MONITORING REPORT OF JI PROJECT

"Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz"

Monitoring period:
01/01/2012-30/06/2012

Version 02
July 20, 2012

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Accompanying document 1[1]: Calculation of GHG emission reductions

Accompanying document 2: Types of metering equipment

[1] Accompanying documents 1, 2 are provided in electronic form

SECTION A. General project activity and monitoring information

A.1.Name of the project:

"Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz"

Sectoral scope:
Sector 1 - Energy industries (renewable/non-renewable sources)
Sector 10 - Fugitive emissions from fuels (solid, oil and gas)

A.2. Information about registration and approval of the project:

JI Project "Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz" was determined by Bureau Veritas Certification (Determination report # UKRAINE-det/0415/2011 dated 06/04/2012. The project obtained approval from Ukraine (Letter of Approval #1271/23/7 dated 17/05/2012, issued by the State Environmental Investment Agency of Ukraine). The project was also approved by the Federal Office for the Environment (FOEN) of Switzerland (Letter of Approval No. J294-0485 dated 14/05/2012).

A.3. Brief description of the project:

The main purpose of the Joint Implementation Project (hereinafter - JIP) entitled "Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz" is implementation of the program of technical improvement and re-equipment of the natural gas production, storage, preparation and transportation system, the introduction of advanced technologies, the transition to a higher level of transportation, measurement and storage of natural gas.

The base of the JIP is introduction of new energy efficient equipment and complex of measures aimed at reducing emissions from natural gas leaks in the elements of the natural gas production, storage, preparation and transportation system. Measures to be implemented under the project (see Section A.4.2 of the determined PDD) as well as the application and conduction of regular monitoring of potential sources of leaks, prevention from their occurrence can reduce the leaks at main equipment of "NJSC "Chornomornaftogaz" significantly.

A.4. Monitoring period:

- Date of commencement of the monitoring period: 01/01/2012
- Date of termination of the monitoring period: 30/06/2012

A.5. Methodology applied to the project:

A.5.1. Baseline methodology:

The proposed project applies a specific approach that is based on the approved Clean Development Mechanism methodology AM0023 "Leak detection and repair in gas production, processing,

transmission, storage and distribution systems and in refinery facilities"[2], Version 4.0.0 with clarification relating to the method of leak measurements as described in section B.1 of the PDD version 02.

A.5.2.Monitoring methodology:

The proposed project applies a JI specific approach based on the requirements to the Joint Implementation projects specified in paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring" (Version 03).

With the purpose of quantitative estimation and preparing reports on methane emission reductions based on the baseline and project activity a specific approach based on approved methodology AM0023 "Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities", Version 4.0.0 is used.

After the detection and measurement of methane leaks, monitoring program was developed for all gas equipment and shut-off and control valves, flanged and threaded joints of "NJSC "Chornomornaftogaz" gas pipelines. Implementation of this program is a part of the project activity. Monitoring covers both emissions from leak sources that occur again and control over gas facilities that were already repaired and where methane leaks were detected earlier.

According to the monitoring methodology, described in the determined PDD version 02, the following parameters and data that are used for calculation of achieved emission reductions are provided:

Data and parameters not monitored throughout the whole crediting period, but determined only once, which are available at the stage of PDD development:

i	Gas equipment sequence number of pipeline fittings and shut-off and control gas valves, flange and threaded connections, where methane leak, which was detected, repaired and then verified, was detected
Vbag	Volume of capacity, m^3

Data and parameters that are not monitored during the crediting period but are identified only once and are not available at the PDD development stage: none

Data and parameters that are monitored during the whole crediting period:

T_i	Number of operation hours of equipment where leak was detected during the year, h
$w_{sampleCH4,i,p}$	Concentration of methane in the sample, %
τ_i	Time within which the concentration of methane in the capacity reaches a certain level, h
t_i	Gas temperature, ^oC
P_i	Gas pressure, Pa
UR_i	Uncertainty range for the flow rate measurement method applied to physical leak, fraction
GWP_{CH4}	Global warming potential, t CO_2e/t CH_4

[2] http://cdm.unfccc.int/methodologies/DB/PZN9ZCTGF3KHFH0W21NY0NYL6X5CIR/view.html

A.6. Status of implementation including project milestones:

The Project activities in the current monitoring period (01/01/2012-30/06/2012) include further implementation of purposeful examination and technical maintenance (PETM) of all gas equipment and fittings that were underwent unscheduled repairs (replacements) in the JI project lifetime.

