure the gas in trade or craft customers. Also they are called meter spinning (rotary positive displacement meters), or meters with rotary pistons (rotary piston gas meters). A rotary meter consists of two pistons that rotate in opposite directions to each other in a stable measurement chamber.

The measurement chamber and the outlet of the gas are located diametrical. The pistons are made in such a way that there is a continuous seal with no contact between pistons at all positions. The combined movement of the piston is achieved by two gears mounted on the axes of the pistons.

During the full rotation of the piston around the axis, volume of gas passes through the meter equal to four times the volume enclosed between the piston in a horizontal position and the measurement chamber.

Depending on the ratio of minimum to maximum flow (Qmin / Qmax) these meters are divided into three categories:

- Low range, Qmin/Qmax = 1/5
- Medium range, Qmin/Qmax =1/10
- High range, Qmin/Qmax = 1/20

The start up flow is from Qmax/800 to Qmax/300. The acceptable measurement errors of rotary meters are:

- For Qmin < Q < 0.2Qmax, 2%
- For 0.2Qmax < Q < Qmax, 1%

A more extensive report on this meter is done in the standard EN 12480 (Table V).

2.3.3 Ultrasonic Meters

Ultrasonic flow meters are metering devices consisting of ultrasonic transducers, located inside the pipe of the metering device. The operating principle relies on ultrasonic pulses transmitted by a transmitter and received by a receiver under φ angle.
Without flow, a pulse from the transducer A to B will travel with the same speed compared to the speed of a pulse from B to A (the speed depends on the transmission medium).
If inside the pipeline there is gas which is moving at a speed different from zero, then the pulse from A to B will travel at different speed (greater or less depending on the direction of the gas) than that from B to A.
The two times of pulse transmission are measured electronically, and thereby the speed of the gas is determined. Since the speed of the gas is known the flow at operating conditions and reference conditions can be calculated.

Commonly it is used multipath reflectors devices
Common measurement errors are:

- For Qmin < Q < 0.05Qmax, 1 %
- For 0.05Qmax < Q <Qmax, 0,05%

A more extensive report on this meter is done in the standard AGA 9 (Table V).

2.3.4 Orifice meters

In orifice meters (restriction type orifice meters) pressure drop is caused by the diameter of the flow pipeline changing and the speed of the fluid increase. Determination of volume flow is done.by determining the pressure drop. The rate of fluid flow is proportional to the square root of pressure drop.
A more extensive report on this meter is done in the standard ISO 5167 (Table V).

2.3.5 Coriolis mass flow meters

The Coriolis meters operate according to the principle that inertia forces are generated when a molecule in a rotating body is moving with the body relatively in toward or away direction from the center of rotation.
Therefore, the (direct or indirect) measurement of the Coriolis force exerted by the flowing fluid in a rotating tube can provide a measurement of mass flow rate.

A more extensive report on this meter is done in the standard ISO 10790 (Table V).

3. Gas Chromatographs

The main feature of a gas chromatograph is the sample injection chamber, the chromatographic column and the detector. The carrier gas is contained in metal cylinders and is provided to the device with one or more pressure regulators. The carrier gas carry the components of the sample into the column, where they are separated one after the other and they are passing through the detector, which sends a signal to a recorder. The column, the sample injection system and the detector are inside a heated chamber of constant temperature. Extensive reference to the carrier gas, the injection of the sample, the chromatographic columns, the filling material, the detectors, the qualitative and quantitative analysis and the normalization of the results is done in the standard ISO 6974 (Table V).

ANNEX 5

CALIBRATION STANDARD INSTRUMENTS

1 *Static Pressure- tester with standard masses (Deadweight tester)*

The basic test device for pressure is the tester with standard masses (Deadweight tester).

The operating principle of a device used to produce a calibrated reference pressure is as follows: A piston with precisely known base surface is positioned within the cylinder. Then known standard masses are placed above the piston. Pump supplies oil with sufficient pressure to lift the standard masses. The force exerted by the pressure of oil on surface of the piston is balanced by the weight of standard masses.

2 *Differential Pressure- Standard masses tester with dual piston function.*

The standards masses testers with dual piston are used to calibrate differential pressure transmitters in the static pressure. The device primarily applies a common static pressure at the ends of low and high pressure of differential pressure transmitter. After, the end of low pressure is isolated, and the end of high pressure is calibrated sequentially to the desired differential pressure range.

3 *Pneumatic dead weight tester, of differential pressure, ball type (AMETEK)*

The test devices of standard masses with ball function are used for calibrating of differential pressure transmitters to atmospheric pressure. The end of low pressure transmitter is at atmospheric pressure, and the end of the high-pressure is calibrated sequentially to the desired differential pressure range.

4 *Static Pressure- Gas Pressure Controller (GPC) type pressure standard*

The GPC is an automatic pneumatic controller and pressure calibrator.

The pressure measurement is achieved by a triple-range quartz pressure sensor, with accuracy of + / - 0.005% of each measurement range.

5 *High Precision (PHP 602) type Standard thermometer*

The PHP 602 is a high precision standard instrument of temperature measurement. It is connected and operated, through PC. Appropriate software processes the measurements, calibrates the temperature sensors and issues relative reference.

Its main applications are as follows:

- Temperature measurements using RTDs sensors.
- Bath temperature stability check.

6 *Communicator device- Hart communicator*

The pressure (static, differential) or temperature transmitter setting and level of communication, is done using a communication device, called HART Communicator (Highway Addressable Remote Transducer). This device is not a measurement device and does not require calibration. It is an electronic communication device, through which disclosure and regulation of the operation data of the pressure or temperature transmitter is feasible. All output parameters shown in this device is data of transmitter to which the communicator device is connected.
The most important operating parameters of this and of measurement generally can be visualized and be managed, as for example:

1. Actual entry parameter (process value pressure / temperature)
2. Actual analog output (4-20 mA)
3. Low range value of measurement instrument
4. High range value of measurement instrument.

LNG FACILITY MEASUREMENTS REGULATION

1. Objective of the LNG Facility Measurements Regulation

The LNG Facility is one of the three N.G. Entry Points into the NNGTS and receives liquefied N.G. by transportation vessels. The liquefied N.G. is temporarily stored, re-gasified and injected into the NNGTS.

