JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

IMPLEMENTATION OF RESOURCE AND ENERGY SAVING MEASURES IN THE SUBSIDIARY “UKRTRANSGAS” OF NATIONAL JOINT STOCK COMPANY "NAFTOGAZ OF UKRAINE"

Sectoral scope (-s):
3 Energy demand
10 Fugitive emissions from fuels
PDD version 2.0 dated 18/08/2011

A.2. Description of the project:

General description of the sector, company and activities
Ukraine is among the world top-5 countries in terms of methane emissions from oil and gas sector[1]. One of the biggest emitter of CO_2 and methane within the sector is the state owned company Ukrtransgas, a subsidiary of National Joint Stock Company Naftogaz of Ukraine (NAK Naftogaz). The latter plays a role of mothers company for the majority of country oil and gas industry (except for oil refineries)[2].
Ukrtransgas is one of the world largest gas transmission companies. It operates over 36 thousands km (including 14 thousands km of large diameter of over 1000 mm) of gas pipelines, 74 gas compressor stations and 13 underground gas storage facilities capable to store over 30 bcm of natural gas (NG) for demand peak-shaving. The current transmission capacity of the system is 288 bcm at input and over 178 bcm at output to the European countries[3].

Large amounts of NG are spent annually for keeping the transmission system in operation. The chart below is showing the distribution of NG usage for different processes, including losses occurring during pumping the gas and maintaining the system.

[1] *Global Anthropogenic Non-CO_2 Greenhouse Gas Emissions: 1990 - 2020*, USEPA, June 2006.

[2] http://www.naftogaz.com/www/2/nakweben.nsf/

[3] See also http://www.iea.org/textbase/nppdf/stud/06/Ukraine2006-UKR.pdf

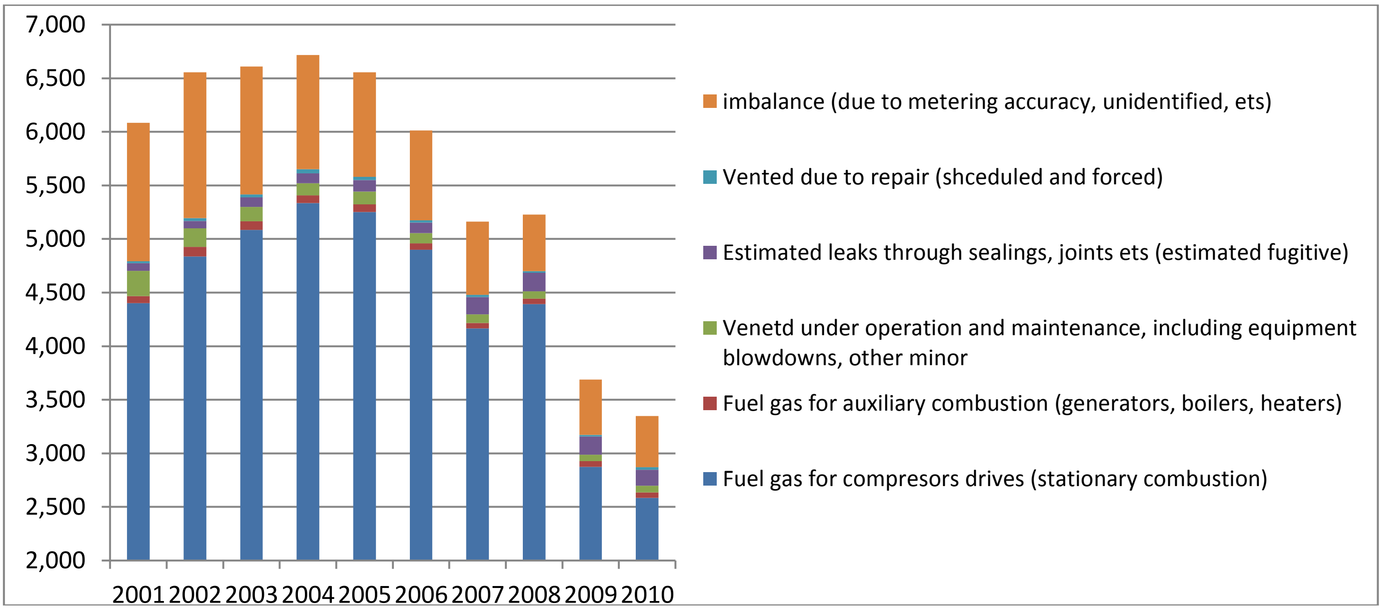

Figure 1: NG usage by Ukrtransgas for operations, including losses and imbalance, millions cubic meters[4].

Reduction in absolute value of losses is mainly caused by the decrease of amount of gas pumped through the system happened during 2005- 2007 and further decrease in 2009.

Situation before the proposed project start
Over past 20 years Ukrtransgas is lacking investments to provide major upgrades of the system. Current financing is only sufficient to maintain the system safe and functioning[5]. The company could not and still cannot allocate financing in excess of immediate needs for regular maintenance. For instance, annual spending to maintain the system in operation is still low as shown below in Table 1:

Year	2009	2010	2011
Billion UAH	0.896	1.75	3.1
MEuro	90	175	310

Table 1. Annual spending for maintenance of gas transmission system[6]

Modernization of the system involving large scale replacement of low efficiency, but still operational equipment by modern types will require far greater investments. Different estimates report some 3 to 5 Billion Euro are required for it[7]. It can be considered unrealistic that Ukrtransgas would ever find financing for it by itself.

Before the start of proposed project the energy conservation/methane venting avoidance activities was carried out on episodic and non-regular base, which could not create a substantial background for GHG emissions reduction. As a result, large amount of GHG was being emitted prior to the proposed project start.

Since 2004, when Ukraine has ratified the Kyoto protocol, and also joined Methane to Markets

[4] Source: Ukrtransgas data

[5] Situation as of 2006 can be found at: http://www.iea.org/textbase/nppdf/stud/06/Ukraine2006-UKR.pdf

[6] Source: http://www.utg.ua/uk/press/site-updates/ukrtransgaz_aktyvizue_modernizaciu_gts/

[7] Interview of EBRD Director for Ukraine, dated 11/05/2011 http://www.ukrinform.ua/eng/order/?id=220820

Partnership Program[8] the understanding and confidence has grown that systematic approach can create a firm base for stimulating energy efficiency and GHG reduction activities.

There can be mentioned several pilot and trial activities started prior to the proposed project start, but they can be regarded as exploration of opportunities for future large JI projects[9].

Proposed project

The proposed project, consisting of three groups of subprojects is being implemented the Ukrtransgas facilities and is aimed to reduction of GHG emissions from the following sources:

1. Reduction of CO_2 emissions due to stationary combustion of NG in the compressor drives, auxiliary boilers and heaters through equipment replacement, modernization or retrofit[10];
2. Reduction of indirect CO_2 emissions due to consumption of electricity by cathode protection systems from the Ukrainian power grid;
3. Reduction of direct methane emissions which are occurring due to blow down and venting of NG from pipeline sections under repair activities by implementation of innovative repair methods.

Emissions due to physical methane leakage[11] is not the subject of the proposed project.

The implementation of proposed project results in significant reduction of GHG emission

The project activity started 1 January 2005 with the adoption of a long term energy and resource saving program, which included procedures for identification of potential saving measures, their assessment, implementation and further monitoring of results achieved.

In the absence of proposed project the saving measures would not be implemented which would result in higher GHG emissions during operation of the gas transmission system.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	Affiliated Company «Ukrtransgas» of National Joint-Stock Company «Naftogaz of Ukraine»	No
Republic of Latvia	SIA “Vidzeme Eko”	No

Table 2. Project Participants.

Role of the Project Participants:

[8] http://www.globalmethane.org/partners/index.aspx

[9] http://www.globalmethane.org/documents/par_110609.pdf#page=44

[10] http://en.wikipedia.org/wiki/Retrofitting

[11] Definition of physical methane leak can be found at: http://cdm.unfccc.int/Panels/meth/meeting/11/050/mp50_an05.pdf

- Affiliated Company «Ukrtransgas» of National Joint-Stock Company «Naftogaz of Ukraine» the legal entity operating and leasing the gas transmission system of Ukraine, which is implementing the proposed JI project;
- SIA "Vidzeme Eko" is responsible for the preparation of the JI project including PDD preparation, obtaining Party approvals, monitoring, and transferring the resulting ERUs/AAUs;

See details of project participants in Annex 1.

A.4. Technical description of the project:

The technical description of the project as well as details of project locations is provided in subsections A.4.1. through A.4.3. below.

A.4.1. Location of the project:

The proposed project is being implemented as a three groups of subprojects throughout the facilities of Ukrtransgas which are located within the whole territory of Ukraine. The facilities include a functional grouping of:

i) Trunk gas pipelines which are used to transmit natural gas to European countries;
ii) Their branches designed to transmit the NG to large consumers (cities, towns, industrial plants);
iii) Pressure reducing stations;
iv) Underground gas storages;
v) Compressor stations located along the gas pipelines indicated in i).

A.4.1.1. Host Party(ies):

Ukraine

A.4.1.2. Region/State/Province etc.:

All regions throughout Ukraine where the Ukrtransgas facilities are located.
The map below depicts the layout of gas transmission facilities, including pipelines, compressor stations and gas storages of Ukrtransgas where the proposed project consisting of individual measures is being implemented.

Figure 2: Ukraine, the project facilities location and neighbouring countries

A.4.1.3. City/Town/Community etc.:

Ukrtransgas facilities are located throughout the whole territory of Ukraine in or nearby a big number of cities, towns and villages along the transmission pipelines and their branches as it is shown in Figure in section A.4.1.2.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

The proposed project will be implemented at all six Ukrtransgas subsidiaries:
- Kievtransgas, located on the north and north-eastern parts of Ukraine, and includes Kiev region;
- Cherkassytransgas, located in central part of the country;
- Lvivtransgas- located in western and north-western parts of Ukraine;
- Prikarpattransgas- located in two separated areas in the country southwest;
- Kharkivtransgas – located in the central southern part of Ukraine;
- Donbasstransgas located at the east of the country.

Location of each of the individual saving measure is uniquely identified used the following data:
- for energy efficiency measures at compressor stations: subsidiary name, division name and address, compressor station # and (or) name, location (or name of nearest village), # of compressor, name of individual measure;

-for modernization of anode groundings of cathode protection system location of individual measure is identified using passport of cathode protection system;
-for methane blow down avoidance during repair of pipeline: subsidiary name, division name and address, identification name of transmission pipeline, exact location of the place along the pipeline and number of the train if any (e.g. 1445.654 km of gas transmission pipeline Urengoy-Pomary-Uzhgorod). To provide more details, during monitoring/verification procedures a drawing of repaired section will be provided which contains the pipeline dimensional data (diameter, section lengths, adjacent valves).

A detailed list of equipment and assets which is under responsibility of Ukrtransgas and included in the project borders (all pipelines, compressor stations and gas distribution stations) with respective asset identification number of each item and its description at 379 pages will be available for AIE and DFP.

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The proposed project consists of three groups of subprojects, and each subproject consisting of a number of standardized individual measures, being continuously added since the project start in 2005.

Group 1: Saving of NG which is combusted in compressor drives, boilers and heaters through implementation of different energy saving modernization or improvements.

Subproject 1.1: Replacement of gas turbine (GT) drives of gas compressors by new ones of higher fuel efficiency.
As of 2005 UTG was running 692 gas compressors out of which 438 have gas turbine drives, 158 are electrically driven and 96 are driven by piston gas engines. The key parameters of most common GT drives and new unit types they are replaced by are shown in a Table below:

Existing drives				**New drives**		
Type of compressor GT drive	Capacity, MW	Thermal efficiency, %	Total number in operation as of 2005	type of compressor GT drive	Capacity, MW	Thermal efficiency, %
NK-12CT	6.3	22.5 to 24	48	DT-71П	6.3	30.5 to 31
NK-12CT	6.3	22.5 to 24		D-336-6-2 as alternative	6.3	30 to 31
GTK-10-4	10	29	over 70	DN-70	10	34
GTK-10-4	10	29		D-336-10-2	10	34
GTK-10-i	10.3	25.7	83	DN-70	10	34
GTK-10-i	10.3	25.7		D-336-10-2 as alternative	10	34
NK-16CT	16	27.5	16	DG-90	16	34
GPA-25/76	25	28	2	DN-80	25	34.5 to 35

Table 3. Typical gas turbine compressor drives (existing and new)

As can be seen in the table above, replacement of the GT drive by the new one with higher efficiency brings sufficient gain in fuel saving, from 5 up to 8 % in function of the engine type. Replacement of the existing fleet of GT drives with actual efficiencies of 22.5 to 29% by advanced types results in substantial reduction of gas combusted at compressor stations.

However, due to higher cost of advanced GT as to compare with the standard one and limited company financial capabilities the number of units replaced annually ranges between 2 and 10, which is still relatively low assuming the overall number of units in operation and understanding that the desired number shall be 20 to 30 each year.
The number of replaced GT drives and further plans is shown in a table 4 below:

Year	2005	2006	2007	2008	2009	2010	2011	2012	Annually from 2012 on
Number of GT replaced	3	0	4	6	0	0	8	10	10 to 15

Table 4. Number of replacement of GT drives over years

Subproject 1.2: Modernization or retrofit of existing gas turbine drives/gas piston engines to improve their efficiency[12] by introducing a number of standardized improvements like:

- Replacement of standard regenerator (combustion air preheater using heat recovered from GT exhaust gases) of a GT by a new one with better efficiency. This measure foresee replacement of standard regenerator using finned tubes by a new one made from plain tubes designed to reduce the flue gas pressure drop across it and to have better regeneration/lower internal leaks. Reducing the gas turbine outlet pressure drop and increase the degree of regeneration[13] allows increasing the GT fuel efficiency by certain percent, typically 1 to 2% in function of engine type, pressure drop reduction and increase of degree of regeneration achieved, thus reducing the amount of gas combusted at compressor unit.

- Introduction of new air inlet filters of lower flow resistance to increase the GT efficiency. Similarly to the effect of regenerator replacement at GT exhaust, replacement of air inlet filter by an advanced one with lower pressure drop contributes to increase of fuel efficiency of the GT. Typically the GT efficiency can be increased by less than one to two percent, varying in function of engine type and pressure drop reduction achieved.

- Improvement of GT exhaust duct thermal insulation. It reduces combustion air inlet temperature and increase overall GT efficiency. Typically, the standard insulation allows the undesired (or parasitic) heat to leak into the air inlet duct. Increase of inlet air temperature leads to reduction of GT efficiency, as more shaft power is consumed by GT air compressor. Thus, improvement of the thermal insulation brings certain fuel saving, typically it increases the efficiency up to some 0.5%.

- Replacement of standard GT nozzle blading by new ones either coated or made from special alloys to withstand higher combustion temperatures. It allows increasing the efficiency of GT by operating at higher inlet gas temperature. This improvement is normally being done during GT scheduled shutdown for overhaul.

- Replacement of standard GT exhaust heat recovery boilers by new ones with lower pressure loss, which allows increasing the GT thermal efficiency. Similarly to the replacement of regenerators, the standard heat recovery boilers which are installed at the exhaust duct of GT drive in order to recover heat for space heating and other site needs are being replaced by advanced ones. They are designed to reduce the flue gas pressure drop across them thus allowing for increase of GT

[12] Reference Document on Best Available Techniques for Large Combustion Plants, chapter 7.5.2 Thermal efficiency of gas fired combustion plants, p 487: http://natura.minenv.gr/batelv/Docs/lcp_gaseous_fuels_BAT.pdf

[13] Degree of regeneration can be defined as temperature transfer efficiency from hot exhaust gas to compressed combustion air http://www.engineeringtoolbox.com/heat-recovery-efficiency-d_201.html

efficiency by typically one to three % depending on the pressure drop achieved.

- Retrofit of existing GTs by replacement of wheel space. Replacement of turbine blading (rotor and stator blades) allows restoring the design efficiency of a GT (normally by several percent).This measure is relatively costly (up to 30-40% of full turbine replacement) but allows to increase the existing fleet fuel efficiency in absence of financing to provide the replacement of entire GTs.

Year	2005	2006	2007	2008	2009	2010	2011	2012	Annually from 2012 on
Number of GT retrofits	64	51	136	48	43	11	15	20	10 to 20

Table 5. Number of GT retrofits/modernization over years and further plans

Subproject 1.3: Installation of GT exhaust heat recovery boilers instead of separate gas fired space heating boilers, replacement of existing gas fired space heating boilers by the new ones with higher efficiency

Group 2: Saving of electricity consumed from the grid by auxiliary systems
Subproject 2.: Modernization of cathode protection system of underground pipelines. Numerous cathode protection systems (4531 pcs. as of 01/01/2005) represent a significant consumer of electricity in Ukrtransgas. They are designed to prevent the pipelines corrosion which occurs when pipeline contacts the soil. The system supplements the main corrosion protection of the pipeline which consists in wrapping it by polymer coating. During pipeline construction and normal operation the coating is being damaged at many random places where the corrosion can start. To prevent it, the pipeline is connected to the negative pole of an external DC source and multiple electrodes immersed into the ground along the pipeline are connected to the DC positive pole thus creating negative polarization of pipeline in the ground and compensating corrosive currents occurring at the places where the coating is damaged.

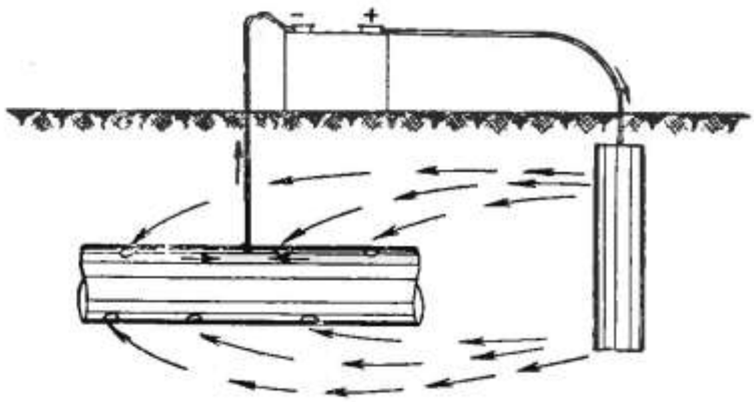

Figure 3: Principle of cathode protection system

Modernization includes firstly replacement of an AC/DC power converter by a new one with higher efficiency due to fewer losses in transformer core and rectifier. Typically, the efficiency of a converter is up to 80% vs. 60% of an old one. Secondly, the anodic earthing bed is modernized. Modernization results in reduction of power consumed due to usage of advanced low solubility electrodes which allows maintaining the required value of protective current at lower tension. Normally up to one hundred cathode protection systems are being modernized annually. Standard size of one system can be from 0.6 to 5 kW in function of the pipeline length protected.

Group 3: Usage of innovative repair techniques with the aim of avoidance of methane venting practices

Subproject 3: Implementation of innovative pipeline and joint repair methods.

The proposed subproject project consists of implementation of innovative pipeline repair and reinforcing methods which allow for repairing the corroded or mechanically damaged pipes, weld seams, including ones having gas leaks, by the use of specially designed prefabricated split sleeves and rings between the repaired pipe and the sleeve and further injection under high pressure of special self-hardening compound into the space formed between the pipe outer surface and inner surface of the sleeve. The proposed repair method includes a series of standardized repair designs suitable for permanent repair of various types of pipe deficiencies like cracks, scratches, corroded areas, other areas of wall metal loss, leaking weld seams etc. Implementation of new repair methods allows not to stop operation of the pipeline and not to release gas prior to the repair.

Under normal operation of large and relatively aged Ukrtransgas pipeline system several hundred cases of pipe corrosion or other types of pipe wall deficiency are diagnosed annually.

Standards and safety rules in force prescribe to cut the damaged pipe section and replace it by new as soon as the deficiency is dangerous for further operation. Only this type of repair was considered safe and permanent until the beginning of 2000th. Like in many other countries with developed gas transmission system[14] local safety legislation limited the type of damaged pipe repair to cutting and welding in a new section.

Such repair technique requires venting the gas into the atmosphere prior to repair work. The pipeline is sectioned by stop valves each 10 to 20 km in most cases, therefore, before the repair it is necessary to isolate the pipeline section where the repair is to be made by closing two valves at its ends. Then the gas contained in the section can be released into atmosphere and the repair can start safely. The volume released prior to a repair can be a million of cubic meters if the section is lengthy. This volume of gas released is included in total volume of gas spent for operation and maintenance of the transmission system as maintenance cost. Figure 3 below shows the process of cutting the section with damage, which will be replaced by new pipe.

Figure 4: Cutting off the damaged pipeline section – still the predominant repair method in the beginning of 2000th.

In order to reduce the amount of gas vented and to decrease the GHG emissions Ukrtransgas in

[14] As an example, in USA, a country having one of the largest gas transmission system, usage of any alternative repair methods was restricted: U.S. Department of Transportation's new pipeline repair rule went into effect on January 13, 2000 that permitted the repair of pipelines using composite materials as long as" reliable engineering tests and analyses show permanent restoration of the serviceability of the pipe." Prior to this rule, pipeline companies had to obtain a waiver from the DOT to use composite wrapping repair and reinforcing method, and no other composite repair methods were officially permitted : Transportation of natural and other gas by pipeline: Minimum federal safety standards

collaboration with research and scientific companies[15] has developed the new repair methods suitable for permanent fixing the pipeline deficiencies without release of gas and in the same time comply with safety regulations in force. Over a period 2001 to 2004 a series of sleeve designs, application techniques and filler composition were created[16]. Along with application of them in real repairs made on high pressure transmission pipelines, the methods were further upgraded so that up to 2011 20 sleeve repair methods have been designed to fix different deficiencies in various conditions, including the case of leaking welding seam, which is impossible to fix in other types of repair. In addition, a method of fixing the leaks through gasket of flanged joints (for example in taps) has been created and implemented, which allows to eliminate the leak without disassembling the joint and venting the gas from pipeline section. Below the methods which are mostly used in practice are shown.

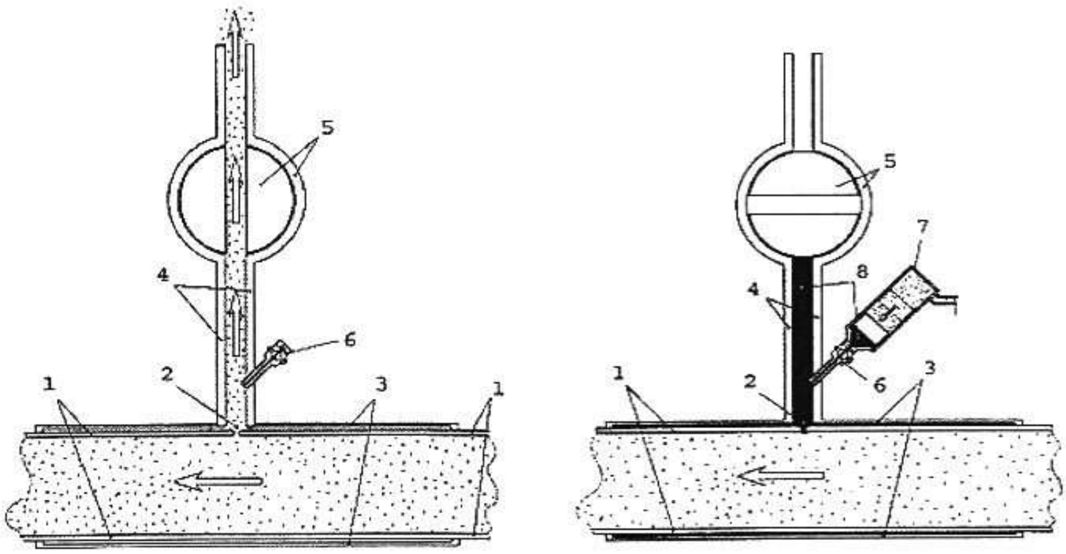

Figure 5: Application of leak elimination in operating pipeline, Pat.#59012A

1- the gas pipeline under pressure; 2- leak; 3- folded sleeve (made of two separate halves); 4 - supplementary pipe; 5- tap; 6- supplementary tap; 7- injector; 8- self-hardening filler.
Injection of self-hardening compound allows to unload the outer surface of the pipe repaired, which was impossible if simple welded sleeve is installed around the pipe, as full surface contact between pipe outer wall and sleeve inner surface cannot be created.
This solution was one of the first methods invented and used in repair practice.

In order to secure better sealing of the ends of space formed by the sleeve and outer surface of the pipe, another method has been invented, as shown below in Fig.6:

[15] Scientific companies: Kiaton; E.O. Paton Electric Welding Institute http://paton.org.ua/eng/inst/inst.html; scientific production company Polypromsyntes http://www.polypromsyntes.com.ua/pipe.html

[16] See Annex 4 where a list of patents on repair methods obtained and links to the sources are presented.

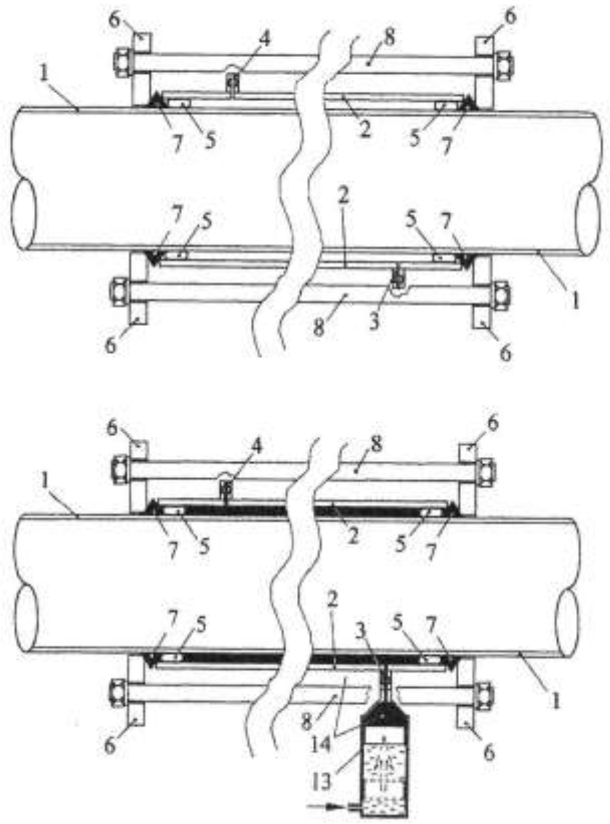

Figure 6: Method of pipeline defect repair with the use of folded sleeve and tightening flanges, pat. # 72840

1-pipeline repaired; 2- folded sleeve; 3- lower tap; 4- upper tap; 5- hose; 6- flanges; 7- additional annular wage shaped gasket; 8- locking bolts; 13- high pressure injector; 14-self-hardening compound.

The sleeve is assembled onto the pipe, then two hoses are wrapped around the pipe by the both ends of the sleeve, then the hoses are inserted in an annular space under the sleeve and a pair of folded flanges 6 is installed. Then the hoses 5 are inflated using compressed air or liquid thus centring the sleeve around the pipe and, at the same time sealing the annular space between the pipe and the sleeve. After this the flanges are tightened with the bolts 8, taps 3 and 4 are set open and compound is being injected through lower tap until the compound appears at the upper tap. Then the upper tap is closed and injection continues until the required pressure is reached in the annular space. After hardening of compound flanges and taps can be removed.

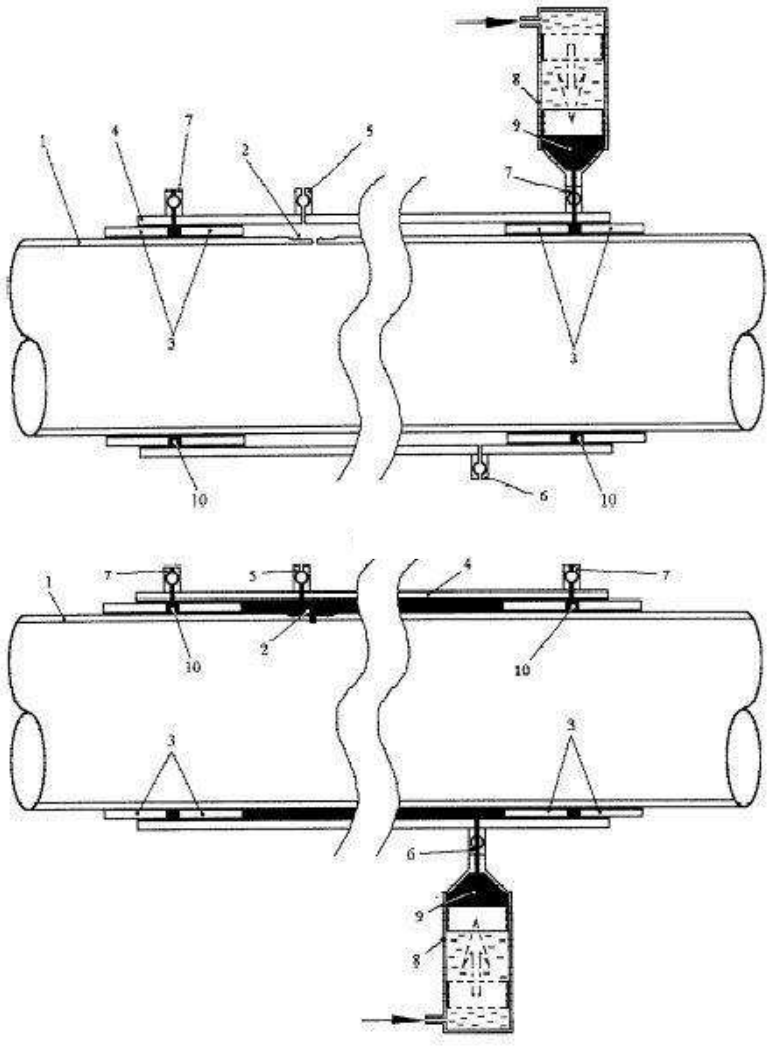

Figure 7: Method of pipeline defect repair with the use of two layer sleeve, pat. # 75859

1-pipeline, 2- damaged place, 3-rings, 4-sleeve, 5 and 6 – upper and lower taps 7-additional taps, 8-injector, 9- self-hardening compound with filler and 10 annular gaskets.

One of the mostly used types of repair due to its simplicity and possibility to repair the pipe sections of high diameter (over 720 mm) which have deviations in dimensional parameters (change in external diameter, ovality, corrugations) is shown in Fig. 7 above.

The application is similar to previously described methods, with the difference that firstly the four folded rings 3 are tightly assembled on the pipe on both sides of the damaged place 2 and welded (glued or brazed) to form two annular spaces 10. Then the folded sleeve is assembled and welded or brazed. After this the spaces 10 is filled with self-hardening compound under pressure to create quality sealing of the space between the pipe and sleeve. After hardening of the compound, this space is then filled with the same compound. If high pressure injection is required by particular requirements, the self-hardening compound can be pre- mixed with filler (granules of elastic material of Teflon chips) to prevent from leaking through joints. Below the pictures are showing the installation of two layer sleeve on high diameter gas pipeline.

Figure 8: Application of two-layer sleeve – from left to right: adjustment of the rings and sleeve, assembling of the sleeve (rings on place), welding (a chain of several sleeves is shown which is covering multiple defects).

Further development of the sleeve repair method – the so called double sleeve is shown below in Fig.9..

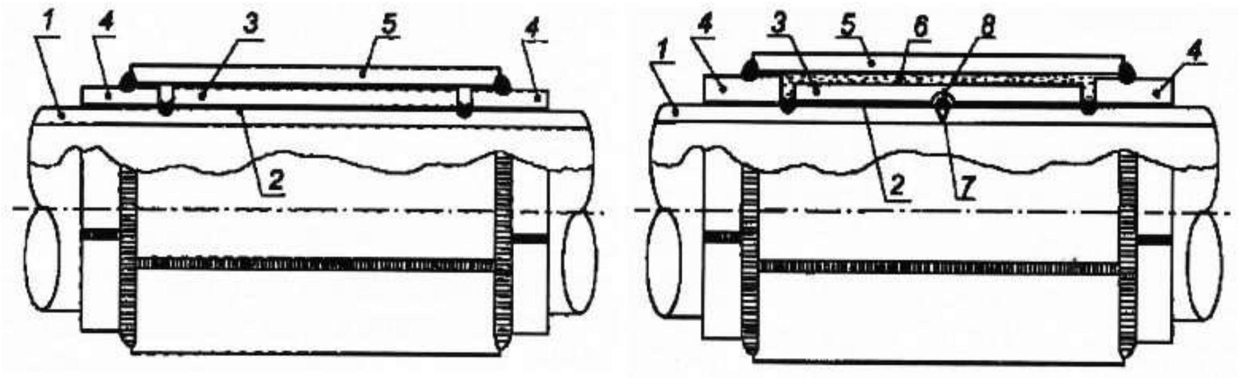

Figure 9: Double sleeve repair method, pat. #76390

1- Pipe repaired, 2- section with defect, 3 – inner sleeve, 4- rings, 5- reinforcing sleeve, 6- gastight self-hardening compound, 7- existing welding seam on repaired pipe, 8 – groove made on inner sleeve to accommodate the overhanging welding seam on the pipe surface.

This type of repair is used to reinforce the damaged section using additional inner sleeve. If the pipe section contains out-of-flat elements e.g. welding seam, which hinders tight contact of inner sleeve and repaired pipe a grove is made to accommodate such out of-flat-element. Similarly to methods described above, the space between inner and main sleeve is filled with self-hardening compound under pressure. This method allows compensating axial and radial forces acting on damaged pipe area.

Another type, suitable for repair of pipe having outstanding corrugation or defects on welding seams is shown below in Fig 10.:

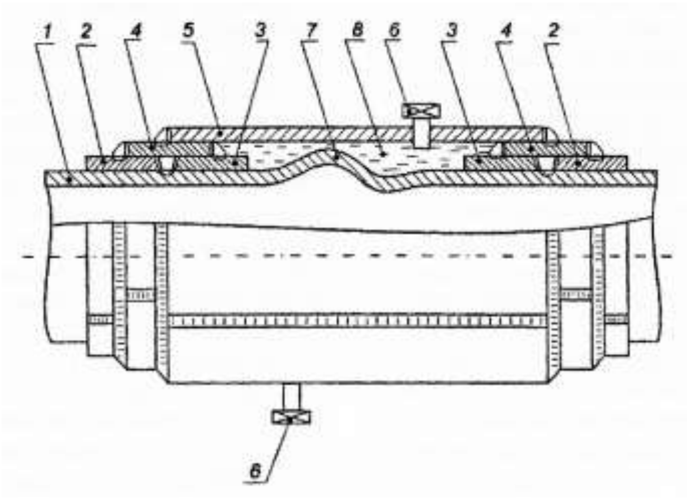

Figure 10: Tree layer sleeve repair method, pat #76391

1- pipe repaired, 2 and 3 – first layer of service rings, 4-second layer of rings, 5 – reinforcing folded sleeve, 6- tapping, 7 – corrugation, 8 – compound.