Gas equipment that was repaired in previous periods of project activity is inspected regularly as a part of standard monitoring program to ensure that it did not became a source of leaks again. There was not a leak, whose value would exceed the value obtained after repair of the relevant gas fittings or equipment. Details of measurements in accordance with Protocol № 13 meeting of the Working Group on JI "Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz" from 6/27/2012 stored electronically with the secretary of the Working Group.

Current repair of gas equipment in accordance with the monitoring plan as defined in the PDD, Version 02, is held once a year, maintenance - every six months.

A.7. Deviations from or change of registered PDD:

Comparison of GHG emission reductions in the monitoring period (01/01/2012-30/06/2012) and estimated amount of GHG emission reductions in the determined PDD version 02 is provided in table below.

Emount of GHG emission reductions in the monitoring period (01/01/2012-30/06/2012), t CO_2 e	Estimated amount of GHG emission reductions in the determined PDD version 02, t CO_2 e
790 733	815 587 – in 6 month period
	1 631 174 – in 12 month period

There is a discrepancy between the amount of emission reductions of the monitoring period (01/01/2012-30/06/2012) and the estimated amount of emission reductions in the determined PDD version 02. This discrepancy is less than 5%. This is due to:

1. To quantify GHG emission reductions values of earlier measurements at typical gas equipment and fittings were used;

2. The data used in the calculations of GHG emission reductions in the determined PDD version 02 were taken were taken by the projected development plan area as the sum of reporting monthly values for one year, i.e. 12 months, and in this monitoring to calculate GHG emission reductions monthly reporting values for 6-month period were used.

A.8. Deviations from or change of registered monitoring plan:

There aren't any deviations from or changes in the registered monitoring plan.

A.9. Persons responsible for preparation and submitting of the monitoring report:

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SECTION B. Key monitoring activities

B.1.1. Applied equipment

The control and monitoring system is divided into three parts:

1) measurement of the amount of methane leaks before repair (replacement) of gas equipment;
2) measurement of the amount of methane leaks after the repair (replacement) of gas equipment;
3) archiving and processing of obtained results.

The measurement of methane leak volumes are made on the basis of technology of the "calibrated bag" that is described in the approved CDM methodology AM0023 version 4.0.0 « Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities». One of the problems of the use of this methodology is that is it difficult to determine the volume of armature used for measuring as well as the initial volume of air when one wants to determine gas volume that entered the "bag".
To solve these problems a special setting was made on the base of plastic capacity of the known volume (0,11 m^3), a package, plastic hose and manometer (refer to Figure 1). All connections are hermetical.

Figure 1. Photo of installation for quantitative measurement of methane leaks

Gas analyzer EX-TEC® SR5. (Figure 2) For determination of methane concentration in a sample a high-accuracy gas analyzer EX-TEC® SR5 is used.

Figure 2. Photo to the gas analyzer EX-TEC® SR5 and stopwatch SOSpr-2b-2

Gas analyzer has explosion protection (CENELEC).
Application of gas analyzer and measurements ranges are given below (Table 1).

Table 1. Application and measurement diapasons of analyzer EX-TEC ® SR5

Application	Measurements range
Above ground examination	From 0 part per million to 10 volume percent (%) CH_4
Measurements in trenches of underground pipeline	From 0 to 100 volume percent (%) CH_4
Examination in closed spaces	From 0 part per million to 10 volume percent (%) CH_4
Indoor checking	From 0 part per million to 10 volume percent (%) CH_4
Information about presence of explosive gases	From 0 part per million to 10 volume percent (%) CH_4
Measurement of quantity foreign mixtures in gases	From 0 to 100 volume percent (%) CH_4
Analysis of ethane	CH, CH_4, C_2H_6, C_3H_8 (additional)

In addition to the gas analyzer EX-TEC ® SR5 mentioned above stationary gas analyzers were also used; their list and characteristics are stated in the accompanying document 2 - "Types of measuring equipment."
The relative error is 10%, which corresponds to standard EN 50054/57[3] of the European Standartization Committee[4].