The LNG Facility Measurements Regulation is to present:

- The measurement and analysis equipment
- The procedures and conditions applicable to the LNG Facility for calculating the quantities of N.G. energy received from LNG vessels and the quantities of N.G. energy managed temporarily by the LNG Facility
- The regular tests and the calibration equipment of the measurement and analysis systems applied by the Operator
- The international standards on which the calculations, measurements and analyses are based

2. Measurement and qualitative analysis equipment of the LNG Facility

The measurement and qualitative analysis equipment of the LNG Facility includes all the measurement and analysis instruments that concern the following:

A. The quality of injected LNG from the transportation vessel to the Facility. The vessel's metering equipment is used for calculating the volume of the injected LNG.

B. The quantity and quality of the stored LNG into the LNG Facility's tanks, the quantity and quality of the re-liquefied gas. A detail description of the instruments' type of the measurement and qualitative analysis equipment is in Annex 2 of this Regulation.

3. Procedures and methods for testing and calibrating the measurement and qualitative analysis equipment in the LNG Facility

The measurement and qualitative analysis equipment is submitted both in functionality and accuracy tests.

The functionality and accuracy tests are all those tests that the Operator's personnel carries out at regular intervals and after damage or suspected damage of the instrument or equipment for the satisfactory operation of the measurement and qualitative analysis equipment of the LNG Facility.

A test procedure includes both the accuracy test of the measurement equipment and its adjustment compared with reference standard equipment (working standard) used by the Operator, which is called calibration equipment and is registered in the table below.

The frequency of calibrations performed by the Operator's personnel is determined by the Operator's Annual Calibration Schedule and for each calibrated instrument a calibration form is issued.

The re-calibration frequency of the measurement equipment, when required to be done in specific metrological laboratories in Greece or abroad, is carried out in accordance with the following table and a relative Calibration certificate is issued.

In the table below and in Annex 3 of this Regulation the main standard instruments (working standards) in general and in particular those that are used for the calibration of the LNG Facility's measurement equipment are analyzed.

Calibration equipment

s/n	Values for calibration	Working Devices (Standards)	Accuracy (Indicative)	Usage	Frequency of Inspection	Inspection Certificate
1	STATIC, DIFFERENTIAL, ABSOLUTE PRESSURE	Gauge of standard masses with double piston	± 0,015%	Differential and Static Pressure Generation	Year	Certificate of accredited laboratory or national metrological institute
2		Pressure Calibrator DPI 610 (IS)	± 0,025%	Pressure Indication	Year	Certificate of accredited laboratory or national metrological institute
3	TEMPERATURE	Multi Calibrator TRX-IS	± 0,025%	Temperature Indication	Year	Certificate of accredited laboratory or national metrological institute
4	-	Communication Device - Brain Communicator		Digital communication with Static Pressure, Differential Pressure, Temperature Transmitters	Year	Certificate of accredited laboratory or national metrological institute
5	GROSS CALORIFIC VALUE - GAS COMPOSITION	Standard Gas	± 0,025% (GCV)	Standard Gas Mixture for Gas Chromatograph Calibration	Year	Certificate of accredited laboratory or national metrological institute

4. Intervention procedures in measurement equipment and terms for dispute resolution

4.1 Operator's responsibilities

The Operator is responsible for the supply, installation, maintenance, replacement in case of failure, testing and proper functioning of the instruments and measurement and analysis equipment that are necessary for carrying out measurement in the LNG Terminal.

Each instrument or part of the measurement equipment is submitted to prescribe tests of accuracy and functionality, as defined in paragraph 3 of this Regulation. The frequency with which the Operator carries out tests on the calibration equipment is indicated in the table above. The Operator after the scheduled accuracy test and the calibration of the instrument or the part of the measurement equipment issues the corresponding testing and calibration form.

The Operator may request and check for any measurement equipment of the transportation vessel its calibration certificates, which should be in force during the vessel unloading at the Operator's LNG Facility.

4.2 User access to measurement equipment

The User may demand, when necessary, the calibration and test forms of the instruments or the parts of the measurement qualitative analysis equipment, conducted by the Operator. The Operator shall notify the User with these forms.

The User has the right to be present during the test of the measurement equipment provided that he requests that by written request at least five (5) days before his desired date of visit. In his application, the User must indicate the date he wishes to make the visit, the estimated duration of the visit, the number of visitors, and the reason for requesting the visit. The Operator may refuse the User's request if it has causes, which make impossible the visit at the date that requested by the User. In this case, and in consultation with the User the Operator provides a new visit date.

The visit of the User and / or its representatives shall be under the supervision and guidance of qualified personnel of the LNG station. The User shall take all necessary measures to prevent damage to the equipment and comply with guidelines and recommendations of the Operator's personnel.

The User is solely responsible for its personnel and / or its representatives who participate in the visit, and must conform to the suggestions and comments that the Operator's personnel at the LNG Facility impose in accordance with the safety rules of the LNG Facility.

The User shall in no case have the right to intervene in the measurement equipment in any way. The User can report to the Operator comments related to the testing and calibration procedure of the measurement equipment or request the recalibration of the measurement or qualitative analysis equipment. The Operator shall examine and reply to the User's comments and re-test the measurement equipment if appropriate.

4.3 Lack of reliable measurements

In case of partial failure to provide reliable measurements or where occasional downtime operation of the measurement or analysis equipment in the Operator's LNG Facility or in the LNG transportation vessel during the LNG cargoes injection, the Operator and the User may proceed, after consultation, in the estimation of the unreliable measurements.

4.4 Dispute resolution

In case of disputes arising in measurement issues, the Operator and the User must make any effort to amicably settle disputes in accordance with the provisions of this Measurements Regulation for each measurement related to the LNG cargoes injection or the measurements related to the stocks calculation.
If the dispute settlement process is not completed within thirty (30) days after the call for amicable settlement, then the Operator and the User may agree to refer their disputes to resolve issues that arise in measurements to an expert consensus.

5. Measurements and calculations Forms

5.1 Measurement Forms of the LNG injected and LNG quantity license

The measurement forms of the injected LNG issued by the transportation vessel before and after LNG injection, co-signed by the captain of the vessel, the representative of the User and Operator and must include the following data:

- The name of the vessel
- The name of the LNG facility in which the unloaded took place
- The number of the LNG cargo
- The Day of LNG Discharge
- Data on the vessel's position when taking measurements, the temperature (of liquid, of gas) and pressure at all of the vessel's tanks.
- The level of the tank with millimeter accuracy
- The volume of LNG in each tank in cubic meter to three decimal places accuracy.