An important method was developed to repair an operating pipe having through-wall defect, for example leaking welding seam. In this case, application of welded sleeves is impossible due to safety reasons and alternative methods, like composite wrapping cannot fix the problem as well. The proposed repair method is shown in Fig.11 below:

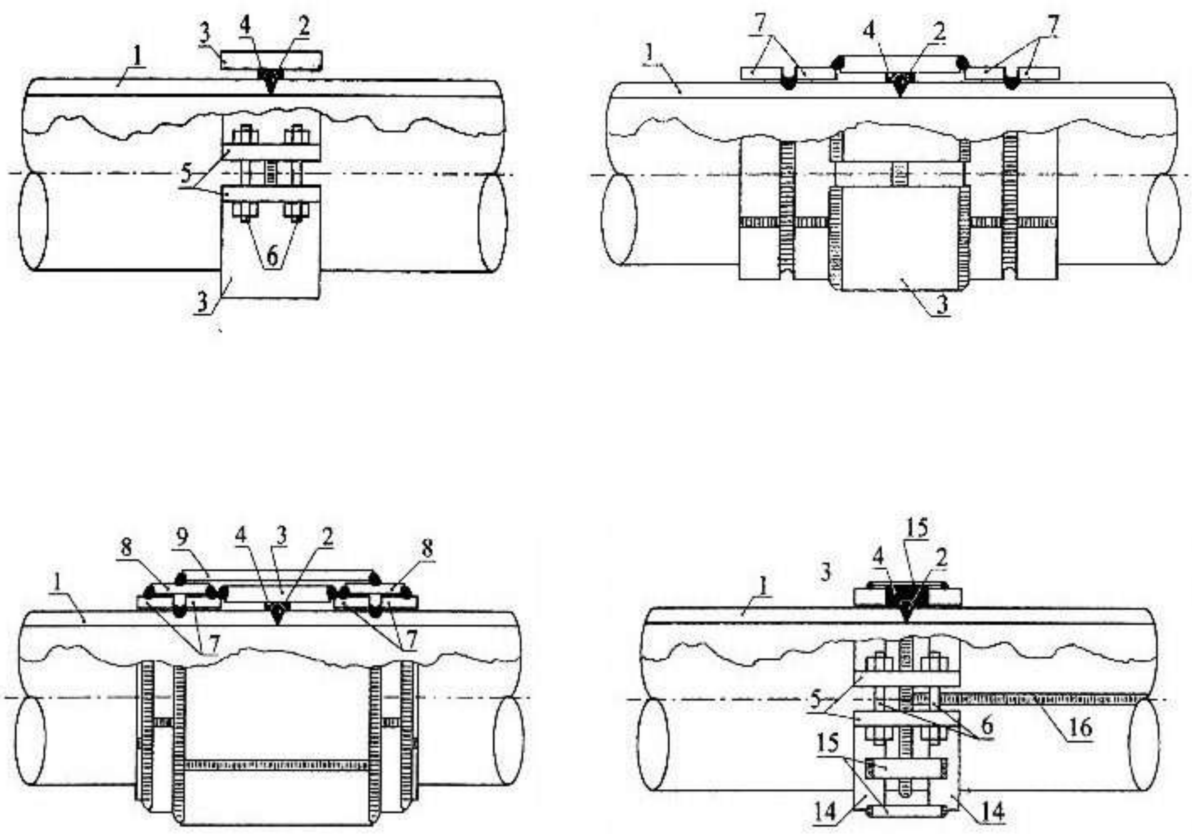

Figure 11: Method of leaking section repair (pat.# 77930)

1-repaired pipe, 2- welding seam having leak, 3- clamp, 4- gasket, 5 and 6 flange and bolts, 7-supplementary rings, 8- secondary rings, 9- main sleeve, 10 – bolt, 11- annular gasket, 12-supplementary tap, 13 – self-hardening compound, 14 – circular clamps, 15- connectors, 16- axial weld.

There are other types of sleeve based repair types like long sleeve (pat. # 78963 and 79417), sleeve assembly quality control ("blow down" sleeve, pat. # 82038), recovery of load capacity of linear and curved sections of operating pipeline (pat # 93789) and others.

Implementation of innovative joints repairs methods.

Along with invention and development of innovative sleeve repair methods for pipe sections Ukrtransgas in co-operation with company «Kiaton» developed a series of methods allowing to repair the leaking gaskets of joints, mainly flanged joints of high diameter taps and cranes, which allow not to stop the operation and not to disassemble the crane thus not venting the gas from it and adjacent pipeline sections. Ukrtransgas has several thousand ball taps of high diameter in operation. During normal operation the joint experience variable axial loads, pressure and temperature variations, forces occurring due to pipe inner survey operations with the use of "smart pigs"[17] as a result of which taps gaskets lose their sealing ability and leak occurs through it as shown in a Figure 12 below.

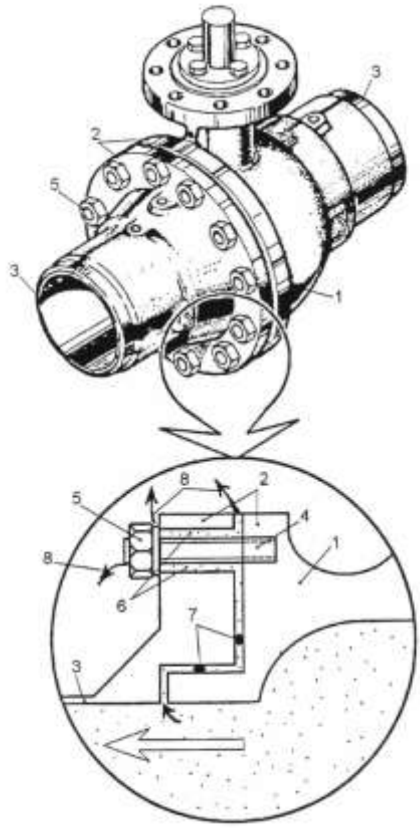

Figure 12: Tap design and leakage occurrence.
1- Body of the tap, 2- flange joint, 3 – pipeline, 4 – double-end-bolt, 5 – nut, 6 - inner space of stud joint, 7 – gaskets, 8- leaking gas.

[17] http://en.wikipedia.org/wiki/Pigging

Leak rate tends to grow over time and simple tightening the nuts gives just temporarily result. Known methods of leak elimination, like installation of new washer gaskets made of soft sealant or injection of sealing compound into the annular space around the bolt require removal the nuts one by one which in many cases are not possible (underground pipelines). Besides, these methods do not fix the leak completely.
To permanently stop the leak, replacement of the gasket must be made, which requires disassembling of the joint and venting the gas.
Innovative repair methods proposed allow repairing the gasket and stopping the leak using injection under high pressure of self-hardening compound into the gasket space. The principle of the method is illustrated in Fig.13 below:

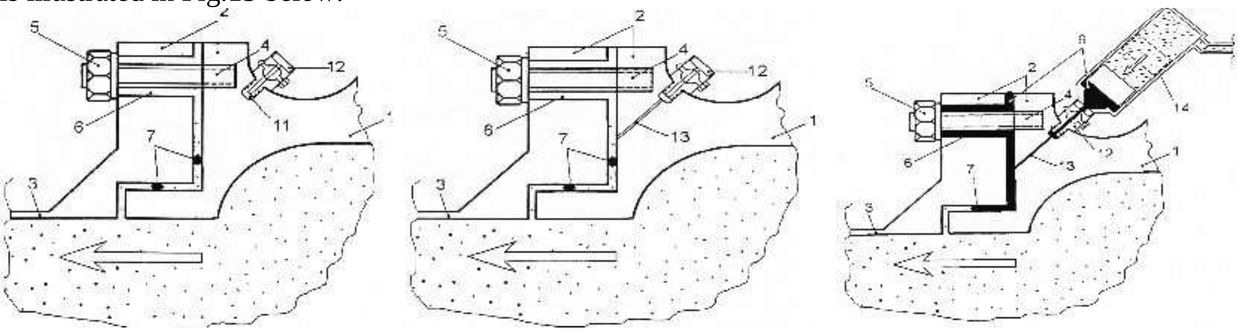

Figure 13: Method of elimination of leakages through flanged joints of taps without stopping the operation of the pipeline, pat. # 42619.

1 -Body of the tap, 2- flange, 3- pipe, 6- annular space around the bolt, 7 - gaskets, 9- self-hardening compound, 11 – blind bore where thread is made for service tap, 12 – service tap, 13 – injection bore, 14 – injector.

Application of the proposed method can be made on operating taps located in the ground. First the blind bore is made and thread is cut. Then service tap screwed in and a narrow bore 13 is made through the open tap. After it the injector 14 is connected to the service tap and self-hardening compound is injected under high pressure through the new channel. The compound is filling the whole space between the flanges and gets in the space 6 around the bolts. After hardening of the compound, the service tap can be removed and the serviceability of the joint is restored.

To secure better flooding of the gasket space a modification of the proposed method has been proposed in which is shown in Fig. 14 below:

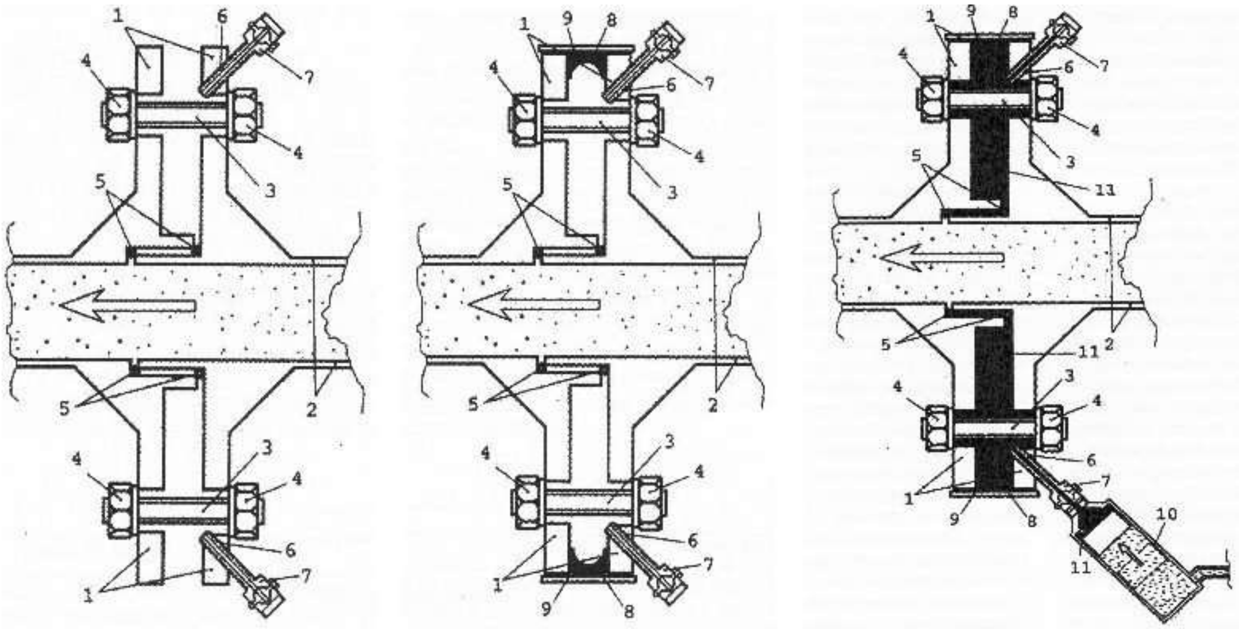

Figure 14: Repair of flange joint with the use of clamps, pat.# 59013

The improvement consists of installing gasket 9 and shroud ring 8 before the injection which helps preventing the spill-out of compound injected. The other details are similar to the previous method.

The number of repairs made using innovative methods has been growing over the years as shown in a table below:

Year	2005	2006	2007	2008	2009	2010	2011	2012
Number of repairs	<70	93	94	117	99	>116	150	160
Amount of gas saved, mln. m^3	71	98	100	106	105	122	>170	>170

Table 6. Number of repairs made using innovative methods over years, 2011 and on -forecasted

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

The proposed project is aimed at the reduction of anthropogenic emissions. Resulting emissions reductions are achieved by means of:
1. Reduction of CO2 emissions due to stationary combustion of NG in the compressor drives, auxiliary boilers and heaters through equipment replacement, modernization or retrofit;
2. Reduction of indirect CO2 emissions due to consumption of electricity by cathode protection systems from the Ukrainian power grid;
3. Reduction of direct methane emissions which are occurring due to blow down and venting of NG from pipeline sections under repair activities by implementation of innovative repair methods.
Achieving of reductions in GHG emissions would be impossible without implementation of the proposed project activity as described in A.2.

A.4.3.1. Estimated amount of emission reductions over the crediting period:

Period before 2008 for which emission reductions are estimated	Estimate of annual emission reductions in tones of CO_2

	equivalent
Length of the period within 2005-2007	3
Year 2005	1,070,050
Year 2006	1,774,042
Year 2007	2,118,758
Total estimated emission reductions over the period indicated (tones of CO2 equivalent)	4,962,850
Annual average of estimated emission reductions over the period within 2005-2007 (tones of CO2 equivalent)	1,654,283

Table 7. Estimated amount of emission reductions before the crediting period

	Years
Length of the crediting period within 2008-2012	5
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2008	2,490,959
Year 2009	2,132,051
Year 2010	2,546,891
Year 2011	2,627,966
Year 2012	2,729,323
Total estimated emission reductions over the crediting period (tones of CO2 equivalent) within 2008 – 2012	12,527,191
Annual average over estimated emission reductions over the crediting period within 2008-2012 (tones of CO2 equivalent)	2,505,438

Table 8. Estimated amount of emission reductions over the crediting period

Period after 2012 for which emission reductions are estimated	Estimate of annual emission reductions in tones of CO_2 equivalent
Length of the period within 2013-2020	8
Year 2013	2,871,000

Year 2014	2,871,000
Year 2015	2,871,000
Year 2016	2,871,000
Year 2017	2,871,000
Year 2018	2,871,000
Year 2019	2,871,000
Year 2020	2,871,000
Total estimated emission reductions over the period indicated (tones of CO2 equivalent)	22,968,000
Annual average of estimated emission reductions over the period within 2013-2020 (tones of CO2 equivalent)	2,871,000

Table 9: Estimated amount of emission reductions generated after the crediting period

A.5. Project approval by the Parties involved:

The Project Idea Note (PIN) has been submitted to the DFP (State Agency For environmental investments) on 10/12/2010. Letter of Endorsement (LoE) # 1893/23/7 has been issued by the DFP 21/07/2011 which is supporting the proposed project.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

Step 1: Indication and description of the approach chosen regarding baseline setting

A baseline for a JI project has to be set in accordance with Appendix B of the Annex to decision 9/CMP.1 (JI guidelines), and with the "Guidance on criteria for baseline setting and monitoring, version 0.2"[18] developed by the Joint Implementation Supervisory Committee (JISC) (hereinafter referred to as "Guidance").
For the proposed project, which consists of three groups of different subprojects aimed at saving of NG as fuel, saving of electricity and decreasing of methane emissions during repair and maintenance procedures no existing methodologies can be applied and the project participant has chosen the JI specific approaches regarding baseline setting and monitoring for each of subproject type or for a group of subprojects which have similar nature.
The baseline is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project[19]. Plausible future scenarios are identified and listed on the basis of conservative assumptions (paragraph 24 of the Guidance).

Baseline identification being applied through the following stepwise approach:

1. Identification of a baseline in accordance with the paragraphs 21 to 29 of the Guidance;
2. Additionality demonstration using the most recent version (05.2) of the "Tool for the demonstration and assessment of additionality";
3. Calculation of emissions in the baseline scenario.

Group 1 subprojects

Subproject 1.1

Step 2: Application of the approach chosen

Sub-step 2a: Identification and listing of plausible alternative baseline scenarios

Identification of a baseline for Group 1 subprojects will be based on the selection of the most plausible alternative scenarios. To identify all realistic and plausible alternatives, all options which are consistent with applicable laws and regulation were considered.

The following circumstances are taken into account when identifying the plausible alternative baseline scenarios:

- Operation of gas transmission system has to continue in safe and uninterrupted way in any circumstance. This is the highest priority for Ukrtransgas.
- There are (as of 2005) 692 gas compressors out of which 438 have gas turbine drives in operation at Ukrtransgas. In case of outage the drive must be repaired and returned into operation in shortest possible time.
- It is unrealistic and unlikely that under current financing the company would replace extensive number of them by new units.
- Under proper servicing and replacement of worn out parts the existing gas turbines can continue operating, though their efficiency is out-dated.

---

[18] http://ji.unfccc.int/Ref/Guida.html

[19] JI guidelines, appendix B

Alternative 1: to continue the existing practice, operate the existing units and provide required service to them to ensure their serviceability. This alternative represents the continuation of existing practice;

Alternative 2: to invest in replacement of existing low efficiency gas turbine drives by new ones of better efficiency, i.e. to implement the proposed subproject without being registered as JI activity.

These two realistic alternatives identified above are further described in details.

***Alternative 1**:*	*Operate the existing units and provide required service to them to ensure their serviceability*

Under this alternative the operation of the existing units would continue. Required service would be provided. In case of forced outages, the units would be repaired with the replacement of malfunctioning parts. This option represents the continuation of existing practice.

***Alternative 2**:*	*Replacement of the existing gas turbine drives by new ones having better efficiency.*

Under this alternative the existing units will be replaced by new ones of modern types and better thermal efficiency. It is unlikely that extensive number would be replaced at once, so the replacement could be conducted on one-by-one basis.
This alternative represents the proposed subprojects without being undertaken as JI activity.

Sub-step 2b: Assessment of the alternative scenarios

Assessment of Alternative 1: Operate the existing units and provide required service to them to ensure their serviceability
Under this alternative Ukrtransgas would continue operating its existing fleet of drives and provide necessary maintenance and repairs.Ukrtransgas has long and extensive experience in servicing the existing aged gas turbines. Supply of spares for these units is reliable; manufacturers continue producing them as a large fleet of these units' types is still used in many countries (mainly Russian Federation, Belorussia, Azerbaijan, Uzbekistan and others).
This alternative represents the continuation of existing practice. Implementation of Alternative 1 is realistic and credible.

Assessment of Alternative 2: Replacement of the existing gas turbine drives by new ones having better efficiency
As described in section A.4.2 there is a way to improve fuel efficiency of compressor stations by replacement of gas turbine drives by new ones having higher efficiency. This would allow to achieve saving of combustion gas. Only partial, case by case turbine replacement can be regarded as realistic way as the company is financially incapable to implement large replacement program at once. Ukrtransgas is operating and maintaining extensive and aging gas transmission system. Uninterrupted and safe operation of the system is regarded as the main task of the company. There is a serious lack of funding to provide major modernization of assets. Own financing is sufficient to cover only immediate maintenance and repair needs and is insufficient to fulfill any renovation program (estimated 2.5 to 4 bln. Euro or minimum 500 MEuro annually within next several years[20]).
This alternative would involve the implementation of the proposed project without taking into consideration any JI incentives.
From this point of view this alternative is attractive but, as further described in section B.2 it has long payback period and therefore is not attractive from financial point of view.

[20] http://www.ut.net.ua/Publication/2326 publication containing expert opinions and officials statements

Conclusion for subproject 1.1.
Alternative 1 – continuation of the existing turbine fleet in the only one feasible and credible alternative and it has been identified as the baseline scenario for the proposed Group 1.1 subproject. The emissions in the baseline are further described in sections B and D.

Demonstration of additionality for subproject 1.1.

Please, refer to section B.2 where additionality has been assessed.

Emissions in the baseline scenario

Baseline emissions

In order to calculate baseline emissions the project participant has chosen project specific approach as described below.

Theoretical description of the approach chosen for calculation of emissions in the baseline scenario for subproject 1.1.
In the baseline scenario the emissions occur due to combustion of fossil fuel (natural gas) in the gas turbine drives at compressor stations. Gas consumption in particular year y depends on thermal efficiency of turbine, its load and time of operation.

As actual efficiency of the gas turbine drive can differ from nominal (passport or nameplate) efficiency in function of actual turbine load during its operation in particular period, the actual or effective efficiencies are used instead of nominal ones.

To obtain actual or effective baseline efficiency $\eta^{e}_{bsl,i,y}$ the actual capacity factor[21] $K_{i,y}$ is monitored for drive i during year y. This factor is a ratio of average load during the year y to nominal capacity of the drive.

Efficiencies of the gas turbines of each type are measured during the performance testing which is carried over for each of the GT drives after its installation (of major overhaul), or can be periodically measured during its operation. The performance tests are carried out by an authorized service company in accordance with the standardized test methodology. Efficiency is defined as ratio of fuel energy consumed by the drive to the mechanical power at shaft. Taking into account several hundreds of gas turbines in operation and limited possibility to test all the turbines every year, the actual efficiencies can be calculated using nominal efficiency and monitored capacity factor in year y.

The following assumptions are used as well:

- Time of operation of i turbine in year y $\tau_{i,y}$ in the baseline scenario would be the same as the one in the project scenario;
- Baseline capacity factor for i turbine in year y would be the same as the one in the project scenario;
- Shaft capacity of i turbine is same for both, baseline and project scenarios.

$$BE_{y}^{1.1} = \sum_{i} BE_{i,y}^{1.1} \qquad (1)$$

Where:

[21] http://www.engineeringtoolbox.com/power-plant-efficiency-d_960.html

$BE^{1.1}_{y}$ is the baseline emissions of subproject 1.1 in year y (tCO2)
$BE^{1.1}_{i\,y}$ is the baseline emissions of *i* gas turbine drive in year y (tCO2)

$$BE^{1.1}_{i,y} = BFC_{i,y} \cdot EF_{ng} \qquad (2)$$

Where:

$BFC_{i,y}$ is the fuel energy which would be consumed by drive i in year y (GJ)
EF_{ng} is the carbon emission factor from combustion of natural gas (tCO2/GJ)

$$BFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta^{e}_{bsl,i,y}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \qquad (3)$$

Where:

$N_{n,i}$ is the nominal capacity of drive i (kW)
$K_{i,y}$ is the capacity factor of i drive in year y (d/less)
$\eta^{e}_{bsl,i,y}$ is the actual drive efficiency of i turbine in year y (d/less)
$\tau_{i,y}$ is the time in operation of drive i in year y (hours)
3600 is the conversion factor from kWh to kJ
10^{-6} is the conversion factor from kJ to GJ

The actual drive efficiency at nominal load is taken from most recent performance test report. If, for some reasons performance test was not conducted prior to replacement of the i-gas turbine, the passport efficiency at nominal load will be used.

In order to calculate the actual drive efficiency which can operate under different loads other than nominal the following formula is used which takes into account nominal efficiency and actual capacity factor in year y. The formula is derived from statistical data on gas turbine drive efficiency as function of its capacity factor [22]:

$$\eta^{e}_{bsl,i,y} = \eta^{n}_{bsl,i} \cdot \frac{K_{i,y}}{1 - 0.75 \cdot (1 - K_{i,y})} \qquad (4)$$

Where:

$\eta^{e}_{bsl,I,y}$ actual or effective baseline efficiency of i drive in year y (d/less)
$\eta^{n}_{bsl,i}$ nominal efficiency of I drive (d/less)
$K_{i,y}$ capacity factor of I drive in year y (d/less)

Key data used to establish the baseline are presented in tabular form below:

Data /Parameter	$\eta^{n}_{bsl,i}$

[22] See SD 3, p.8

Data unit	D/less
Description	Nominal or passport efficiency of i drive
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Passport (nameplate data) of i drive
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$\eta^{e}_{bsl,i,y}$
Data unit	D/less
Description	Actual efficiency of i drive in year y
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Technical report based on performance testing of i drive or calculation
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$K_{i,y}$
Data unit	d/less
Description	Capacity factor of i drive in year y
Time of determination/monitoring	annually

Source of data (to be) used	Compressor stations log, “Expert” software
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Capacity factor is being monitored constantly using compressor station (or particular drive) automatic control system, records are stored, annual average value reported for monitoring
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$\tau_{i,y}$
Data unit	hours
Description	Hours of operation of i drive in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Compressor station logs, “Expert” software
Value of data applied (for ex ante calculations/determinations)	See supporting document for data
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
OA/QC procedures (to be) applied	
Any comment	

Data /Parameter	EF_{ng}
Data unit	tCO2/GJ
Description	Default carbon emission factor from combustion of natural gas
Time of determination/monitoring	-
Source of data (to be) used	http://www.neia.gov.ua/nature/doccatalog/document?id=124939 p.376
Value of data applied (for ex ante	0.05548

calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	Country specific EF for NG combustion is available since 2011, see link to the source above. New value differs from the IPCC default (15.13 tC/TJ vs 15.3 tC/TJ). For practical use calculations it has been recalculated in tCO2/GJ

Subproject 1.2 Modernisation/retrofit of existing gas turbines to improve efficiency

Step 2: Application of the approach chosen

Sub-step 2a: Identification and listing of plausible alternative baseline scenarios

Identification of a baseline for subproject 1.2 will be based on the selection of the most plausible alternative scenarios. To identify all realistic and plausible alternatives, all options which are consistent with applicable laws and regulation were considered.

The following circumstances are taken into account when identifying the plausible alternative baseline scenarios:

- Operation of gas transmission system has to continue in safe and uninterrupted way in any circumstance. This is the highest priority for Ukrtransgas.
- There are (as of 2005) 692 gas compressors out of which 438 have gas turbine drives in operation at Ukrtransgas. In case of outage the drive must be repaired and returned into operation in shortest possible time.
- It is unrealistic and unlikely that under current financing the company would replace extensive number of them by new units.
- Under proper servicing and replacement of worn out parts the existing gas turbines can continue operating, though their efficiency is out-dated.
- There exist a number of technologies which allow increasing the efficiency of existing gas turbines or, at least restoring their efficiency by retrofitting packages.

Alternative 1: to continue the existing practice, operate the existing units and provide required service to them to ensure their serviceability. This alternative represents the continuation of existing practice;

Alternative 2: to invest in modernisation of existing low efficiency gas turbine drives by replacing certain parts by new ones in order to increase turbine, i.e. to implement the proposed subproject 1.2 without being registered as JI activity.

These two realistic alternatives identified above are further described in details.

***Alternative 1**:*	*Operate the existing units and provide required service to them to ensure their serviceability*

Under this alternative the operation of the existing units would continue. Required service would be provided. In case of forced outages, the units would be repaired with the replacement of malfunctioning parts by the parts of same type. This option represents the continuation of existing practice.

***Alternative 2**: Modernization of existing low efficiency gas turbine drives*

Under this alternative the existing units will be modernized or retrofitted with the aim to increase their efficiency. Some retrofit types can be rather expensive, for example full replacement of wheel space or replacement of regenerator. The resulting increase of efficiency, from other hand, can be very small, in most of cases within one to two percent.
This alternative represents the proposed subprojects without being undertaken as JI activity.

Sub-step 2b: Assessment of the alternative scenarios

Assessment of Alternative 1: Operate the existing units and provide required service to them to ensure their serviceability
Under this alternative Ukrtransgas would continue operating its existing fleet of drives and provide necessary maintenance and repairs.Ukrtransgas has long and extensive experience in servicing the existing aged gas turbines. Supply of spares for these units is reliable; manufacturers continue producing them as a large fleet of these units' types is still used in many countries (mainly Russian Federation, Belorussia, Azerbaijan, Uzbekistan and others). The most typical spare parts are produced using own Ukrtransgas repair divisions. Modernisation of old units will not be provided.
This alternative represents the continuation of existing practice. Implementation of **Alternative 1** is realistic and credible.

Assessment of Alternative 2: Modernization of the existing gas turbine drives
As described in section A.4.2 (subprojects 2.) there is a way to improve fuel efficiency of existing gas turbine drives by modernization or retrofit activities. This would allow to achieve saving of combustion gas. In most cases the modernization or retrofit is rather costly and the resulting efficiency increase is small.
This alternative would involve the implementation of the proposed subproject without taking into consideration any JI incentives.
This alternative is attractive but, as further described in section B.2 it has long payback period and therefore is not attractive from financial point of view.

Conclusion for subprojects 1.2.
Alternative 1 – continuation of operation of the existing turbine fleet in the only one feasible and credible alternative and it has been identified as the baseline scenario for the proposed Group 1.1 subproject. The emissions in the baseline are further described in sections B and D.

Demonstration of additionality for subprojects 1.2.

Please, refer to section B.2 where additionality has been assessed.

Emissions in the baseline scenario for 1.2 subprojects

In order to calculate baseline emissions the project participant has chosen project specific approach as described below.

Theoretical description of the approach chosen for calculation of emissions in the baseline scenario for subprojects 1.2.
In the baseline scenario the emissions occur due to combustion of fossil fuel (natural gas) in the gas turbine drives at compressor stations. Gas consumption in particular year y depends on thermal efficiency of turbine, its load and time of operation. Replacement of outdated elements of gas turbine by new resulting in better efficiency allows saving gas fuel and reducing GHG emissions.

As actual efficiency of the gas turbine drive can differ from nominal (passport or nameplate) efficiency in function of actual turbine load during its operation in particular period, the actual or effective efficiencies are used instead of nominal ones.

To obtain actual or effective baseline efficiency $\eta^{e}_{bsl,i,y}$ the actual capacity factor[23] $K_{i,y}$ is monitored for drive i during year y. This factor is a ratio of average load during the year y to nominal capacity of the drive. Operation of all gas turbine drives is monitored by special monitoring software "Expert" and the capacity factor of each drive can be easily obtained for each period of interest.

Efficiencies of the gas turbines of each type are measured during the performance testing which is carried over for each of the GT drives after its installation (major overhaul or retrofit), or can be periodically measured during its operation. The performance tests are carried out by an authorized service company in accordance with the standardized test methodology. Efficiency is defined as ratio of fuel energy consumed by the drive to the mechanical power at shaft. Taking into account several hundreds of gas turbines in operation and limited possibility to test all the turbines every year, the actual efficiencies can be calculated using nominal (passport) efficiency and monitored real capacity factor in year y.

The following assumptions are used as well:

- Time of operation of i turbine in year y $\tau_{i,y}$ in the baseline scenario would be the same as the one in the project scenario;
- Baseline capacity factor for i turbine in year y would be the same as the one in the project scenario;
- Shaft capacity of i turbine is not changed by modernization/retrofit and is taken as same for both, baseline and project scenarios.
- Natural degradation of efficiency is not taken into account. As old type drives efficiency can fall faster than that of a drive passed modernization activity, this assumption is conservative.
- Similarly to the subproject 1.1, it is has not been taken into account that drives of new design have lower specific power consumption used by its auxiliaries (controls, fans, oil pumps). This assumption is conservative as well.

$$BE_{y}^{1.2} = \sum_{i} BE_{i,y}^{1.2} \qquad (5)$$

Where:

$BE^{1.2}_{y}$ is the baseline emissions of subproject 1.2 in year y (tCO2)

$BE^{1.2}_{i,y}$ is the baseline emissions of *i* gas turbine drive in year y(tCO2)

$$BE_{i,y}^{1.2} = BFC_{i,y} \cdot EF_{ng} \qquad (6)$$

Where:

$BFC_{i,y}$ is the fuel energy which would be consumed by drive i in year y (GJ)

EF_{ng} is the carbon emission factor from combustion of natural gas (tCO2/GJ)

[23] http://www.engineeringtoolbox.com/power-plant-efficiency-d_960.html

$$BFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta^{e}_{bsl,i,y}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \qquad (7)$$

Where:

$N_{n,i}$	is the nominal capacity of drive i (kW)
$K_{i,y}$	is the capacity factor of i drive in year y (d/less)
$\eta^{e}_{bsl,i,y}$	is the actual thermal efficiency of i turbine in year y (d/less)
$\tau_{i,y}$	is the time in operation of drive i in year y (hours)
3600	is the conversion factor from kWh to kJ
10^{-6}	is the conversion factor from kJ to GJ

The actual drive efficiency at nominal capacity is taken from most recent performance test report. If, for some reasons performance test was not conducted prior to replacement of i- gas turbine, the actual baseline efficiency at nominal load will be taken from passport of the drive.

In order to calculate the actual efficiency of the drive which can operate under different loads other than nominal the following formula is used which takes into account nominal efficiency and actual capacity factor in year y:

$$\eta^{e}_{bsl,i,y} = \eta^{n}_{bsl,i} \cdot \frac{K_{i,y}}{1 - 0.75 \cdot (1 - K_{i,y})} \qquad (8)$$

Where:

$\eta^{e}_{bsl,I,y}$	actual or effective baseline efficiency of i drive in year y (d/less)
$\eta^{n}_{bsl,i}$	nominal efficiency of I drive (d/less)
$K_{i,y}$	capacity factor of I drive in year y (d/less)

Key data used to establish the baseline for subprojects 1.2 are presented in tabular form below:

Data /Parameter	$\eta^{n}_{bsl,i}$
Data unit	D/less
Description	Nominal or passport efficiency of i drive
Time of determination/monitoring	Fixed ex-ante prior to implementation
Source of data (to be) used	Passport (nameplate data) of i drive, as alternative, result of most recent direct performance test, if performed for i drive
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be)	

applied	
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$\eta^{e}_{bsl,i,y}$
Data unit	D/less
Description	Actual efficiency of i drive in year y
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Technical report of performance testing of i gas turbine drive or calculation
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$K_{i,y}$
Data unit	D/less
Description	Capacity factor of i drive in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Compressor stations log books, “Expert” software
Value of data applied (for ex ante calculations/determinations)	See supporting documents
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Capacity factor is being monitored constantly using compressor station (of particular drive) automatic control system, records are stored, annual average value reported for monitoring
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$\tau_{i,y}$
Data unit	Hours
Description	Hours of operation of i drive in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Compressor station logs, "Expert" software
Value of data applied (for ex ante calculations/determinations)	See supporting document for data
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	EF_{ng}
Data unit	tCO2/GJ
Description	Default carbon emission factor from combustion of natural gas
Time of determination/monitoring	-
Source of data (to be) used	http://www.neia.gov.ua/nature/doccatalog/document?id=124939 p.376
Value of data applied (for ex ante calculations/determinations)	0.05548
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	Country specific EF for NG combustion is available since 2011, see link to the source above. New value differs from the IPCC default (15.13 tC/TJ vs 15.3 tC/TJ). For practical use calculations it has been recalculated in tCO2/GJ

Subproject 1.3 Installation of heat recovery boilers at the exhaust of gas turbines

Step 2: Application of the approach chosen

Sub-step 2a: Identification and listing of plausible alternative baseline scenarios

Identification of a baseline for subproject 1.3 will be based on the selection of the most plausible alternative scenarios. To identify all realistic and plausible alternatives, all options which are consistent with applicable laws and regulation were considered.

To identify the plausible baseline scenarios for subproject 1.3 the following circumstances have been taken into account:

- There are over 70 compressor stations in operation as of 2005; most of all have low heat demand (space heating and sanitary hot water). At these stations heat demand can be covered by small size individual boilers as usually;
- There are a limited number of compressor stations where heat demand is much larger, as certain infrastructure is located near or within their borders. Such large heat consumers are: repair and service divisions of Ukrtransgas, dwellings, greenhouses e.t.c. historically connected to the compressor stations. Their heat demand is covered by existing heating boilers firing natural gas. These boilers belong to Ukrtransgas.
- There is excessive waste heat energy originating from gas turbines exhaust.

Alternative 1: continuation of existing practice and usage of gas fired heating boilers;

Alternative 2: investing in heat recovery boilers at gas turbine exhaust to replace gas fired boilers at some compressor station where heat demand is large. Existing gas fired boilers would be put in reserve, i.e. to implement the proposed subproject 1.3 without being registered as JI activity.

The two identified realistic alternatives are further described in details.

Alternative 1*: Continuation of existing practice and usage of gas fired heating boilers*

Under this alternative no heat recovery boilers would be installed at the exhaust of gas turbine drives and the large heat demand at some compressor stations would be covered by existing gas fired boilers. This alternative represents the continuation of existing practice.