[3] (Electrical apparatus for the detection and measurement of combustible gases). General requirements and test methods).
[4] http://www.cen.eu/cen/pages/default.aspx

Stopwatch SOS pr-2b-2 (Fig. 2). The stopwatch is designed for measurement of time in minutes, seconds and fractions of seconds. It is used in science research, and in the process of time-keeping.

The stopwatch has a 60-second scale with 0.2 s point value and 60-minute counter with the point value of 1 min. Specifications of the stopwatch are provided below (Table 2).

Table 2. Specifications of SOS pr-2b-2 stopwatch

Specifications	SOS pr-2b-2
Accuracy class	2
Permitted deviation, sec.	
- 10 minutes - 60 minutes	- ±0.6 - ±1.8
Operating temperature range, °C	-20..+40
Dimensional specifications mm	d55 x 19 x 76
Weight, kg	0.12
Mechanism	anti-shock device of balance unit

Upon leak detection and measurement either repair and replacement of GDP (CGDP) gas equipment and gas fittings of gas pipelines is executed with the use of modern materials of sealers (GOST 7338-906[5] GOST 5152-846[6] or GOST 10330-766[7]) or complete replacement of worn out equipment with new and modern one of European manufacturers or their analogues of domestic production takes place.

B.1.2. Calibration procedure

Measuring equipment for the JI project is subject to regular verification / calibration according to national procedures.

Gas analyzer EX-TEC® SR5, that is one of the major metering devices, according to the Law of Ukraine «On metrology and metrological activity»[8] requires calibration procedures and is used in the monitoring of methane leaks. Inter-calibration and inter-verification interval is 1 year. As a result of verification (calibration) the certificate confirming the technical serviceability of device is issued.

Dates of calibration and inter-calibrations intervals for stationary gas analyzers are stated in Accompanying document 2 “Types of metering equipment”.

Frequency control of metrological characteristics of mechanical stopwatch type SOS pr-2b-2 is determined according to the Law of Ukraine "On metrology and metrological activity", DSTU 7230:2011[9] and Derzhspozhyvstandard of Ukraine "Measuring instruments that are included in the State Register of Ukraine"[10] and is: verification interval - 1 year, calibration interval - 1 year.

Frequency control of metrological characteristics of glass thermometer TL-4 is determined according to the Law of Ukraine "On metrology and metrological activity"[11] and Derzhspozhyvstandard of Ukraine "Measuring instruments that are included in the State Register of Ukraine"[12] and is: verification interval - 3 years, calibration interval - 3 years.

[5] «Rubber and rubber-fabric plates»
[6] «Stuffing»
[7] «Scutched flax fibre. Technical conditions»
[8] http://zakon2.rada.gov.ua/laws/show/113/98-вр
[9] "Metrology. Stop-mechanical. Methods of verification (calibration) »
[10] http://www.stand.lutsk.ua/downloads/ZVT.pdf
[11] http://zakon2.rada.gov.ua/laws/show/113/98-вр
[12] http://www.stand.lutsk.ua/downloads/ZVT.pdf

Frequency control of metrological characteristics of aneroid barometer BAMM-1 and M-67 is determined according to the Law of Ukraine "On metrology and metrological activity" and TU 25-04-1797-75[13] and is: verification interval - 2 years, calibration interval - 2 years.

As a result of verification (calibration) of stopwatch, aneroid barometer and thermometer the certificate confirming the technical serviceability or metrological stamp of device is issued.

B.1.3. Involvement of third parties

Calibration of gas analyzers is performed by State Enterprise "Crimean Scientific-Production Center of Standardization, Metrology and Certification"[14]
State Enterprise "Crimean Scientific-Production Center of Standardization, Metrology and Certification" is a local authority of the State Committee of Ukraine for technical regulation and consumer policy in the Autonomous Republic of Crimea, which represents the State Consumption Standards of Ukraine in the region. SE "Scientific-Production Center of Standardization, Metrology and Certification" has the legal authority to conduct state verification and calibration of gas analyzers.