The quantity certificate of LNG issued by transportation vessel after the end of LNG injection, signed by the captain of the vessel, the representative of the User and the Operator and must include the following data:

- The name of the vessel
- The name of the LNG facility in which the unloaded took place
- The number of the LNG Cargo
- The Day of LNG Discharge
- Data on the vessel’s position when taking measurements, the temperature (of liquid, of gas) and absolute pressure at all of the vessel’s tanks.
- The level of the tank before and after the injection with millimeter accuracy
- The volume of LNG in each tank before and after the injection in cubic meter to three decimal places.
- The volume of LNG in each tank before and after the injection in cubic meter to three decimal places.
- The injected volume of LNG in cubic meter to three decimal places.

5.2 Supply form of LNG cargo

The supply form of LNG cargo issued by the Operator, after the discharge of transportation vessels in LNG facility, using the LNG injection forms that issued by transportation vessel and includes the following data:

- Measurement of tank’s level of transportation vessel before and after injection of LNG in meter to three decimal places.
- Measurement of Temperature (average temperature of the vessel tanks) at the liquid and vapour phase before and after injection (^oC).
- The pressure of vessel tanks (bara).
- The LNG volume of each tank of vessel (m^3).
- The composition and the quality characteristics of LNG injection
- The volume of injected LNG (m^3)
- The energy of injected LNG and of return gas (MWh).

5.3 Monthly energy stock form

The daily energy stock issued by Operator every Day D includes the following data:

- Initial and final energy stock in MWh which is stored in tanks of LNG facility
- The injected LNG energy by transportation vessel, in MWh.
- The injected energy of regasified LNG in the NNGTS, in MWh, as resulting from Ag. Triada Metering Station.

- At Annex 4 of this Regulation are listed the supply LNG cargo form and the Monthly energy stock form.

6. LNG Injection from transportation vessel to LNG facility

6.1 General

For the calculation of the injected LNG from a transportation vessel to the LNG Facility a series of measurements and analyses are made on the vessel and the LNG facility.

- The first set of measurements is done in the transportation vessel before starting the injection, i.e. before opening the valves in the liquid and gas phase between the transportation vessel and the LNG facility and after stopping the consumption of heating gas in the LNG transportation vessel.
- The second set of measurements is done in the transportation vessel after the injection, meaning the emptying of the arms, the shutting down of the valves and the stopping of the heating gas consumption in the LNG transportation vessel.
- For the two measurements, before and after the injection, two forms of measurements are issued by the LNG transportation vessel. The forms of measurements are supplied to the Operator of LNG facility.
- At the LNG Facility a sampling, analysis and calculation of the quality characteristics of the injected LNG is carried out.
- A form of analysis and qualitative characteristics of the injected LNG is issued by the LNG facility. This form of analysis of the injected LNG is delivered to the User.
- The process of measurement and calculation of the injected LNG energy is done as described in the LNG Custody Transfer Handbook, GIIGNL 2001, and 2nd Edition.

Operator or User during the injection of LNG by a transportation vessel to the LNG facility and the performance of measurements and analyses, may require the presence of an independent third party for inspection and certification of measurements and analyses and to issue the final certificate of injected LNG Energy. While conducting the measurements on the transportation vessel, a representative of the Operator may be present for the testimony of proper measurement, but his absence, in case he has been notified in time, in no case it should to delay or postpone the scheduled measurements performance. The User, upon request, may be present in the procedure of sampling and analysis in the LNG facility.
If during the LNG injection the Operator or the User has not request the presence of a third party in the performance of measurements and analyses, then the final form of LNG cargo supply is issued by the LNG facility.

6.2 Measurements made on the LNG transportation vessel

6.2.1 Volumetric tables and LNG tanks correction tables

The volumetric tables of the LNG transportation vessel tanks, correlate the level of the tanks with the respective volume of LNG contained therein and must be certified by an independent certification body, whose certificates should be valid for unloading LNG cargoes in the Operator's LNG facility.

In the area of level, where measurements are done before and after the unloading, the volumetric tables should give the relative volume content of LNG per millimetre (mm).

For the tanks of the transportation vessel there should be correction tables for the list, the trim of the vessel, the contraction of the vessel's tanks and other factors if needed. The accuracy of the volumetric tables and the correction tables should not exceed + / -0.2% in any case.

6.2.2 Tank Level Gauges

The LNG transportation vessel should have a main and an auxiliary level gauge, using a different measurement principle.

The type of instrumentations and their accuracy should follow all international standards, calibration certificates that should be valid during the unloading from the vessel to the Operator's LNG facility.

The accuracy of the tank level gauges should be as little as possible and no more than this that international standards impose for each type of level gauge (standards are listed below in the paragraph 8 of this Regulation). The level of measurement should be expressed in the form of measurement, in meters to three decimal places.

The LNG transportation vessel must be able to measure the tilt, trim and temperature of the LNG and any other factor that may affect the measurement of the tank level.

In a case of failure or suspicion of incorrect measurement of the main metering system of the transportation vessel, the auxiliary measuring equipment should be used, which should meet all the requirements of a reliable metering system.

In a case of failure of both systems of the level measurement, then historical data of unloading of the transportation vessel should be taken into consideration, if any, and the Operator and User agree to use them. In the absence of historical data, then the parties must reach an agreement considering the volume of the injected LNG.

6.2.3 LNG Temperature and gas measurement in the tanks of LNG transportation vessel

Each tank of a transportation vessel should have appropriate equipment for measuring the LNG temperature in both liquid and gas phase.

Temperature of injected LNG is considered the numeric average of the temperatures of all readings of thermo wells located submerged in the liquid in all tanks of transportation vessel prior to the injection start up.

Exhaust temperature is considered the numeric average of all readings of thermo wells located in the gas phase in each tank of LNG transportation vessel.

The temperature value should be expressed in degrees Celsius to two decimal places.

The required accuracy of the thermo wells should be + / -0.2 °C for a temperature range from-165 ^{o}C to -145 ^{o}C, and + / -1.5 for a temperature range from -145 ^{o}C to +40 ^{o}C.

In case of failure to measure the temperature, both parties should reach a common agreement on the temperature, taking into consideration the temperature measured at the loading port and historical data of the transportation vessel to the LNG facility from the same facility loading.

6.2.4 Measurement of tanks pressure of transportation vessel

Each tank of a transportation vessel should have appropriate equipment for measuring the pressure. The pressure measurement is needed to calculate the volume of the return gas; therefore it is essential that the pressure should be measured in absolute pressure. If the vessel's instruments measure the relative pressure, then the atmospheric pressure must be measured and recorded and added to the measurement of the relative pressure.