Alternative 2*: Investing in heat recovery boilers at gas turbine exhaust to replace gas fired boilers*

Under this alternative the heat demand at some compressor station where heat demand is large would be covered by heat recovery boilers which use exhaust heat from operating gas turbine drives. Existing gas fired boilers would be put in reserve. Thus, the production of heat in heat recovery boilers would require less gas to be fired and will result in lower GHG emissions. This alternative represents the implementation of the proposed subproject 1.3 without being registered as JI activity.

Sub-step 2b: Assessment of the alternative scenarios

Assessment of Alternative 1: Continuation of existing practice and usage of gas fired heating boilers
Usage of existing gas fired boilers to cover the heat demand of compressor plant site and adjacent consumers can be regarded as realistic and credible alternative. Gas fired boilers are simple and robust equipment requiring little maintenance. When the lifetime of them expires, they are replaced with the new ones of same or similar type available on the market.

Assessment of Alternative 2: Investing in heat recovery boilers at gas turbine exhaust to replace gas fired boilers

Where site heat demand is large a heat recovery boiler could replace gas fired boilers. Heat produced due to exhaust recovery would reduce the amount of gas combusted in existing boilers. Installation of heat recovery boilers at GT exhaust is technically possible for most of types of GTs used, however the efficiency of turbine drops as the boiler introduce additional pressure drop across the turbines exhaust. This can to some extent reduce saving of gas. This alternative, representing the proposed subproject 1.3 without JI incentive can be regarded as realistic. As further described in section B.2 it is not attractive from financial point of view and is excluded from consideration.

Conclusion for subproject 1.3.

Alternative 1 which consists in continuation of heat production using existing gas fired boilers remains the only one feasible alternative. It has been selected as the baseline scenario for the proposed subproject 1.3. The emissions in the baseline are further described in section B and D.

Demonstration of additionality for subproject 1.3.

Please refer to section B.2.

Emissions in the baseline scenario for subproject 1.3.

In order to estimate emissions in the baseline scenario for subproject 1.3 the project participant has choses project specific approach as further described below.

Theoretical description of the approach chosen for calculation of emissions in the baseline scenario for subprojects 1.3.

In the baseline scenario emissions occur due to combustion of natural gas in the existing boilers which supply heat to consumers. In the project scenario this heat is generated by heat recovery boilers using waste heat.

The amount of gas combusted in the baseline is calculated assuming that the gas fired boilers would produce the same amount of heat as was produced by heat recovery boilers.

$$BE_y^{1.3} = \sum_i BE_{i,y}^{1.3} \qquad (9)$$

Where:

$BE^{1.3}_y$ Emissions in the baseline from subproject 1.3 in year y (tCO_2)

$BE^{1.3}_{i,y}$ Emissions in the baseline from boiler i- in year y (tCO_2)

$$BE_{i,y}^{1.3} = \frac{Q_{i,y}}{\eta_i} \cdot EF_{ng} \cdot 4.187 \qquad (10)$$

Where:

$Q_{i,y}$ Amount of heat produced which would be produced by old boiler in year y (Gcal)

η_i Efficiency of old i-boiler (d/less)

EF_{ng} Carbon emission factor for combustion of natural gas (tCO_2/GJ)

4,187 Conversion factor from Gcal into GJ

Key data used to establish the baseline for subproject 1.3 are presented in tabular form below:

Data /Parameter	$Q_{i,y}$
Data unit	Gcal
Description	Quantity of produced energy by GT exhaust heat recovery i-boiler in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Compressor station logs
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	η_i
Data unit	d/less
Description	Efficiency of heat boiler plant on i CS
Time of determination/monitoring	Fixed ex-ante prior to implementation
Source of data (to be) used	Report of heat engineering inspection/boiler passport data
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	EF_{ng}
Data unit	tCO2/GJ
Description	Default carbon emission factor from combustion

	of natural gas
Time of determination/monitoring	The most recent available EF will be used
Source of data (to be) used	http://www.neia.gov.ua/nature/doccatalog/document?id=124939 p.376
Value of data applied (for ex ante calculations/determinations)	0.05548
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	Country specific EF for NG combustion is available since 2011, see link to the source above. New value differs from the IPCC default (15.13 tC/TJ vs 15.3 tC/TJ). For practical use calculations it has been recalculated in tCO2/GJ

Subproject 2. Modernization of cathode protection system of underground pipelines

Step 2: Application of the approach chosen

Sub-step 2a: Identification and listing of plausible alternative baseline scenarios

Identification of a baseline for subproject 2. will be based on the selection of the most plausible alternative scenarios. To identify all realistic and plausible alternatives, all options which are consistent with applicable laws and regulation were considered.

> **Alternative 1**: to continue the existing practice and operate the existing cathode protection systems with existing underground anodes;
>
> **Alternative 2**: to invest in modernisation of underground anodes in order to reduce their electrical resistance, i.e. to implement the proposed subproject 2 without being registered as JI activity.

***Alternative 1**:*	To operate the existing cathode protection system with existing underground anodes

***Alternative 2**:*	To invest in modernisation of underground anodes

Sub-step 2b: Assessment of the alternative scenarios

Assessment of Alternative 1:

Under this alternative Ukrtransgas would continue operating numerous (over 4000 systems) cathode protection systems. Due to high electrical resistance of underground anodes more electricity would be consumed. This electricity is included in operation cost of Ukrtransgas as other costs are. There is no regulation in force which would oblige Ukrtransgas to use better or more efficient cathode protection systems, as soon as they perform the required protection functions. This alternative represents the continuation of existing practice. Implementation of it is realistic and credible.

Assessment of Alternative 2: Modernization of the underground anodes
Under this alternative the existing underground anodes would be replaced by new ones having lower resistance. Consumption of electricity will be lower.
This alternative would involve the implementation of proposed subproject 2. without any JI incentive. This alternative is realistic but, as shown in section B.2. it is not attractive from financial point of view.

Conclusion for subproject 2.
As described above, Alternative 1 which consists in continuation of existing practice remains the only feasible and credible alternative. It has been identified as the baseline scenario for subproject 2.

Demonstration of additionality for subprojects 2.

Please, refer to section B.2 where additionality has been assessed.

Emissions in the baseline scenario for 2. subprojects

In order to calculate emissions in the baseline the project participants has selected project specific approach as described further in details.

Theoretical approach selected to estimate the baseline emissions
In the baseline scenario indirect grid emissions occur due to consumption of electricity by cathode protection systems. Electric power is used to maintain difference of potential between gas pipeline (cathode) and protective anodes. Consumption of electricity by particular cathode protection system depends on electric current and voltage. The value of current is primary and depends on the state of insulation of pipeline and its lengths. Voltage in the protection system depends on the selected current and resistance in the loop. Without the proposed project (replacement of electrodes by better having lower solubility and transition resistance) there would be necessary to keep higher voltage and thus to consume more electricity from grid. To calculate the consumption in the baseline scenario the electric resistance prior to project implementation is being fixed for each cathode protection.

The following assumption has been made:

- The value of current can vary over time in function of the state of pipeline insulation.
- The value of current is equal in project and baseline scenario for each i-system, as current defines protection level;
- Electric resistance in the baseline is taken constant. This assumption is conservative as transition resistance tends to grow over time.

$$BE_y^2 = \sum_i BE_{i,y}^2 \qquad (11)$$

Where:
$BE^{2.}_{y}$ Baseline emissions for subproject 2. in year y (tCO2)
$BE^{2.}_{i,y}$ Emissions in the baseline for i-cathode protection system in year y (tCO2)

$$BE_{i,y}^2 = BEL_{i,y} \cdot EF_{ee,y} \cdot 10^{-3} \qquad (12)$$

Where:

$BEL_{i,y}$	Baseline consumption of electricity from i-cathode protection system in year y (kWh)
$EF_{ee,y}$	Standardized Ukrainian grid emission factor for consumption of electricity in year y (kgCO2/kWh)
10^{-3}	Conversion factor from kgCO2 into tCO2

$$BEL_{i,y} = \frac{U_{bsl,i,y} \cdot I_{proj,i,y}}{\eta_i} \cdot \frac{\tau_{i,y}}{1000} \qquad (13)$$

Where:

$U_{bsl,i,y}$	Baseline voltage in the loop of i-cathode protection system in year y (V)
$I_{proj,i,y}$	Current in the loop of i-cathode protection system in year y (A)
η_i	Efficiency of the AC/DC converter of i- cathode protection system (d/less)
$\tau_{i,y}$	Is the number of hours of operation of i-cathode protection system in year y(hours)
1000	Conversion factor from Wh into kWh

To calculate the voltage which would be in the baseline scenario the following formulae is used:

$$U_{bsl,i,y} = R_{bsl,i} \cdot I_{proj,i,y}, \qquad (14)$$

Where:

$U_{bsl,i,y}$	Baseline voltage in i-system in year y (V)
$R_{bsl,i}$	Baseline resistance in i-system (Ohm)
$I_{proj,i,y}$	Current in i-system in year y (A)

Baseline resistance is calculated using the Ohm law taking the voltage and current which were in the i-system prior to implementation of subproject 2:

$$R_{bsl,i} = \frac{U_i}{I_i} \qquad (15)$$

Where:

$R_{bsl,i}$	Baseline resistance in the -system (Ohm)
U_i	Voltage in i-system prior to subproject implementation (V)
I_i	Current in i-system prior to subproject implementation (A)

The key data and parameters used to establish the baseline are presented in tabular form below:

Data /Parameter	$R_{bsl,i}$
Data unit	Ohm
Description	Resistance in i-cathode protection system
Time of determination/monitoring	Fixed ex-ante prior to implementation
Source of data (to be) used	Passport of i- system
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$I_{proj,i,y}$
Data unit	A
Description	Current in the loop of i-cathode protection system in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Passport of i- system
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$\tau_{i,y}$
Data unit	hours
Description	Is the number of hours of operation of i-cathode protection system in year y
Time of determination/monitoring	Annually
Source of data (to be) used	Estimated ex-ante
Value of data applied (for ex ante calculations/determinations)	*8760*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	Cathode protection systems operate constantly

Data /Parameter	η_i
Data unit	D/less
Description	Efficiency of the AC/DC converter of i- cathode protection system
Time of determination/monitoring	Fixed ex-ante prior to implementation
Source of data (to be) used	Passport of AC/DC converter
Value of data applied (for ex ante calculations/determinations)	-
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data /Parameter	$EF_{ee,y}$
Data unit	kgCO2/kWh
Description	Standardized Ukrainian grid emission factor for consumption of electricity
Time of determination/monitoring	Periodically until 2007, annually from 2008
Source of data (to be) used	See Annex 5 PDD
Value of data applied (for ex ante calculations/determinations)	See Annex 5 for values for different years
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Group 3 subprojects

Step 2: Application of the approach chosen for Group 3 subprojects

Sub-step 2a: Identification and listing of plausible alternative baseline scenarios

Identification of a baseline for Group 3 subprojects will be based on the selection of the most plausible alternative scenarios. To identify all realistic and plausible alternatives, all options which are consistent with applicable laws and regulation were considered.

There can be up to several hundred pipeline deficiencies in the gas transmission system found annually which require repair. In case of identification of high pressure pipeline deficiency which has to be repaired Ukrtransgas has the following three options:

- **Alternative 1**: to vent the gas from pipe section, then cut the deficient pipe section and weld in a new pipe;
- **Alternative 2**: to apply an innovative repair method which would allow to permanently repair the deficiency without stopping pipeline operation and not releasing gas from it, i.e. to implement the proposed subproject without being registered as JI activity;
- **Alternative 3:** to use mobile compressors stations to pump out the gas contained in the repaired sections into adjacent pipelines prior to start the repair.

These three realistic alternatives identified above are further described in details.

***Alternative 1**: Cutting the deficient pipe section and welding in a new pipe.*

Under this alternative the operation of the pipeline is stopped, repaired section with deficiency is isolated by taps on its ends and containing high pressure gas from it is released into the atmosphere. Then the repair can be conducted, which consists of cutting the entire piece of pipe and welding in a new one. This option represents the continuation of existing and predominant repair practice; moreover this type of repair was prescribed at the time prior to the proposed group of sub- project start.

***Alternative 2**: Application of innovative pipeline repair methods which would allow repairing the deficient pipe without stopping its operation and without venting the gas.*

This alternative constitutes in application of new and innovative pipeline repair methods (special single and multi-layer sleeves and pressurization with the use of injection of self-hardening compound). The proposed innovative repair methods are described in section A.4.2. They allow not to vent the gas prior to repair.
This alternative represents the proposed subprojects without being undertaken as JI activity.

***Alternative 3**:*	*Usage of mobile compressors stations, which would pump out the gas contained in the repaired sections to adjacent pipelines prior to start the repair.*

This alternative constitutes of purchase of a number of mobile compressor stations which would be used to evacuate the gas from the pipeline section prior to its repair. The gas would be pumped in adjacent pipelines and thus the venting can be avoided. The mobile compressor station represents a gas engine driven mobile high pressure gas booster, having capacity of several hundred kW and mounted on a trailer to provide possibility to access remote locations along the transmission pipelines[24].

Sub-step 2b: Assessment of the alternative scenarios

Ukrtransgas is operating and maintaining extensive and aging gas transmission system. Uninterrupted and safe operation of the system is regarded as the main task of the company. There is a serious lack of funding to provide major modernization of assets. Own financing is sufficient to cover only immediate maintenance and repair needs and is insufficient to fulfill any renovation program (estimated 2.5 to 4 bln. Euro or minimum 500 MEuro annually within next several years).

Assessment of Alternative 1: Cutting the deficient pipe section and welding in a new pipe

This alternative assumes release of gas contained in the pipe into the atmosphere prior to repair. When pipeline or tap repair is required, venting of gas prior to repair is not restricted and the amount of gas released due to it is accounted as maintenance loss.

It represents the continuation of existing and predominant repair practice.
Selection of repair method depends mainly on the safety reasons. In all cases full replacement of damaged pipeline is considered as safe and permanent repair method, therefore, implementation of **Alternative 1** is realistic and credible.

Assessment of Alternative 2: Application of innovative pipeline repair methods which would allow repairing the deficient pipe without stopping its operation and without venting the gas

This alternative would involve the implementation of the proposed project without taking into consideration any JI incentives associated with the ability to transfer ERUs. It would allow saving the gas otherwise being released prior to repair.

From this point of view this alternative is attractive but, as further described in section B.2 it is facing prohibitive barriers.

---

24 http://www.bureauveritas.com/wps/wcm/connect/f7f723804d83b50eb3cfbb4478e3bcf8/JI_PDD_MCS_25+03+2009.pdf?MOD=AJPERES&CACHEID=f7f723804d83b50eb3cfbb4478e3bcf8

Assessment of Alternative 3: Usage of mobile compressors stations to pump out the gas contained in the repaired sections into adjacent pipelines prior to start the repair

This alternative would consist of purchase of a number of mobile compressors mounted on trailers. The minimum number of mobile compressors would be 6 (to have one for each of 6 Ukrtransgas divisions). Assuming that one unit can cost within 2 to 3 MEuro, cost of this alternative can be conservatively (not taking into account import duties and fees) estimated as 10 to 15 MEuro. Implementation of this alternative falls beyond the current financing capabilities of Ukrtransgas and can be only implemented using governmental or international financing.
Therefore, this alternative is technically possible but not realistic under current situation.

Conclusion for Group 3 subprojects
Alternative 1 in the only one feasible and credible alternative and it has been identified as the baseline scenario for the proposed Group 3 subproject. The emissions in the baseline are further described in section D.

Demonstration of additionality for group 3 subprojects

Please, refer to section B.2 where additionality has been assessed.

Emissions in the baseline scenario

Option (b) of Annex 2 of Guidance on criteria for baseline setting and monitoring[25] has been selected to monitor the emission reductions from Group 3 subprojects which foresee direct monitoring of resulting emission reductions. Therefore separate calculations of emissions in the baseline scenario will not be conducted. Please, refer to section D.1.2

[25] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

The proposed project consists of three groups of subprojects as described in section A.4.2. Each group unites different subprojects which are similar by nature or principle. Assessment of additionality has been provided for each subproject or group of subprojects if applicable. In order to demonstrate that the sub-project or its group provides reductions in emissions by sources that are additional to any that would otherwise occur, the following step-wise approach was used for each of them:

Assessment of additionality for Group 1 subprojects

Indication and description of the approach chosen
For Group 1 subproject the latest version of the CDM Executive Board approved "Tool for the demonstration and assessment of additionality" Version 05.2[26] has been applied to show that the reductions of anthropogenic emissions of the greenhouse gases are reduced below those that would have otherwise occurred. The tool has been applied in accordance with the JISC Guidance on Criteria for Baseline Setting and Monitoring, version02.
Group 1 consists of subprojects aimed at increase of natural gas combustion efficiency in gas turbine drives at compressor stations. The measures include:

i. either entire replacement of existing turbine by a new one (subproject 1.1), or
ii. Modernization of the gas turbine driven compressor unit by replacing its elements by new ones resulting in increase of efficiency or retrofitting (subproject 1.2).

All the individual measures under subproject 1.1 have identical nature (turbine replacement) and typically result in nominal efficiency increase within some 3 to 8% in function of engine type. There were 13 turbine replacements made within the period of 2005-2010. Among three replacement made in 2005, a case was selected with consisted in replacement of GTN-25 by new turbine type DN-80 (UGT-25000) to establish a baseline. This case represents the most favourable situation for payback as it foresees the highest efficiency increase among others. Other cases would represent less efficient measures. Additionality of this case was assessed as further described in B.2. The result with good certainty can be extended to other individual turbine replacements in 1.1.

Same approach was proposed for assessment of additionality of subproject 1.2 and has been applied further below in B.2.

Application of the approach chosen

Subproject 1.1.

Step 1. Identification of alternatives to the proposed project activity

Sub-step 1a: Define alternatives to the project activity:
Please refer to section B.1 in which the two feasible and credible alternatives have been identified: Alternative 1: Operation the existing units and provide required service to them to ensure their serviceability and Alternative 2: Replacement of the existing turbines by new ones with higher efficiency. Alternative 2 represents the proposed subproject not undertaken as JI.

Sub-step 1b: Consistency with mandatory laws and regulations:
Both identified alternatives fully conforms the existing regulative framework in force. Continuation of

[26] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf Hereinafter referred to as Additionality Tool

usage of existing drive fleet is allowed, as soon as required service is provided and safety norms are respected. Similarly, if the replacement is foreseen, new unit has to be designed and operated in conformance with all applicable norms and regulations. There are no obligatory norms that would enforce the owner to do it.

Outcome of Step 1: At least one realistic and credible alternative scenario have been identified to the project activity that is in compliance with mandatory legislation and regulations taking into account the enforcement in Ukraine.

Step 2. Investment analysis
The purpose of the investment analysis is to determine whether the proposed project activity is not:

a) The most economically or financially attractive; or

b) Economically or financially feasible, without the revenue from the sale of emission reductions.

The investment analysis has been carried out by the project participants in accordance with the Additionality Tool's Annex: Guidance on the Assessment of Investment Analysis: (Version 05.2).

Sub-step 2a. Determination of the analysis method
The proposed sub-project generates cost savings, so cost analysis (sub-step 2b Option III) of the Additionality Tool can be used.

In line with the CDM Additionality Tool version 05.2 Option III – benchmark analysis – has been chosen. The project participants have chosen to use project NPV as the assessment indicator. In order to select a proper benchmark for the indicator chosen project participants have assessed options contained in the Additionality Tool.

The (4) approach of the Option III was selected. Project participants have taken the average commercial lending rates from the statistics of the National Bank of Ukraine[27] relevant for the decision taking context of this project and have used it to calculate real discount rate[28] for cash flow calculation.

Sub-step 2b. Application of the benchmark analysis
NPV was selected as a sub-project benchmark. It means that project owner would not consider the investment if the project is generating cash flow with negative NPV.

Sub-step 2c. Calculation and comparison of the indicators
The project's cash flow was calculated using the following assumptions:

- The benchmark is the project net present value (NPV)
- Cash flow calculation was made for the period 2005-2019 (15 years) to reflect the minimum expected lifetime of new equipment (gas turbine)
- The fair value of project activity assets has been applied in the calculations. Conservatively, it was estimated as 10 times current cost of stainless steel alloy scrap.
- Real discount rate was calculated using nominal rate of 15.5% corrected for average inflation during four years preceding the subproject start (6.5%).
- Capacity factor of 0.7 and 8000 hours of turbine operation a year was taken for the calculation. This is conservative, as real turbine load at compressor station is lower than that.

[27] http://www.bank.gov.ua/Statist/Electronic%20bulletin/data/4-Financial%20markets(4.1).xls

[28] Real discount rate calculated using average inflation for 2001-2004 from http://www.ukrstat.gov.ua/

- Actual turbine efficiencies were used which were obtained from nominal efficiencies corrected for the capacity factor.

The resulting project NPV **is -3,077,823** UAH if no JI income is regarded. If the JI revenue is taken into account, the NPV would become positive: **1,764,660** UAH. Taking this into consideration, the project would not have been attractive without JI incentive.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out to assess the impact of fluctuation of the most important factors: investment cost and gas tariff.

The following scenarios were considered*:*

- *Scenario 1* – Investment cost down 10%;
- *Scenario 2* – Fuel price up 10%.

The results for the sensitivity analysis are shown in table below:

Scenario 1	**Scenario 2**
NPV (UAH)	NPV (UAH)
-161,156	**-557,784**

Table 10: Scenarios in sensitivity analysis for 1.1 Subproject

Scenario 1 represents the most favourable course for this energy efficiency project attractiveness as lowering the investment cost would increase the project financial indicators. Even in this case the project NPV stays below zero. This confirms that the calculation of the project financial indicators is robust to the changes in the key input parameters.

Outcome of Step 2: It is concluded that the proposed JI sub-project is unlikely to be financially/economically attractive. Proceeding to Step 4 (Common practice analysis).

Step 3. Barrier analysis (optional)

Not applicable.

Step 4. Common practice analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity:

Ukrainian gas transmission system is lacking investments and only episodic replacement of gas turbines can be observed. Only 10% of existing gas turbines fleet consists of new modern units installed over past 20 years. The rest of fleet is consists of old type and low efficiency units, which are, however still operational. There are several industry renovation plans which foresee large scale replacement, but, due to continuing absence of financing they remain on paper.
From this point of view the conclusion can be made that the proposed activity is not a common practice in the industry.

Sub-step 4b: Discuss any similar Options that are occurring:

As shown in the previous sub-step similar activities are not widely observed and are not commonly carried out.

Due to abovementioned the conclusion can be made that the proposed JI activity is not common practice in Ukrainian gas sector.

Conclusion: This JI subproject (1.1) provides a reduction in emissions that is additional to any that would otherwise occur.

Subproject 1.2.

Step 1. Identification of alternatives to the proposed project activity
Individual measures in subproject 1.2 as described in section A.4.2 are aimed at increase of GT efficiency by retrofitting the turbine or by replacement of different items of a GT cycle with improved elements. The turbine remains the same. Therefore, as proposed in section B.1 additionality of subproject 1.2 will be demonstrated using the case of typical individual measure. The result with good certainty can be extrapolated to all identical individual measures in subproject 1.2.

Sub-step 1a: Define alternatives to the project activity:
Please refer to section B.1 in which the two feasible and credible alternatives for subproject 1.2 have been identified: Alternative 1: to continue the existing practice, operate the existing units and provide required service to them to ensure their serviceability. This alternative represents the continuation of existing practice and Alternative 2: to invest in modernisation of existing low efficiency gas turbine drives by replacing certain parts of it by new ones in order to increase its efficiency, i.e. to implement the proposed subproject 1.2 without being registered as JI activity.

Sub-step 1b: Consistency with mandatory laws and regulations:
Both identified alternatives fully conforms the existing regulative framework in force. Continuation of usage of existing practice as well as partial modernisation of existing drive fleet is allowed, as soon as required service is provided and safety norms are respected.

Outcome of Step 1: At least one realistic and credible alternative scenario have been identified to the proposed sub-projects 1.2 activity that is in compliance with mandatory legislation and regulations taking into account the enforcement in Ukraine.

Step 2. Investment analysis for subproject 1.2
The purpose of the investment analysis is to determine whether the proposed project activity is not:

c) The most economically or financially attractive; or

d) Economically or financially feasible, without the revenue from the sale of emission reductions.

The investment analysis has been carried out by the project participants in accordance with the Additionality Tool's Annex: Guidance on the Assessment of Investment Analysis: (Version 02).
The subproject 1.2 is assessed by performing the cash flow analysis.

Sub-step 2a. Determination of the analysis method
The proposed 1.2 sub-project results in cost saving (fuel would be saved), so cost analysis (sub-step 2b Option III) of the Additionality Tool has been selected.

In line with the CDM Additionality Tool version 05.2 Option III – benchmark analysis – has been chosen. The project participants have chosen to use project NPV as the assessment indicator. In order to select a proper benchmark for the indicator chosen project participants have assessed options contained in the Additionality Tool.

The (4) approach of the Option III was selected. Project participants have taken the average commercial lending rates from the statistics of the National Bank of Ukraine[29] relevant for the decision taking context of this project and have used it to calculate real discount rate[30] for cash flow calculation.

Sub-step 2b. Application of the benchmark analysis

NPV was selected as a sub-project benchmark. It means that project owner would not consider the investment if the project is generating cash flow with negative NPV. For information, the NPV is calculated as well to see if and how the expected JI revenue would improve the indicator.

Sub-step 2c. Calculation and comparison of the indicators

The project's cash flow was calculated using the following assumptions:

- The benchmark is the sub-project net present value (NPV)
- Cash flow calculation was made for the period 2005-2019 (15 years) to reflect the expected lifetime of retrofitted gas turbine.
- Three cash flow calculations were made for three most typical turbine retrofits or modernization: for 6 MW unit GT-750-6; for 10 MW GTK-10-I and GTK-10.
- The fair values of project activity assets have been applied in the calculations. Conservatively, it was estimated as current cost of steel or steel alloy scrap of equipment installed.
- Real discount rate was calculated using nominal rate of 15.5% and average inflation during four years preceding the subproject start (6.5%).
- Capacity factor of 0.7 and 6000 hours of turbine operation a year was taken for the calculation. This is conservative, as real turbine load at compressor station is lower.
- Actual turbine efficiencies were used which were obtained from nominal efficiencies (obtained at most recent performance testing) corrected for the capacity factor.

The result is presented in a tabular form below:

Subproject 1.2	NPV base case	NPV with JI revenue
1. Retrofit/modernisation of GT-750-6	-401,355	330,935
2. Retrofit/modernisation of GTK-10-I	-4,522,098	-3,254,319
3. Retrofit/modernisation of GTK-10	-454,994	378,961

Table 11: Calculation of NPV for subproject 1.2

Taking this into consideration, the project would not have been attractive without JI incentive. The case of GTK-10-I shows that NPV stays always negative. This can be explained by the fact that this turbine has more expensive spare parts since it is imported equipment, while the rest machines are of local manufacture.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out to assess the impact of fluctuation of the most important factors: investment cost and gas tariff.

The following scenarios were considered*:*

[29] http://www.bank.gov.ua/Statist/Electronic%20bulletin/data/4-Financial%20markets(4.1).xls

[30] Real discount rate calculated using average inflation for 2001-2004 from http://www.ukrstat.gov.ua/

- *Scenario 1* – Investment cost down 10%;
- *Scenario 2* – Fuel price up 10%.

The results for the sensitivity analysis are shown in table below:

Subproject 1.2 typical cases	Scenario 1	Scenario 2
1. Retrofit/modernisation of GT-750-6	11,645	-30,860
2. Retrofit/modernisation of GTK-10-I	-3,426,098	-3,324,675
3. Retrofit/modernisation of GTK-10	14,806	-33,062

Table 12: Scenarios in sensitivity analysis for sub-group subprojects 1.2

Scenarios 1and 2 represent the most favourable course for all energy efficiency projects attractiveness as lowering the investment cost or increasing the fuel tariff would improve the project financial indicators. This confirms that the calculation of the project financial indicators is robust to the changes in the key input parameters.

Outcome of Step 2: It is concluded that the proposed sub-project is unlikely to be financially or economically attractive. Proceeding to Step 4 (Common practice analysis).

Step 3. Barrier analysis (optional)

Not applicable.

Step 4. Common practice analysis for subproject 1.2

Sub-step 4a: Analyse other activities similar to the proposed project activity:

Ukrainian gas transmission system is lacking investments and only episodic replacement of gas turbines can be observed. Only 10% of existing gas turbines fleet consists of new modern units installed over past 20 years. The rest of fleet is consists of old type and low efficiency units, which are, however still operational. There are several industry renovation plans which foresee large scale replacement, but, due to continuing absence of financing they remain on paper.
From this point of view the conclusion can be made that the proposed activity is not a common practice in the industry.

Sub-step 4b: Discuss any similar Options that are occurring:

As shown in the previous sub-step similar activities are not widely observed and are not commonly carried out.

Due to abovementioned the conclusion can be made that the proposed JI activity is not common practice in Ukrainian gas sector.

Conclusion: This JI subproject (1.2) provides a reduction in emissions that is additional to any that would otherwise occur.

Subproject 1.3.

Step 1. Identification of alternatives to the proposed project activity
Individual measures in subproject 1.3 as described in section A.4.2 are aimed at decrease of amount of natural gas combusted in heating boilers. Therefore, as proposed in section B.1 additionality of subproject 1.3 will be demonstrated using the case of typical individual measure. The result with good certainty can be extrapolated to all identical individual measures in subproject 1.3.

Sub-step 1a: Define alternatives to the project activity:

Please refer to section B.1 in which the two feasible and credible alternatives for subproject 1.3 have been identified: **Alternative 1**: continuation of existing practice and usage of gas fired heating boilers;
Alternative 2: investing in heat recovery boilers at gas turbine exhaust to replace gas fired boilers at some compressor station where heat demand is large. Existing gas fired boilers would be put in reserve, i.e. to implement the proposed subproject 1.3 without being registered as JI activity.

Sub-step 1b: Consistency with mandatory laws and regulations:
Both identified alternatives fully conforms the existing regulative framework in force. Continuation of usage of existing practice as well as installation of heat recovery boilers at turbine exhaust is allowed, as soon as required service is provided and safety norms are respected.

Outcome of Step 1: At least one realistic and credible alternative scenario have been identified to the proposed sub-projects 1.3 activity that is in compliance with mandatory legislation and regulations taking into account the enforcement in Ukraine.

Step 2. Investment analysis for subproject 1.3
The purpose of the investment analysis is to determine whether the proposed project activity is not:

e) The most economically or financially attractive; or

f) Economically or financially feasible, without the revenue from the sale of emission reductions.

The investment analysis has been carried out by the project participants in accordance with the Additionality Tool's Annex: Guidance on the Assessment of Investment Analysis: (Version 02).
The subproject 1.2 is assessed by performing the cash flow analysis.

Sub-step 2a. Determination of the analysis method
The proposed 1.2 sub-project results in cost saving (fuel would be saved at boilers), so cost analysis (sub-step 2b Option III) of the Additionality Tool has been selected.

In line with the CDM Additionality Tool version 05.2 Option III – benchmark analysis – has been chosen. The project participants have chosen to use project NPV as the assessment indicator. In order to select a proper benchmark for the indicator chosen project participants have assessed options contained in the Additionality Tool.

The (4) approach of the Option III was selected. Project participants have taken the average commercial lending rates from the statistics of the National Bank of Ukraine[31] relevant for the decision taking context of this project and have used it to calculate real discount rate[32] for cash flow calculation.

Sub-step 2b. Application of the benchmark analysis
NPV was selected as a sub-project benchmark. It means that project owner would not consider the investment if the project is generating cash flow with negative NPV. For information, the NPV is calculated as well to see if and how the expected JI revenue would improve the indicator.

Sub-step 2c. Calculation and comparison of the indicators
The project's cash flow was calculated using the following assumptions:

---

[31] http://www.bank.gov.ua/Statist/Electronic%20bulletin/data/4-Financial%20markets(4.1).xls

[32] Real discount rate calculated using average inflation for 2001-2004 from http://www.ukrstat.gov.ua/

- The benchmark is the sub-project net present value (NPV)
- Cash flow calculation was made for the period 2005-2019 (15 years) to reflect the expected lifetime of retrofitted gas turbine.
- The fair values of project activity assets have been applied in the calculations. Conservatively, it was estimated as current cost of steel or steel alloy scrap of equipment installed.
- Real discount rate was calculated using nominal rate of 15.5% and average inflation during four years preceding the subproject start (6.5%).
- Turbine efficiency deterioration due to boiler installation has been taken into account.
- Conservative value of replaced boiler efficiency was taken

The result is presented in a tabular form below:

Subproject 1.3	NPV base case	NPV with JI revenue
Installation of heat recovery boiler at GT exhaust	-1,066,980	-109,468

Table 13: Calculation of NPV for subproject 1.3

Taking this into consideration, the project would not have been attractive without JI incentive, which greatly increases the NPV.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out to assess the impact of fluctuation of the most important factors: investment cost and gas tariff.

The following scenarios were considered*:*

- *Scenario 1* – Investment cost down 10%;
- *Scenario 2* – Fuel price up 10%.

The results for the sensitivity analysis are shown in table below:

Subproject 1.3	Scenario 1	Scenario 2
Installation of heat recovery boiler at GT exhaust	-416,980	-582,908

Table 14: Scenarios in sensitivity analysis for sub-group subproject 1.3

Scenarios 1and 2 represent the most favourable course for all energy efficiency projects attractiveness as lowering the investment cost or increasing the fuel tariff would improve the project financial indicators. This confirms that the calculation of the project financial indicators is robust to the changes in the key input parameters.

Outcome of Step 2: It is concluded that the proposed sub-project is unlikely to be financially or economically attractive. Proceeding to Step 4 (Common practice analysis).

Step 3. Barrier analysis (optional)

Not applicable.

Step 4. Common practice analysis for subproject 1.3

Sub-step 4a: Analyse other activities similar to the proposed project activity:
Usage of heat recovery boilers installed at gas turbines exhaust is not a common practice in Ukrainian gas transmission system.
From this point of view the conclusion can be made that the proposed activity is not a common practice in the industry.

Sub-step 4b: Discuss any similar Options that are occurring:

As shown in the previous sub-step similar activities are not widely observed and are not commonly carried out.

Due to abovementioned the conclusion can be made that the proposed JI activity is not common practice in Ukrainian gas sector.

Conclusion: This JI subproject (1.3) provides a reduction in emissions that is additional to any that would otherwise occur.

Assessment of additionality for Group 2 subprojects

Subproject 2.

Step 1. Identification of alternatives to the proposed project activity
Individual measures in subproject 2. as described in section A.4.2 are aimed at decrease of amount of electricity consumed by numerous cathode protection systems from the grid. Therefore, as proposed in section B.1 additionality of subproject 2. can be demonstrated using the case of typical individual measure. The result with good certainty can be extrapolated to all identical individual measures in subproject 2.

Sub-step 1a: Define alternatives to the project activity:

Please refer to section B.1 in which the two feasible and credible alternatives for subproject 2. have been identified:

> **Alternative 1**: to continue the existing practice and operate the existing cathode protection systems with existing underground anodes;
>
> **Alternative 2**: to invest in modernisation of underground anodes in order to reduce their electrical resistance, i.e. to implement the proposed subproject 2 without being registered as JI activity.

Sub-step 1b: Consistency with mandatory laws and regulations:
Both identified alternatives fully conforms the existing regulative framework in force. Continuation of usage of existing practice as well as modernization of anodes by replacement of them by better materials having lower solubility is not restricted, as soon as required service is provided and safety norms are respected.