B.2. Data collection (data collected in the whole monitoring period)

B.2.1. The operational and management structure in order to enable the project operator implement the monitoring plan.

Co-ordination of work of all departments and services of NJSC "Chornomornaftogaz" relating to the JI project is carried out by a Working Team (protocol #1 meeting of the Working Team on JI "Methane leaks reduction and implementation of energy efficiency measures at technological equipment of Public Joint Stock Company "National Joint Stock Company "Chornomornaftogaz" from 07/12/2005). The structure of the Working Team is presented in Figure 3.

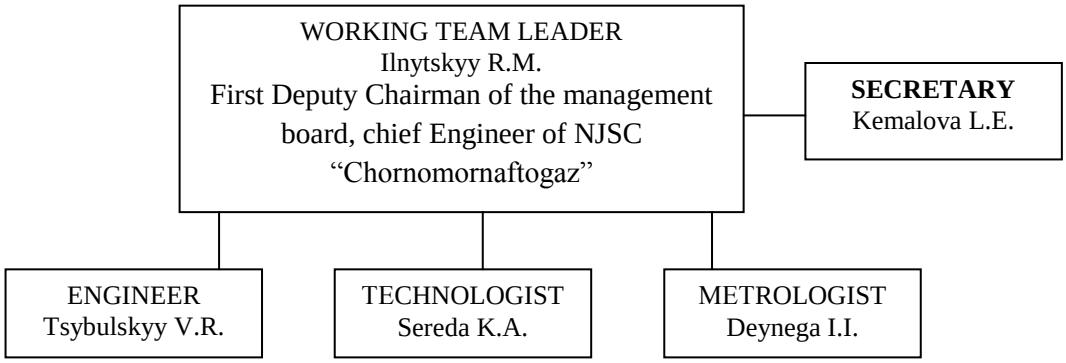

Figure 3. The structure of the Working Team

B.2.2. List of parameters used in the course of calculation

The parameters given in Table 3-Table 5 are used in the course of calculation.

Table. 3. List of fixed parameters that are not monitored in the monitoring period

Parameter identifier	Description	Source of data	Value, data unit	Comments

[13] «Control barometer aneroid. General technical conditions»
[14] http://www.standard.crimea.ua/

Parameter identifier	Description	Source of data	Value, data unit	Comments
1. i	Gas equipment sequence number of pipeline fittings and shut-off and control gas valves, flange and threaded connections, where methane leak, which was detected, repaired and then verified, was detected	Methodology AM0023 version 4.0.0[15]		It is used according to the approved CDM Methodology AM0023 version 4.0.0. List of gas equipment units is stated in accompanying document 1 "Calculation of GHG emission reductions"
2. *Vbag*	Volume of capacity	Methodology AM0023 version 4.0.0[16]	0,11 m^3	It is used according to the approved CDM Methodology AM0023 version 4.0.0.

Table 4.Parameters that are monitored during the monitoring period and used to calculate project emissions

Parameter identifier	Description	Source of data	Unit of measurement	Monitoring frequency	Comments
T_i	Number of operation hours of equipment where leak was detected during the year	Examination results (stored electronically with the secretary of the Working Team)	hours	Annually	Number of operation hours of equipment during the year after its replacement (repair)
GWP_{CH4}	Global warming potential	IPCC	t CO_2e / t CH_4	Annually	The project developer will carry out the monitoring of any changes in the global warming potential of methane published by the IPCC and approved by the COP.
t_i	Gas temperature	Mercury thermometer of glass type TL-4 (state standard 8.279-78[17]). Examination results (stored	^{0}C	Every time during measurements according to monitoring	It is measured to identify the density of CH_4 to bring the leak rate to normal conditions