The numeric average of the pressure of all tanks of the vessel equals to the pressure of the vessel before and after injection. The pressure value should be expressed in a bar to three decimal places.

The required accuracy of pressure measuring instrument is + /-10mbar or + / -1% of the range of the instrument.

In case of failure to measure the pressure of the tank vessel, the two parties should reach a common agreement on the pressure, taking into consideration the pressure of tanks or other indication closer to the vessel (pressure indication of line gas) of LNG facility.

6.2.5 Volume Calculation of Injected LNG

The LNG volume calculation for the LNG in the tanks of the vessel before and after the injection derives from the measurement of the level, the use of volume calculated tables and the correction tables.

The volume calculation of the injected LNG is determined by the difference in the LNG volumes of the transportation vessel that were calculated by the measurements before and after the injection of LNG. The volume of injected LNG should be expressed in cubic meters to three decimal places.

6.3 Sampling and analyses performed in the LNG facility during the LNG injection

6.3.1 Sampling of the injected LNG and the return gas

During the Injection of LNG from a transportation vessel to the LNG facility vapour LNG samples are collected, which are gasified in an appropriate sampling unit, per hour (except the first and last hour of Injection, where the rate of Injection is not constant). The gas sample is collected in sampling cylinders and transported to the laboratory where the analysis takes place. This type of sampling is called discontinuous sampling.

Detailed description of the sampling unit is described in Annex 2 of this Regulation.

During the LNG injection and regardless of the specified sampling, three additional samples are taken after the completion of 25%, 50%, 75% of total LNG injection. Sampling cylinders of the three samples are stored in the LNG facility for a period of 20 days. If within 20 days after the ending of unloading any dispute arises between the User and the Operator for the quality of the LNG injection, then the three samples can be sent for analysis to a commonly accepted laboratory for further clarification of the quality of the gas injected from the transportation vessel to the Operator's LNG Facility.

During the LNG injection from the transportation vessel to LNG facility, a sampling of the return gas also takes place to dedicated sampling unit. The gas samples are collected in sampling cylinders and transported to the laboratory where their analysis takes place. Two return gas samples, the last two hours of the LNG injection, before reducing the injection rate, are sufficient to determine its composition.

6.3.2 Gas Analysis

The samples of the gasified LNG and the return gas to the LNG transportation vessel are analyzed using the technique of gas chromatography.

Before each LNG unloading, the Operator should perform a calibration of the gas chromatograph, which will be used for the analysis of the injected LNG, using the appropriate calibration gas. The results of the calibration are stored and are available to the User of the LNG Facility upon request.

Selection of the proper calibration gas is done according to the ISO 6974.

The components of the gas are defined as follows:

- Methane C_1
- Ethane C_2
- Propane C_3
- Isobutane i-C_4
- Normal Butane n-C_4
- Isopentane i-C_5
- Normal Pentane n-C_5

• Nitrogen N_2

The percentage of each component, in the final composition of the injected LNG, is calculated as the average of all percentages for each component of all analyzed samples.

6.3.3 Injected LNG Density Calculation

The density calculation is done using the revised method KLOSEK-McKINLEY described in NBS 1030, December 1980. To implement this method requires:

- The average LNG temperature in the tanks of the transportation vessel before the injection, as indicated in the form of measurement.
- The composition of the Injected LNG as resulted from the analysis of samples in the LNG facility.

The accuracy of the method is ± 0.1%, when the nitrogen or butane content shall not exceed 5% of the LNG composition. Density calculation is done by using an electronic spreadsheet or software program for calculation.

The method is applied within the following limits of composition and temperature:

CH_4	$>$	60% mol
$iC_4 + nC_4$	$<$	4%
$iC_5 + nC_5$	$<$	2%
N_2	$<$	4%
T	$<$	115 K

6.3.4 Injected LNG and return gas quality characteristics calculation.

From the final composition of the Injected LNG and the return gas at the transportation vessel calculations are made for the physicochemical parameters, in accordance with ISO 6976:

- The gas compressibility factor
- Molecular weight
- The Gross and Net calorific value of gas
- The density of gas in normal conditions
- The relative density of the gas
- Wobbe Index

In case of total failure of the LNG facility to take the LNG samples and do the analysis, then the parties should come to mutual agreement as for the quality of the Injected LNG. If the Operator and the User agree, they may use historical data for unloading from the same source of LNG cargoes to the Operator's Facility, or by historical data kept by the vessel from other unloading at other LNG facilities, but from the same port of loading and approximately the same travel dates.

6.3.5 Return Gas Energy Calculation

The Return Gas energy is determined by the following formula:

$$E_{\text{return gas}} = V_{LNG}\, x \frac{273.15}{273.15+T}\, x \frac{P}{1.01325}\, x\, \text{GCVreturn gas}$$

Where:

$E_{\text{return gas}}$: the energy that returns to the vessel via the return gas, in MWh.

V_{LNG}: injected LNG volume expressed in m^3 as indicated by the forms of measurement before and after the injection.

P: the average pressure of the tanks of the transportation vessel expressed in bara.

T: the average temperature of the gas in all tanks of the transportation vessel expressed in Celsius degrees (^oC).

$GCV_{\text{return gas}}$: the gross calorific value of the return gas, replacing the quantity of the injected LNG in KWh/Nm^3.

6.3.6 Injected LNG Energy Calculation.

Injected LNG Energy E_{LNG}, from the transportation vessel that is stored in the LNG facility is estimated at LNG receiving port using the following formula:

$E_{LNG} = V_{LNG}$ x D_{LNG} x GCV_{LNG}- $E_{\text{return gas}}$

E_{LNG} : in MWh.

V_{LNG} : Injected LNG volume in m^3, as indicated by the forms of measurement before and after injection of LNG.

D_{LNG}: Injected LNG density in kg/m^3.

GCV_{LNG}: the gross calorific value of the injected LNG in MJ / Kg (a conversion factor is used, determined by the GIIGNL).

$E_{\text{return gas}}$: the energy in MWh, of return gas from the LNG facility to the transportation vessel.

7. Measurements, analyses and calculations made in LNG facility

For the measurement and calculation of daily energy stocks, of the LNG quantities that were re-gasified and injected in NNGTS and the losses in the LNG facility, the Operator records all necessary measurements, each day at 08:00 am.

The details for the measurements systems of the Operator's LNG facility are described in Annex 2 of this Regulation.