Outcome of Step 1: At least one realistic and credible alternative scenario have been identified to the proposed sub-project 2. activity that is in compliance with mandatory legislation and regulations taking into account the enforcement in Ukraine.

Step 2. Investment analysis for subproject 2.
The purpose of the investment analysis is to determine whether the proposed project activity is not:

g) The most economically or financially attractive; or

h) Economically or financially feasible, without the revenue from the sale of emission reductions.

The investment analysis has been carried out by the project participants in accordance with the Additionality Tool's Annex: Guidance on the Assessment of Investment Analysis: (Version 02).
The subproject 2 is assessed by performing the cash flow analysis.

Sub-step 2a. Determination of the analysis method
The proposed 2 sub-project results in cost saving (fuel would be saved at boilers), so cost analysis (sub-step 2b Option III) of the Additionality Tool has been selected.

In line with the CDM Additionality Tool version 05.2 Option III – benchmark analysis – has been chosen. The project participants have chosen to use project NPV as the assessment indicator. In order to select a proper benchmark for the indicator chosen project participants have assessed options contained in the Additionality Tool.

The (4) approach of the Option III was selected. Project participants have taken the average commercial lending rates from the statistics of the National Bank of Ukraine[33] relevant for the decision taking context of this project and have used it to calculate real discount rate[34] for cash flow calculation.

Sub-step 2b. Application of the benchmark analysis
NPV was selected as a sub-project benchmark. It means that project owner would not consider the investment if the project is generating cash flow with negative NPV. For information, the NPV is calculated as well to see if and how the expected JI revenue would improve the indicator.

Sub-step 2c. Calculation and comparison of the indicators
The project's cash flow was calculated using the following assumptions:

- The benchmark is the sub-project net present value (NPV)
- Cash flow calculation was made for the period 2005-2019 (15 years) to reflect the expected lifetime of retrofitted gas turbine.
- The fair values of project activity assets have been applied in the calculations. Conservatively, it was estimated as current cost of steel or steel alloy scrap of equipment installed.
- Real discount rate was calculated using nominal rate of 15.5% and average inflation during four years preceding the subproject start (6.5%).
- Conservative case was selected in which power consumption was reduced by minimum observed value. In other measures consumption decrease was greater (2 to 5 times).

The result is presented in a tabular form below:

Subproject 2	NPV base case	NPV with JI revenue
Modernization of anodes at cathode protection systems	-9,217	799

Table 15: Calculation of NPV for subproject 2.

Taking this into consideration, the project would not have been attractive without JI incentive.

[33] http://www.bank.gov.ua/Statist/Electronic%20bulletin/data/4-Financial%20markets(4.1).xls

[34] Real discount rate calculated using average inflation for 2001-2004 from http://www.ukrstat.gov.ua/

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out to assess the impact of fluctuation of the most important factors: investment cost and gas tariff.

The following scenarios were considered:

- *Scenario 1* – Investment cost down 10%;
- *Scenario 2* – Fuel price up 10%.

The results for the sensitivity analysis are shown in table below:

Subproject 2.	Scenario 1	Scenario 2
Modernization of anodes at cathode protection systems	-3,217	-4,790

Table 16: Scenarios in sensitivity analysis for sub-group subproject2.13

Scenarios 1and 2 represent the most favourable course for all energy efficiency projects attractiveness as lowering the investment cost or increasing the fuel tariff would improve the project financial indicators. This confirms that the calculation of the project financial indicators is robust to the changes in the key input parameters.

<u>*Outcome of Step 2*</u>: It is concluded that the proposed sub-project is unlikely to be financially or economically attractive. Proceeding to Step 4 (Common practice analysis).

Step 3. Barrier analysis (optional)

Not applicable.

Step 4. Common practice analysis for subproject 2.

Sub-step 4a: Analyse other activities similar to the proposed project activity:
Usage of advanced anodes in pipeline cathode protection system is not a common practice in Ukrainian gas transmission system. Steel pipes or rails made of conventional steel are mostly used.
From this point of view the conclusion can be made that the proposed activity is not a common practice in the industry.

Sub-step 4b: Discuss any similar Options that are occurring:

As shown in the previous sub-step similar activities are not widely observed and are not commonly carried out.

Due to abovementioned the conclusion can be made that the proposed JI activity is not common practice in Ukrainian gas sector.

Conclusion: This JI subproject (2) provides a reduction in emissions that is additional to any that would otherwise occur.

Assessment of additionality for Group 3 subprojects

STEP 1. Indication and description of the approach chosen
The latest version of the CDM Executive Board approved "Tool for the demonstration and assessment of additionality" Version 05.2[35] has been applied to show that the reductions of anthropogenic emissions of the greenhouse gases are reduced below those that would have otherwise occurred. The tool has been applied in accordance with the JISC Guidance on Criteria for Baseline Setting and Monitoring.

STEP 2. Application of the approach chosen

Step 1. Identification of alternatives to the proposed project activity

Sub-step 1a: Define alternatives to the project activity

Please refer to section B.1 in which the three alternatives have been identified. Two of them: Alternative 1: Cutting the deficient pipe section and welding in a new pipe, which represent the continuation of the existing practice and Alternative 2: Proposed Group 3 subprojects not undertaken as JI were deemed the feasible and credible alternatives.

Sub-step 1b: Consistency with mandatory laws and regulations:

Alternative 1 does not contradict any existing law and regulation in force as it was the only available and prescribed repair method.
Alternative 2 complies the safety regulations as well as long as safety of repair work is safeguarded and the method demonstrates that it can permanently fix the deficiency.
Evacuating of gas from pipeline with the use of mobile compressor and pumping it to another high pressure pipeline conforms the safety regulations as well, on condition that safety precautions are fulfilled, so **Alternative 3** conforms the applicable regulations as well. But there is no regulation that would oblige the pipeline operator to use any innovative repair method.

Outcome of Step 1: At least one realistic and credible alternative scenario have been identified to the project activity that is in compliance with mandatory legislation and regulations taking into account the enforcement in Ukraine.

Step 2. Investment analysis

Optional. Not applicable for **Group 3 subprojects**. Please, refer to step 3: Barrier analysis.

Step 3. Barrier analysis

Under this step the determination has been made that the proposed project activity faces barriers that:

a) Prevent the implementation of this type of project activity; and
b) Do not prevent the implementation of at least one of the alternatives.

The proposed Group 3 project activity consists of implementation of innovative pipeline and taps repair and reinforcing methods which allow for repairing the corroded or mechanically damaged pipes, weld seams, including ones having gas leaks by the use of specially designed prefabricated split sleeves and

---

[35] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf Hereinafter referred to as Additionality Tool

rings between the repaired pipe and the sleeve and further injection under high pressure of special self-hardening compound into the space formed between the pipe outer surface and inner surface of the sleeve. The proposed repair method includes a series of standardized repair designs suitable for permanent repair of various types of pipe deficiencies like cracks, scratches, corroded areas, other areas of wall metal loss, leaking weld seams etc. For repair of taps a series of standardized solutions has been proposed which use the injection of special self-hardening compound into the gasket space of a tap under high pressure. The details of proposed methods are described in section A.4.2.

Sub-step 3a: Identify barriers that would prevent the implementation of proposed JI/CDM project activity

a) **Investment barriers**, other than the economic / financial barriers identified in Step 2 above.

b) **Technological barriers**
the issue of reliable and in the same time simple enough to be suitable for large-scale application repair techniques for high pressure pipelines is of greatest importance for Ukrtransgas which is operating an extensive system of 36.5 thousands km long pipelines. The average annual number of pipeline repairs of this type is roughly one hundred and tends to grow over recent years.
Absence of reliable technology for permanent repairs of high pressure pipelines without stopping the production releasing the gas required development of own repair technology.
It must comply with safety regulations which are setting a number of requirements to which the repair method has to comply. In practice, only damaged pipe section replacement was regarded at that time as fully conforming standard method from safety point of view. This solution is not restricted by existing regulations and laws and is not only predominant, but the only prescribed and only one in force in time prior to the proposed project start.

The following barriers have been identified which prevent the implementation of the proposed project

- **Development barriers**. Development of a new technology requires lengthy period of time and availability of R&D resources, besides dedicated financing. Normally, manufacturers or service providers, which possess own R&D develop the new technologies rather than the gas transmission companies, like Ukrtransgas. Creation of innovative repair methods required several years of preparatory and approbation work, during which a number of patents was obtained[36] for different design types of sleeves, compound filler and application methods (patents UA # 42619, 59012A, 59013, 68311, 72840, 75859, 76390, 76391, 77930, 77931, 78963, 79417, 81894, 81895, 82038, 93789)[37]. Also please, refer to Annex 4 Patents obtained for pipe repair methods.
- **Labor skills/training sufficiency to apply the new repair methods**. Skills to use new repair methods did not exist prior to project implementation. Usage of new repair methods, allowing not releasing gas and keeping its pressure in the pipeline under repair, or repair the section with gas leakage or repair the operating tap can represent unacceptably high risk of malfunctioning of repaired pipe section. In addition, carrying out a repair of leaking pipe section, which is possible with new technology, can represent higher risk as to compare with traditional method, under which the pipe is emptied prior to repair.

---

[36] In collaboration with E.O. Paton electric welding institute: http://paton.org.ua/eng/inst/inst.html and scientific company NPIP "Kiaton": http://users.iptelecom.net.ua/~kiaton/kiaton1.html

[37] Patents can be found at http://base.ukrpatent.org/searchINV

- **Approval and recognition barriers.** Any new and especially innovative repair technology faces recognition and approval barriers: it must be demonstrated that reliable engineering tests and analyses has been carried out proving that the method proposed can permanently[38] restore the serviceability of the pipe and that its application is safe. In the case of proposed Group 3 subprojects (innovative pipeline and tap repair methods) it took several years to create optimal design of sleeves and application routine.

c) **Barriers due to prevailing practice** (first of its kind, inter alia)
Safety regulations[39]s which were in force in the beginning of 2000-s require release of gas from the pipeline section prior to repair. In general the permanent repair methods were limited to replacement of damaged or leaking pipe section as long as it is concerns the high pressure gas transmission pipelines. Alternative repair method which uses full encirclement sleeve welded over the damaged section was allowed as well, but has serious disadvantages: they cannot be used to repair in case of gas leak and, secondly, they do not provide close tolerance surface contact to the damaged pipe section, not allowing to relieve forces acting on damaged section. Usage of other methods was restricted or limited. For instance, in USA, a country with developed gas infrastructure, usage of innovative high pressure gas pipelines repair methods was restricted by law until beginning of 2000s.

Taking into account the abovementioned, it can be considered that the proposed Group 3 subprojects can be regarded as “first of its kind”.

The barriers described above make the implementation and further usage of proposed innovative pipe repair methods difficult and risky.

Sub-step 3b: **Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except for the proposed project activity):**

The identified barriers do not prevent application of at least one of the alternatives which is the Alternative 1: traditional and prescribed method of cutting off the damaged section and welding a new pipe section instead. This method is not affected by any of the identified barriers listed above.

Step 4. Common practice analysis

As demonstrated in Sub-step 3a the proposed project is “first-of-its-kind”. Therefore Step 4 is not used.

Conclusion

The proposed JI project activity (subproject 3) is not common practice and is “first-of-its-kind” in the industry.
Registration of the proposed JI activity would alleviate technological barriers and risks to the project.

---

[38] Permanently can be described as “until the full replacement of pipeline by new one under scheduled major repair, whenever it occurs in the future”, i.e. not setting the durability limit for the repair made.

[39] The following standards are describing the methods of repair and safety requirements: VSN 006-89 Welding; NPAOP 0.005.11-85 Standard instruction on safety of gas dangerous work; Standard instruction on safety of hot-fire work on gas containing items of DK Ukrtransgas; NPAOP 1.1.23-1.03-04 Gas transmission pipelines safety rules (2004). It will be available for AIE as supporting document.

The proposed JI activity provides a reduction in emissions that is additional to any that would otherwise occur.

B.3. Description of how the definition of the project boundary is applied to the project:

Application of proposed project boundary is based on the following definition:

"In case of a JI project aimed at reducing emissions the project boundary shall:

(a) Encompass all anthropogenic emissions by sources of GHG which are:
   i. Under the control of the project participants;
   ii. Reasonably attributable to the project; and
   iii. Significant……."

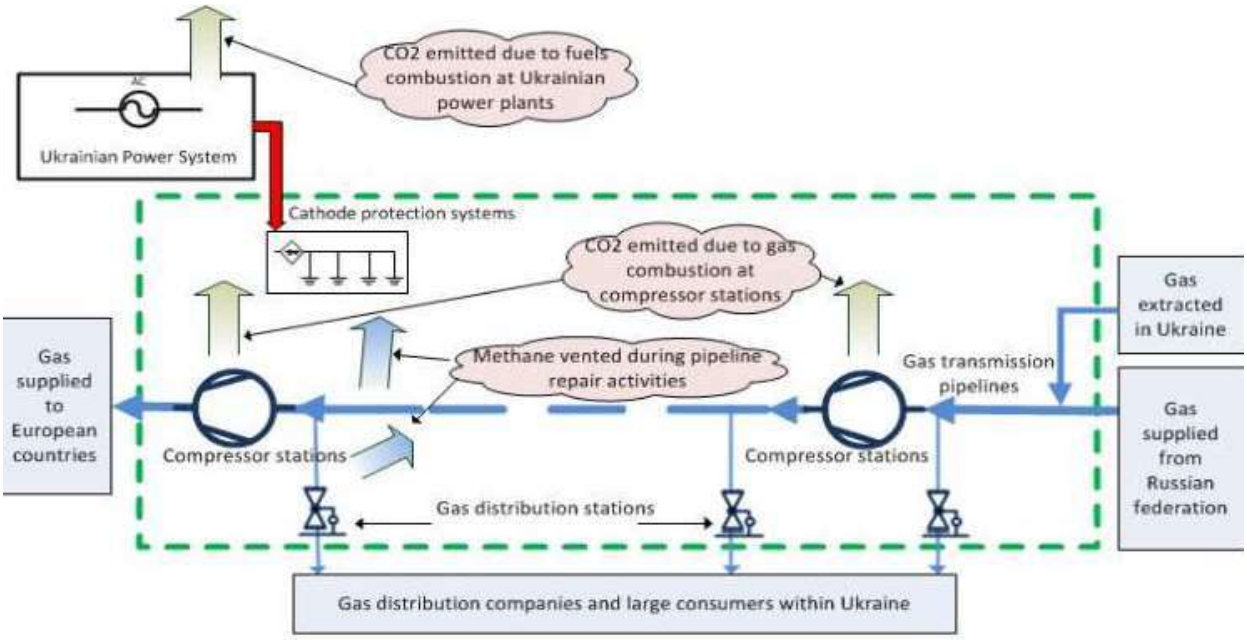

Figure 15: Project borders and emission sources

Some sources have been excluded from the project boundary:

1. Fugitive methane emissions occurring due to:
   - Leakages in taps, valves and joints of pipelines;
2. Emissions of methane due to venting of gas at compressor stations;
   - Venting of gas due to shutdown of equipment (i.e. prescribed venting of gas from equipment and piping at compressor station when the compressors are stopped for any reason);
   - Venting of gas under routine purging of dryers, separators e.t.c.

These emission sources are not attributable to the proposed project, however are to a great extent under control of the project participant.

	Source	**Gas**			**Justification/Explanation**
Baseline	Combustion of natural gas in the compressor drives	CO_2	Direct	Included	CO_2 is the main emission source
		CH_4	Indirect	Excluded	Excluded for simplification as minor source.
		N_2O	Direct	Excluded	Excluded for simplification as minor source.
	Consumption of electricity from Ukrainian grid by cathode protection systems	CO_2	Indirect	Included	Main emission source
	Venting of methane due to pipeline or tap repair activities	CH_4	Direct	Included	Main emission source
	Fugitive methane emissions due to leakages in joints, taps etc.	CH_4	Direct	Excluded	Not attributable to the proposed project
	Venting of methane at compressor stations due to shutdown of equipment and due to routine purging	CH_4	Direct	Excluded	Not attributable to the proposed project
Project	Combustion of natural gas in the compressor drives	CO_2	Direct	Included	CO2 is the main emission source
		CH_4	Indirect	Excluded	Excluded for simplification as minor source.
		N_2O	Direct	Excluded	Excluded for simplification as minor source.
	Consumption of electricity from Ukrainian grid by cathode protection systems	CO_2	Indirect	Included	Main emission source
	Venting of methane due to pipeline or tap repair activities	CH_4	Direct	Included	Main emission source
	Fugitive methane emissions due to leakages in joints, taps etc.	CH_4	Direct	Excluded	Not attributable to the proposed project
	Venting of methane at compressor stations due to shutdown of equipment and due to routine purging	CH_4	Direct	Excluded	Not attributable to the proposed project

Table 17: Sources of emissions

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of completion of the baseline study: 18/08/2011

Name of person/entity setting the baseline:

- Alexey Doumik, Project manager at SIA Vidzeme EKO.

Vidzeme EKO is the project participant listed in Annex 1.

See Annex 1 for detailed contact information.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

19/01/2005.

C.2. Expected operational lifetime of the project:

At least until 2020. The implemented measures provided proper maintenance can be operational at least for 10 years or 120 months.

C.3. Length of the crediting period:

During first crediting period:
• Five years (60 months or 1826 days). From 01/01/2008 until 31/12/2012/
Within the frames of any relevant post-Kyoto agreement with host country from the beginning of 2013:
• Until the end of the relevant agreement, but not longer than the lifetime of the equipment.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Step 1. Indication and description of the approach chosen regarding monitoring

Monitoring plan composition and emission reduction assessment approach

Monitoring for the proposed project consists of three sections, each for particular group of subprojects:
Group 1: Stationary combustion.
A number of subprojects (1.1 to 1.3) aimed at saving of NG which is combusted in compressor drives, different boilers and heaters through implementation of energy conservation measures.
Group 2: Saving of electricity.
A number of energy efficiency measures implemented at compressor stations, involving cathode protection systems (subproject 2)
Group 3: Reduction of direct methane emission trough reduction of NG losses occurring during repair activities.
It includes a number of individual measures aimed at venting avoidance by using innovative repair techniques, recovery of gas which would be otherwise vented during repairs (subproject 3).

Monitoring for the first two groups of subprojects will be assessed using option (a) of Annex 2 of Guidance on criteria for baseline setting and monitoring[40] and the monitoring of Group 3 will be based on option (b) of the Annex 2 of the said Guidance: direct assessment of emission reductions.

Monitoring of Group 1 subprojects

As described in section A.4.2 (project description) project activity under this group of subprojects results in reduction of natural gas combusted. In order to determine the baseline and project emissions the amount of gas combusted has to be accessed.

For subproject 1.1 – replacement of gas turbine drives, to obtain the amount of gas consumed the following parameters are being monitored for each unit replaced: actual operation time and capacity factor. Operation time is monitored constantly and the capacity factor is regularly calculated and stored using compressor station control and monitoring software “Expert”. Then the nominal drive efficiency is used to calculate the actual gas consumption in GJ in year y. The energy consumed in form of gas fuel is then used to calculate the emissions using carbon emission factor of natural gas. At last step the resulting emission reductions are calculated as difference between baseline and project emissions.

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Number of hours of drive operation is equal for baseline and project scenarios;
- Capacity factor for each drive replaced is the same for both, baseline and project scenarios;
- Actual capacity for each drive is the same in bot, baseline and project scenarios;
- Efficiencies prior to replacement and new turbine efficiency are taken from most recent performance test;
- Lower specific power consumption by drive auxiliary equipment of new modern drive as to compare with the old one is not taken into account. This is conservative.

The following parameters are fixed as default: carbon emission factor for combustion of natural gas.

[40] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

Fixed baseline parameters: nominal efficiency of GT drive before replacement (efficiency of old drive) and nominal capacity of old drive.

Monitored parameters: time of operation of drive in year y, capacity factor of the drive in year y.

For subproject 1.2 – modernization/retrofit of existing gas turbine drives to improve their efficiency. Approach is similar to that of subproject 1.1.

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Number of hours of drive operation is equal for baseline and project scenarios;
- Capacity factor for each drive replaced is the same for both, baseline and project scenarios;
- Actual capacity for each drive is the same in both, baseline and project scenarios;
- Natural degradation for both, turbine in the baseline and modernized turbine in project scenario is not taken into account;
- Lower specific power consumption by drive auxiliary equipment of new modern drive as to compare with the old one is not taken into account. This is conservative.

The following parameters are fixed as default: carbon emission factor for combustion of natural gas.

Fixed baseline parameters: nominal efficiency of GT drive before retrofit/modernization and nominal capacity of drive (not changed under retrofit).

Monitored parameters: time of operation of drive in year y, capacity factor of the drive in year y.

For subproject 1.3 – Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers.

Monitoring will be performed for each case where the existing boiler was replaced by new heat recovery boiler. In order to monitor the emission reduction the following data will be collected for each individual measure:

- Amount of heat produced by heat recovery boiler to calculate the amount of gas which would be used by heating boilers in the baseline
- Annual fuel gas consumption by the gas turbine to evaluate the additional amount of gas which is combusted by the gas turbine due to decrease of its efficiency as a result of additional flue gas pressure drop created by heat recovery boiler. As alternative, this amount of gas can be calculated using nominal hourly gas consumption by the turbine multiplied by monitored number of hours of operation in a year y. The latter will give overestimated gas consumption and therefore is more conservative.

Resulting emissions reduction is calculated as difference in emissions in the baseline scenario (in which the old gas fired boilers would produce the same amount of heat as do the heat recovery boilers in the project scenario) and the project scenario (in which only additional amount of gas is fired in the gas turbine to compensate the aerodynamic resistance of heat recovery boiler).

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Amounts of heat produced in the baseline and projects scenarios are equal;
- Efficiencies of old gas fired boilers are taken as their passport (nominal) efficiencies;
- Deterioration of efficiency of gas turbine, at which exhaust a heat recovery boiler is installed, is estimated as 0.25% based on performance tests conducted[41].

[41] Methodology for calculation of saving of gas and electricity from implementation of energy conservation measures in transmission, underground storage and automated compressed natural gas filling stations. DK Ukrtransgas, order #51 from 14.02.05. Will be available for AIE as supporting document.

The following parameters are fixed as default: carbon emission factor from combustion of natural gas, deterioration of GT drive efficiency caused by installation of heat recovery boiler at its exhaust.
Fixed baseline parameters: efficiency of replaced gas fired boiler.
Monitored parameters: amount of heat which is produced by heat recovery boiler in year y, consumption of gas by the GT drive at which the heat recovery boiler is installed, LCV of natural gas.

Monitoring of Group 2 subprojects
As described in section A.4.2 (project description) project activity under this group of subprojects results in reduction of electricity consumed. In order to determine the baseline and project emissions the amount of electricity consumed has to be accessed.

For subproject 2 – modernization of pipelines cathode protection systems**.**
The following parameters are monitored for subproject 2.:

- Current and voltage which are being consumed by i-system in year y. They are monitored periodically and values are logged in passport of each cathode protection system. Average annual data are used.

The resulting emissions reductions are calculated then as difference between baseline and project power consumption for each i- system modernized.

In the baseline scenario the power consumed is calculated using actual current in year y and voltage which would be required to maintain it under fixed baseline resistance $R_{bsl,i}$.

Resistance in the baseline is fixed using actual current and voltage which were prior to modernization of i-system.

The following assumptions were made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Level of current in the loop of i-system is equal for both, baseline and project scenarios;
- Within the year y the levels of current and voltage for particular system are taken constant.
- The most recent grid emission factor will be used for each particular year y.

The following SP 2 parameters are fixed as default: carbon emission factor for consumption of electricity from the grid, time of operation of cathode protection system during year (assumed 8760 h)

Fixed baseline parameters: resistance in the loop of cathode protection system before the modernization of anode earthing.

Monitored parameters: current and voltage in the loop of cathode protection system after the modernization.

Monitoring of Group 3 subprojects using option (b)[42].

The option (b) defines the direct assessment of emissions reductions:

(i) Direct estimation/calculation of the difference between the anthropogenic emissions by sources within the project boundary in the baseline scenario and in the project scenario (e.g. in the case of landfill gas projects, the emission reductions can be calculated by multiplying the methane captured with an appropriate factor used on the global warming potential of methane);
(ii) Adjustment of the result of subparagraph (i) above for leakage.

The reason for selecting the option (b) to assess the resulting emissions reduction from Group 3 subprojects is that methane venting avoidance measures proposed in Group 3 cannot be assessed with any

[42] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

good accuracy using option (a). To understand this one can regard the breakdown of the gas amount spent annually for operation and maintenance (O&M) of the whole gas transmission system (please, refer to figure 1). The whole amount of gas used for operation and maintenance (which includes repair venting) is roughly 2 to 3 % of gas entering the system. Repair venting constitutes just less than 1% of O&M amount, while imbalance can be some 10% of O&M. Therefore estimating repair venting avoidance contribution using measured baseline and project venting will lead to great errors, which is unacceptable and therefore the option (b) will be used.

There is no approved monitoring methodology to estimate emission reductions from project activities of this type, therefore project specific methodology for direct assessment of the amount of venting avoidance is proposed, in which calculation is performed for each particular case of innovative repair implemented, by calculating the volume and mass of methane contained in the repaired section which would have been vented in the absence of the proposed project activity and multiplication by GWP of methane, as further described in D.1.2.

Parameters fixed as default: GWP of methane, density of methane at standard conditions.
Fixed baseline parameters: no
Monitored parameters: inner pipeline diameter, length of section under repair, temperature, pressure and density of gas in the pipeline section under repair, weighted average methane content in itransmission pipelines in year y.

Step 2. Application of approach selected

Further below the approach selected in step 1 is applied for monitoring.

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

Monitoring using Option 1 is applied for sub-projects 1.1; 1.2; 1.3; 2 . Project emissions for Group 3 are equal to zero (PE^{3}_{y}=0).

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Group 1 subprojects								
Subproject 1.1. Replacement of gas turbine drives								
P1	$PE^{1.1}_{i,y}$	Monitoring of GHG emissions from measure i in year y	tCO2	c	Annually	100%	In paper and electronic form	Calculated using formulae from D.1.1.2
P2	EF_{ng}	IPCC 1996	tCO2/GJ	*c*	*Most recent factor is used*	*100%*	In paper and electronic form	
P3	$\eta^{n}_{p,i}$	Passport of i drive	d/less	*m/c*	*Fixed ex-ante*	*100%*	In paper and electronic form	*The value of passport efficiency of the drive is based on performance testing conducted by drive manufacturer for each type of turbine it is producing*
P4	$\eta^{e}_{p,i,y}$	Report of most recent performance test of i drive or calculation	d/less	*m/c*	*Annually*	*100%*	In paper and electronic form	

P5	$N_{n,i}$	Passport of drive	kW	*m*	*Fixed ex-ante*	*100%*	In paper and electronic form	
P6	$\tau_{i,y}$	Compressor station log, "Expert" software	hours	*m*	continuously	*100%*	In paper and electronic form	*Data taken from compressor station control and monitoring system "Expert"*
P7	$K_{i,y}$	Compressor station log, "Expert" software	d/less	*m/c*	continuously	*100%*	In paper and electronic form	*Same as above*
Subprojects 1.2 Modernization of existing gas turbine drives to improve their efficiency by introducing a number of standardized improvements								
P8	$PE^{1.2}_{i,y}$	Monitoring of GHG emissions from measure i in year y	tCO2	c	Annually	100%	In paper and electronic form	Calculated using formulae from D.1.1.2
P2	EF_{ng}	IPCC 1996	tCO2/GJ	*c*	*Most recent factor is used*	*100%*	In paper and electronic form	
P9	$\eta^{n}_{p,i}$	Passport of i drive	d/less	*m/c*	*Fixed ex-ante*	*100%*	In paper and electronic form	*The value of passport efficiency of the drive is based on performance testing conducted by drive manufacturer for each type of turbine it is producing*
P10	$\eta^{e}_{p,i,y}$	Report of most recent performance test of i drive or calculation	d/less	*m/c*	*Annually*	*100%*	In paper and electronic form	
P11	$N_{n,i}$	Passport of drive	kW	*m*	*Fixed ex-ante*	*100%*	In paper and	

							electronic form	
P12	$\tau_{i,y}$	Compressor station log, "Expert" software	hours	*m*	continuously	*100%*	In paper and electronic form	*Data taken from compressor station control and monitoring system "Expert"*
P13	$K_{i,y}$	Compressor station log, "Expert" software	d/less	*m/c*	continuously	*100%*	In paper and electronic form	*Same as above*
Subproject 1.3 Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers								
P14	$PE^{1.3}_{i,y}$	Monitoring of GHG emissions from measure i in year y	tCO2	c	Annually	100%	In paper and electronic form	Calculated using formulae from D.1.1.2
P2	EF_{ng}	IPCC 1996	tCO2/GJ	*c*	*Most recent factor will be used if available*	*100%*	In paper and electronic form	
P15	$G_{i,y}$	Application software "Expert"	000 m^3	*m/c*	Annually	*100%*	In paper and electronic form	
P16	LCV_{ng}	Application software "Expert"	Mcal/000 m^3	*m*	Annually	*100%*	In paper and electronic form	
Group 2subprojects								
Subproject 2. Modernization of cathode protection system of underground pipelines								
P17	$PE^{2}_{i,y}$	Monitoring of GHG emissions from	tCO2	*c*	Annually	*100%*	In paper and electronic	

		measure i in year y					form	
P18	EF_{ee}	See Annex 5 PDD	$kgCO_2/kWh$	*c*	*Most recent factor is used when available*	*100%*	In paper and electronic form	
P19	$I_{proj,i,y}$	Passport data	A	*m*	Annually	*100%*	In paper and electronic form	
P20	$U_{proj,i,y}$	Passport data	V	*m*	Annually	*100%*	In paper and electronic form	
P21	$\tau_{i,y}$	Fixed ex-ante	Hours a year	*c*	Annually	*100%*	In paper and electronic form	
P22	η_i	Passport data	d/less	*m/c*	Fixed ex ante	*100%*	In paper and electronic form	

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO2 equivalent):

Group 1 subprojects

Subproject 1.1. Replacement of gas turbine drives

$$PE_y^{1.1} = \sum_i PE_{i,y}^{1.1} \qquad (16)$$

Where:

$PE^{1.1}_{y}$ Project emissions in year y (tCO2)

$PE^{1.1}_{i,y}$ Project emissions of CO_2 from combustion of gas at i GT in year y (tCO2)

$$PE_{i,y}^{1.1} = PFC_{i,y} \cdot EF_{ng} \qquad (17)$$

Where:

$PFC_{i,y}$ Fuel energy consumed by i GT in project scenario in year y (GJ)

EF_{ng} Default carbon emission factor for combustion of natural gas (tCO2/GJ)

$$PFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta_{p,i,y}^{e}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \qquad (18)$$

Where:

$PFC_{i,y}$ Fuel energy consumed by i GT in project scenario in year y (GJ)

$N_{n,i}$ Nominal capacity of GT i in project scenario (kW)

$K_{i,y}$ Capacity factor of GT drive i in year y (d/l)

$\eta^{e}_{p,i,y}$ Actual efficiency of GT i in project scenario in year y (d/l)

$\tau_{i,y}$ Time of operation of i GT drive in year y (hours)

3600 conversion factor from kWh to kJ

10^{-6} conversion factor from kJ to GJ

In order to calculate the actual efficiency of the drive which can operate under different loads other than nominal the following formulae is used which takes into account nominal efficiency and actual capacity factor in year y:

$$\eta^{e}_{p,i,y} = \eta^{n}_{p,i} \cdot \frac{K_{i,y}}{1 - 0.75 \cdot (1 - K_{i,y})}, \qquad (19)$$

Where:

$\eta^{e}_{p,i,y}$ Actual efficiency of GT i in project scenario in year y (d/l)

$\eta^{n}_{p,i}$ Nominal efficiency of GT i in project scenario(d/l)

$K_{i,y}$ Capacity factor for i GT in year y (d/l)

Subproject 1.2. Modernization of existing gas turbine drives

$$PE^{1.2}_{y} = \sum_{i} PE^{1.2}_{i,y} \qquad (20)$$

Where:

$PE^{1,2}_{y}$ Project emissions for subproject 1.2 in year y (yCO_2)
$PE^{1,2}_{i,y}$ Project emissions due to combustion of gas in i-GT drive in year y (tCO2)

$$PE^{1.2}_{i,y} = PFC_{i,y} \cdot EF_{ng} \qquad (21)$$

Де:
$PFC_{i,y}$ Fuel energy content consumed by i-GT in year y (GJ)
EF_{ng} Natural gas combustion carbon emission factor (tCO2/GJ)

$$PFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta^{e}_{p,i,y}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \quad (22)$$

Where:

$N_{n,i}$	Nominal capacity of i-GT drive (kW)
$K_{i,y}$	Capacity factor of i-GT drive in year y (d/less)
$\eta^{e}_{p,i,y}$	Effective efficiency of i-GT drive in year y (d/less)
$\tau_{i,y}$	Time of operation of i-drive in year y (hours)
3600	Conversion factor from kWh into kJ
10^{-6}	Conversion factor from kJ into GJ

Ehe following formulae to calculate effective efficiency in function of passport efficiency and capacity factor can be used[43]:

$$\eta^{e}_{p,i,y} = \eta^{n}_{p,i} \cdot \frac{K_{i,y}}{1-0.75\cdot(1-K_{i,y})} \quad (23)$$

Де:

$\eta^{e}_{p,i,y}$	efficient efficiency of i-drive in year y (d/less)
$\eta^{n}_{p,i}$	nominal efficiency of i-drive (d/less)
$K_{i,y}$	capacity factor of i-drive in year y (d/less)

Capacity factor which is the ratio of drive actual capacity to its nominal capacity, is being constantly monitored using compressor station log which is regularly reported (entered as one of the inputs) into the monitoring system Expert, where it is stored and data can be extracted for any period of interest. For monitoring of the proposed project annual average values of capacity factor are used.

Subproject 1.3. Using GT exhaust heat recovery boilers instead of gas fired space heating boilers

$$PE^{1.3}_{y} = \sum_{i} PE^{1.3}_{i,y} \quad (24)$$

Where:

$PE^{1.3}_{y}$ Project emissions from subproject 1.3 in year y (tCO2)

[43] See SD 3 for source of formulae

$PE^{1.3}_{i,y}$ Project emissions from i-boiler in year y (tCO2)

$$PE_{i,y} = 0.025 \cdot G_{i,y} \cdot LCV_{ng} \cdot \frac{4.187}{1000} \cdot EF_{ng} \qquad (25)$$

Where:

0,025	fixed value of related deterioration of i-GT drive efficiency as a result of installation of heat recovery boiler (d/less). Is based on statistical data on drop of efficiency of GT drive.[44]
$G_{i,y}$	Fuel consumption at i- GT drive in year y (000, m^3)
LCV_{ng}	Lower calorific value of NG in year y (Mcal/000, m^3)
EF_{ng}	NG combustion carbon emission factor (tCO2/GJ)
1000	Conversion factor from Mcal into Gcal
4,187	Conversion factor from Gcal into GJ

Group 2 subprojects

EF

Subproject 2 Modernization of cathode protection system of underground pipelines.

$$PE^2_y = \sum PE^2_{i,y} \qquad (26)$$

Where:

PE^2_y	Project emissions from SP 2 in year y (tCO2)
$PE^2_{i,y}$	Project CO_2 emissions due to consumption of grid electricity by i-cathode protection system in year y (tCO2)

$$PE^2_{i,y} = PEL_{i,y} \cdot EF_{ee,y} \cdot 10^{-3} \qquad (27)$$

Where:

$EF_{ee,y}$ Grid emission factor for consumption of electricity from Ukrainian grid in year y(kgCO2/kWh)

---

[44] See SD 3, p.38.