[15] http://cdm.unfccc.int/methodologies/DB/PZN9ZCTGF3KHFH0W21NY0NYL6X5CIR
[16] http://cdm.unfccc.int/methodologies/DB/PZN9ZCTGF3KHFH0W21NY0NYL6X5CIR
[17] http://www.gosthelp.ru/gost/gost31800.html - «Liquid operational gas thermometers. Methods and means of calibration»

		electronically with the secretary of the Working Team)		plan	
P_i	Gas pressure	Barometer aneroid BAMM-1 or M-67 (TU 25-04-1797-75[18]) Examination results (stored electronically with the secretary of the Working Team)	MPa	Every time during measurements according to monitoring plan	It is measured to identify the density of CH_4 to bring the leak rate to normal conditions
$w_{sampleCH4,i}$	Concentration of methane in the sample	Gas analyzers EX-TEC® SR5. Examination results (stored electronically with the secretary of the Working Team)	%	Every time during measurements according to monitoring plan	Concentration of methane in the capacity of leak *i* is the difference between the concentration of methane in the capacity at the beginning and at the end of measurement. Concentration is measured by gas analyzer EX-TEC ® SR5.
τ_i	Time within which the concentration of methane in the capacity reaches a certain level	Stopwatch «SOS pr-2б-2», State standard 5072-72[19]	second	Every time during measurements according to monitoring plan	Time within which the concentration of methane in the capacity reaches a certain level is determined with a stopwatch. The measurement begins with the opening tap on the tank lid and ends after 180 seconds.
UR_i	Uncertainty range for the flow rate measurement method applied to physical leak	Manufacturer's information and/or IPCC	fraction	Annually	Estimated where possible, at a 95% confidence interval, consulting the guidance provided in chapter 6 of the 2000 IPCC Good Practice Guidance[20]. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed.

[18] «Control barometer aneroid. General technical conditions»
[19] «Mechanical stopwatches»
[20] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000: http://www.ipcc-nggip.iges.or.jp/public/gp/english/6_Uncertainty.pdf

Table 5. Parameters that are monitored during the monitoring period and used to calculate emissions in the baseline scenario.

Parameter identifier	Description	Source of data	Data unit	Monitoring frequency	Comments
T_i	Number of operation hours of equipment where leak was detected during the year	Examination results (stored electronically with the secretary of the Working Team)	hours	Annually	Number of operation hours of equipment during the year after its replacement (repair)
GWP_{CH4}	Global warming potential	IPCC	t CO_2e / t CH_4	Annually	The project developer will carry out the monitoring of any changes in the global warming potential of methane published by the IPCC and approved by the COP.
t_i	Gas temperature	Mercury thermometer of glass type TL-4 (state standard 8.279-78[21]). Examination results (stored electronically with the secretary of the Working Team)	^{0}C	Every time during measurements according to monitoring plan	It is measured to identify the density of CH_4 to bring the leak rate to normal conditions
P_i	Gas pressure	Barometer aneroid BAMM-1 or M-67 (TU 25-04-1797-75[22]) Examination results (stored electronically with the secretary of the Working Team)	MPa	Every time during measurements according to monitoring plan	It is measured to identify the density of CH_4 to bring the leak rate to normal conditions
$w_{sampleCH4,i}$	Concentration of methane in the sample	Gas analyzers EX-TEC® SR5 or EX-TEC® HS 680	%	Every time during measurements according to monitoring plan	Concentration of methane in the capacity of leak *i* is the difference between the concentration of methane in the capacity at the beginning and at the end of measurement. Concentration is measured by gas analyzers EX-TEC ® SR5.
τ_i	Time within which the concentration of methane in	Stopwatch «SOS pr-2б-2», State standard 5072-72[23]. Examination results	second	Every time during measurements according to	Time within which the concentration of methane in the capacity reaches a

[21] http://www.gosthelp.ru/gost/gost31800.html - «Liquid glass operating thermometers. Calibration methods and means»
[22] «Control barometer aneroid. General technical conditions»
[23] «Mechanical stopwatches»

	the capacity reaches a certain level	(stored electronically with the secretary of the Working Team)		monitoring plan	certain level is determined with a stopwatch. The measurement begins with the opening tap on the tank lid and ends after 180 seconds.
UR_i	Uncertainty range for the flow rate measurement method applied to physical leak	Manufacturer's information and/or IPCC	fraction	Annually	Estimated where possible, at a 95% confidence interval, consulting the guidance provided in chapter 6 of the 2000 IPCC Good Practice Guidance[24]. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed.