7.1 Volumetric Tables of LNG tanks

The volumetric tables of LNG tanks at the LNG Facility are numeric tables, which correlate each millimeter of the tank level to the relative LNG stored volume in litters to two decimal places. For the calculations of LNG facility the volume is expressed in meters to three decimal places. The tank capacity was calculated using the ISO7507-1 and certified under the ISO7507-3.

7.2 LNG tanks level measurement

At each LNG tank of the LNG Facility there are two systems of level measurement (one of them is the back-up), and the indication of the level of the tanks is always displayed on the screens of the control system of LNG facilities. The measurement of the LNG tank levels is expressed in meters to three decimal places.

7.3 Calculation of stored LNG volume

For the calculation of each day's stored LNG volume the LNG tanks level measurement is used (at 8:00a.m. day D) combined with the volumetric tables of the tanks.

7.4 Measurement of the temperature of the stored LNG and gases (boil off) in the LNG tanks

Each LNG tank in the LNG Facility is equipped with thermo wells for continuous indication of the temperature of the LNG on the control system screens of the LNG facility. As the temperature of the LNG, the average of the thermo wells that are submerged in the LNG is considered.

Furthermore each tank is equipped with thermo wells for the gas temperature measurement in the LNG tanks and for the continuous indication of gas temperature on the control system screen of the LNG facility.

The value of temperature in both cases is expressed in Celsius degrees to one decimal place.

7.5 LNG tanks pressure measurement

Each tank is equipped with pressure measurement instruments (relative and absolute) and continuous indication on the control system screens of the LNG facility.

The value of pressure is expressed in bar to three decimal places.

7.6 Measurement of the re-liquefied gases

The gas volume per hour in the LNG tanks of the LNG facilities, which led to re-liquefaction, is converted to volume at normal conditions by the control system of the facility by taking the gas temperature and pressure. The volume is measured continuously and is transferred to the control system screens and to measurement totalisers of the total re-liquefied gas volume during a day.

7.7 Sampling, Analysis and calculations in the LNG Facility

The following samples are taken an analyzed daily (except on holidays) in the LNG Facility:

- The LNG that is treated each day from the tanks (treated LNG)
- Gases from the tanks of the Facility that are led to re-liquefaction
- The injected N.G. in the NNGTS in a case of failure/breakdown/maintenance of the chromatographs of the metering station at Agia Triada

For sampling of each of above samples, there are different sampling units in the LNG Facility. Above fluids are under different pressure, temperature conditions and their composition is altered due to processes taking place in the LNG Facility.

All samples are analyzed using the technique of gas chromatography. The components of the gas are determined as follows:

- Methane C_1
- Ethane C_2
- Propane C_3
- Iso butane i-C_4
- Normal Butane n-C_4
- Iso pentane i-C_5
- Normal Pentane n-C_5
- Nitrogen N_2

For each sample, calculations are made for its quality characteristics in accordance with ISO 6976:

- Gas Compressibility Factor
- Molecular Weight
- Gas Gross and Net Calorific Value
- Gas density in normal conditions
- Gas relative density
- Wobbe Index

The LNG density, daily treated in the LNG Facility, is calculated using the average temperature of the LNG tank that is used, and the revised KLOSEK-McKINLEY method described in NBS 1030, December 1980.

In case of a failure to take samples and analyze them in the LNG Facility during a day D, then the daily stocks are calculated using the previous day analyses, as it occurs during public holidays.

7.8 Calculation of LNG volume that is treated in a day D (Treated LNG)

The treated LNG in m^3 derives from the difference of the LNG volume at 8:00 a.m. in the day D-1 and at 8:00 a.m. in the day D.

Treated LNG in m^3 (day D) = LNG volume in m^3 (day D-1) – LNG volume in m^3 (day D) + Total volume of injected LNG in m^3 (day D).

7.9 Calculation of stored N.G. energy (energy stock)

For the calculation of the stored N.G. energy of each day D (energy stock), in the LNG tanks of the LNG Facility, the following formula is used:

Energy Stock (day D) = Energy Stock (day D-1) – Treated LNG Energy + Injected LNG Energy (day D)

Where:

Energy Stock day D / D-1, in MWh, is the energy quantity that is stored in the tanks of the LNG Facility the day D / D-1.

Injected LNG Energy (day D), in MWh, is the energy that was injected from a transportation vessel to the LNG Facility during the day D.

Treated LNG Energy, in MWh, is the energy that corresponds to the LNG volume that was treated in the LNG Facility during the day D.

The treated LNG corresponds to either the LNG that was gasified in the tanks via normal evaporation or the LNG that was pumped from the tanks. For the calculation of the treated LNG energy both phases are taken into consideration because they have different calorific value.

7.10 Calculation of the injected N.G. to the NNGTS

The quantity of the injected N.G. to the NNGTS is measured and corrected at the metering station of Agia Triada, which is an Entry Point to the NNGTS. Furthermore, for the calculation of the energy of the gas quantity that is injected to the network, a calculation for the calorific value is done at the chromatograph of Agia Triada Metering Station. The energy of the injected N.G. to the NNGTS from the LNG Facility is measured in a daily basis from Agia Triada metering station and is used to the calculations of the energy balance of the LNG Facility.

7.11 LNG Facility losses

As LNG Facility Total Loss in MWh, during a period, is defined the difference between the sum of the LNG Cargoes (in MWh) that were injected in the LNG Facility during the same period and the Quantities that were re-gasified and injected in MWh to the NNGTS from the LNG Facility during the same period, as they are measured in the NNGTS LNG Entry Point, increased to the difference between the N.G. quantities in MWh that were stored at LNG facility at starting and ending of the same period.

All the above values are expressed in energy units (MWh).