10^{-3} Conversion factor from $kgCO_2$ into tCO2

$$PEL_{i,y} = \frac{U_{proj,i,y} \cdot I_{proj,i,y}}{\eta_i} \cdot \frac{\tau_{i,y}}{1000} \quad (28)$$

Where:

$PEL_{i,y}$ Consumption of grid electricity by i-cathode protection system in year y (kWh)
$U_{proj,i,y}$ Voltage of i-system in year y (V)
$I_{proj,i,y}$ Current in i-system in year y (A)
η_i Efficiency of AC/DC converter of i-cathode protection system (d/less)
$\tau_{i,y}$ Time of operation of i-system in year y (hours)
1000 Conversion factor from Wh into kWh

Group 3

$$PE^3_y=0 \quad (29)$$

Where:
PE^3_y is the project emissions form group 3 subprojects in year y (tCO2)
Option of direct monitoring of emissions reduction for group 3 is used. Please, refer to section D.1.2.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Group 1 subprojects								
Subproject 1.1. Replacement of gas turbine drives								

B1	$BE^{1.1}_{i,y}$	Monitoring of GHG emissions from i measure in year y	tCO2	c	Annual	100%	Electronic and paper form	Calculated using formulae in D.1.1.4
B2	$\eta^{n}_{bsl,i}$	Passport of i drive	*d/less*	*m/c*	*Fixed ex-ante*	*100%*	*Electronic and paper form*	
B3	$\eta^{e}_{bsl,i,y}$	Performance test report of i drive or calculation	*d/less*	*m/c*	*annually*	*100%*	*Electronic and paper form*	
P2	EF_{ng}	IPCC 1996	tCO2/GJ	c	Most recent factor is used	100%	In paper and electronic form	
P5	$N_{n,i}$	Passport of drive	kW	m	Fixed ex-ante	100%	In paper and electronic form	
P6	$\tau_{i,y}$	Compressor station log, “Expert” software	hours	m	continuously	100%	In paper and electronic form	Data taken from compressor station control and monitoring system “Expert”
P7	$K_{i,y}$	Compressor station log, “Expert” software	d/less	m/c	continuously	100%	In paper and electronic form	Same as above
Subprojects 1.2 Modernization of existing gas turbine drives to improve their efficiency by introducing a number of standardized improvements								
B4	$BE^{1.2}_{i,y}$	Monitoring of GHG emissions from i measure in year y	tCO2	c	Annual	100%	Electronic and paper form	Calculated using formulae in D.1.1.4
B5	$\eta^{n}_{bsl,i}$	*GT passport data*	*d/less*	*m*	*Fixed ex-ante*	*100%*	*Electronic and paper form*	
B6	$\eta^{e}_{bsl,i,y}$	Technical report of inspection of i drive or calculation	*d/less*	*c*	*annually*	*100%*	*Electronic and paper form*	
P2	EF_{ng}	IPCC 1996	tCO2/GJ	e	Most recent factor is used	100%	In paper and electronic form	
P11	$N_{n,i}$	Passport of drive	kW	m	Fixed ex-ante	100%	In paper and electronic form	

P12	$\tau_{i,y}$	Compressor station log, "Expert" software	hours	m	continuously	100%	In paper and electronic form	Data taken from compressor station control and monitoring system "Expert"
P13	$K_{i,y}$	Compressor station log, "Expert" software	d/less	m/c	continuously	100%	In paper and electronic form	Same as above
Subproject 1.3. Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers								
B7	$BE^{1.3}_{i,y}$	Monitoring of GHG emissions from i measure in year y	tCO2	c	Annual	100%	Electronic and paper form	Calculated using formulae in D.1.1.4
B8	$Q_{i,y}$	Compressor station logs	*Gcal*	*m*	Annual	*100%*	*Electronic and paper form*	
B9	η_i	Report of heat engineering inspection	*d/less*	*c*	Annual	*100%*	*Electronic and paper form*	
P2	EF_{ng}	IPCC 1996	tCO2/GJ	*e*	Most recent factor is used	*100%*	In paper and electronic form	
Group 2subprojects								
Subproject 2. Modernization of cathode protection system								
B10	$BE^{2}_{i,y}$	Monitoring of GHG emissions from i measure in year y	tCO2	c	Annual	100%	Electronic and paper form	Calculated using formulae in D.1.1.4
B11	$R_{bsl,i}$	Fixed baseline data	Ом	c	Ex-ante	100%	In paper and electronic form	
P18	$EF_{ee,y}$	See Annex 5 PDD	kg CO2/kWh	*c*	*Most recent available factor to be used*	*100%*	In paper and electronic form	
P21	$\tau_{i,y}$	Fixed ex-ante	hours	m	Fixed ex-ante	100%	In paper and electronic form	
P22	η_i	Passport of i- cathode protection system		m	Fixed ex-ante	100%	Electronic and paper form	

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO2 equivalent):

Group 1 subprojects

Subproject 1.1. Replacement of gas turbine drives

$$BE^{1.1}_{y} = \sum_{i} BE^{1.1}_{i,y} \qquad (30)$$

Where:

$BE^{1.1}_{y}$ is the baseline emissions of subproject 1.1 in year y (tCO2)

$BE^{1.1}_{i,y}$ is the baseline emissions of *i* gas turbine drive in year (tCO2)

$$BE^{1.1}_{i,y} = BFC_{i,y} \cdot EF_{ng} \qquad (31)$$

Where:

$BFC_{i,y}$ is the fuel energy which would be consumed by drive i in year y (GJ)

EF_{ng} is the carbon emission factor from combustion of natural gas (tCO2/GJ)

$$BFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta^{e}_{bsl,i,y}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \qquad (32)$$

Where:

$N_{n,i}$ is the nominal capacity of drive i (kW)

$K_{i,y}$ is the capacity factor of i drive in year y (d/less)

$\eta^{e}_{bsl,i,y}$ is the actual thermal efficiency of i turbine in year y (d/less)

$\tau_{i,y}$ is the time in operation of drive i in year y (hours)

3600 is the conversion factor from kWh to kJ

10^{-6} is the conversion factor from kJ to GJ

The actual efficiency will be used upon availability, on the report of most recent performance test. If those are absent or obsolete, actual efficiency will be calculated as shown below in formulae which takes into account nominal efficiency (measured during test or taken from passport data)and actual capacity factor in year y:

$$\eta^{e}_{bsl,i,y} = \eta^{n}_{bsl,i} \cdot \frac{K_{i,y}}{1-0.75\cdot(1-K_{i,y})} \quad (33)$$

Where:

$\eta^{e}_{bsl,I,y}$ actual or effective baseline efficiency of i drive in year y (d/less)

$\eta^{n}_{bsl,i}$ nominal efficiency of i drive (d/less)

$K_{i,y}$ capacity factor of i drive in year y (d/less)

Subproject 1.2. Modernization of gas turbine drives

$$BE^{1.2}_{y} = \sum_{i} BE^{1.2}{}_{i,y} \quad (34)$$

Where:

$BE^{1.2}{}_{y}$ is the baseline emissions of subproject 1.2 in year y (tCO2)

$BE^{1.2}{}_{i,y}$ is the baseline emissions of *i* gas turbine drive in year (tCO2)

$$BE^{1.2}{}_{i,y} = BFC_{i,y} \cdot EF_{ng} \quad (35)$$

Where:

$BFC_{i,y}$	is the fuel energy which would be consumed by drive i in year y (GJ)
EF_{ng}	is the carbon emission factor from combustion of natural gas (tCO2/GJ)

$$BFC_{i,y} = N_{n,i} \cdot K_{i,y} \cdot \frac{1}{\eta^{e}_{bsl,i,y}} \cdot \tau_{i,y} \cdot 3600 \cdot 10^{-6} \quad (36)$$

Where:

$N_{n,i}$	is the nominal capacity of drive i (kW)
$K_{i,y}$	is the capacity factor of i drive in year y (d/less)
$\eta^{e}_{bsl,i,y}$	is the actual thermal efficiency of i turbine in year y (d/less)
$\tau_{i,y}$	is the time in operation of drive i in year y (hours)
3600	is the conversion factor from kWh to kJ
10^{-6}	is the conversion factor from kJ to GJ

The actual efficiency will be used upon availability, on the report of most recent performance test. If those are absent or obsolete, actual efficiency will be calculated as shown below in formulae which takes into account nominal efficiency (measured at test of taken from passport) and actual capacity factor in year y:

$$\eta^{e}_{bsl,i,y} = \eta^{n}_{bsl,i} \cdot \frac{K_{i,y}}{1 - 0.75 \cdot (1 - K_{i,y})} \quad (37)$$

Where:

$\eta^{e}_{bsl,i,y}$	actual or effective baseline efficiency of i drive in year y (d/less)
$\eta^{n}_{bsl,i}$	nominal efficiency of I drive (d/less)
$K_{i,y}$	capacity factor of I drive in year y (d/less)

Subproject 1.3. Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers

$$BE_y^{1.3} = \sum_i BE_{i,y}^{1.3} \quad (38)$$

Де:

$BE^{1.3}_y$ Baseline emissions from subproject 1.3 in year y(tCO2)

$BE^{1.3}_{i,y}$ Baseline emissions from i-boiler replaced in year y (tCO2)

$$BE_{i,y} = \frac{Q_{i,y}}{\eta_i} \cdot EF_{ng} \cdot 4.187 \quad (39)$$

Де:

$Q_{i,y}$ Amount of heat produced by the heat recovery boiler in year y (Gcal)
η_i Efficiency of i-boiler replaced by heat recovery boiler (d/less)
EF_{ng} Carbon emission factor from combustion of natural gas (tCO2/GJ)
4,187 Conversion factor from Gcal into GJ

Subproject 2. Modernization of cathode protection system of underground pipelines.

$$BE_y^{2} = \sum_i BE_{i,y}^{2} \quad (40)$$

Where:
$BE^{2,}_{y}$ Baseline emissions from SP 2 in year y (tCO2)
$BE^{2}_{i,y}$ Baseline emission due to grid power consumption by i-cathode protection system in year y (tCO2)

$$BE_{i,y}^{2} = BEL_{i,y} \cdot EF_{ee,y} \cdot 10^{-3} \quad (41)$$

Where:
$BEL_{i,y}$ Grid power consumption by i-cathode protection system in year y (kWh)
$EF_{ee,y}$ Standardized grid efficiency factor of Ukrainian grid in year y (kgCO2/kWh)
10^{-3} Conversion factor from kgCO2 into tCO2

$$BEL_{i,y} = \frac{U_{bsl,i,y} \cdot I_{proj,i,y}}{\eta_i} \cdot \frac{\tau_{i,y}}{1000} \qquad (42)$$

Where:

$U_{bsl,i,y}$	Voltage in i-system in the baseline in year y (V)
$I_{proj,i,y}$	Current in project scenario in i-system in year y (A)
η_i	Efficiency of AC/DC convertor of i-system (d/less)
$\tau_{i,y}$	Time operation of i-system in year y (hours)
1000	Conversion factor from Wh into kWh

To calculate the voltage which would be in the baseline scenario the following formulae is used:

$$U_{bsl,i,y} = R_{bsl,i} \cdot I_{proj,i,y}, \qquad (43)$$

Where:

$U_{bsl,i,y}$	Baseline voltage in i-system in year y (V)
$R_{bsl,i}$	Baseline resistance in i-system (Ohm)
$I_{proj,i,y}$	Current in i-system in year y (A)

Baseline resistance is calculated using the Ohm law taking the voltage and current which were in the i-system prior to implementation of subproject 2:

$$R_{bsl,i} = \frac{U_i}{I_i} \qquad (44)$$

Where:

$R_{bsl,i}$	Baseline resistance in the -system (Ohm)
U_i	Voltage in i-system prior to subproject implementation (V)
I_i	Current in i-system prior to subproject implementation (A)

Group 3
Subproject 3

Direct monitoring of emissions reduction is used, as described in D.1.2. Therefore emissions in the baseline are equal to emissions reductions monitored:

$BE^3_y=ER^3_y$ (45)

Please, further to D.1.2.

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

This option is used to monitor the emission reductions resulting from subprojects of Group 3.
It is not applicable neither for Group 1, nor for Group 2 projects.
In the absence of approved monitoring methodologies for project activities of this type the following monitoring methodology has been proposed. Before performing each repair using innovative repair method (sleeves and other types) the number of variables needed to calculate the amount of gas contained in the pipeline and which would be vented in the absence of proposed project are measured and entered in a special form, which is stored until the end of crediting period or longer if required. The form is signed by the authorised persons (head or chief engineer of respective division, under which responsibility is the regarded section of the pipeline or compressor station). The form is supported with a drawing which depicts the layout of regarded section, isolating taps, place of repair (-s).
Then, based on the variables the amount of gas which would be vented is calculated using modified equation Van der Waals equation of state.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Subproject 3								
M1	$ER^{3.1}_{i,y}$	*Monitoring of GHG emissions from individual measure I in year y*	*tCO2*	*c*	*Annually*	*100%*	*Electronic and paper*	
M2	$Q^{3}_{i,y}$	*Monitoring of GHG emissions from individual measure I in year y*	*1000 m3*	*c*	*Once, prior to implementation of measure i*	*100%*	*Electronic and paper*	
M3	ρ_{CH4}	*Default value*	*Kg/m3, standard conditions*	*c*	*Fixed ex-ante*	*100%*	*Paper*	
M4	C_{CH4}	*Certificate*	*d/less*	*m*	*Annually*	*100%*	*Paper*	

M5	EF_{CH4}	*IPCC*	*tCO2/tCH4*	*e*	*Estimated ex-ante*	*100%*	*Electronic and paper*	
M6	D_i	*Act of measurement*	*M*	*m*	*Once, prior to implementation of measure i*	*100%*	*Paper*	
M7	L_i	*Act of measurement*	*M*	*m*	*Once, prior to implementation of measure i*	*100%*	*Paper*	
M8	P_i	*Act of measurement*	*MPa*	*m/c*	*Once, prior to implementation of measure i*	*100%*	*Paper*	
M9	T_i	*Act of measurement*	*Degree K*	*m/c*	*Once, prior to implementation of measure i*	*100%*	*Paper*	
M10	ρ_i	*Act of measurement*	*Kg/m3, standard conditions*	*m/c*	*Once, prior to implementation of measure i*	*100%*	*Paper*	*Density of natural gas in the pipeline to be repaired. Is used to calculate compressibility factor of gas*

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO2 equivalent):

Subproject 3.1: Usage of innovative pipeline and tap repair methods

To calculate the emission reduction resulted from implementation of avoidance of methane emission the following stepwise calculation is performed:

1. Firstly, the volume of natural gas venting avoided is calculated (using generalized Mendeleev-Clapeyron equation of state[45] for each i individual repair. To calculate the volume of gas under high pressure, the compressibility factor Z[46] is accounted as well which is used to account the difference of real gas from an ideal one. The volume of methane which would be vented in the absence of the proposed subproject (individual repair) consists of two parts.

---

[45] http://ru.wikipedia.org/wiki/%D0%A0%D0%B5%D0%B0%D0%BB%D1%8C%D0%BD%D1%8B%D0%B9_%D0%B3%D0%B0%D0%B7

[46] http://en.citizendium.org/wiki/Compressibility_factor_(gases)

The first one is the amount of gas contained in the pipeline section under actual working pressure and temperature which would have been released prior to the repair. The second one is the gas which would have been used to blow down the pipeline after the completion the repair to secure that all air in the pipe is replaced with the gas.

2. Then a sum of volume of gas venting of which was avoided is obtained by summing up the result of all individual measures made in year y.
3. Then the mass of methane which is contained in the volumetric amount of natural gas saved is calculated using density of methane and its volumetric share in the natural gas in transmission system in year y.
4. Resulting emissions reduction generated due to implementation of innovative repairs in year y is calculated using carbon emission factor (EF) for methane.

For each year *y* the emission reductions achieved due to it consists of sum of emission reduction due to individual repair measures implemented within this year The resulting emission reductions will be calculated using the following formula:

$$ER_y^3 \quad = \sum_i^n ER_{i,y}^3 \qquad (46)$$

Where:

ER_y^3	is the resulting emission reduction from implementation of individual measures in subproject of type 3 (innovative pipeline repair methods) in year y	(t CO_2)
$ER_{i,y}^3$	is the emission reduction achieved due to implementation of individual measure *i* within the subproject of type 3 in year y	(tCO2)
n	is the total number of innovative pipe repairs implemented during year y	(d/less number)

$$ER_{i,y}^3 = Q_{i,y}^3 * \rho_{CH4} * C_{CH4} * EF_{CH4} \qquad (47)$$

Where:

$ER^3_{i,y}$ is the emission reduction from implementation of *i* innovative individual pipeline repair in year y (tCO2)

$Q^3_{i,y}$ is the amount of natural gas which would be released in in the absence of *I* individual pipeline repair in year y (000 m3)

ρ_{CH4} is the density of methane[47] (kg/m3)

C_{CH4} is the volumetric share of methane contained in transmission pipelines in year y (d/less)

EF_{CH4} is the GHG potential of methane if vented into the atmosphere[48] (tCO2/tCH4)

The volume of natural gas which would have been released in the absence of proposed repair methods is calculated using formulae below, it consists of two parts – first one is the volume of gas contained in the pipeline under pressure P_i and the second one is the doubled pipeline section volume containing gas under atmospheric pressure, which would have been used to blow down the pipe:

$$Q_{i,y}^3 = (\frac{\pi * D_i^2}{4} * L_i * P_i * \frac{T_0}{T_i * Z_i * P_0} + \frac{\pi}{2} * D_i^2 * L_i) * 10^{-3} \quad (48)$$

Where:

$Q^3_{i,y}$ is the amount of natural gas which would be released in the absence of innovative technology to be applied in i- individual pipeline or tap repair in year y (1000 m3)

D_i is the inner diameter of the *i* pipeline section which would have been isolated and emptied (m)

L_i is the lengths of the *i* pipeline section which would have been isolated and emptied (m)

P_i is the average actual absolute pressure of gas in the *i* pipeline section which would have been isolated and emptied[49] (MPa)

---

[47] Density of methane at standard conditions = 0.668 kg/m3; standard conditions T=293.15 K, P=0.1013 MPa http://www.engineeringtoolbox.com/gas-density-d_158.html

[48] IPCC default data

T_i	is the average gas temperature in *i* pipeline section which would have been isolated and emptied	(K)
T_0	is the temperature under standard conditions	(K)
P_0	is the pressure under standard conditions	(MPa)
Z_i	is the compressibility factor of natural gas depending on its temperature and pressure	(d/less)
ρ_i	is the density under standard conditions of natural gas in the pipeline prior to implementation of i-repair activity	(kg/m3)
π	is the *pi* number	(d/less)

If the section which would have been emptied consists of pipe section having different diameters, the total volume is calculated as sum of volumes of these sections.

Compressibility factor Z is calculated for each i-repair made with the use of model GERG-91[50], which is one of the three calculation tools approved by GOST 30319.2-96 to calculate compressibility of natural gas in gas transmission pipelines.

D.1.3. Treatment of leakage in the monitoring plan:

Reduction of leakages attributed to gas extraction and treatment prior to directing into gas transmission pipelines are not taken into consideration. This is conservative. Other leakages are not identified.

[49] The average pressure in the pipeline section is defined as arithmetic mean of two pressures measured at section ends. This approximation has good accuracy in case of large diameter transmission pipelines. See I. Kotlyar, V. Pilyak "Operation of transmission pipelines", Leningrad, "NEDRA" 1971, 2-nd edition; p.41

[50] Standard GERG Virial Equation for Field Use. Simplification of the Input Data Requirements for the GERG Virial Equation - an Alternative Means of Compressibility Factor Calculation for Natural Gases and Similar Mixtures. GERG TM5 1991. - GERG Technical Monograph, 1991, 173 p

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable.

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

Not applicable.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Resulting emissions reduction from the proposed project is obtained as sum of emissions reduction from three groups of subprojects:

$$ER_y = ER_y^{1.} + ER_y^2 + ER_y^3 \qquad (49)$$

Where:

ER^1_y Emissions reduction due to implementation of subprojects of Group 1 in year y (tCO2)

ER^2_y Emissions reduction due to implementation of subprojects of Group 2 in year y (tCO2)

ER^3_y Emissions reduction due to implementation of subprojects of Group 3 in year y (tCO2)

Group 1 subprojects

$$ER_y^1 = ER_y^{1.1} + ER_y^{1.2} + ER_y^{1.3} \qquad (50)$$

ER^{1}_{y} Emissions reduction due to implementation of subprojects of Group 1 in year y (tCO2)

$ER^{1.1}_{y}$ Emission reductions due to individual; measures implemented under subproject 1.1 in year y (tCO2)

$ER^{1.2}_{y}$ Emission reductions due to individual; measures implemented under subproject 1.2 in year y (tCO2)

$ER^{1.3}_{y}$ Emission reductions due to individual; measures implemented under subproject 1.3 in year y (tCO2)

Subproject 1.1.

$$ER_y^{1.1} = BE_y^{1.1} - PE_y^{1.1} \quad (51)$$

Where:

$ER^{1.1}_{y}$ Emission reductions due to individual; measures implemented under subproject 1.1 in year y (tCO2)

$BE^{1.1}_{y}$ Baseline emissions under subproject 1.1 in year y (tCO2)

$PE^{1.1}_{y}$ Project emissions under subproject 1.1 in year y (tCO2)

Subproject 1.2.

$$ER_y^{1.2} = BE_y^{1.2} - PE_y^{1.2} \quad (52)$$

Where:

$ER^{1.2}_{y}$ Emission reductions due to individual; measures implemented under subproject 1.2 in year y (tCO2)

$BE^{1.2}_{y}$ Baseline emissions under subproject 1.2 in year y (tCO2)

$PE^{1.2}_{y}$ Project emissions under subproject 1.2 in year y (tCO2)

Subproject 1.3.

$$ER_y^{1.3} = BE_y^{1.3} - PE_y^{1.3} \quad (53)$$

Where:

$ER^{1,3}_{y}$	Emission reductions due to individual; measures implemented under subproject 1.3 in year y (tCO2)
$BE^{1,3}_{y}$	Baseline emissions under subproject 1.3 in year y (tCO2)
$PE^{1,3}_{y}$	Project emissions under subproject 1.3 in year y (tCO2)

Group 2 subprojects

Subproject 2.

$$ER_y^2 = BE_y^2 - PE_y^2 \quad (54)$$

Where:

$ER^{2,}_{y}$	Emission reductions due to individual; measures implemented under subproject 2 in year y (tCO2)
$BE^{2,}_{y}$	Baseline emissions under subproject 2 in year y (tCO2)
$PE^{2,}_{y}$	Project emissions under subproject 2 in year y (tCO2)

Group 3 subprojects

Subproject 3

$$ER_y^3 = \sum_i^n ER_{i,y}^3 \quad (55)$$

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

Not applicable. The project foresees replacement/modernization of equipment by similar types and usage of innovative pipe repair methods. This does not cause emissions to be controlled In addition, there is no major construction/'civil work involved in the project. Operation of new/modernized equipment is monitored and data are stored as part of normal operation practice of the company.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P2	Low	Either IPCC default of country specific EF is used upon availability
P6	Low	Time of operation of each gas turbine drive are constantly monitored at each compressor station with good accuracy
P7	Low	Capacity factors of gas turbine drives are constantly monitored at each compressor station with good accuracy
P12	Low	Similarly to P6
P13	Low	Similarly to P7
P15	Low	Gas turbine fuel metering has good accuracy
P16	Low	LCV of natural gas can be measured with high accuracy at one of numerous laboratories of Ukrtransgas
P18	Low	Standardized grid emission factor for Ukraine exists since 2007 and has been recently recalculated, most recent factor will be used upon availability
P21	Medium	Time of operation of small power consumers like pumps/fans is monitored with acceptable accuracy
P23	Medium	Electric current at small (0.5-5 kW) consumers like cathode protection systems is measured with acceptable accuracy
P24	Medium	Voltage at small (0.5-5 kW) consumers like cathode protection systems is measured with acceptable accuracy
P25	Low	
B3	Low	
B6	Low	
B8	Low	
M4	Low	DFP official data are taken
M6	Low	Lengths of pipeline sections are known with good accuracy
M7	Low	Diameters of pipeline sections and wall thicknesses are known with good accuracy
M8	Medium	
M9	Low	

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

There is an up flow system allowing for initial data collection, consolidation and cross-checking engaged in monitoring plan preparation as shown in figure below:

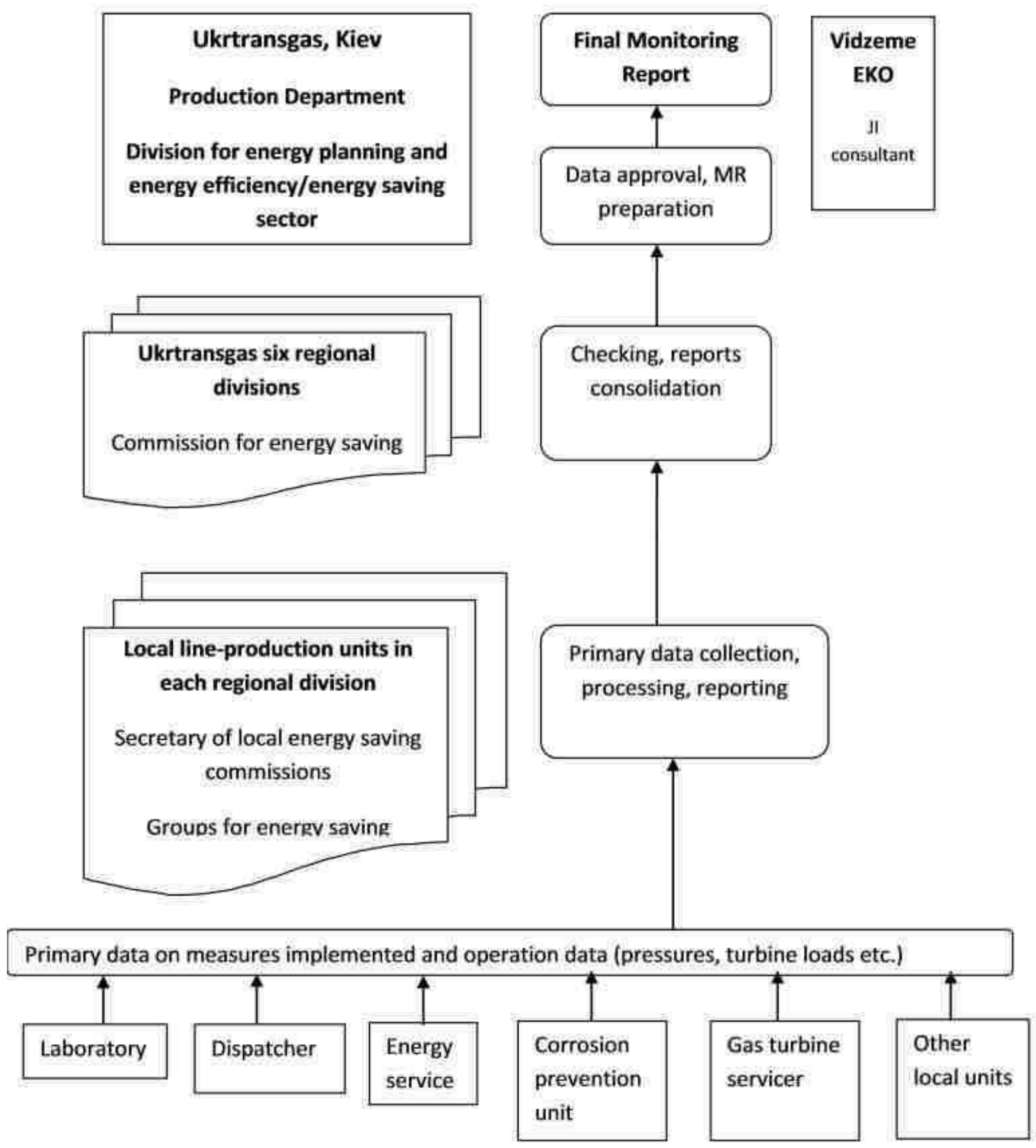
Ukrtransgas, Kiev
Production Department
Division for energy planning and energy efficiency/energy saving sector
Final Monitoring Report
Vidzeme EKO
JI consultant
Data approval, MR preparation
Ukrtransgas six regional divisions
Commission for energy saving
Checking, reports consolidation
Local line-production units in each regional division
Secretary of local energy saving commissions
Groups for energy saving
Primary data collection, processing, reporting
Primary data on measures implemented and operation data (pressures, turbine loads etc.)
Laboratory
Dispatcher
Energy service
Corrosion prevention unit
Gas turbine servicer
Other local units

Figure 16: Management structure and data flows applied for monitoring plan preparation/

At company local level, the relevant primary information originated in different production units, if function of subproject type, is collected and processed. Responsible unit is the local group of energy saving and local secretary of energy saving commission. Primary reports are regularly directed to the higher authority, which is one of six regional divisions.

At regional level these primary reports are checked and consolidated, then submitted to central Ukrtransgas office in Kiev. At regional level the six commissions for energy saving are responsible for this.

At central Ukrtransgas office these consolidated reports are being concentrated and checked. Data are used to prepare Monitoring Report for the proposed project close co-operation with Ukrtransgas external JI consultant, company Vidzeme Eko.

By this two-step collection and checking procedure, quality control and cross checking is being done twice, at regional level and in the central office of Ukrtransgas.

Data collection and processing for monitoring activities to a great extent uses the standard Ukrtransgas procedures "Procedure for organisation of energy surveys in production units of DK Ukrtransgas" which came into force 19/01/2005 according to order #12 and "Planning and control of energy saving measures" implemented according to Ukrtransgas order #69 from 28/03/2005.

Operational data related to operation of compressor station equipment are collected using monitoring and data acquisition program EXPERT. This software was commissioned in 1999 and upgraded several times since then. EXPERT allows to monitor, aggregate and archive all key gas transmission system parameters: volumes of gas pumped through each of the pipelines, gas pressures and chemical compositions, methane content; gas consumption by every compressor drive and heater, time of operation and capacity factors of all major items of equipment. It stores the data on thermal efficiency of gas turbines, including the most recent data obtained during regular performance tests.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Alexey Doumik, Project manager at SIA Vidzeme EKO, which is the project participant. Please, refer to Annex 1 for contact details

SECTION E. Estimation of greenhouse gas emission reductions

This section contains the estimate of GHG emission reductions. The calculations are made using formulae described in details in section D of the document.

E.1. Estimated project emissions:

Estimated project emissions before the crediting period

	Group of subprojects		2005	2006	2007	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	1,125,433	3,029,160	3,836,241	7,990,834
2	Consumption of electricity by cathode protection systems	tCO2/y	106	278	514	898
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	0	0	0	0
	Total	tCO2/y	1,125,539	3,029,438	3,836,756	7,991,732
	Total 2005-2007	tCO2	7,991,732			

Estimated project emissions during the crediting period

	Group of subprojects		2008	2009	2010	2011	2012	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	4,755,423	3,302,446	3,227,480	3,504,800	3,574,000	18,364,148
2	Consumption of electricity by cathode protection systems	tCO2/y	876	1,027	1,226	1,500	1,800	6,429
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	0	0	0	0	0	0
	Total	tCO2/y	4,756,299	3,303,473	3,228,705	3,506,300	3,575,800	18,370,577
	Total 2008-2012	tCO2	18,370,577					

Estimated project emissions after the crediting period

	Group of subprojects		2013	2014	2015	2016	2017	2018	2019	2020	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	28,592,000
2	Consumption of electricity by cathode protection systems	tCO2/y	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	16,000
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	0	0	0	0	0	0	0	0	0
	Total	tCO2/y	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	28,608,000
	Total 2013-2020	tCO2	28,608,000								

E.2. Estimated leakage:

Leakages were not identified in the proposed project. Therefore LE_y=0.

E.3. The sum of E.1. and E.2.:

Estimated total project emissions before the crediting period

	Group of subprojects		2005	2006	2007	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	1,125,433	3,029,160	3,836,241	7,990,834
2	Consumption of electricity by cathode protection systems	tCO2/y	106	278	514	898
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	0	0	0	0
	Total	tCO2/y	1,125,539	3,029,438	3,836,756	7,991,732
	Total 2005-2007	tCO2	7,991,732			

Estimated total project emissions during the crediting period

	Group of subprojects		2008	2009	2010	2011	2012	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	4,755,423	3,302,446	3,227,480	3,504,800	3,574,000	18,364,148
2	Consumption of electricity by cathode protection systems	tCO2/y	876	1,027	1,226	1,500	1,800	6,429
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	0	0	0	0	0	0
	Total	tCO2/y	4,756,299	3,303,473	3,228,705	3,506,300	3,575,800	18,370,577
	Total 2008-2012	tCO2	18,370,577					

Estimated total project emissions after the crediting period

	Group of subprojects		2013	2014	2015	2016	2017	2018	2019	2020	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	3,574,000	28,592,000
2	Consumption of electricity by cathode protection systems from the Ukrainian power grid	tCO2/y	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	16,000
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	0	0	0	0	0	0	0	0	0
	Total	tCO2/y	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	3,576,000	28,608,000
	Total 2013-2020	tCO2	28,608,000								

E.4. Estimated baseline emissions:

Estimated baseline emissions before the crediting period

Group of subprojects			2005	2006	2007	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	1,197,825	3,224,285	4,071,224	8,493,334
2	Consumption of electricity by cathode protection systems	tCO2/y	412	1,128	2,012	3,551
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	997,352	1,578,067	1,882,278	4,457,697
	Total	tCO2/y	2,195,589	4,803,479	5,955,514	12,954,583
	Total 2005-2007	tCO2	12,954,583			

Estimated baseline emissions during the crediting period

Group of subprojects			2008	2009	2010	2011	2012	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	5,054,639	3,511,652	3,441,859	3,802,000	3,936,000	19,746,151
2	Consumption of electricity by cathode protection systems	tCO2/y	3,483	4,178	4,993	5,850	6,920	25,424
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	2,189,136	1,919,694	2,328,744	2,326,416	2,362,203	11,126,193
	Total	tCO2/y	7,247,259	5,435,524	5,775,596	6,134,266	6,305,123	30,897,768
	Total 2008-2012	tCO2	30,897,768					

Estimated baseline emissions after the crediting period

	Group of subprojects		2013	2014	2015	2016	2017	2018	2019	2020	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	3,940,000	3,940,000	3,940,000	3,940,000	3,940,000	3,940,000	3,940,000	3,940,000	31,520,000
2	Consumption of electricity by cathode protection systems	tCO2/y	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	56,000
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	20,000,000
	Total	tCO2/y	6,447,000	6,447,000	6,447,000	6,447,000	6,447,000	6,447,000	6,447,000	6,447,000	51,576,000
	Total 2013-2020	tCO2	51,576,000								

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

Estimated emissions reduction before the crediting period

	Group of subprojects		2005	2006	2007	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	72,392	195,124	234,983	502,500
2	Consumption of electricity by cathode protection systems	tCO2/y	306	851	1,497	2,653
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	997,352	1,578,067	1,882,278	4,457,697
	Total	tCO2/y	1,070,050	1,774,042	2,118,758	4,962,850
	Total 2005-2007	tCO2	4,962,850			

Estimated emissions reduction during the crediting period

Group of subprojects			2008	2009	2010	2011	2012	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	299,216	209,207	214,380	297,200	362,000	1,382,002
2	Consumption of electricity by cathode protection systems	tCO2/y	2,607	3,151	3,767	4,350	5,120	18,995
3	Usage of innovative repair techniques with the aim of avoidance of methane venting	tCO2/y	2,189,136	1,919,694	2,328,744	2,326,416	2,362,203	11,126,193
	Total	tCO2/y	2,490,959	2,132,051	2,546,891	2,627,966	2,729,323	12,527,191
	Total 2008-2012	tCO2	12,527,191					

Estimated emissions reduction after the crediting period

Group of subprojects			2013	2014	2015	2016	2017	2018	2019	2020	Total
1	Stationary combustion of NG in the compressor drives, auxiliary boilers and heaters	tCO2/y	366,000	366,000	366,000	366,000	366,000	366,000	366,000	366,000	2,928,000
2	Consumption of electricity by cathode protection systems	tCO2/y	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	40,000
3	Usage of innovative repair techniques with the aim of avoidance of methane venting practices	tCO2/y	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	20,000,000
	Total	tCO2/y	2,871,000	2,871,000	2,871,000	2,871,000	2,871,000	2,871,000	2,871,000	2,871,000	22,968,000
	Total 2013-2020	tCO2	22,968,000								

E.6. Table providing values obtained when applying formulae above:

Estimated balance of emissions under the proposed project before the crediting period

Year	*Estimated project emissions (tonnes of CO_2 equivalent)*	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
Year 2005	1,125,539	0	2,195,589	1,070,050
Year 2006	3,029,438	0	4,803,479	1,774,042
Year 2007	3,836,756	0	5,955,514	2,118,758
Total (tonnes of CO_2 equivalent.)	7,991,732	**0**	12,954,583	4,962,850

Estimated balance of emissions under the proposed project over the crediting period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
Year 2008	4,756,299	0	7,247,259	2,490,959
Year 2009	3,303,473	0	5,435,524	2,132,051
Year 2010	3,228,705	0	5,775,596	2,546,891
Year 2011	3,506,300	0	6,134,266	2,627,966

Year 2012	3,575,800	0	6,305,123	2,729,323
Total (tonnes of CO_2 equivalent.)	18,370,577	**0**	30,897,768	12,527,191

Estimated balance of emissions under the proposed project after the crediting period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
Year 2013	3,576,000	0	6,447,000	2,871,000
Year 2014	3,576,000	0	6,447,000	2,871,000
Year 2015	3,576,000	0	6,447,000	2,871,000
Year 2016	3,576,000	0	6,447,000	2,871,000
Year 2017	3,576,000	0	6,447,000	2,871,000
Year 2018	3,576,000	0	6,447,000	2,871,000
Year 2019	3,576,000	0	6,447,000	2,871,000
Year 2020	3,576,000	0	6,447,000	2,871,000
Total (tonnes of CO_2 equivalent.)	28,608,000	**0**	51,576,000	22,968,000

SECTION F. Environmental impacts

The environmental assessment impact has been performed according the Ukrainian legislation in force as described in section F. It describes in details the collection and archiving of the information of the project environmental impacts, if applicable. The subprojects are being implemented in the framework of operation/maintenance activities and do not require performance of the EIA. Such subprojects are: retrofit or partial modernization of existing gas turbine drives (subprojects 1.2), electrical efficiency.