B.2.3. Data concerning leakage

There is no leakage during the project implementation (the JI Specific Approach on the basis of the approved Methodology AM0023, version 4.0.0 as well as Methodology AM0023, version 4.0.0 don't provide for any leakage).

B.3. Data processing and archiving

All data are processed and archived in hard and electronic copies throughout the project lifetime and two years after the end of the project.

B.4. Extraordinary situations and disturbances

There were no extraordinary situations in the current monitoring period (from 01/01/2012 to 30/06/2012) at NJSC "Chornomornaftogaz".

B.5. Procedures for detection and elimination of failures at technological equipment of NJSC "Chornomornaftogaz"

Detection, elimination and registration of failures and extraordinary situations at shut-off stations of NJSC «Chornomornaftogaz» is carried out according to the Gas Supply Safety Rules of Ukraine.

According to the approved schedule of routine and preventive maintenance staff of the natural gas production, storage, preparation and transportation systems conducts constant (daily) monitoring of technical condition of production equipment.

In case of any breakdowns, staff immediately take steps to repair them. First of all, the damaged section or equipment is disconnected from the general technological scheme. Then, depending on the type of

[24] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000: http://www.ipcc-nggip.iges.or.jp/public/gp/english/6_Uncertainty.pdf

failure, repairs can be carried out by their own qualified staff or with the involvement of sub-contractors in strict compliance with safety requirements and fire safety.

B.6. External data (type, source, access)

The following external data are used in the monitoring:

Parameter	Description	Source of data	Unit of measurement	Monitoring frequency	Comments
UR_i	Uncertainty range for the flow rate measurement method applied to physical leak	Manufacturer's information and/or IPCC	fraction	Annually	Estimated where possible, at a 95% confidence interval, consulting the guidance provided in chapter 6 of the 2000 IPCC Good Practice Guidance[25]. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed.
GWP_{CH4}	Global warming potential	IPCC	t CO_2e / t CH_4	Annually	The project developer will carry out the monitoring of any changes in the global warming potential of methane published by the IPCC and approved by the COP.

[25] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000: http://www.ipcc-nggip.iges.or.jp/public/gp/english/6_Uncertainty.pdf

Section C. Quality assurance and quality control measures

C.1. Documented procedures and management structure

C.1.1. Roles and responsibilities

The structure of data collection and management of the project was provided in Section B.2 of this monitoring report.

C.1.2. Trainings

The project does not provide for the introduction of equipment that would require conduction of additional trainings for the personnel. If such equipment is installed the representatives of equipment manufacturers will conduct trainings on the use and maintenance of the equipment for employees of NJSC "Chornomornaftogaz".

Training of employees at the State Joint Stock Company "Chornomornaaftogaz" is conducted in accordance with the Regulation on the system of training approved in Order No. 133 dated 16/03/2010 and program of training and creation of personnel reserve for the period until 2015 taking into account the prospects for development of new deposits, purchase and jack-up drilling rigs and vessels, approved by Order No. 534 dated 27/08/2010.

Training company has negotiated with National Oilwell Varco - the equipment manufacturing company, that produced 70% of equipment of a new jack-up project B-312. National Oilwell Varco has educational center that is ready to provide its educational base for training of our employees.

There is a Training center at the National Joint Stock Company; it conducts training, retraining and upgrades qualifications in 27 professions; this almost completely meets the needs for staff training of NJSC “Chornomornaftogaz”. So in 2011, 1094 employees of the Company have been trained, retrained and developed their professional skills (932 people studies issues related to Labour Protection and Safety Rules, 162 people studied professional and technical issues.). At present the Training center of the Company is working on obtaining a new license for training, retraining and development professional skills in 10 professions.

C.2. Internal audits and control measures

Under the guidance of a specially established working team of NJSC “Chornomornaftogaz” a group for measurement of all necessary parameters planned in the methane leak monitoring plan was formed.

Monitoring measurements are performed by specifically trained personnel according to the Methods of measurements. Data on Monitoring measurements are recorded in paper form directly in the course of measurements. Then, on the basis of paper data the single electronic database of leak monitoring measurements is formed.