8. Measurements Standards, qualitative analysis and calculations

The Measurements Standards, qualitative analysis and calculations which are valid at the LNG facility for**:**

- The methodology for determining the qualitative and quantitative analysis of Natural gas.
- The type of instrument and the accuracy required for LNG tanks level measurement.
- The methodology of LNG density calculation
- The measurements methodology and the required calculations for quantification of LNG injection from transportation vessel
- The methodology used for required tests of each item of measurement equipment and analysis are listed in the table below

Measurement of LNG injected volume	**G.I.I.G.N.L.**	LNG Custody Transfer Handbook.
	ISO 13689	Refrigerated light hydrocarbon fluids -- Measurement of liquid levels in tanks containing liquefied gases -- Microwave-type level gauge.
	ISO 10574	Refrigerated light-hydrocarbon fluids; measurement of liquid levels in tanks containing liquefied gases; float-type level gauges.
	ISO 13398	Refrigerated light hydrocarbon fluids -- Liquefied natural gas -- Procedure for custody transfer on board vessel.
	ISO 8309	Refrigerated light hydrocarbon fluids -- Measurement of liquid levels in tanks containing liquefied gases -- Electrical capacitance gauges.
LNG Sampling	**ISO 8943**	Refrigerated light hydrocarbon fluids -- Sampling of liquefied natural gas - Continuous method.
	EN 12838	Installations and equipment for liquefied natural gas. Suitability testing of LNG sampling systems.
Analysis / Gas Quality	**ISO 6976**	Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition.
	ISO 12213	Natural gas – Calculation of Compression Factor.
	ISO 6974	Determination of composition with defined uncertainty by gas chromatography.
	ISO 6141	Gas analysis - Requirements for certificates for calibration gases and gas mixtures
	ISO 6142	Gas analysis – Preparation of calibration gas mixtures – Gravimetric method.
	ISO 6143	Gas analysis – Comparison methods for determining and checking the calibration gas mixtures' composition.
	NBS 1030, DEC. 2001	Revised KMK method for calculation of LNG Density.

Note: The Standards are referred to currently in force publications and may be revised or supplemented by the issuing international organizations.

ANNEX 1

GENERAL DESCRIPTION OF LNG FACILITY

1. General Description of LNG facility

The Revythoussa LNG facility performs the procedures of:

α) LNG injection by transportation vessel, b) LNG store quantities, c) re-liquefied gases which derive from natural evaporation of the LNG tanks, d) LNG pumping and re-gasification , e) Natural Gas injection at NNGTS.

For the LNG injection from the transportation vessels to storage tanks of the LNG facility there is an adequate system of arms and injection lines. The system of arms consists of 3 arms LNG injection LNG Z3101A/B/C and a returning gas arm to transportation vessel Z3102

For LNG storage at LNG facility there are two storage tanks with total capacity of 130.000 m^3. The LNG is stored at a temperature of about-160 ^oC and at about atmospheric pressure.

In these conditions gases (mostly methane and nitrogen) are generated in the LNG Storage Tanks by natural evaporation of LNG. To maintain the pressure in the tanks at low levels in the LNG facility a system of removal and recovery of gases from the tanks is predicted. This system consists of the compressor and gas re-liquefier.

The pumping and gasification system of the stored LNG consists of J3201A/B/C/D/E/F/G/H low pressure pumps that are submerged into the storage tanks and lead the pumped LNG to the re-liquefier or directly to the high pressure pumps. The re-liquefier is functioning as suction vessel of J3101A/B, J3102A/B and J3103A/B high pressure pumps as well. The high pressure pumps raise the LNG pressure to the NNGTS operating pressure and send it to the gasifiers for gasification.

The gasifiers (M-3101 A/B/C and M-3102 A/B/C/D) are installations for transferring the necessary heat to the LNG, so as to be gasified and additional to heat the produced N.G. to at least 3^0C before its entry to the transportation network.

The LNG facility is linked to the NNGTS via 2 underwater pipes with a diameter of 20" each, and a length of 510m and 620m respectively, to Agia Triada, which is the Entry Point to the NNGTS.

In the LNG Facility there is a 13MWe Power and Heat Plant, using N.G. The N.G. that supplies the plant comes from the gasified LNG of the LNG Facility.

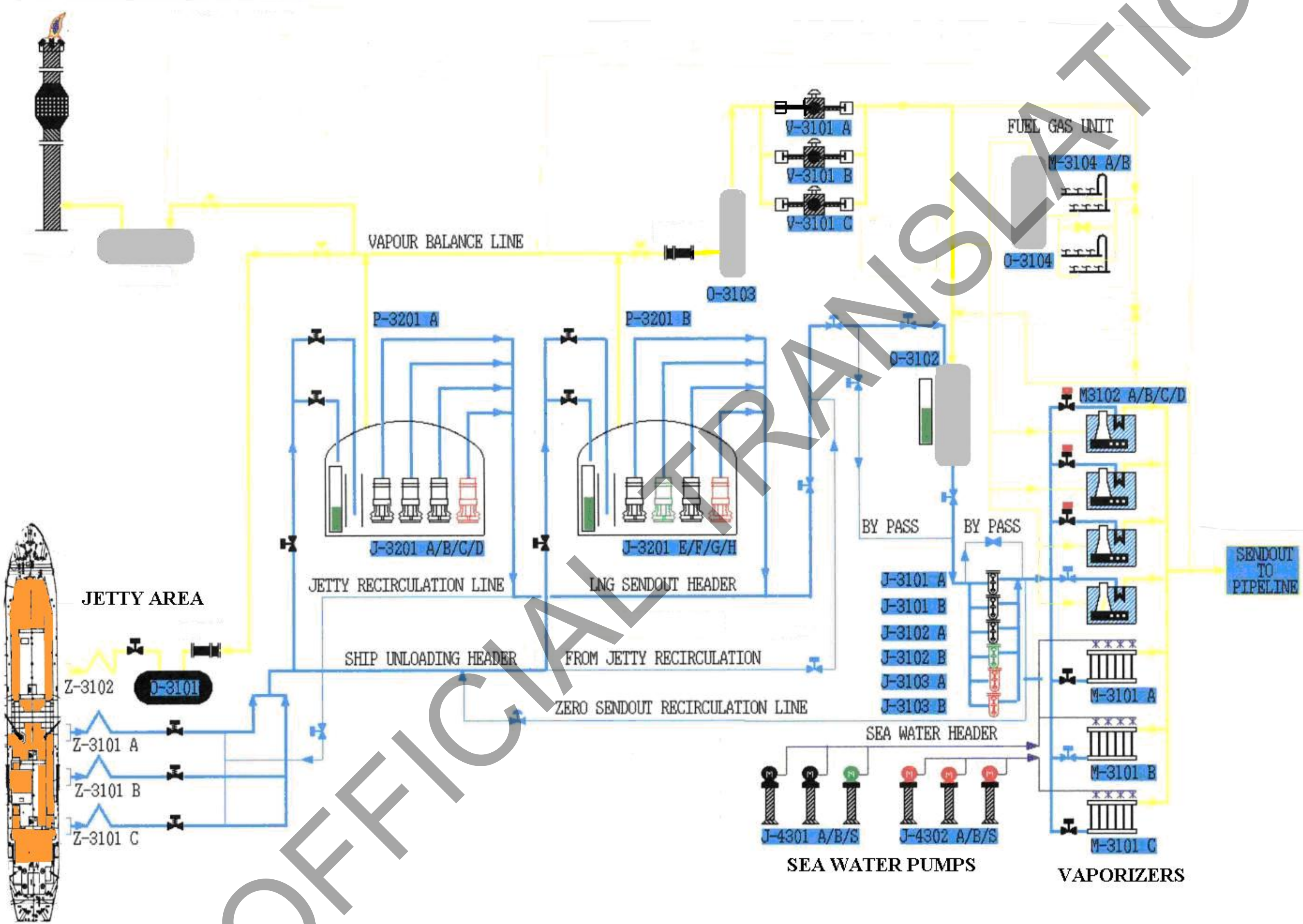
LNG Facility Capacity		
LNG Injection from transportation vessel		**7,250 m^3/h**
Gasification	Stable Rate (SMSR)	**1,000 m^3/h**
	Peak Rate (PEAK)	**1,250 m^3/h**

The basic equipment of the LNG facility is listed in the following table.