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

Activities of Ukrtransgas are performed within the current legislation of Ukraine, in particular it compliance to the law of Ukraine "On Environment Protection", law of Ukraine "On ecological expertise", the Law of Ukraine "On protection of atmospheric air ", the Law of Ukraine "On Waste management" and other applicable norms and regulations[51].

Compliance to the environmental norms requires systematic approach and continuous improvement of environmental management. For this purpose the Standard of Enterprise «Guidance on the principles of environmental management and means of ensuring» was developed, enacted by the order from 26/12/2002№361.

In 2004 the Department of rational use of resources and ecology of Ukrtransgas had developed a standard “Indicators of emissions (specific emissions) of pollutants from the main and auxiliary equipment of gas transportation network in Ukraine”. Determination of emissions can be performed using specific emissions determined for each type of equipment. The source of data was the environmental and thermal tests on the entire range of equipment.

Environmental management system of Ukrtransgas has been certified according to the requirements of ISO 14001:2006 “Environmental management systems. Guidelines for application”. Certificate was registered in the registry on 28 December 2006. Environment Management System is an integral part of management within the company, while developing and implementing an integrated system is a continuous process.

Total number of specialists employed in environmental protection service of Ukrtransgas accounts for over 100 persons.

[51] Can be found at http://www.budinfo.com.ua/dbn/8.htm

Permanent attention is paid to environmental security of company operation. There are laboratories which control the emissions from stationary and mobile sources, including wastewater. Requirements for new and modernized equipment, materials and components are always taking into account the environmental component. There is a system in place for aggregating and analysing of statistical reporting of environmental and energy use data.

The following categories of emissions are calculated/measured and reported:

- Emissions to air;
- Discharges to water ;
- Waste Management ;
- Soil Contamination;
- Use of raw materials and natural resources;
- Other local problems of environment and biodiversity.

According to project documentation, including impact assessment (EIA), transboundary impact is not expected because contamination occurs within the territory, close to the pipeline system, spread across the territory of Ukraine. Power boilers and gas turbine are order of magnitude less power, than thermal power plants located nearby. Thus, the concentration of pollutants in areas of work of these facilities is localized and at some distance from them can't be detected against the background of much higher emissions of thermal power stations.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The project "IMPLEMENTATION OF RESOURCE AND ENERGY SAVING MEASURES IN THE SUBSIDIARY “UKRTRANSGAS” OF NATIONAL JOINT STOCK COMPANY "NAFTOGAZ OF UKRAINE" has positive impact on the environment in general and locally. This occurs due to:

- Increase of thermal efficiency of gas turbines replaced or modernised within the project. It results in lowering the volume of natural gas combusted in these equipment and release of the pollutants contained in the flue gas into atmosphere. Combustion of natural gas is the major contributor in air pollution;
- Reducing the amount of electricity consumed from the grid and thus lowering the emissions at grid power plants;
- Reducing the amount of natural gas by reducing the amount which is vented due to repair activities.

Technologies involved in implementation of proposed measures do not increase the emissions of pollutants.

Therefore it can be concluded that the proposed project has positive environmental impact.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

The project complies with the current norms and requirements stipulated in Ukraine. Due to the proposed project nature (replacement of equipment to more efficient, modernization and retrofit activities made on existing equipment, no major civil or construction work is involved. There is no legislative enforcement of host country to obtain stakeholders comments for these types of activities. Therefore no stakeholders comments were obtained.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Affiliated Company «Ukrtransgas» of National Joint-Stock Company «Naftogaz of Ukraine»
Street/P.O.Box:	Klovsky uzviz
Building:	9 / 1
City:	Kyiv
State/Region:	
Postal code:	01021
Country:	Ukraine
Phone:	+38044 254-31-54
Fax:	+38044 461-20-95
E-mail:	ukrtransgas.utg@naftogaz.net
URL:	http://www.utg.ua
Represented by:	Serhiy Vinokurov
Title:	Director
Salutation:	Mr.
Last name:	Vinokurov
Middle name:	Oleksijovych
First name:	Serhiy
Department:	
Phone (direct):	+38044 461-20-11
Fax (direct):	+38044 461-20-95
Mobile:	
Personal e-mail:	

Organisation:	Affiliated Company «Ukrtransgas» of National Joint-Stock Company «Naftogaz of Ukraine»
Street/P.O.Box:	Klovsky uzviz
Building:	9 / 1
City:	Kyiv
State/Region:	
Postal code:	01021
Country:	Ukraine
Phone:	+38044 254-31-54
Fax:	+38044 461-20-95
E-mail:	ukrtransgas.utg@naftogaz.net
URL:	http://www.utg.ua
Represented by:	Ihor Prischepo
Title:	Chief of section
Salutation:	Mr.
Last name:	Prischepo
Middle name:	Oleksandrovych
First name:	Ihor
Department:	Department of fuel and energy norms, ecology and energy efficiency, Energy-savings section
Phone (direct):	+38044 461-23-77
Fax (direct):	+38044 461-26-20
Mobile:	
Personal e-mail:	Iprishepo.utg@naftogaz.net

Organisation:	SIA "Vidzeme Eko"
Street/P.O.Box:	Zolitudes
Building:	46 k-2 –76
City:	Riga
State/Region:	
Postal code:	LV-1029
Country:	Latvia
Phone:	+371 29518171
Fax:	+371 67284770
E-mail:	info@ekoji.lv
URL:	http://www.holdings.lv
Represented by:	Mikus Vilsons
Title:	Director
Salutation:	Mr
Last name:	Vilsons
Middle name:	
First name:	Mikus
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	+371 29518171
Personal e-mail:	

Organisation:	SIA “Vidzeme Eko”
Street/P.O.Box:	Zolitudes
Building:	46 k-2 –76
City:	Riga
State/Region:	
Postal code:	LV-1029
Country:	Latvia
Phone:	+371 29518171
Fax:	+371 67284770
E-mail:	info@ekoji.lv
URL:	http://www.holdings.lv
Represented by:	Aleksandrs Fridkins
Title:	Finance director
Salutation:	Mr.
Last name:	Fridkins
Middle name:	
First name:	Aleksandrs
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	+371 29442040
Personal e-mail:	

Organisation:	SIA “Vidzeme Eko”
Street/P.O.Box:	Zolitudes
Building:	46 k-2 –76
City:	Riga
State/Region:	
Postal code:	LV-1029
Country:	Latvia
Phone:	+371 29518171
Fax:	+371 67284770
E-mail:	info@ekoji.lv
URL:	http://www.holdings.lv
Represented by:	Viktor Tkachenko
Title:	Official representative in Ukraine
Salutation:	Mr
Last name:	Tkachenko
Middle name:	
First name:	Viktor
Department:	
Phone (direct):	+38095 272 45 74
Fax (direct):	
Mobile:	
Personal e-mail:	

Organisation:	SIA “Vidzeme Eko”
Street/P.O.Box:	Zolitudes
Building:	46 k-2 –76
City:	Riga
State/Region:	
Postal code:	LV-1029
Country:	Latvia
Phone:	+371 29518171
Fax:	+371 67284770
E-mail:	info@ekoji.lv
URL:	http://www.holdings.lv
Represented by:	Doumik Aleksey
Title:	Project Manager
Salutation:	Mr.
Last name:	Doumik
Middle name:	
First name:	Aleksey
Department:	
Phone (direct):	+38044 222 61 63
Fax (direct):	
Mobile:	
Personal e-mail:	Alex.doumik@yahoo.com

Annex 2

BASELINE INFORMATION

Below the fixed baseline parameters are provided for each of the subprojects: 1.1; 1,2; 1.3 and 2

Subproject 1.1. Replacement of gas turbine drives		
i	$\eta^{n}_{bsl,i}$	unit
1	27.0%	d/l
2	28.0%	d/l
3	27.5%	d/l
4	25.0%	d/l
5	25.0%	d/l
6	25.0%	d/l
7	25.0%	d/l
8	25.0%	d/l
9	25.0%	d/l
10	25.0%	d/l
11	25.0%	d/l
12	25.0%	d/l
13	25.0%	d/l
Subprojects 1.2 Modernization of existing gas turbine drives to improve their efficiency by introducing a number of standardized improvements		
14	22.60%	d/l
15	26.90%	d/l
16	20.00%	d/l
17	23.20%	d/l
18	26.00%	d/l
19	28.80%	d/l
20	27.70%	d/l
21	24.60%	d/l
22	30.20%	d/l
23	24.90%	d/l
24	26.20%	d/l
25	25.50%	d/l
26	24.30%	d/l
27	24.20%	d/l
28	25.60%	d/l

i	$\eta^{n}_{bsl,i}$	unit
29	28.60%	d/l
30	24.70%	d/l
31	24.70%	d/l
32	24.00%	d/l
33	26.90%	d/l
34	27.10%	d/l
35	24.50%	d/l
36	22.20%	d/l
37	24.40%	d/l
38	25.50%	d/l
39	25.90%	d/l
40	24.00%	d/l
41	23.90%	d/l
42	26.20%	d/l
43	25.60%	d/l
44	25.90%	d/l
45	22.60%	d/l
46	25.00%	d/l
47	19.90%	d/l
48	27.30%	d/l
49	26.50%	d/l
50	25.00%	d/l
51	39.00%	d/l
52	22.00%	d/l
53	24.70%	d/l
54	27.30%	d/l
55	26.90%	d/l
56	26.20%	d/l
57	26.00%	d/l
58	26.00%	d/l
59	24.40%	d/l
60	21.40%	d/l
61	24.80%	d/l
62	24.50%	d/l
63	22.70%	d/l
64	24.10%	d/l

i	$\eta^{n}_{bsl,i}$	unit
65	26.00%	d/l
66	23.50%	d/l
67	27.90%	d/l
68	26.90%	d/l
69	33.80%	d/l
70	22.50%	d/l
71	25.10%	d/l
72	25.60%	d/l
73	24.70%	d/l
74	28.10%	d/l
75	24.50%	d/l
76	24.80%	d/l
77	25.10%	d/l
78	25.00%	d/l
79	25.50%	d/l
80	21.40%	d/l
81	24.20%	d/l
82	19.70%	d/l
83	26.10%	d/l
84	24.60%	d/l
85	26.80%	d/l
86	23.10%	d/l
87	24.90%	d/l
88	24.50%	d/l
89	25.20%	d/l
90	26.10%	d/l
91	26.00%	d/l
92	24.90%	d/l
93	25.00%	d/l
94	25.30%	d/l
95	23.70%	d/l
96	22.20%	d/l
97	25.90%	d/l
98	25.20%	d/l
99	25.30%	d/l
100	25.10%	d/l
101	22.00%	d/l
102	26.10%	d/l
103	23.80%	d/l
104	26.50%	d/l
105	23.10%	d/l
106	25.50%	d/l
107	26.70%	d/l

i	$\eta^{n}_{bsl,i}$	unit
108	24.40%	d/l
109	25.30%	d/l
110	25.10%	d/l
111	24.90%	d/l
112	19.40%	d/l
113	24.80%	d/l
114	27.00%	d/l
115	21.70%	d/l
116	26.70%	d/l
117	24.30%	d/l
118	24.20%	d/l
119	25.60%	d/l
120	25.20%	d/l
121	26.90%	d/l
122	27.10%	d/l
123	26.50%	d/l
124	24.90%	d/l
125	25.20%	d/l
126	24.10%	d/l
127	25.30%	d/l
128	22.10%	d/l
129	24.60%	d/l
130	27.20%	d/l
131	24.70%	d/l
132	26.70%	d/l
133	24.30%	d/l
134	24.90%	d/l
135	25.30%	d/l
136	23.80%	d/l
137	24.40%	d/l
138	26.50%	d/l
139	26.90%	d/l
140	33.80%	d/l
141	22.30%	d/l
142	26.30%	d/l
143	25.30%	d/l
144	24.50%	d/l
145	26.10%	d/l
146	25.40%	d/l
147	25.70%	d/l
148	24.90%	d/l
149	34.00%	d/l
150	24.80%	d/l

i	$\eta^{n}_{bsl,i}$	unit
151	25.20%	d/l
152	26.70%	d/l
153	24.80%	d/l
154	25.00%	d/l
155	27.50%	d/l
156	24.60%	d/l
157	24.40%	d/l
158	22.50%	d/l
159	27.10%	d/l
160	20.00%	d/l
161	24.70%	d/l
162	26.10%	d/l
163	27.50%	d/l
164	24.70%	d/l
165	33.20%	d/l
166	25.00%	d/l
167	24.90%	d/l
168	25.60%	d/l
169	25.10%	d/l
170	24.70%	d/l
171	25.50%	d/l
172	25.70%	d/l
173	24.60%	d/l
174	27.00%	d/l
175	26.50%	d/l
176	26.20%	d/l
177	25.00%	d/l
178	26.40%	d/l
179	26.60%	d/l
180	23.60%	d/l
181	23.50%	d/l
182	27.40%	d/l
183	25.10%	d/l
184	21.00%	d/l
185	22.50%	d/l
186	26.60%	d/l
187	25.00%	d/l
188	27.70%	d/l
189	26.70%	d/l
190	21.80%	d/l
191	27.10%	d/l
192	26.00%	d/l
193	24.90%	d/l

i	$\eta^{n}_{bsl,i}$	unit
194	25.90%	d/l
195	26.60%	d/l
196	24.90%	d/l
197	25.90%	d/l
198	25.50%	d/l
199	25.10%	d/l
200	20.40%	d/l
201	28.00%	d/l
202	26.20%	d/l
203	26.50%	d/l
204	24.50%	d/l
205	34.10%	d/l
206	26.20%	d/l
207	28.60%	d/l
208	20.50%	d/l
209	25.80%	d/l
210	24.60%	d/l
211	25.00%	d/l
212	26.90%	d/l
213	24.50%	d/l
214	26.90%	d/l
215	25.10%	d/l
216	24.40%	d/l
217	27.00%	d/l
218	24.80%	d/l
219	26.40%	d/l
220	25.00%	d/l
221	28.70%	d/l
222	26.00%	d/l
223	27.00%	d/l
224	25.50%	d/l
225	27.90%	d/l
226	25.30%	d/l
227	25.90%	d/l
228	25.30%	d/l
229	25.10%	d/l
230	23.20%	d/l
231	26.20%	d/l
232	27.90%	d/l
233	26.20%	d/l
234	24.50%	d/l
235	26.50%	d/l
236	29.00%	d/l

i	$\eta^{n}_{bsl,i}$	unit
237	26.20%	d/l
238	23.90%	d/l
239	24.00%	d/l
240	25.40%	d/l
241	25.10%	d/l
242	25.40%	d/l
243	20.80%	d/l
244	27.00%	d/l
245	28.00%	d/l
246	21.50%	d/l
247	25.80%	d/l
248	28.00%	d/l
249	24.90%	d/l
250	30.40%	d/l
251	25.10%	d/l
252	24.20%	d/l
253	23.90%	d/l
254	26.00%	d/l
255	27.40%	d/l
256	17.90%	d/l
257	27.40%	d/l
258	25.40%	d/l
259	22.90%	d/l
260	23.80%	d/l
261	29.70%	d/l
262	26.80%	d/l
263	27.90%	d/l
264	26.00%	d/l
265	25.80%	d/l
266	22.50%	d/l
Subproject 1.3 Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers		
i	η_i	unit
267	88.70%	d/l

Subproject 2. Modernization of cathode protection system of underground pipelines		
i	$R_{bsl,i}$	units
268	3.07	Ohm
269	2.40	Ohm
270	10.67	Ohm
271	8.67	Ohm
272	4.50	Ohm
273	18.75	Ohm
274	32.00	Ohm
275	30.00	Ohm
276	3.54	Ohm
277	4.78	Ohm
278	5.50	Ohm
279	1.86	Ohm
280	1.76	Ohm
281	3.75	Ohm
282	8.75	Ohm
283	13.50	Ohm
284	18.00	Ohm
285	3.42	Ohm
286	25.00	Ohm
287	10.00	Ohm
288	7.00	Ohm
289	7.67	Ohm
290	9.20	Ohm
291	11.50	Ohm
292	8.75	Ohm
293	1.58	Ohm
294	9.33	Ohm
295	8.13	Ohm
296	7.83	Ohm
297	9.29	Ohm
298	5.00	Ohm
299	4.20	Ohm
300	9.20	Ohm
301	4.75	Ohm
302	15.75	Ohm
303	4.48	Ohm
304	7.67	Ohm
305	48.00	Ohm
306	21.67	Ohm
307	9.20	Ohm
308	0.27	Ohm
309	6.30	Ohm
310	15.50	Ohm

i	$R_{bsl,i}$	units
311	8.60	Ohm
312	3.84	Ohm
313	4.25	Ohm
314	93.00	Ohm
315	4.00	Ohm
316	30.00	Ohm
317	3.13	Ohm
318	2.06	Ohm
319	9.10	Ohm
320	6.43	Ohm
321	4.35	Ohm
322	3.68	Ohm
323	10.00	Ohm
324	6.00	Ohm
325	21.25	Ohm
326	2.13	Ohm
327	13.00	Ohm
328	3.00	Ohm
329	3.43	Ohm
330	6.67	Ohm
331	2.97	Ohm
332	13.75	Ohm
333	3.17	Ohm
334	8.90	Ohm
335	17.33	Ohm
336	13.00	Ohm
337	5.20	Ohm
338	12.00	Ohm
339	1.73	Ohm
340	15.00	Ohm
341	4.80	Ohm
342	10.67	Ohm
343	5.63	Ohm
344	6.64	Ohm
345	3.60	Ohm
346	3.48	Ohm
347	26.67	Ohm
348	11.13	Ohm
349	25.00	Ohm
350	24.50	Ohm
351	5.11	Ohm
352	3.00	Ohm
353	16.00	Ohm

i	$R_{bsl,i}$	units
354	2.60	Ohm
355	2.08	Ohm
356	6.36	Ohm
357	9.20	Ohm
358	2.97	Ohm
359	10.63	Ohm
360	2.09	Ohm
361	7.50	Ohm
362	3.43	Ohm
363	8.00	Ohm
364	9.20	Ohm
365	9.40	Ohm
366	23.00	Ohm
367	2.90	Ohm
368	5.75	Ohm
369	3.54	Ohm
370	20.00	Ohm
371	17.20	Ohm
372	12.13	Ohm
373	11.75	Ohm
374	4.18	Ohm
375	9.10	Ohm
376	3.74	Ohm
377	9.20	Ohm
378	5.47	Ohm
379	10.11	Ohm
380	5.00	Ohm
381	5.00	Ohm
382	5.00	Ohm
383	3.07	Ohm
384	6.86	Ohm
385	4.60	Ohm
386	3.75	Ohm
387	6.57	Ohm
388	2.57	Ohm
389	4.72	Ohm
390	4.83	Ohm
391	3.30	Ohm
392	6.43	Ohm
393	4.22	Ohm
394	9.60	Ohm
395	2.17	Ohm
396	4.68	Ohm

i	$R_{bsl,i}$	units
397	3.04	Ohm
398	9.20	Ohm
399	10.25	Ohm
400	38.00	Ohm
401	5.56	Ohm
402	11.75	Ohm
403	7.08	Ohm
404	4.10	Ohm
405	13.50	Ohm
406	6.07	Ohm
407	23.50	Ohm
408	10.63	Ohm
409	12.00	Ohm
410	14.00	Ohm
411	9.60	Ohm
412	8.60	Ohm
413	9.00	Ohm
414	4.86	Ohm
415	13.50	Ohm
416	16.67	Ohm
417	9.20	Ohm
418	3.17	Ohm
419	18.50	Ohm
420	8.00	Ohm
421	4.10	Ohm
422	4.60	Ohm
423	7.00	Ohm
424	4.50	Ohm
425	17.20	Ohm
426	4.33	Ohm
427	3.18	Ohm
428	12.50	Ohm
429	3.75	Ohm
430	5.00	Ohm
431	3.79	Ohm
432	3.68	Ohm
433	4.75	Ohm
434	10.11	Ohm
435	3.71	Ohm
436	7.50	Ohm
437	11.75	Ohm
438	5.38	Ohm
439	7.50	Ohm

i	$R_{bsl,i}$	units
440	24.00	Ohm
441	12.00	Ohm
442	3.80	Ohm
443	3.71	Ohm
444	24.00	Ohm
445	14.00	Ohm
446	6.71	Ohm
447	7.00	Ohm
448	11.38	Ohm
449	28.00	Ohm
450	6.73	Ohm
451	3.42	Ohm
452	2.97	Ohm
453	12.50	Ohm
454	8.70	Ohm
455	16.00	Ohm
456	4.39	Ohm
457	28.00	Ohm
458	14.40	Ohm
459	32.00	Ohm
460	2.34	Ohm
461	9.33	Ohm
462	12.14	Ohm
463	3.64	Ohm
464	6.91	Ohm
465	2.06	Ohm
466	3.42	Ohm
467	3.33	Ohm
468	27.00	Ohm
469	3.91	Ohm
470	7.60	Ohm
471	3.25	Ohm
472	24.00	Ohm
473	8.00	Ohm
474	24.00	Ohm
475	3.48	Ohm
476	25.00	Ohm
477	1.27	Ohm
478	112.00	Ohm
479	5.56	Ohm
480	2.35	Ohm
481	26.50	Ohm
482	5.56	Ohm

i	$R_{bsl,i}$	units
483	4.94	Ohm
484	2.33	Ohm
485	5.47	Ohm
486	21.67	Ohm
487	6.29	Ohm
488	4.05	Ohm
489	3.27	Ohm
490	42.00	Ohm
491	9.00	Ohm
492	44.00	Ohm
493	14.17	Ohm
494	19.00	Ohm
495	3.30	Ohm
496	8.33	Ohm
498	8.00	Ohm
499	27.00	Ohm
500	4.80	Ohm

i	$R_{bsl,i}$	units
501	48.00	Ohm
502	5.23	Ohm
503	2.79	Ohm
504	46.00	Ohm
505	16.40	Ohm
506	6.40	Ohm
507	6.57	Ohm
508	2.28	Ohm
509	4.09	Ohm
510	2.51	Ohm
511	4.89	Ohm
512	2.60	Ohm
513	9.60	Ohm
514	8.00	Ohm
515	6.17	Ohm
516	3.79	Ohm
517	6.90	Ohm

Annex 3

ПЛАН МОНІТОРИНГУ

Monitoring for the proposed project consists of three sections, each for particular group of subprojects:
Group 1: Stationary combustion.
A number of subprojects (1.1 to 1.3) aimed at saving of NG which is combusted in compressor drives, different boilers and heaters through implementation of energy conservation measures.
Group 2: Saving of electricity.
A number of energy efficiency measures implemented at compressor stations, involving cathode protection systems (subproject 2)
Group 3: Reduction of direct methane emission trough reduction of NG losses occurring during repair activities.
It includes a number of individual measures aimed at venting avoidance by using innovative repair techniques, recovery of gas which would be otherwise vented during repairs (subproject 3).

Monitoring for the first two groups of subprojects will be assessed using option (a) of Annex 2 of Guidance on criteria for baseline setting and monitoring[52] and the monitoring of Group 3 will be based on option (b) of the Annex 2 of the said Guidance: direct assessment of emission reductions.

Monitoring of Group 1 subprojects

As described in section A.4.2 (project description) project activity under this group of subprojects results in reduction of natural gas combusted. In order to determine the baseline and project emissions the amount of gas combusted has to be accessed.

For subproject 1.1 – replacement of gas turbine drives, to obtain the amount of gas consumed the following parameters are being monitored for each unit replaced: actual operation time and capacity factor. Operation time is monitored constantly and the capacity factor is regularly calculated and stored using compressor station control and monitoring software "Expert". Then the nominal drive efficiency is used to calculate the actual gas consumption in GJ in year y. The energy consumed in form of gas fuel is then used to calculate the emissions using carbon emission factor of natural gas. At last step the resulting emission reductions are calculated as difference between baseline and project emissions.

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Number of hours of drive operation is equal for baseline and project scenarios;
- Capacity factor for each drive replaced is the same for both, baseline and project scenarios;
- Actual capacity for each drive is the same in bot, baseline and project scenarios;
- Efficiencies prior to replacement and new turbine efficiency are taken from most recent performance test;
- Lower specific power consumption by drive auxiliary equipment of new modern drive as to compare with the old one is not taken into account. This is conservative.

The following parameters are fixed as default: carbon emission factor for combustion of natural gas.

Fixed baseline parameters: nominal efficiency of GT drive before replacement (efficiency of old drive) and nominal capacity of old drive.

Monitored parameters: time of operation of drive in year y, capacity factor of the drive in year y.

[52] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

For subproject 1.2 – modernization/retrofit of existing gas turbine drives to improve their efficiency. Approach is similar to that of subproject 1.1.

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Number of hours of drive operation is equal for baseline and project scenarios;
- Capacity factor for each drive replaced is the same for both, baseline and project scenarios;
- Actual capacity for each drive is the same in both, baseline and project scenarios;
- Natural degradation for both, turbine in the baseline and modernized turbine in project scenario is not taken into account;
- Lower specific power consumption by drive auxiliary equipment of new modern drive as to compare with the old one is not taken into account. This is conservative.

The following parameters are fixed as default: carbon emission factor for combustion of natural gas.

Fixed baseline parameters: nominal efficiency of GT drive before retrofit/modernization and nominal capacity of drive (not changed under retrofit).

Monitored parameters: time of operation of drive in year y, capacity factor of the drive in year y.

For subproject 1.3 – Using GT exhaust heat recovery boilers instead of separate gas fired space heating boilers.

Monitoring will be performed for each case where the existing boiler was replaced by new heat recovery boiler. In order to monitor the emission reduction the following data will be collected for each individual measure:

- Amount of heat produced by heat recovery boiler to calculate the amount of gas which would be used by heating boilers in the baseline
- Annual fuel gas consumption by the gas turbine to evaluate the additional amount of gas which is combusted by the gas turbine due to decrease of its efficiency as a result of additional flue gas pressure drop created by heat recovery boiler. As alternative, this amount of gas can be calculated using nominal hourly gas consumption by the turbine multiplied by monitored number of hours of operation in a year y. The latter will give overestimated gas consumption and therefore is more conservative.

Resulting emissions reduction is calculated as difference in emissions in the baseline scenario (in which the old gas fired boilers would produce the same amount of heat as do the heat recovery boilers in the project scenario) and the project scenario (in which only additional amount of gas is fired in the gas turbine to compensate the aerodynamic resistance of heat recovery boiler).

The following assumptions have been made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Amounts of heat produced in the baseline and projects scenarios are equal;
- Efficiencies of old gas fired boilers are taken as their passport (nominal) efficiencies;
- Deterioration of efficiency of gas turbine, at which exhaust a heat recovery boiler is installed, is estimated as 0.25% based on performance tests conducted[53].

The following parameters are fixed as default: carbon emission factor from combustion of natural gas, deterioration of GT drive efficiency caused by installation of heat recovery boiler at its exhaust.
Fixed baseline parameters: efficiency of replaced gas fired boiler.

---

[53] Methodology for calculation of saving of gas and electricity from implementation of energy conservation measures in transmission, underground storage and automated compressed natural gas filling stations. DK Ukrtransgas, order #51 from 14.02.05. Will be available for AIE as supporting document SD3.

Monitored parameters: amount of heat which is produced by heat recovery boiler in year y, consumption of gas by the GT drive at which the heat recovery boiler is installed, LCV of natural gas.

Monitoring of Group 2 subprojects

As described in section A.4.2 (project description) project activity under this group of subprojects results in reduction of electricity consumed. In order to determine the baseline and project emissions the amount of electricity consumed has to be accessed.

For subproject 2 – modernization of pipelines cathode protection systems**.**

The following parameters are monitored for subproject 2:

- Current and voltage which are being consumed by i-system in year y. They are monitored periodically and values are logged in passport of each cathode protection system. Average annual data are used.

The resulting emissions reductions are calculated then as difference between baseline and project power consumption for each i- system modernized.

In the baseline scenario the power consumed is calculated using actual current in year y and voltage which would be required to maintain it under fixed baseline resistance $R_{bsl,i}$.

Resistance in the baseline is fixed using actual current and voltage which were prior to modernization of i- system.

The following assumptions were made:

- Lifetime of existing equipment can last at least until the end of crediting period;
- Level of current in the loop of i-system is equal for both, baseline and project scenarios;
- Within the year y the levels of current and voltage for particular system are taken constant.
- The most recent grid emission factor will be used for each particular year y.

The following SP 2 parameters are fixed as default: carbon emission factor for consumption of electricity from the grid, time of operation of cathode protection system during year (assumed 8760 h)

Fixed baseline parameters: resistance in the loop of cathode protection system before the modernization of anode earthing.

Monitored parameters: current and voltage in the loop of cathode protection system after the modernization.

Monitoring of Group 3 subprojects using option (b)[54].

The option (b) defines the direct assessment of emissions reductions:

[54] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

(iii) Direct estimation/calculation of the difference between the anthropogenic emissions by sources within the project boundary in the baseline scenario and in the project scenario (e.g. in the case of landfill gas projects, the emission reductions can be calculated by multiplying the methane captured with an appropriate factor used on the global warming potential of methane);

(iv) Adjustment of the result of subparagraph (i) above for leakage.

The reason for selecting the option (b) to assess the resulting emissions reduction from Group 3 subprojects is that methane venting avoidance measures proposed in Group 3 cannot be assessed with any good accuracy using option (a). To understand this one can regard the breakdown of the gas amount spent annually for operation and maintenance (O&M) of the whole gas transmission system (please, refer to figure 1). The whole amount of gas used for operation and maintenance (which includes repair venting) is roughly 2 to 3 % of gas entering the system. Repair venting constitutes just less than 1% of O&M amount, while imbalance can be some 10% of O&M. Therefore estimating repair venting avoidance contribution using measured baseline and project venting will lead to great errors, which is unacceptable and therefore the option (b) will be used.

There is no approved monitoring methodology to estimate emission reductions from project activities of this type, therefore project specific methodology for direct assessment of the amount of venting avoidance is proposed, in which calculation is performed for each particular case of innovative repair implemented, by calculating the volume and mass of methane contained in the repaired section which would have been vented in the absence of the proposed project activity and multiplication by GWP of methane, as further described in D.1.2.

Parameters fixed as default: GWP of methane, density of methane at standard conditions.
Fixed baseline parameters: no
Monitored parameters: inner pipeline diameter, length of section under repair, temperature, pressure and density of gas in the pipeline section under repair, weighted average methane content in itransmission pipelines in year y.