Current repair of gas equipment of gas fittings of the natural gas production, storage, preparation and transportation system is carried out once per year, and maintenance is performed once per half-year.

Repaired gas equipment is inspected regularly as a component part of standard monitoring activity, to ascertain, that it didn’t become the source of leak again.

C.3. Information on factors of social influence of the project and its influence on the environment

As a result of the project implementation there will be a reduction of natural gas losses, reduction of GHG emissions which cause greenhouse gas effect and climate change. The level of safety of gas pipelines operation will increase.

SECTION D. Calculation of GHG emission reductions

D.1. Formulae used for calculation of GHG reductions.

D.1.1.Formulae for calculation of project emissions:

Formulae 1 – Volume of methane emissions in period *y* for equipment after the repair of replacement (t CO_{2e})	
	$PE_y = ConvFactor \sum_{i=1}^{n} \left[F_{CH_4,i,p}^{STP} \cdot T_i^y \cdot (1+UR_i) \right] \cdot GWP_{CH_4}$
	PE_y - Methane emissions in period *y* for equipment after the repair or replacement (t CO_2e); $ConvFactor$ - Conversion factor to convert m³ CH_4 into t CH_4 under normal temperature and pressure (0 ^{0}C, 101.3 kPa) is 0.0007168 t CH_4 /m^3 CH_4; UR_i - Uncertainty range for the flow rate measurement method applied to physical leak (fraction); T_i^y - The time the relevant component *i* has been operating during the given period *y* (h); GWP_{CH_4} Global warming potential of methane (t CO_{2e} / t CH_4); $F_{CH_4,i,p}^{STP}$ - methane leak volume from one piece of equipment reduced to normal conditions (m^3/h).
	[p] – index relating to the project scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction; *[STP]* – index corresponding to the data reduced to normal conditions.

Formulae 2 – project (after repair, replacement) methane leak rate (volume) for equipment unit *i*, reduced to normal conditions (m^3/h)	
	$F_{CH_4,i,p}^{STP} = \frac{F_{CH_4,i,p} \cdot 273 \cdot P_i}{0.1013 \cdot (273+t_i)}$,
	$F_{CH_4,i,p}^{STP}$ – project (after repair, replacement) methane leak rate (volume) for equipment unit *i*, reduced to normal conditions (m^3/h); $F_{CH_4,i,p}$ – project (after repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h); P_i – gas pressure in tank (MPa); t_i – gas temperature in tank (°C);. 273 – gas temperature under normal conditions, corresponds to 0 ^{o}C (K); 0.1013 – the gas pressure under normal conditions, corresponds to atmospheric pressure 101.3 kPa, (MPa).
	[p] – index relating to the project scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction; *[STP]* – index corresponding to the data reduced to normal conditions.

Formulae 3 – project (after repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h);	
	$F_{CH_4,i,p} = \frac{Vbag \cdot w_{sampleCH_4,i,p} \cdot 3600}{\tau_i}$,

	$F_{CH_4,i,p}$ project (after repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h); $Vbag$ - volume of leakproof tank for measurement (m^3); $w_{sampleCH_4,i,p}$ - methane concentration in the leak sample «i», which is the difference between concentrations at the beginning and the end of the measuring (%); τ_i - average duration of tank filling for leak «i» after reconstruction (seconds); 3600 – conversion factor from hours to seconds (s/h).
	[p] – index relating to the project scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction;

D.1.2. Formulae for calculation of baseline emissions:

Formulae 4 – Volume of methane emissions in period *y* for equipment before the repair of replacement (t CO_{2e})	
	$BE_y = ConvFactor \sum_{i=1}^{n} \left[F_{CH_4,i,b}^{STP} \cdot T_i^y \cdot (1 - UR_i) \right] \cdot GWP_{CH_4}$
	BE_y - Methane emissions in period *y* for equipment before the repair or replacement (t CO_2e); $ConvFactor$ - Conversion factor to convert m³ CH_4 into t CH_4 under normal temperature and pressure (0 ^{0}C, 101.3 kPa) is 0.0007168 t CH_4 /m^3 CH_4; UR_i - Uncertainty range for the flow rate measurement method applied to physical leak (fraction); T_i^y - The time the relevant component *i* has been operaing during the given period *y* (h); GWP_{CH_4} Global warming potential of methane (t CO_2e / t CH_4); $F_{CH_4,i,b}^{STP}$ - methane leak volume from one piece of equipment reduced to normal conditions (m^3/h).
	[b] – index relating to the baseline scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction; *[STP]* – index corresponding to the data reduced to normal conditions.