LNG Facility Basic equipment		
Description	**Symbol**	**Capacity per equipment**
Low pressure pumps	J3201A/B/C/D/E/F/G/H	**200 m^3 LNG/h**
High pressure Pumps	J3101A/B	**120 m^3 LNG/h**
	J3102A/B	**220 m^3 LNG/h**
	J3103A/B	**300 m^3 LNG/h**
Gasifiers		
Sea water heating equipment (ORV)	M-3101 A/B	**125 m^3 LNG/h**
	M-3101 C	**375 m^3 LNG/h**
Water bath heated by the N.G. burn exhausted gases (SCV)	M-3102 A/B	**125 m^3 LNG/h**
	M-3102 A/B	**190 m^3 LNG/h**
Sea water pumps	J 4101A/B/S	**2050 m^3 /h**
	J4102 A/B/S	**3050 m^3 /h**

A simplified diagram of the processes that are taking place in the LNG facility is shown below.

SIMPLIFIED LNG FACILITY DIAGRAM



All the measurement instruments and quality analysis are listed in the table below.

Tank P-3201 A	**Instrument Name**	**Unit**	**Accuracy**
Level	LI 32010 /LI 32014	m	±1mm
Gases temperature	TI 32036	°C	±0.1% (-200/+65°C)
Absolute Pressure	PI/PT 32022	mbara	±0.1% (800-1600mbar)
Thermo wells	RTD32034, 32006	°C	±0.2% (-162/-120)
Tank P-3201 B			
Level	LI 32110/ LI 32114	m	±1mm
Gases temperature	TI/TT 32136	°C	±0.1% (-200/+65°C)
Absolute Pressure	PI/PT 32122	mbara	±0.1% (800-1600mbar)
Thermo wells	RTD32134, 32106	°C	±0.2% (-162/-120°C)
Re-liquefaction			
Flow	FI/FQI31302	Nm^3	±0.1% (0-625mmH_2O)
Temperature	TI/TT31302	°C	±0.2%(-170/+100°C)
Pressure	PI/PT31303	bar	±0.1%(0-10mbar)
Gas Quality			
Gas Chromatography	ABB NGC 8206	GCV	0.077MJ/Nm^3

ANNEX 2

INSTRUMENTS OF MEASUREMENT AND SAMPLING EQUIPMENT AT LNG FACILITY

1. LNG tank level meter

In each tank of Operator's LNG facility there are two level measurement systems of the same type.The sensor of level meter in the tanks is a capacitive bridge. The imbalance of capacitive bridge (sensor) due to changes in fluid level, leads to the sensor movement. The sensor remains always on the surface of the liquid and follows the fluid level changes. The sensor is connected via cryogenic film of special type with the level measurement system. At every level change and sensor movement, the film is wrapped / folded into a drum at which a potentiometer system with known resistance is adapted, corresponding to the level of tanks. The potentiometer's measurement (level measurement), is transferred to electronic card (level transmitter) and transmitted through the communication protocol to the LNG facility control system.

The tanks' level accuracy is ± 1 mm.

In order to calibrate them, a reference level is used for each tank. The reference level is the highest point of the tank with the cryogenic film completely wrapped.

2. Temperature measurement

The temperature measurement is performed by using electrical resistance thermometers (RTD-Resistant Temperature Detector) operated with a measurable change of metal or semiconductor resistance (Thermistor) as a function of temperature. The metal is platinum and the semiconductor is metal oxide.

The electrical resistance of the RTD changes as a function of temperature. An electrical circuit, similar to a Wheatstone bridge, is installed in control systems that are designed for resistance instruments (RTD) usage. A continuous current of the bridge produces an output voltage which varies with temperature.

3. Temperature transmitters

The temperature transmitters are used to transmit the measurement to the LNG facility control center.

The basic operating principle of a transmitter is to convert the temperature into an electrical signal from 4 mA to 20 mA, and transmit it to the final recipient, who receives this electrical signal and converts it into a temperature reading. The calibration of the transmitter is based on the above scale.

The measurement accuracy is ± 0, 2% of the instrument scale.

4. Pressure measurement

At the LNG facility, various instruments are used for pressure measurement either mechanically or digitally. The mechanical pressure measurement is based on the basic principle that the static pressure of a fluid or a gas causes a mechanical change of a component or part of the measurement equipment.

This change is converted to a measurement upon a calibrated pressure scale by a mechanical indicator. The digitally pressure measurement is based on the fact that measurement instruments convert primary value through an electronic process to an electronic indication on a display screen. These instruments can be designed with great accuracy, always on the application intended.

5. Transmitters of relative, differential, absolute pressure

The technology of piezoresistive silicon sensor is used for signal transmission of pressure measurement (relative, differential and absolute) used in the measurement protocols of LNG facility.

The piezoresistive silicon sensor of calibration instrument converts the applied pressure to frequency. Any change in pressure applied to the sensor changes the frequency in proportion to this pressure. This change in frequency is obtained from a transmitter (microchip) and converts the pressure into an electrical signal of 4-20mA.

The accuracy of such a transmitter is 0.1% of the maximum scale.

6. Flow meters

Flow measurement in LNG facility concerned the measurement protocols takes place only in the measurement of gas to re-liquefaction. To measure the gas used to re-liquefaction an orifice type volume flow meter is used. At orifice meters pressure drop caused by changing the diameter of the flow pipeline and increase of the velocity of the fluid. By determining the pressure drop, determination of volume flow is done. The rate of fluid flow is proportional to the square root of pressure drop. For signal transmission and recording to the control system, transmitters are used similar to that used for signal transmission of the differential pressure mentioned above. In the central control system (DCS) the volume is converting to volume at N.C. (0 ° C, 1 atm) using the actual pressure and temperature of gases to re-liquefaction. At above flow meter, a volume flow totalizer is used for recording the total volume of gas to re-liquefaction during the day.