See section D in PDD for detailed description of monitoring plan

Annex 4

PATENTS OBTAINED FOR INNOVATIVE REPAIR METHODS
патенти на винаходи інноваційних способів ремонту газопроводів

Patent # № патенту	Invention/назва винаходу	Link / посилання
42619	Method of elimination of leakages through flanged joints of taps without stopping the operation of the pipeline/спосіб усунення витоків газу крізь фланцеві з'єднання кранів газопроводів під час перекачування газу по газопроводу	http://base.ukrpatent.org/searchINV/search.php?action=viewsearchres&dbname=inv&page=1&lang=eng&sortby=np_asc http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=62283 http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=134191
59012A	Method of elimination of gas leak through crack at the gas transmission pipeline/спосіб усунення витоку газу через отвір на лінійній ділянці газопроводу	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=55648
59013	Method of elimination of leakage through flanged joints of gas pipeline without stopping their operation/спосіб усунення витоків газу через фланцеві з'єднання газопроводів без припинення перекачування газу по газопроводу	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=9156
68310	Method of repair of gas transmission pipeline sections located on cross-valley pillars without stopping the operation/спосіб ремонту ділянок газопроводів розташованих на колонах балкових переходів, без зупинення перекачування газу	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=26902
68311	Method of repair of gas transmission pipeline sections located on cross-valley pillars without stopping the operation/спосіб ремонту ділянок газопроводів розташованих на колонах балкових переходів, без зупинення перекачування газу	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=26903
72840	Method of repair of gas transmission pipeline (flanged sleeve)/спосіб ремонту лінійної ділянки газопроводу (муфта з фланцями)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=664
75859	Method of repair of operating gas transmission pipeline (two-layer sleeve)/спосіб ремонту дефектної ділянки діючого газопроводу (муфта двошарова)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=25824
76390	Method of repair of operating gas transmission pipeline (double sleeve)/спосіб ремонту дефектної ділянки діючого газопроводу (муфта подвійна)	http://base.ukrpatent.org/searchINV/search.php?action=viewsearchres&dbname=inv&page=1&lang=eng&sortby=np_asc
76391	Method of repair of operating gas transmission pipeline (three-layer sleeve)/спосіб ремонту дефектної ділянки діючого газопроводу (трьохшарова муфта)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=15562

77930	Method of repair of operating pipeline having through-wall defect/спосіб ремонту ділянки діючого трубопроводу з наскрізним дефектом	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=514
77931	Method of repair of pipeline under pressure (thin sleeve)/спосіб ремонту дефектної ділянки трубопроводу що знаходиться під тиском(тонка муфта)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=515
78963	Method of upgrading of security category of long section of operating pipeline (long sleeve KTG)/спосіб підвищення категорії протяжної ділянки діючого трубопровода. (Муфта довга КТГ).	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=8940
79417	Method of repair of long section of operating pipeline (long sleeve PTG)/спосіб ремонту протяжної ділянки діючого трубопроводу (муфта довга ПТГ)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=7229
81894	Method of repair of pipeline section without interruption of operation/спосіб ремонту дефектної ділянки трубопроводу без зміни режимів транспортування продукту	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=7796
81895	Method of pipeline repair under operation (sleeve with welding sealing)/спосіб ремонту трубопроводу в умовах експлуатації (муфта з зварним ущільненням)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=7797
82038	Method of operating pipeline repair with sleeve assembly quality control (“blow down” sleeve)/спосіб муфтового ремонту дефектної ділянки діючого трубопроводу з контролем якості монтажу (муфта продувка)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=21379
83789	Method of recovery of load capacity of linear and curved sections of operating pipeline/спосіб поновлення несучої здатності лінійних та вигнутих ділянок діючого трубопроводу	http://base.ukrpatent.org/searchINV/search.php?action=setsearchcond&dbname=inv&lang=eng&sortby=_
2208196	Method of elimination of leakages through flanged joints of taps without stopping the operation of the pipeline/спосіб усунення витоків газу крізь фланцеві з’єднання кранів газопроводів під час перекачування газу по газопроводу	Patent of Russian Federation for invention as of patent of Ukraine # 42619
2268438	Method of elimination of leakage through flanged joints of gas pipeline without stopping their operation/спосіб усунення витоків газу через фланцеві з’єднання газопроводів без припинення перекачування газу по газопроводу	Patent of Russian Federation for invention as of patent of Ukraine # 59013
2292512	Method of repair of gas transmission pipeline (flanged sleeve)/спосіб ремонту лінійної ділянки газопроводу (муфта з фланцями)	Patent of Russian Federation for invention as of patent of Ukraine # 72840
2314453	Method of repair of operating gas transmission pipeline (two-layer sleeve)/спосіб ремонту	Patent of Russian Federation for invention as of patent of Ukraine # 75859

	дефектної ділянки діючого газопроводу (муфта двошарова)	
29500	Method of leak through contact gaskets of joints elimination (without disassembling)/спосіб усунення витоків через контактні ущільнення з'єднань (без розбирання з'єднання)	http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=4679 http://base.ukrpatent.org/searchINV/search.php?action=viewdetails&IdClaim=100533

Annex 5

Ukrainian standardized grid emission factors/коефіцієнти викидів CO_2 від споживання електроенергії з енергосистеми України

FOR THE PERIOD UNTIL 2008:

Standardized emission factors for the Ukrainian electricity grid

Introduction

Many Joint Implementation (JI) projects have an impact on the CO_2 emissions of the regional or national electricity grid. Given the fact that in most Economies in Transition (IET) an integrated electricity grid exists, a standardized baseline can be used to estimate the amount of CO_2 emission reductions on the national grid in case of:

a) Additional electricity production and supply to the grid as a result of a JI project (=producing projects);
b) Reduction of electricity consumption due to the JI project resulting in less electricity generation in the grid (= reducing projects);
c) Efficient on-site electricity generation with on-site consumption. Such a JI project can either be a), b), or a combination of both (e.g. on-site cogeneration with partial on-site consumption and partial delivery to the grid).

So far most JI projects in EIT, including Ukraine, have used the standardized Emission Factors (EFs) of the ERUPT programme. In the ERUPT programme for each EIT a baseline for producing projects and reducing projects was developed. The ERUPT approach is generic and does not take into account specific local circumstances. Therefore in recent years new standardized baselines were developed for countries like Romania, Bulgaria, and Estonia. In Ukraine a similar need exist to develop a new standardized electricity baseline to take the specific circumstances of Ukraine into account. The following baseline study establishes a new electricity grid baseline for Ukraine for both producing JI projects and reducing JI projects.

This new baseline has been based on the following guidance and approaches:

- The "Guidance on criteria for baseline setting and monitoring" for JI projects, issued by the Joint Implementation Supervisory Committee[55];
- The "Operational Guidelines for the Project Design Document", further referred to as ERUPT approach or baseline[56];
- The approved CDM methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"[57];
- Specific circumstances for Ukraine as described below.

ERUPT

The ERUPT baseline was based on the following main principles:

- Based mainly on indirect data sources for electricity grids (i.e. IEA/OECD reports);
- Inclusion of grid losses for reducing JI projects;

---

[55] Guidance on criteria for baseline setting and monitoring, version 01, Joint Implementation Supervisory Committee, ji.unfccc.int

[56] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Ministry of Economic Affairs of the Netherlands, May 2004

[57] Consolidated baseline methodology for grid-connected electricity generation from renewable sources, version 06, 19 May 2006, cdm.unfccc.int

- An assumption that all fossil fuel power plants are operating on the margin and in the period of 2000-2030 all fossil fuel power plants will gradually switch to natural gas.

The weak point of this approach is the fact that the date sources are not specific. For example, the Net Calorific Value (NCV) of coals was not determined on installation level but was taken from IPCC default values. Furthermore the IEA data included electricity data until 2002 only. ERUPT assumes that Ukraine would switch all its fossil-fuel plant from coal to natural gas. In Ukraine such an assumption is unrealistic as the tendency is currently in the opposite direction.

ACM0002

The ACM0002 methodology was developed in the context of CDM projects. The methodology takes a combination of the Operating Margin (OM) and the Build Margin (BM) to estimate the emissions in absence of the CDM project activity. To calculate the OM four different methodologies can be used. The BM in the methodology assumes that recent built power plants are indicative for future additions to the grid in the baseline scenario and as a result of the CDM project activity construction of new power plants is avoided. This approach is valid in electricity grids in which the installed generating capacity is increasing, which is mostly the case in developing countries. However, the Ukrainian grid has a significant overcapacity and many power plants are either operating below capacity or have been moth-balled.

Nuclear is providing the base load in Ukraine

In Ukraine nuclear power plants are providing the base load of the electricity in Ukraine. To reduce the dependence on imported fuel the nuclear power plants are running at maximum capacity where possible. In the past five years nuclear power plants provide almost 50% of the total electricity:

Year	2001	2002	2003	2004	2005
Share of AES	44%	45%	45%	48%	48%

- *Table 17: Share of nuclear power plant in the annual electricity generation*

All other power stations are operating on the margin. This includes hydro power plants which is show in the table below.

	Minimum; 03:00	Maximum; 19:00
Consumption, MW	21,287	27,126
Generation, MW	22,464	28,354
Thermal power plants	*10,049*	*13,506*
Hydro power plants	*527*	*3,971*
Nuclear power plants	*11,888*	*10,877*
Balance imports/export, MW	-1,177	-1,228

- *Table 18: Electricity demand in Ukraine on 31 March 2005*[58]

Development of the Ukrainian electricity sector

The National Energy Strategy[59] sets the approach for the overall energy complex of Ukraine and the electricity sector in particular. The main priority of Ukraine is to reduce the dependence of imported fossil fuels. The strategy sets the following priorities[60]:

- increased use of local coal as a fuel;

[58] Ukrenergo, http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/article?art_id=39047&cat_id=35061

[59] http://mpe.kmu.gov.ua/fuel/control/uk/doccatalog/list?currDir=50505

[60] Energy Strategy of Ukraine for the Period until 2030, section 16.1, page 127.

- construction of the new nuclear power plants;
- energy efficiency and energy saving.

Due to the sharp increase of imported natural gas prices a gradual switch from natural gas to coal at the power plants is planned in the nearest future. Ukraine possesses a large overcapacity of the fossil-powered plants of which many are mothballed. These moth-balled plants might be connected to the grid in case of growing demand.

In the table below the installed capacity and load factor is given in Ukraine. As one can see the average load factor of thermal power plant is very low.

	Installed capacity (GW)	Average load factor, %
Thermal power plants	33.6	28.0
Hydro power plants	4.8	81.4
Nuclear power plants	13.8	26.0
Total	**52.2**	**39.0**

• *Table 19: Installed capacity in Ukraine in 2004*[61]

According to IEA's estimations, about 25% of thermal units might not be able to operate (though there is no official statistics). This means that still at least 45% of the installed thermal power capacity could be utilized, but is currently not used. In accordance with the IEA report the 'current capacity will be sufficient to meet the demand in the next decade'[62].

In the table below the peak load of the years 2001- 2005 are given which is approximately 50% of the installed capacity.

	2001	2002	2003	2004	2005
Peak load (GW)	28.3	29.3	26.4	27.9	28.7

• *Table 20: Peak load in Ukraine in 2001 - 2005*[63]

New nuclear power plants will take significant time to be constructed will not get on-line before the end of the second commitment period in 2012. There is no nuclear reactor construction site at such an advanced stage remaining in Ukraine, it is unlikely that Ukraine will have enough resources to commission any new nuclear units in the foreseeable future (before 2012)[64].

Latest nuclear additions (since 1991):
- Zaporizhzhya NPP unit 6, capacity 1 GW, commissioned in 1995;
- Rivne NPP unit 4, capacity 1 GW, commissioned in 2004;
- Khmelnitsky NPP unit 2, capacity 1 GW, commissioned in 2004.

Nuclear power plants under planning or at early stage of construction:
- South Ukraine NPP one additional unit, capacity 1 GW;
- Khmelnitsky NPP two additional units, capacity 1 GW each.

[61] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 272, table 8.1

[62] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 269

[63] Ministry of Energy, letter dated 11 January 2007

[64] http://www.xaec.org.ua/index-ua.html

Approach chosen

In the selected approach of the new Ukrainian baseline the BM is not a valid parameter. Strictly applying BM in accordance with ACM0002 would result in a BM of zero as the latest additions to the Ukrainian grid were nuclear power plants. Therefore applying BM taking past additions to the Ukrainian grid would result in an unrealistic and distorted picture of the emission factor of the Ukrainian grid. Therefore the Operating Margin only will be used to develop the baseline in Ukraine.

The following assumptions from ACM0002 will be applied:

1) The grid must constitute of all the power plants connected to the grid. This assumption has been met as all power plants have been considered;
2) There should be no significant electricity imports. This assumption has been met in Ukraine as Ukraine is a net exporting country as shown in the table below;
3) Electricity exports are not accounted separately and are not excluded from the calculations.

	2001	2002	2003
Electricity produced, GWh	175,109	179,195	187,595
Exports, GWh	5,196	8,576	12,175
Imports, GWh	2,137	5,461	7,235

Table 21: Imports and exports balance in Ukraine[65]

ACM0002 offers several choices for calculating the OM. Dispatch data analysis cannot be applied, since the grid data is not available[66]. Simple adjusted OM approach is not applicable for the same reason. The average OM calculation would not present a realistic picture and distort the results, since nuclear power plants always work in the base load due to the technical limitations (and therefore cannot be displaced) and constitute up to 48% of the overall electricity generation during the past 5 years.

Therefore, the simple OM approach is used to calculate the grid emission factor. In Ukraine the low-cost must-run power plants are nuclear power stations. Their total contribution to the electricity production is below 50% of the total electricity production. The remaining power plants, all being the fossil-fuel plants and hydro power plants, are used to calculate the Simple OM.

%	2001	2002	2003	2004	2005
Nuclear power plants	44.23	45.08	45.32	47.99	47.92
Thermal power plants	38.81	38.32	37.24	32.50	33.22
Combined heat and power	9.92	11.02	12.28	13.04	12.21
Hydro power plants	7.04	5.58	5.15	6.47	6.65

Table 22: Share of power plants in the annual electricity generation of Ukraine[67]

[65] Source: State Committee of Statistics of Ukraine. Fuel and energy resources of Ukraine 2001-2003. Kyiv, 2004

[66] Ministry of Energy, letter dated 11 January 2007

[67] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

The simple OM is calculated using the following formula:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum GEN_{j,y}} \quad \textit{(Equation 56)}$$

Where:

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y* (2001-2005);

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid;

$COEF_{i,j,y}$ is the CO2 emission coefficient of fuel *I* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The CO2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \quad \text{(Equation 57)}$$

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;

$OXID_i$ is the oxidation factor of the fuel;

$EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel *i*.

Individual data for power generation and fuel properties was obtained from the individual power plants[68]. The majority of the electricity (up to 95%) is generated centrally and therefore the data is comprehensive[69].

The Net Calorific Value (NCV) of fossil fuel can change considerably, in particular when using coal. Therefore the local NCV values of individual power plants for natural gas and coal were used. For heavy fuel oil, the IPCC[70] default NCV was used. Local CO_2 emission factors for all types of fuels were taken for the purposes of the calculations and Ukrainian oxidation factors were used. In the case of small-scale power plants some data regarding the fuel NCV is missing in the reports. For the purpose of simplicity, the NCV of similar fuel from a power plant from the same region of Ukraine was used.

Reducing JI projects

The Simple OM is applicable for additional electricity production delivered to the grid as a result of the project (producing JI projects). However, reducing JI projects also reduce grid losses. For example a JI project reduces on-site electricity *consumption* with 100,000 MWh and the losses in the grid are 10%.

---

[68] “Overview of data on electrical power plants in Ukraine 2001 - 2005“, Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

[69] The data for small units (usually categorized in the Ukrainian statistics as ‘CHPs and others’) is scattered and was not always available. As it was rather unrealistic to collect the comprehensive data from each small-scale power plant, an average CO2 emission factor was calculated for the small-scale plants that provided the data. For the purpose of simplicity it was considered that all the electricity generated by the small power plants has the same average emission factor obtained.

[70] IPCC 1996. Revised guidelines for national greenhouse gas inventories.

This means that the actual reduction in electricity *production* is 111,111 MWh. Therefore a reduction of these grid losses should be taken into account for reducing JI projects to calculate the actual emission reductions.

The losses in the Ukrainian grid are given in the table below and are based on the data obtained directly from the Ukrainian power plants through the Ministry of Energy.

Year	Technical losses %	Non-technical losses %	Total %
2001	14,2	7	21,2
2002	14,6	6,5	21,1
2003	14,2	5,4	19,6
2004	13,4	3,2	16,6
2005	13,1	1,6	14,7

Table 23: Grid losses in Ukraine[71]

As one can see grid losses are divided into technical losses and non-technical losses. For the purpose of estimating the EF only technical losses[72] are taken into account. As can been seen in the table the technical grid losses are decreasing. The average decrease of grid losses in this period was 0.275% per annum. Extrapolating these decreasing losses to 2012 results in technical grid losses of 12% by 2012. However, in order to be conservative the grid losses *over the full period 2006-2012* have been taken as 10%.

Further considerations

The "Guidance on criteria for baseline setting and monitoring" for JI projects requires baselines to be conservative. The following measures have been taken to adhere to this guidance and to be conservative:

- The grid emission factor is actually expected to grow due to the current tendency to switch from gas to coal;
- Hydro power plants have been included in the OM. This is conservative;
- With the growing electricity demand, out-dated mothballed fossil fired power plants are likely to come on-line as existing nuclear power plants are working on full load and new nuclear power plants are unlikely to come on-line before 2012. The emission factor of those moth-balled power plants is higher as all of them are coal of heavy fuel oil fired[73];
- The technical grid losses in Ukraine are high, though decreasing. With the current pace the grid losses in Ukraine will be around 12% in 2012. To be conservative the losses have been taken 10%;
- The emissions of methane and nitrous oxide have not taken into consideration, which is in line with ACM0002. This is conservative.

Conclusion

An average CO_2 emission factor was calculated based on the years 2003-2005. The proposed baseline factors is based on the average constituting a fixed emission factor of the Ukrainian grid for the period of 2006-2012. Both baseline factors are calculated using the formulae below:

- $EF_{grid,produced,y} = EF_{OM,y}$ *(Equation 58)*

[71] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

[72] Ukrainian electricity statistics gives two types of losses – the so-called 'technical' and 'non-technical'. 'Non-technical' losses describe the non-payments and other losses of unknown origin.

[73] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

and

• $$EF_{grid,reduced,y} = \frac{EF_{grid,produced,y}}{1 - loss_{grid}}$$ *(Equation 59)*

Where:

$EF_{grid,produced,y}$ is the emission factor for JI projects supplying additional electricity to the grid (tCO2/MWh);
$EF_{grid,reduced,y}$ is the emission factor for JI projects reducing electricity consumptionfrom the grid (tCO2/MWh)factor of the fuel;
$EF_{OM,y}$ is the simple OM of the Ukrainian grid (tCO2/MWh);
$loss_{grid}$ is the technical losses in the grid (%).

The following result was obtained:

Type of project	**Parameter**	**EF (tCO2/MWh)**
JI project producing electricity	$EF_{grid,produced,y}$	0.807
JI projects reducing electricity	$EF_{grid,reduced,y}$	0.896

• *Table 24: Emission Factors for the Ukrainian grid 2006 - 2012*

Monitoring

This baseline requires the monitoring of the following parameters:

- Electricity produced by the project and delivered to the grid in year y (in MWh);
- Electricity consumption reduced by the project in year (in MWh);
- Electricity produced by the project and consumed on-site in year y (in MWh);

The baseline emissions are calculated as follows:

• $$BE_y = EF_{grid,produced,y} x EL_{produced,y} + EF_{grid,reduced,y} x \left(EL_{reduced,y} + EL_{consumed,y} \right)$$ *(Equation 60)*

Where:

BE_y are the baseline emissions in year y (tCO2);
$EF_{grid,produced,y}$ is the emission factor of producing projects (tCO2/MWh);
$EL_{produced,y}$ is electricity produced and delivered to the grid by the project in year y (MWh);
$EF_{grid,reduced,y}$ is the emission factor of reducing projects (tCO2/MWh);
$EL_{produced,y}$ is electricity consumption reduced by the project in year y(MWh);
$EL_{consumed,y}$ is electricity produced by the project and consumed on-site in year y (MWh).

This baseline can be used as ex-ante (fixed for the period 2006 – 2012) or ex-post. In case an ex-post baseline is chosen the data of the Ukrainian grid have to be obtained of the year in which the emission reductions are being claimed. Monitoring will have to be done in accordance with the monitoring plan of ACM0002 with the following exceptions:

- the Monitoring Plan should also include monitoring of the grid losses in year y;
- power plants at which JI projects take place should be excluded. Such a JI project should have been approved by Ukraine and have been determined by an Accredited Independent Entity.

Acknowledgements

The development of this new baseline has been made possible by funding of the EBRD and the Netherlands' Ministry of Economic Affairs. The authors would further like to thank the Ukrainian Ministry of Energy for supplying the data and the Ministry of Environmental Protection for their support.
This baseline study can be used freely in case of proper reference.

Global Carbon B.V.
Version 5, 2 February 2007

НАЦІОНАЛЬНЕ АГЕНТСТВО ЕКОЛОГІЧНИХ ІНВЕСТИЦІЙ УКРАЇНИ

НАКАЗ

м. Київ

15.04.2011 № 62

Про затвердження показників питомих викидів двоокису вуглецю у 2008 році

На виконання п.2.1 наказу від 21 березня 2011 № 39 "Про затвердження Методики розрахунку питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні" та з метою впорядкування розрахунків питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні,

НАКАЗУЮ:

1. Установити такі показники питомих викидів двоокису вуглецю у 2008 році:

- питомі викиди двоокису вуглецю при виробництві електричної енергії тепловими електростанціями, які підключені до Об'єднаної енергетичної системи України – 1,055 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 1 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,082 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 2 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,219 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю, які пов'язані із витратами електричної енергії при її передачі місцевими (локальними) електричними мережами – 1,082 кг CO_2/кВт*год.

2. Зазначені в п.1 цього наказу показники питомих викидів двоокису вуглецю у 2008 році рекомендується застосовувати при підготовці:

- проектних пропозицій щодо обґрунтування скорочення антропогенних викидів парникових газів, проектно-технічної документації, річних звітів з розрахунком обсягів скорочення викидів, що розробляються відповідно до Порядку підготовки, розгляду, схвалення та реалізації проектів, спрямованих на скорочення обсягу антропогенних викидів парникових газів, затвердженого постановою Кабінету Міністрів України від 22 лютого 2006 року № 206;
- розрахунків планових скорочень викидів парникових газів, що розробляються відповідно до Порядку розгляду, схвалення і реалізації проектів цільових екологічних (зелених) інвестицій та пропозицій щодо здійснення заходів, пов'язаних з реалізацією таких проектів і виконанням зобов'язань сторін Кіотського протоколу до Рамкової конвенції ООН про зміну клімату затвердженого постановою Кабінету Міністрів України від 22 лютого 2008 року № 221 та розрахунків фактичних скорочень викидів парникових газів в результаті реалізації таких проектів.

3. Управлінню гнучких механізмів Кіотського протоколу (Шевченко О.В.) та Управлінню схеми зелених інвестицій та розвитку ринку (Єрмакову В.М.) керуватись цим наказом під час розгляду проектів спільного впровадження та проектів цільових екологічних (зелених) інвестицій.

4. Управлінню національної системи обліку парникових газів (Хабатюк О.П.) керуватися цим наказом під час розгляду проектів спільного впровадження відповідно до Інструкції про організацію роботи щодо розгляду та розміщення документів за проектами спільного впровадження, затвердженої наказом Нацекоінвестагентства від 08.12.2010 № 184.

5. Сектору зв'язків з громадськістю та засобами масової інформації (Засць І.В.) забезпечити розміщення цього наказу на веб-сторінці Нацекоінвестагентства.

Голова комісії
з проведення реорганізації **І.Варга**

НАЦІОНАЛЬНЕ АГЕНТСТВО ЕКОЛОГІЧНИХ ІНВЕСТИЦІЙ УКРАЇНИ

НАКАЗ

м. Київ

15.04.2011 № 63

Про затвердження показників питомих викидів двоокису вуглецю у 2009 році

На виконання п.2.1 наказу від 21 березня 2011 № 39 "Про затвердження Методики розрахунку питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні" та з метою впорядкування розрахунків питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні,

НАКАЗУЮ:

1. Установити такі показники питомих викидів двоокису вуглецю у 2009 році:

- питомі викиди двоокису вуглецю при виробництві електричної енергії тепловими електростанціями, які підключені до Об'єднаної енергетичної системи України – 1,068 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 1 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,096 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 2 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,237 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю, які пов'язані із витратами електричної енергії при її передачі місцевими (локальними) електричними мережами – 1,096 кг CO_2/кВт*год.

2. Зазначені в п.1 цього наказу показники питомих викидів двоокису вуглецю у 2008 році рекомендується застосовувати при підготовці:

- проектних пропозицій щодо обґрунтування скорочення антропогенних викидів парникових газів, проектно-технічної документації, річних звітів з розрахунком обсягів скорочення викидів, що розробляються відповідно до Порядку підготовки, розгляду, схвалення та реалізації проектів, спрямованих на скорочення обсягу антропогенних викидів парникових газів, затвердженого постановою Кабінету Міністрів України від 22 лютого 2006 року № 206;
- розрахунків планових скорочень викидів парникових газів, що розробляються відповідно до Порядку розгляду, схвалення і реалізації проектів цільових екологічних (зелених) інвестицій та пропозицій щодо здійснення заходів, пов'язаних з реалізацією таких проектів і виконанням зобов'язань сторін Кіотського протоколу до Рамкової конвенції ООН про зміну клімату затвердженого постановою Кабінету Міністрів України від 22 лютого 2008 року № 221 та розрахунків фактичних скорочень викидів парникових газів в результаті реалізації таких проектів.

3. Управлінню гнучких механізмів Кіотського протоколу (Шевченко О.В.) та Управлінню схеми зелених інвестицій та розвитку ринку (Єрмакову В.М.) керуватись цим наказом під час розгляду проектів спільного впровадження та проектів цільових екологічних (зелених) інвестицій.

4. Управлінню національної системи обліку парникових газів (Хабатюк О.П.) керуватися цим наказом під час розгляду проектів спільного впровадження відповідно до Інструкції про організацію роботи щодо розгляду та розміщення документів за проектами спільного впровадження, затвердженої наказом Нацекоінвестагентства від 08.12.2010 № 184.

5. Сектору зв'язків з громадськістю та засобами масової інформації (Засць І.В.) забезпечити розміщення цього наказу на веб-сторінці Нацекоінвестагентства.

Голова комісії
з проведення реорганізації **І.Варга**

НАЦІОНАЛЬНЕ АГЕНТСТВО ЕКОЛОГІЧНИХ ІНВЕСТИЦІЙ УКРАЇНИ

НАКАЗ

м. Київ

28.03.2011 № 43

Про затвердження показників питомих викидів двоокису вуглецю у 2010 році

На виконання п.2.1 наказу від 21 березня 2011 № 39 "Про затвердження Методики розрахунку питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні" та з метою впорядкування розрахунків питомих викидів двоокису вуглецю при виробництві електричної енергії на теплових електростанціях та при її споживанні,

НАКАЗУЮ:

1. Установити такі показники питомих викидів двоокису вуглецю у 2010 році:

- питомі викиди двоокису вуглецю при виробництві електричної енергії тепловими електростанціями, які підключені до Об'єднаної енергетичної системи України – 1,067 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 1 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,093 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 2 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,225 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю, які пов'язані із витратами електричної енергії при її передачі місцевими (локальними) електричними мережами – 1,093 кг CO_2/кВт*год.

2. Зазначені в п.1 цього наказу показники питомих викидів двоокису вуглецю у 2010 році рекомендується застосовувати при підготовці:

- проектної пропозиції щодо обґрунтування скорочення антропогенних викидів парникових газів, проектно-технічної документації, річного звіту з розрахунком обсягів скорочення викидів, що розробляються відповідно до Порядку підготовки, розгляду, схвалення та реалізації проектів, спрямованих на скорочення обсягу антропогенних викидів парникових газів, затвердженого постановою Кабінету Міністрів України від 22 лютого 2006 року № 206 ;
- розрахунку планових скорочень викидів парникових газів, що розробляється відповідно до Порядку розгляду, схвалення і реалізації проектів цільових екологічних (зелених) інвестицій та пропозицій щодо здійснення заходів, пов'язаних з реалізацією таких проектів і виконанням зобов'язань сторін Кіотського протоколу до Рамкової конвенції ООН про зміну клімату затвердженого постановою Кабінету Міністрів України від 22 лютого 2008 року № 221 та розрахунку фактичних скорочень викидів парникових газів в результаті реалізації таких проектів.

3. Управлінню гнучких механізмів Кіотського протоколу (Шевченко О.В.) та Управлінню схеми зелених інвестицій та розвитку ринку (Єрмакову В.М.) керуватись цим наказом при перевірці документації за проектами спільного впровадження та проектами цільових екологічних (зелених) інвестицій.

4. Управлінню національної системи обліку парникових газів (Хабатюк О.П.) керуватися цим наказом при розгляді документації за проектами спільного впровадження, що проходять перевірку відповідно Інструкції про організацію роботи щодо розгляду та розміщення документів за проектами спільного впровадження, затвердженої наказом Нацекоінвестагентства від 08.12.2010 № 184.

5. Сектору зв'язків з громадськістю та засобами масової інформації (Засць І.В.) забезпечити розміщення цього наказу на веб-сторінці Нацекоінвестагентства.

Голова комісії
з проведення реорганізації **І.Варга**

НАЦІОНАЛЬНЕ АГЕНТСТВО ЕКОЛОГІЧНИХ ІНВЕСТИЦІЙ УКРАЇНИ

НАКАЗ

м. Київ

12.05.2011 № 75

Про затвердження показників питомих викидів двоокису вуглецю у 2011 році

З метою встановлення єдиного підходу до оцінки скорочень антропогенних викидів парникових газів проектами, що реалізуються відповідно до Порядку підготовки, розгляду, схвалення та реалізації проектів, спрямованих на скорочення обсягу антропогенних викидів парникових газів, затвердженого постановою Кабінету Міністрів України від 22 лютого 2006 року № 206 та Порядку розгляду, схвалення і реалізації проектів цільових екологічних (зелених) інвестицій та пропозицій щодо здійснення заходів, пов'язаних з реалізацією таких проектів і виконанням зобов'язань сторін Кіотського протоколу до Рамкової конвенції ООН про зміну клімату затвердженого постановою Кабінету Міністрів України від 22 лютого 2008 року № 221,

НАКАЗУЮ:

1. Установити такі показники питомих викидів двоокису вуглецю на 2011 рік:

- питомі викиди двоокису вуглецю при виробництві електричної енергії тепловими електростанціями, які підключені до Об'єднаної енергетичної системи України – 1,063 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 1 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,090 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю при споживанні електричної енергії споживачами електричної енергії, які віднесені до 2 класу відповідно до Порядку визначення класів споживачів, затвердженого постановою Національної комісії регулювання електроенергетики України від 13 серпня 1998 № 1052 – 1,227 кг CO_2/кВт*год;
- питомі непрямі викиди двоокису вуглецю, які пов'язані із витратами електричної енергії при її передачі місцевими (локальними) електричними мережами – 1,090 кг CO_2/кВт*год.

2. Зазначені в п.1 цього наказу показники питомих викидів двоокису вуглецю на 2011 рік рекомендується застосовувати до моменту затвердження показників питомих викидів двоокису вуглецю в 2011 році, що підлягають розрахунку щорічно до 1 березня, відповідно до п.2.2 наказу Нацекоінвестагентства від 21 березня 2011 року № 39 при підготовці:

- проектних пропозицій щодо обґрунтування скорочення антропогенних викидів парникових газів, проектно-технічних документацій, річних звітів з розрахунком обсягів скорочення викидів, що розробляються відповідно до Порядку підготовки, розгляду, схвалення та реалізації проектів, спрямованих на скорочення обсягу антропогенних викидів парникових газів, затвердженого постановою Кабінету Міністрів України від 22 лютого 2006 року № 206;
- розрахунків планових скорочень викидів парникових газів, що розробляються відповідно до Порядку розгляду, схвалення і реалізації проектів цільових екологічних (зелених) інвестицій та пропозицій щодо здійснення заходів, пов'язаних з реалізацією таких проектів і виконанням зобов'язань сторін Кіотського протоколу до Рамкової конвенції ООН про зміну клімату затвердженого постановою Кабінету Міністрів України від 22 лютого 2008 року № 221 та розрахунків фактичних скорочень викидів парникових газів в результаті реалізації таких проектів.

3. Управлінню гнучких механізмів Кіотського протоколу (Шевченко О.В.) та Управлінню схеми зелених інвестицій та розвитку ринку (Єрмакову В.М.) керуватись цим наказом під час розгляду проектів спільного впровадження та проектів цільових екологічних (зелених) інвестицій.

4. Управлінню національної системи обліку парникових газів (Хабатюк О.П.) керуватися цим наказом під час розгляду проектів спільного впровадження відповідно до Інструкції про організацію роботи щодо розгляду та розміщення документів за проектами спільного впровадження, затвердженої наказом Нацекоінвестагентства від 08.12.2010 № 184.

5. Сектору зв'язків з громадськістю та засобами масової інформації (Засць І.В.) забезпечити розміщення цього наказу на веб-сторінці Нацекоінвестагентства.