Formulae 5 – baseline (after repair, replacement) methane leak rate (volume) for equipment unit *i*, reduced to normal conditions (m^3/h)	
	$F_{CH_4,i,b}^{STP} = \frac{F_{CH_4,i,b} \cdot 273 \cdot P_i}{0.1013 \cdot (273 + t_i)}$,
	$F_{CH_4,i,b}^{STP}$ – baseline (before repair, replacement) methane leak rate (volume) for equipment unit *i*, reduced to normal conditions (m^3/h); $F_{CH_4,i,b}$ – baseline (before repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h); P_i – gas pressure in tank (MPa); t_i – gas temperature in tank (°C);. 273 – gas temperature under normal conditions, corresponds to 0 ^{o}C (K); 0.1013 – the gas pressure under normal conditions, corresponds to atmospheric pressure 101.3 kPa, (MPa).
	[b] – index relating to the baseline scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction; *[STP]* – index corresponding to the data reduced to standard conditions.

Formulae 6 – baseline (before repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h)	
	$F_{CH_4,i,b} = \frac{Vbag \cdot w_{sampleCH_4,i,b} \cdot 3600}{\tau_i}$,
	$F_{CH_4,i,b}$ baseline (before repair, replacement) methane leak rate (volume) for equipment unit *i* (m^3/h); $Vbag$ - volume of leakproof tank for measurement (m^3); $w_{sampleCH_4,i,b}$ - methane concentration in the leak sample «i», which is the difference between concentrations at the beginning and the end of the measuring (%); τ_i - average duration of tank filling for leak «i» before reconstruction (seconds); 3600 – conversion factor from hours to seconds (s/h).
	[b] – index relating to the baseline scenario; *[i]* – index relating to the sequence number of the element subject to reconstruction;

D.1.3. Formulae for calculation of GHG emission reductions:

Formulae 7 – Quantity of Emission Reduction Units (ERUs)
$ERU_y = BE_y - PE_y$
BE_y - total methane emissions from equipment before the repair or replacement, in period «*y*», (t CO_{2e}); PE_y - total methane emissions from equipment after the repair or replacement, in period «*y*», (t CO_{2e});
$[y]$ - index that corresponds to monitoring period.

D.2. Results of the GHG emission reductions monitoring

D.2.1. GHG emissions in the project scenario

The following GHG emission volumes were achieved in the reporting period as a result of the implementation of measures under the project:

Monitoring period:	Project emissions (t CO_2e)
01/01/2012 – 30/06/2012	44 500
Total project emissions in the monitoring period of 01/01/2012 – 30/06/2012 (t CO_2e)	**44 500**

D.2.2. GHG emissions in the baseline scenario

Emissions that would occur in the absence of implementation of measures under the project are the following:

Monitoring period:	Baseline emissions (t CO_2e)
01/01/2012 – 30/06/2012	835 233
Total baseline emissions in the monitoring period of 01/01/2012 – 30/06/2012 (t CO_2e)	**835 233**

D.2.3. Emission reductions due to the project implementation in the monitoring period:

Emission reductions due to the project implementation are calculated as the difference between the baseline and the project emissions.

Monitoring period:	Emission reductions (t CO_2e)
01/01/2012 – 30/06/2012	790 733
Total estimated emission reductions in the monitoring period of 01/01/2012 – 30/06/2012 (t CO_{2e})	**790 733**

To quantify GHG emission reductions values of earlier measurements at typical gas equipment and fittings were used. Estimated and predicted quantities of gas equipment units and fittings were also used. At the same time, in accordance with the approved monitoring methodology stated in the PDD, for calculating the number of ERUs equipment measurements for each unit of gas equipment and fittings were used. Therefore the actually calculated emission reductions for each project year are slightly different from those values that were provided in the PDD.