7. LNG and NG Sampling Units

The main parts of LNG sampling unit are:

- LNG sample nozzle collector.

- the gasifier for the LNG gasification. The used gasifier is water bath with electrical resistance type. The temperature of the bath should remain stable as long as the sampling is taken place.

- the measurement instruments of pressure and flow of the gasified sample

- the structure of pipe for cleaning the unit

- sampling cylinders, with stainless steel material.

For sampling is necessary to be made specific steps so that the LNG injected to be converted from its original state, liquid at low temperature, to the final state gas at ambient temperature without partial gasification or loss of product. The sampling unit is equipped with pressure, temperature and flow gauges. The sampling unit needed for receiving LNG vaporized samples, treated by the tanks each day (LNG-treated), is similar to the sampling unit for sampling gasified LNG, during the LNG injection as described above.

The sampling units used to sample

- Gases from tanks Facilities led to re-liquefaction

- Injected NG in NNGTS, in case that metering station of Ag. Triada is not operating

are simple devices of valves and fittings since these samples are in the gas phase and is not required gasification.

At the sampling unit for sampling boil off from tanks, because they are at low-pressure, a pump is used to increase the pressure to obtain the sample.

ANNEX3

CALIBRATION STANDARD INSTRUMENTS

1. Static pressure-tester with standard masses (Deadweight tester)

The basic test instrument for pressure is the tester with standard masses (Deadweight tester).

The operating principle of a device used to produce a calibrated reference pressure is as follows: A piston with precisely known surface base positioned within the cylinder. Then known standard masses are placed above the piston. Pump supplies oil with sufficient pressure to lift the standard masses. The force exerted by the pressure of oil on the surface of the piston is balanced by the weight of standard masses.

2. Pressure calibrator DPI 610 (IS)

Digital pressure instrument with silicon sensor of high accuracy (0.025% of maximum scale).

Used for calibration of pressure transmitters and calibration of field pressure transmitters.

The construction is IS (Intrinsically Safe) and is to operate in dangerous - explosive environment.

3. Multi calibrator TRX-IS

It is an instrument for measuring and simulating temperature with accuracy of 0.025%. It is used for calibration of temperature transmitters RTD and thermocouple type.

Its construction is IS (Intrinsically safe) and is used to operate in dangerous - explosive environment.

4. **Brain communicator**

The setting and level of communication of pressure transmitter (static, differential) is done using a communication device, called Brain Terminal BT 200 Communicator.

This device is not a measurement device and does not require calibration. It is an electronic communication device through which feasible disclosure and regulation of the operation data of the pressure transmitter.

All output variables shown by this device is a transmitter data to which the communication device is connected. The most important operating parameters of this and generally of the measurement can be shown and managed, as for example:

- Actual entry parameter (process value - pressure)
- Actual analogue output (4-20mA)
- Low range value of measurement instrument
- High range value of measurement instrument

5. Calibration of Equipment for qualitative analysis (Chromatographs)

The calibration of chromatographs is performed by a standard gas (calibration gas) of similar composition to the sample gas. The calibration procedure includes sequential analyses of the standard gas so as to be checked:

• The response factors of each component in accordance with ISO 6974

• The composition of standard gas, repeatability - accuracy in accordance with ISO 6974.

ANNEX 4

FORMS

Off take LNG Load form

DESFA
Hellenic Gas Transmission System Operator

NATIONAL NATURAL GAS SYSTEM OPERATOR S.A.- REVYTHOUSSA LNG STATION

OFF TAKE LNG LOAD FORM

SHIP NAME		UNLOAD	START TIME	END TIM
SHIP ORIGIN		DATE		
LOAD NUMBER		HOUR		
TANK UNLOADING		TOTAL TIME		

BEFORE UNLOADING LNG VOLUME		AFTER UNLOADING LNG VOLUME	
SHIP TANK	VOLUME (m3)	SHIP TANK	VOLUME (m3)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
TOTAL VOLUME (m^3):		TOTAL VOLUME (m^3):	
LNG TEMPERATURE °C):		LNG TEMPERATURE °C):	
VAPOR TEMPERATURE(?C):		VAPOR TEMPERATURE °C):	
VAPOR PRESSURE (bar abs):		VAPOR PRESSURE (bar abs):	

LNG CHARACTERISTICS					RETURN GAS CHARACTERISTICS				
COMPOSITION (%mol)		PARAMETERS			COMPOSITION (%mol)		PARAMETERS		
NITROGEN:		Z			NITROGEN:		Z		
METHANE					METHANE				
ETHANE		MW			ETHANE		MW		
PROPANE					PROPANE				
I-BUTANE:		GCV (Hm) *		MJ/kg	Ii-BUTANE		GCV (Hm) *		MJ/kg
N-BUTANE:					N-BUTANE:				
I-PENTANE		GCV (Hv) *		*MJ/Nm^3	I-PENTANE		GCV (Hvap) *		MJ/Nm^3
N-PENTANE:					N-PENTANE				
TOTAL		GCV		Kcal/Nm^3	TOTAL		GCV		Kcal/Nm^3

LNG DENSITY (D), KMK NBS 1980		Kg/m^3

RESULTS

LNG UNLOADING VOLUME (V)			m^3
LNG UNLOADING ENERGY	$Q_D = V * D * Hm$		KWh
RETURN GAS ENERGY	$Q_V = V * 273,15 / (273,15+T)*P / 1,01325 * Hvap$		KWh
LNG DELIVERY ENERGY	$Q_{NET} = Q_D - Q_V$		KWh
			MMBTU
LNG DELIVERY VOLUME *LNG VOLUME QUANTITY RESPECTIVE TO LNG DELIVERY ENERGY (GIIGNL)*			Nm^3

**GCV CALCULATION (Hm, Hv) IS BASED ON ISO 6976 (0 °C & 1,01325 bar)*

THE LNG MANAGER

DESFA
Hellenic Gas Transmission System Operator

REVYTHOUSSA LNG FACILITY

MONTHLY ENERGY STOCK FORM

MONTH

DATE	INITIAL STOCK MWh	IMPORTS LNG MWh	EXPORTS NG MWh	TOTAL LOSSES MWh	FINAL STOCK MWh
TOTAL					