Заступник Голови комісії
з проведення реорганізації **В.Сидюченко**

Annex 6

Referencing of individual measures within subprojects

For each individual measure within a respective subproject an individual reference number ***i*** is assigned as shown in a table below:

i	Individual measure	Commissioning date dd.mm.yyyy	Comments
Subproject 1.1 Gas turbine drives replacement by new ones			
1	Replacing GT drive by new one on gas compressor unit #3 at CS #32P (CS Romnenska)	22.09.2005	
2	Replacing GT drive by new one on gas compressor unit #3 at CS Sofiivska	16.11.2005	
3	Replacing GT drive by new one on gas compressor unit #5 at CS #3 (CS Romnenska)	22.12.2005	
4	Replacing GT drive by new one on booster gas compressor unit #1 at CS Opary	09.11.2007	
5	Replacing GT drive by new one on booster gas compressor unit #2 at CS Opary	09.11.2007	
6	Replacing GT drive by new one on booster gas compressor unit #3 at CS Opary	09.11.2007	
7	Replacing GT drive by new one on booster gas compressor unit #4 at CS Opary	09.11.2007	
8	Replacing GT drive by new one at unit #1 CS Bobrovnytska	04.12.2008	
9	Replacing GT drive by new one at unit #2 CS Bobrovnytska	04.12.2008	
10	Replacing GT drive by new one at unit #3 CS Bobrovnytska	04.12.2008	
11	Replacing GT drive by new one at unit #4 CS Bobrovnytska	04.12.2008	
12	Replacing GT drive by new one at unit #5 CS Bobrovnytska	04.12.2008	
13	Replacing GT drive by new one at unit #6 CS Bobrovnytska	04.12.2008	
Subproject 1.2 Modernization or retrofit of existing gas turbine drives			
14	- Odesskoe LVUMG at unit # 3 at CS Orlovka	10.01.2005	
15	- Kremenchugskoe LVUMG at unit # 6 at CS Zadneprovskaya	14.01.2005	
16	- Yagotynskoe LVUMG at unit # 6 at CS Yagotyn	20.01.2005	
17	- Schebelinskoe LVUMG at unit # 7 at CS Schebelynka	26.01.2005	

18	- Barskoe LVUMG at unit # 1 at CS Gusyatyn	31.01.2005	
19	- Krasilovskoe LVUMG at unit # 1 at CS Krasilov	01.02.2005	
20	- Lubenskoe LVUMG at unit # 1 at CS Grebenka	04.02.2005	
21	- Gajsynskoe LVUMG at unit # 2 at CS Talnoe	08.02.2005	
22	- Zolotonoshskoe LVUMG at unit # 2 at CS Stavysche	12.02.2005	
23	- Barskoe LVUMG at unit # 6 at CS Bar	04.03.2005	
24	- Gajsynskoe LVUMG at unit # 3 at CS Ilinovskaya	06.03.2005	
25	- Lubenskoe LVUMG at unit # 8 at CS Lubny	09.03.2005	
26	- Yagotynskoe LVUMG at unit # 4 at CS Yagotyn	18.03.2005	
27	- Bogorodchanskoe LVUMG at unit # 5 at CS Bogorodchany	21.03.2005	
28	- Kremenchugskoe LVUMG at unit # 6 at CS Kremenchug	30.03.2005	
29	- Berdychevskoe LVUMG at unit # 4 at CS Berdychev	05.04.2005	
30	- Aleksandrovskoe LVUMG at unit # 1 at CS Aleksandrovka	09.04.2005	
31	- Pervomajskoe LVUMG at unit # 5 at CS Pervomayskaya	13.04.2005	
32	- Dikanskoe LVUMG at unit # 2 at CS Dykanka	22.04.2005	
33	- Ternopolskoe LVUMG at unit # 4 at CS Ternopol	22.04.2005	
34	- Kremenchugskoe LVUMG at unit # 7 at CS Zadneprovskaya	26.04.2005	
35	- Barskoe LVUMG at unit # 1 at CS Gusyatyn	26.05.2005	
36	- Yagotynskoe LVUMG at unit # 5 at CS Glushkovka	03.06.2005	
37	- Barskoe LVUMG at unit # 4 at CS Bar	13.06.2005	
38	- Gajsynskoe LVUMG at unit # 6 at CS Gajsyn	14.06.2005	
39	- Gajsynskoe LVUMG at unit # 1 at CS Talnoe	23.06.2005	
40	- Aleksandrovskoe LVUMG at unit # 7 at CS Kirovogradskaya	25.06.2005	
41	- Kremenchugskoe LVUMG at unit # 1 at CS Kremenchug	11.07.2005	
42	- Zolotonoshskoe LVUMG at unit # 3 at CS Stavysche	28.07.2005	

43	- Zolotonoshskoe LVUMG at unit # 3 at CS Sofievskaya	05.08.2005	
44	- Pervomajskoe LVUMG at unit # 7 at CS Borovaya	15.08.2005	
45	- Odesskoe LVUMG at unit # 4 at CS Orlovka	17.08.2005	
46	- Barskoe LVUMG at unit # 5 at CS Bar	26.08.2005	
47	- 0 LVUMG at unit # 5 at CS Sokal	28.08.2005	
48	- Kremenchugskoe LVUMG at unit # 3 at CS Zadneprovskaya	08.09.2005	
49	- Sumskoe LVUMG at unit # 4 at CS Romny	12.09.2005	
50	- Dikanskoe LVUMG at unit # 7 at CS Dykanka	14.09.2005	
51	- Zolotonoshskoe LVUMG at unit # 5 at CS Stavysche	24.09.2005	
52	- Yagotynskoe LVUMG at unit # 2 at CS Yagotyn	29.09.2005	
53	- Bogorodchanskoe LVUMG at unit # 4 at CS Bogorodchany	30.09.2005	
54	- Lubenskoe LVUMG at unit # 7 at CS Lubny	03.10.2005	
55	- Zolotonoshskoe LVUMG at unit # 3 at CS Stavysche	03.10.2005	
56	- Bogorodchanskoe LVUMG at unit # 3 at CS Bogorodchany	05.10.2005	
57	- Gajsynskoe LVUMG at unit # 1 at CS Ilinovskaya	05.10.2005	
58	- Ternopolskoe LVUMG at unit # 4 at CS Rogatyn	05.10.2005	
59	- N.Pskovskoe LVUMG at unit # 6 at CS N.Pskov	06.10.2005	
60	- Bibrskoe LVUMG at unit # 2 at CS Komarno	10.10.2005	
61	- Zolotonoshskoe LVUMG at unit # 2 at CS Stavysche	13.10.2005	
62	- Ternopolskoe LVUMG at unit # 5 at CS Rogatyn	14.10.2005	
63	- Lubenskoe LVUMG at unit # 6 at CS Grebenka	18.10.2005	
64	- Pervomajskoe LVUMG at unit # 2 at CS Borovaya	31.10.2005	
65	- Dikanskoe LVUMG at unit # 7 at CS Reshetilovka	01.11.2005	
66	- Yagotynskoe LVUMG at unit # 1 at CS Glushkovka	02.11.2005	
67	- Dashavske UGS LVUMG at unit # 4 at CS Dashava	11.11.2005	

68	- Khustskoe LVUMG at unit # 4 at CS Golyatyn	23.11.2005	
69	- Barskoe LVUMG at unit # 1 at CS Bar	08.12.2005	
70	- Odesskoe LVUMG at unit # 2 at CS Orlovka	13.12.2005	
71	- Barskoe LVUMG at unit # 4 at CS Gusyatyn	15.12.2005	
72	- Ternopolskoe LVUMG at unit # 6 at CS Ternopol	15.12.2005	
73	- Aleksandrovskoe LVUMG at unit # 2 at CS Aleksandrovka	17.12.2005	
74	- Zolotonoshskoe LVUMG at unit # 1 at CS Stavysche	20.12.2005	
75	- Barskoe LVUMG at unit # 5 at CS Gusyatyn	21.12.2005	
76	- Kremenchugskoe LVUMG at unit # 3 at CS Mashevka	26.12.2005	
77	- Gajsynskoe LVUMG at unit # 3 at CS Talnoe	30.12.2005	
78	- Zakarpatske LVUMG at unit # 7 at CS Rossosh	19.01.2006	
79	- Khustskoe LVUMG at unit # 5 at CS Khust	30.01.2006	
80	- Bibrskoe LVUMG at unit # 1 at CS Komarno	31.01.2006	
81	- Pervomajskoe LVUMG at unit # 5 at CS Borovaya	03.02.2006	
82	- Yagotynskoe LVUMG at unit # 2 at CS Glushkovka	03.02.2006	
83	- Kremenchugskoe LVUMG at unit # 2 at CS Zadneprovskaya	03.02.2006	
84	- Barskoe LVUMG at unit # 3 at CS Gusyatyn	04.02.2006	
85	- Khustskoe LVUMG at unit # 7 at CS Golyatyn	27.02.2006	
86	- Lubenskoe LVUMG at unit # 1 at CS Lubny	02.03.2006	
87	- Bogorodchanskoe LVUMG at unit # 2 at CS Bogorodchany	03.03.2006	
88	- Kremenchugskoe LVUMG at unit # 4 at CS Kremenchug	03.03.2006	
89	- Gajsynskoe LVUMG at unit # 1 at CS Gajsyn	21.03.2006	
90	- Ternopolskoe LVUMG at unit # 3 at CS Ternopol	25.03.2006	
91	- Odesskoe LVUMG at unit # 2 at CS Ananev	28.03.2006	
92	- Pervomajskoe LVUMG at unit # 6 at CS Pervomayskaya	05.04.2006	

93	- Kremenchugskoe LVUMG at unit # 5 at CS Mashevka	10.05.2007	
94	- Yagotynskoe LVUMG at unit # 12 at CS Yagotyn	13.04.2006	
95	- Sumskoe LVUMG at unit # 2 at CS Sumy	03.05.2006	
96	- Lubenskoe LVUMG at unit # 5 at CS Grebenka	06.05.2006	
97	- Sumskoe LVUMG at unit # 3 at CS Romny	17.05.2006	
98	- Gajsynskoe LVUMG at unit # 7 at CS Talnoe	20.05.2006	
99	- Barskoe LVUMG at unit # 3 at CS Gusyatyn	08.06.2006	
100	- Barskoe LVUMG at unit # 6 at CS Gusyatyn	10.07.2006	
101	- Ternopolskoe LVUMG at unit # 6 at CS Rogatyn	18.07.2006	
102	- Sumskoe LVUMG at unit # 2 at CS Romny	19.07.2006	
103	- Aleksandrovskoe LVUMG at unit # 6 at CS Aleksandrovka	26.07.2006	
104	- Dikanskoe LVUMG at unit # 2 at CS Reshetilovka	31.07.2006	
105	- Odesskoe LVUMG at unit # 5 at CS Orlovka	07.08.2006	
106	- Bogorodchanskoe LVUMG at unit # 1 at CS Bogorodchany	08.08.2006	
107	- Khustskoe LVUMG at unit # 6 at CS Golyatyn	08.08.2006	
108	- Barskoe LVUMG at unit # 4 at CS Gusyatyn	10.08.2006	
109	- Kremenchugskoe LVUMG at unit # 4 at CS Mashevka	14.08.2006	
110	- Pervomajskoe LVUMG at unit # 3 at CS Borovaya	17.08.2006	
111	- Pervomajskoe LVUMG at unit # 2 at CS Pervomayskaya	04.09.2006	
112	- Dolynskoe LVUMG at unit # 3 at CS Dolyna	26.09.2006	
113	- Gajsynskoe LVUMG at unit # 5 at CS Talnoe	03.10.2006	
114	- Zolotonoshskoe LVUMG at unit # 1 at CS Sofievskaya	04.10.2006	
115	- Bibrskoe LVUMG at unit # 3 at CS Komarno	26.10.2006	
116	- Zolotonoshskoe LVUMG at unit # 1 at CS Stavysche	26.10.2006	
117	- Barskoe LVUMG at unit # 2 at CS Bar	01.11.2006	

118	- Yagotynskoe LVUMG at unit # 9 at CS Yagotyn	03.11.2006	
119	- Kremenchugskoe LVUMG at unit # 4 at CS Zadneprovskaya	08.11.2006	
120	- Zakarpatske LVUMG at unit # 9 at CS Rossosh	04.12.2006	
121	- Barskoe LVUMG at unit # 1 at CS Gusyatyn	07.12.2006	
122	- Ternopolskoe LVUMG at unit # 2 at CS Ternopol	11.12.2006	
123	- Aleksandrovskoe LVUMG at unit # 6 at CS Yu.Bugskaya	12.12.2006	
124	- Gajsynskoe LVUMG at unit # 2 at CS Gajsyn	14.12.2006	
125	- Pervomajskoe LVUMG at unit # 4 at CS Borovaya	25.12.2006	
126	- Schebelinskoe LVUMG at unit # 2 at CS Schebelynka	25.12.2006	
127	- Schebelinskoe LVUMG at unit # 8 at CS Schebelynka	25.12.2006	
128	- Ternopolskoe LVUMG at unit # 1 at CS Rogatyn	29.12.2006	
129	- Bogorodchanskoe LVUMG at unit # 3 at CS Bogorodchany	16.01.2007	
130	- Dashavske UGS LVUMG at unit # 1 at CS Dashava	18.01.2007	
131	- N.Pskovskoe LVUMG at unit # 5 at CS N.Pskov	02.02.2007	
132	- Gajsynskoe LVUMG at unit # 2 at CS Ilinovskaya	15.02.2007	
133	- Barskoe LVUMG at unit # 6 at CS Gusyatyn	22.02.2007	
134	- Gajsynskoe LVUMG at unit # 3 at CS Gajsyn	23.02.2007	
135	- Pervomajskoe LVUMG at unit # 4 at CS Pervomayskaya	13.03.2007	
136	- Aleksandrovskoe LVUMG at unit # 7 at CS Aleksandrovka	12.04.2007	
137	- Barskoe LVUMG at unit # 7 at CS Bar	12.04.2007	
138	- Dolynskoe LVUMG at unit # 6 at CS Dolyna	07.05.2007	
139	- Zolotonoshskoe LVUMG at unit # 2 at CS Sofievskaya	22.05.2007	
140	- Barskoe LVUMG at unit # 3 at CS Bar	18.06.2007	
141	- Aleksandrovskoe LVUMG at unit # 4 at CS Yu.Bugskaya	25.06.2007	
142	- Yagotynskoe LVUMG at unit # 7 at CS Yagotyn	25.06.2007	

143	- Pervomajskoe LVUMG at unit # 7 at CS Pervomayskaya	19.07.2007	
144	- Gajsynskoe LVUMG at unit # 4 at CS Talnoe	20.07.2007	
145	- Gajsynskoe LVUMG at unit # 4 at CS Gajsyn	09.08.2007	
146	- Pervomajskoe LVUMG at unit # 6 at CS Borovaya	13.08.2007	
147	- Yagotynskoe LVUMG at unit # 5 at CS Yagotyn	03.09.2007	
148	- Aleksandrovskoe LVUMG at unit # 4 at CS Aleksandrovka	20.09.2007	
149	- Lubenskoe LVUMG at unit # 1 at CS Grebenka	24.09.2007	
150	- N.Pskovskoe LVUMG at unit # 4 at CS N.Pskov	28.09.2007	
151	- Kremenchugskoe LVUMG at unit # 5 at CS Kremenchug	05.10.2007	
152	- Gajsynskoe LVUMG at unit # 3 at CS Ilinovskaya	18.10.2007	
153	- Barskoe LVUMG at unit # 3 at CS Bar	22.10.2007	
154	- Barskoe LVUMG at unit # 2 at CS Gusyatyn	22.10.2007	
155	- Ternopolskoe LVUMG at unit # 5 at CS Ternopol	15.11.2007	
156	- Gajsynskoe LVUMG at unit # 6 at CS Talnoe	28.11.2007	
157	- Ternopolskoe LVUMG at unit # 5 at CS Rogatyn	29.11.2007	
158	- Ternopolskoe LVUMG at unit # 2 at CS Rogatyn	30.11.2007	
159	- Aleksandrovskoe LVUMG at unit # 3 at CS Kirovogradskaya	01.12.2007	
160	- Proletarskoe UGS LVUMG at unit # 2 at CS Proletarka	05.12.2007	
161	- Kremenchugskoe LVUMG at unit # 6 at CS Mashevka	06.12.2007	
162	- Zakarpatske LVUMG at unit # 2 at CS Rossosh	20.12.2007	
163	- Aleksandrovskoe LVUMG at unit # 3 at CS Yu.Bugskaya	21.12.2007	
164	- Gajsynskoe LVUMG at unit # 7 at CS Gajsyn	25.12.2007	
165	- Barskoe LVUMG at unit # 2 at CS Bar	09.01.2008	
166	- Aleksandrovskoe LVUMG at unit # 3 at CS Aleksandrovka	25.01.2008	
167	- Pervomajskoe LVUMG at unit # 1 at CS Borovaya	13.02.2008	

168	- Stryjske LVUMG at unit # 20 at CS B.Volytsya	16.02.2008	
169	- Stryjske LVUMG at unit # 12 at CS B.Volytsya	18.02.2008	
170	- Pervomajskoe LVUMG at unit # 3 at CS Pervomayskaya	21.02.2008	
171	- Barskoe LVUMG at unit # 5 at CS Gusyatyn	25.02.2008	
172	- Zolotonoshskoe LVUMG at unit # 2 at CS Stavysche	04.03.2008	
173	- Barskoe LVUMG at unit # 1 at CS Bar	07.03.2008	
174	- Barskoe LVUMG at unit # 7 at CS Gusyatyn	07.03.2008	
175	- Ternopolskoe LVUMG at unit # 4 at CS Ternopol	04.04.2008	
176	- Dikanskoe LVUMG at unit # 7 at CS Zinkov	30.04.2008	
177	- Krasilovskoe LVUMG at unit # 5 at CS Krasilov	17.05.2008	
178	- Sumskoe LVUMG at unit # 1 at CS Romny	17.05.2008	
179	- Bogorodchanskoe LVUMG at unit # 3 at CS Bogorodchany	05.06.2008	
180	- Lubenskoe LVUMG at unit # 3 at CS Grebenka	06.06.2008	
181	- Lubenskoe LVUMG at unit # 3 at CS Lubny	06.06.2008	
182	- Dashavske UGS LVUMG at unit # 6 at CS Dashava	13.06.2008	
183	- Kremenchugskoe LVUMG at unit # 3 at CS Kremenchug	13.06.2008	
184	- Odesskoe LVUMG at unit # 1 at CS Orlovka	23.06.2008	
185	- Yagotynskoe LVUMG at unit # 4 at CS Yagotyn	23.06.2008	
186	- Dikanskoe LVUMG at unit # 1 at CS Reshetilovka	25.06.2008	
187	- N.Pskovskoe LVUMG at unit # 1 at CS N.Pskov	02.07.2008	
188	- Berdychevskoe LVUMG at unit # 5 at CS Berdychev	03.07.2008	
189	- Barskoe LVUMG at unit # 3 at CS Gusyatyn	03.07.2008	
190	- Kremenchugskoe LVUMG at unit # 8 at CS Zadneprovskaya	01.08.2008	
191	- Dashavske UGS LVUMG at unit # 4 at CS Dashava	06.08.2008	
192	- Zolotonoshskoe LVUMG at unit # 3 at CS Stavysche	16.08.2008	

193	- Aleksandrovskoe LVUMG at unit # 5 at CS Aleksandrovka	18.08.2008	
194	- Ternopolskoe LVUMG at unit # 3 at CS Rogatyn	11.09.2008	
195	- Lubenskoe LVUMG at unit # 7 at CS Lubny	18.09.2008	
196	- Kremenchugskoe LVUMG at unit # 1 at CS Mashevka	30.09.2008	
197	- Ternopolskoe LVUMG at unit # 6 at CS Ternopol	30.09.2008	
198	- Zakarpatske LVUMG at unit # 6 at CS Uzhgorod	04.11.2008	
199	- Aleksandrovskoe LVUMG at unit # 5 at CS Yu.Bugskaya	07.11.2008	
200	- Kramatorske LVUMG at unit # 6 at CS Loskutovka	13.11.2008	
201	- Dashavske UGS LVUMG at unit # 3 at CS Dashava	14.11.2008	
202	- Pervomajskoe LVUMG at unit # 7 at CS Borovaya	25.11.2008	
203	- Berdychevskoe LVUMG at unit # 1 at CS Berdychev	27.11.2008	
204	- Pervomajskoe LVUMG at unit # 5 at CS Pervomayskaya	27.11.2008	
205	- Sumskoe LVUMG at unit # 2 at CS Romny	02.12.2008	
206	- Lubenskoe LVUMG at unit # 2 at CS Lubny	03.12.2008	
207	- Krasilovskoe LVUMG at unit # 1 at CS Krasilov	04.01.2008	
208	- Kramatorske LVUMG at unit # 7 at CS Loskutovka	12.12.2008	
209	- Zakarpatske LVUMG at unit # 4 at CS Rossosh	17.12.2008	
210	- Kremenchugskoe LVUMG at unit # 2 at CS Kremenchug	22.12.2008	
211	- 0 LVUMG at unit # 7 at CS Kupyansk	23.12.2008	
212	- Aleksandrovskoe LVUMG at unit # 1 at CS Kirovogradskaya	30.12.2008	
213	- Ternopolskoe LVUMG at unit # 3 at CS Ternopol	26.01.2009	
214	- Aleksandrovskoe LVUMG at unit # 6 at CS Kirovogradskaya	29.01.2009	
215	- Gajsynskoe LVUMG at unit # 1 at CS Gajsyn	30.01.2009	
216	- Barskoe LVUMG at unit # 6 at CS Bar	01.02.2009	
217	- Lubenskoe LVUMG at unit # 1 at CS Grebenka	21.04.2009	

218	- Barskoe LVUMG at unit # 1 at CS Gusyatyn	08.05.2009	
219	- Barskoe LVUMG at unit # 2 at CS Gusyatyn	18.05.2009	
220	- Aleksandrovskoe LVUMG at unit # 2 at CS Aleksandrovka	25.05.2009	
221	- Dashavske UGS LVUMG at unit # 6 at CS Dashava	25.05.2009	
222	- Zolotonoshskoe LVUMG at unit # 3 at CS Stavysche	29.05.2009	
223	- Krasilovskoe LVUMG at unit # 6 at CS Krasilov	02.06.2009	
224	- Pervomajskoe LVUMG at unit # 2 at CS Pervomayskaya	04.06.2009	
225	- Zolotonoshskoe LVUMG at unit # 1 at CS Stavysche	05.06.2009	
226	- Yagotynskoe LVUMG at unit # 9 at CS Yagotyn	18.06.2009	
227	- Kremenchugskoe LVUMG at unit # 3 at CS Zadneprovskaya	22.06.2009	
228	- Aleksandrovskoe LVUMG at unit # 7 at CS Yu.Bugskaya	23.06.2009	
229	- Barskoe LVUMG at unit # 4 at CS Bar	25.06.2009	
230	- Yagotynskoe LVUMG at unit # 1 at CS Glushkovka	25.06.2009	
231	- Lubenskoe LVUMG at unit # 1 at CS Lubny	25.06.2009	
232	- Dolynskoe LVUMG at unit # 5 at CS Dolyna	26.06.2009	
233	- Sumskoe LVUMG at unit # 7 at CS Romny	01.07.2009	
234	- Kremenchugskoe LVUMG at unit # 2 at CS Mashevka	04.07.2009	
235	- Gajsynskoe LVUMG at unit # 2 at CS Ilinovskaya	14.07.2009	
236	- Dashavske UGS LVUMG at unit # 2 at CS Dashava	27.07.2009	
237	- Ternopolskoe LVUMG at unit # 5 at CS Ternopol	27.07.2009	
238	- Khustskoe LVUMG at unit # 6 at CS Khust	27.07.2009	
239	- Yagotynskoe LVUMG at unit # 1 at CS Yagotyn	10.08.2009	
240	- N.Pskovskoe LVUMG at unit # 2 at CS N.Pskov	14.08.2009	
241	- Kremenchugskoe LVUMG at unit # 6 at CS Kremenchug	17.08.2009	
242	- N.Pskovskoe LVUMG at unit # 6 at CS N.Pskov	28.08.2009	

243	- Stryjske LVUMG at unit # 5 at CS B.Volytsya	28.09.2009	
244	- Sumskoe LVUMG at unit # 3 at CS Romny	02.10.2009	
245	- Zakarpatske LVUMG at unit # 5 at CS Uzhgorod	06.10.2009	
246	- Stryjske LVUMG at unit # 8 at CS B.Volytsya	08.10.2009	
247	- Aleksandrovskoe LVUMG at unit # 6 at CS Yu.Bugskaya	08.10.2009	
248	- Dashavske UGS LVUMG at unit # 1 at CS Dashava	19.10.2009	
249	- Pervomajskoe LVUMG at unit # 2 at CS Borovaya	05.03.2009	
250	- Zakarpatske LVUMG at unit # 3 at CS Uzhgorod	21.10.2009	
251	- Aleksandrovskoe LVUMG at unit # 1 at CS Aleksandrovka	09.11.2009	
252	- Barskoe LVUMG at unit # 5 at CS Bar	20.11.2009	
253	- Zakarpatske LVUMG at unit # 11 at CS Rossosh	04.12.2009	
254	- Barskoe LVUMG at unit # 4 at CS Gusyatyn	20.12.2009	
255	- Bogorodchanskoe LVUMG at unit # 2 at CS Bogorodchany	25.12.2009	
256	- Odesskoe LVUMG at unit # 6 at CS Orlovka	26.01.2010	
257	- Dolynskoe LVUMG at unit # 7 at CS Dolyna	30.01.2010	
258	- N.Pskovskoe LVUMG at unit # 3 at CS N.Pskov	11.04.2010	
259	- Odesskoe LVUMG at unit # 1 at CS Orlovka	07.06.2010	
260	- Khustskoe LVUMG at unit # 7 at CS Khust	08.06.2010	
261	- Zakarpatske LVUMG at unit # 1 at CS Uzhgorod	17.09.2010	
262	- N.Pskovskoe LVUMG at unit # 5 at CS N.Pskov	26.10.2010	
263	- Dolynskoe LVUMG at unit # 2 at CS Dolyna	03.11.2010	
264	- Khustskoe LVUMG at unit # 5 at CS Golyatyn	08.11.2010	
265	- Kremenchugskoe LVUMG at unit # 7 at CS Kremenchug	23.12.2010	
266	- Aleksandrovskoe LVUMG at unit # 3 at CS Kirovogradskaya	31.12.2010	
Subproject 1.3 Installation of GT exhaust heat recovery boilers			

267	Installation of GT exhaust heat recovery boilers at unit #3 CS Souz	01.12.2010	
	I. Subproject 2 Modernization of cathode protection system of underground pipelines.		
268	Branch pipeline to GDS Volnovaha at km 10, passport #40	27.01.2005	
269	Pipeline SOUZ, Orenburg-Novopskov at km 1214, passport #597	08.02.2005	
270	Branch pipeline to GDS Prosyanoe at km 1.465, passport #633	10.03.2005	
271	Underground gas storage Dashava at Boster CS area, passport #2	23.03.2005	
272	Compressor Station (CS) Krasnaya Popovka at TS of CS, passport #51	01.04.2005	
273	Pipeline PKC at km 535, passport #566	04.04.2005	
274	Branch pipeline to Mshanets at GDS Mshanets, passport #89	07.04.2005	
275	Branch pipeline to Kohanivka at GDS area, passport #80	13.04.2005	
276	Pipeline PKC at km 451, passport #55	28.04.2005	
277	Underground gas storage (UGS) Krasnopopovskoe at gas gathering station (GGS) , passport #56	01.05.2005	
278	Pipeline Dashava-Kyiv at km 77, passport #6	11.05.2005	
279	Pipeline Dashava-Kyiv at km 142 Romanove selo, passport #13	13.05.2005	
280	Pipeline Kramatorsk-Donetsk at km 23, passport #95	15.05.2005	
281	Pipeline PKC at km 471, passport #54	18.05.2005	
282	Pipeline Kyiv-Zahid Ukrainy II at km 357 Myslova, passport #19	19.05.2005	
283	Branch pipeline to collective farm Kirova at km 13 at GDS Vladimirovka, passport #1/50	31.05.2005	
284	Pipeline Lugansk-Lysychansk- Krasnaya Popovka at km 104, passport #25	01.06.2005	
285	Pipeline Taganrog-Mariupol at km 100 GDS-1 Mariupol, passport #43	01.06.2005	
286	Pipeline Kyiv-Zahid Ukrainy II at km 458 Zboriv, passport #18	05.06.2005	
287	Branch pipeline to GDS Rodakovo at km 57, passport #27	10.06.2005	

288	Branch pipeline to Kremenets at GDS Kremenets, passport #95	12.06.2005	
289	Branch pipeline to GDS Makeevka-Zapadnaya at km 224, passport #45	14.06.2005	
290	Pipeline Mariupol-Berdyansk at km 31, passport #16	16.06.2005	
291	Branch pipeline to Pochaiv at GDS Pochaiv, passport #88	16.06.2005	
292	Branch pipeline to GDS Krasnodon-2 at km 2.35, passport #1	24.06.2005	
293	Pipeline Gorlovka-Slavyansk at km 1628, Gorlovka-Kramatorsk at km 960	30.06.2005	
294	CS Rogatyn at CS area, passport 100	04.07.2005	
295	Pipeline Dashava-Kyiv at km 38, passport #4	04.07.2005	
296	Branch pipeline to GDS Kamyanka at km 2.95, passport #614	08.07.2005	
297	Pipeline Kyiv-Zahid Ukrainy II at km 499 Zakamin, passport #33	08.07.2005	
298	Branch pipeline to Zbarazh at GDS Zbarazh, passport #53	09.07.2005	
299	Pipeline Dashava-Kyiv at km 46, passport #3	09.07.2005	
300	Branch pipeline to Lopushno at km 50 GDS Lopushno, passport #46	11.07.2005	
301	Pipeline Mariupol-Berdyansk at km 91, passport #29	15.07.2005	
302	Branch pipeline to Krasivka, passport #73	20.07.2005	
303	Pipeline Amvrosievka-Gorlovka at km 1150, passport #53	22.07.2005	
304	Pipeline PKC at km 383, passport #24	25.07.2005	
305	Branch pipeline to Pidgajtsi at Kryve, passport #84	01.08.2005	
306	Branch pipeline to Zhukiv at GDS Zhukiv, passport #56	23.08.2005	
307	Pipeline Mariupol-Berdyansk at km 42, passport #17	05.09.2005	
308	Branch pipeline to GDS Ugledar at km 190, passport #43	14.09.2005	
309	Branch pipeline to GDS Alchevsk at km 21, passport #38	14.09.2005	
310	Branch pipeline to collective farm Kozachenko at km 18, passport #1/52	30.09.2005	

311	Branch pipeline to GDS Semejkino at km 0.4, passport #1	01.10.2005	
312	Branch pipeline to Siversk at km 46 at GDS Siversk, passport #	30.10.2005	
313	Pipeline Lugansk-Lysychansk-Rubezhnoe at km 760, passport #17	20.11.2005	
314	Branch pipeline to GDS Bilolutsk at km 0.35, passport #656	06.01.2006	
315	Pipeline PKC at km 415, passport #40	01.03.2006	
316	Branch pipeline to Zhukiv at Berezhany, passport #55	03.04.2006	
317	Pipeline Lutugino at km 12, passport #2	14.04.2006	
318	Branch pipeline to CS Loskutivka at km 10 leg 2, passport	18.04.2006	
319	Branch pipeline to GDS Novozarevka at km 14+05, passport #19	30.04.2006	
320	Branch pipeline to Brazhkivka at km 3.3, passport #	30.04.2006	
321	Branch pipeline to GDS Ocheretyno at km 790, passport #93	06.05.2006	
322	Branch pipeline to GDS Shahtersk at km 126, passport #67	28.05.2006	
323	Pipelines at #2-8 area on Vergunske UGS, passport #76	30.05.2006	
324	Branch pipeline to GDS Vladimirovka at km 1+77, passport #27	01.06.2006	
325	Pipeline PKC at km 538, passport #568	01.06.2006	
326	Pipeline Mariupol-Berdyansk at km 88, passport #28	01.06.2006	
327	Pipeline Petrovsk-Novopskov at km 582, passport #638	02.06.2006	
328	Pipeline Ivatsevichi-Dolyna at km 257 Bobly, passport #38	08.06.2006	
329	Branch pipeline Ivatsevichi-Dolyna at km 182/165, passport #6	20.06.2006	
330	Pipeline Ivatsevichi-Dolyna at km 242 Garusha, passport #35	20.06.2006	
331	Pipeline Amvrosievka-Gorlovka at km 57, passport #49	26.06.2006	
332	Pipeline Kyiv-Zahid Ukrainy I at km 426 Draganivka, passport #16	29.06.2006	
333	Pipeline Taganrog-Mariupol at km 79, passport #4	03.07.2006	
334	Branch pipeline to GDS Telmanovo at km 53.3, passport #15	08.07.2006	
335	Pipeline Dashava-Kyiv at km 78 GDS Kryve, passport #7	10.07.2006	

336	Branch pipeline to Avgustivka at km 5 Zaruddya, passport #49	12.07.2006	
337	Pipeline Kyiv-Zahid Ukrainy II at km 375 Galushintsi, passport #21	16.07.2006	
338	AGDS Turijske, at AGDS area, passport #36	17.07.2006	
339	Branch pipeline to Avgustivka at GDS Avgustivka, passport #50	18.07.2006	
340	Branch pipeline to Burshtynska TPP at km 9, passport #58	21.07.2006	
341	AGDS Kupychiv at AGDS area, passport #42	28.07.2006	
342	Branch pipeline to Terebovlya at km 37 Terebovlya, passport #66	28.07.2006	
343	CS Kovel at CS area, passport #28	29.07.2006	
344	Pipeline Kyiv-Zahid Ukrainy II at GDS Ternopil, passport #72	29.07.2006	
345	Branch pipeline to GDS Novoazovsk at km 0.625, passport #2	31.07.2006	
346	Branch pipeline to GDS Snezhnoe at km 0, passport #2	17.08.2006	
347	CS 2 Ternopil at CS area, passport #97	31.08.2006	
348	Pipeline SOUZ at km 1189, passport #595	01.09.2006	
349	Branch pipeline to Ozerna at GDS Ozerna , passport #54	08.09.2006	
350	Branch pipeline to GDS Marynivka at km 47.6, passport #35	10.09.2006	
351	Branch pipeline to Izjum at km 908, passport #	15.09.2006	
352	Branch pipeline to K. Shahtinske and B. Kalitva at km 5, passport #1	15.09.2006	
353	Branch pipeline to Krasnyj Lyman at km 223, passport #	23.09.2006	
354	Branch pipeline to GDS Amvrosievka at km 6, passport #13	28.09.2006	
355	Branch pipeline to GDS-1 Konstantinovka at km 16+6, passport #	01.10.2006	
356	Pipeline Novopskov-Loskutovka at km 62, passport #87	12.10.2006	
357	Pipeline Krasnyy Luch at km 40, passport #5	13.10.2006	
358	Branch pipeline to thermal power-station Slovyanska at km 81+00 GDS 1, passport #	13.10.2006	
359	Branch pipeline to Podgorovka at km 0.48, passport #83	21.10.2006	

360	Branch pipeline to thermal power-station Slovyanska at km 81+00 GDS 2, passport #	27.10.2006	
361	Pipeline Torzhok-Dolyna at km 3478.7, passport #5	03.11.2006	
362	Branch pipeline to Artemivsk at km 228, passport #	09.11.2006	
363	Pipeline Dashava-Minsk at km 271, passport #18	20.11.2006	
364	Branch pipeline to GDS Severnaya at km 24, passport #75	30.11.2006	
365	Branch pipeline to GDS Druzhba at km 266, passport #1	03.12.2006	
366	Branch pipeline to GDS Kotovskogo at km 15.4, passport #21	13.12.2006	
367	Branch pipeline to GDS Teplychnyj at km 7.5, passport #47	24.12.2006	
368	Pipeline PKC at km 348, passport #9	15.01.2007	
369	Branch pipeline to GDS Dokuchaevska at km 65, passport #22	17.01.2007	
370	AGDS Ohnivka, at AGDS area, passport #48	17.01.2007	
371	Branch pipeline to GDS Bilokurakine at km 4.15, passport #619	18.01.2007	
372	Pipeline Amvrosievka-Donetsk at km 338, passport #9	22.02.2007	
373	Branch pipeline to GDS-2 Zugres at km 6+37, passport #69	25.02.2007	
374	Branch pipeline to Lugansk at km 0,616, passport #1	13.03.2007	
375	Branch pipeline to DHMZ at km 194, passport #34	18.03.2007	
376	Branch pipeline to GDS Dokuchaevska at km 221, passport #24	20.03.2007	
377	Pipeline Petrovsk-Novopskov, Urengoy-Novopskov at km 592, passport #640	22.03.2007	
378	Branch pipeline to GDS Olginskiy at km 1+54, passport #39	23.03.2007	
379	Pipeline Kramatorsk-Donetsk at km 1207, passport #103	25.03.2007	
380	Pipeline Kyiv-Zahid Ukrainy II at km 480 Chesnyki, passport #31	05.04.2007	
381	Branch pipeline to Burshtynska TPP at km 17, passport #59	10.04.2007	
382	Branch pipeline to Burshtynska TPP at km 2, passport #57	10.04.2007	
383	Pipeline Lutugino at km 0, passport #1	23.04.2007	

384	Pipeline PKC at km 396, passport #30	25.04.2007	
385	Pipeline PKC at km 392, passport #28	29.04.2007	
386	Pipeline Sverdlovsk at km 3, passport #	01.05.2007	
387	Pipeline Lutugino at km 19.7, passport #2	05.05.2007	
388	Pipeline Mariupol-Berdyansk at km 49, passport #21	15.05.2007	
389	Pipeline Lugansk-Lysychansk-Rubezhnoe at km 139.5, passport #30	29.05.2007	
390	Pipeline Lugansk-Lysychansk- Krasnaya Popovka at km 136.5, passport #28	30.05.2007	
391	Pipeline Lugansk-Lysychansk at km 58, passport #13	01.06.2007	
392	Branch pipeline to Pervomaysk at km 11.5, passport #44	01.06.2007	
393	Pipeline Lugansk-Lysychansk at km 76, passport #17	01.06.2007	
394	Branch pipeline to Gorohiv at km 21, passport #80	01.08.2007	
395	AGDS Rozhysche, at AGDS area, passport #67	01.08.2007	
396	Branch pipeline to GDS Volnovaha at km 12, passport #41	22.08.2007	
397	Branch pipeline to GDS-1 Gorlovka at km 1680, passport #82	29.08.2007	
398	Pipeline Novodarivka-Avrosiivka at km 15.4, passport #2	05.09.2007	
399	Branch pipeline to GDS Bondarevo at km 0.45, passport #652	14.09.2007	
400	GDS Lanivtsi 2 at GDS Lanivtsi, passport #68	04.10.2007	
401	Pipeline Amvrosievka-Gorlovka at km 713, passport #58	21.10.2007	
402	Branch pipeline to Novoajdar at km 22, passport #2	01.11.2007	
403	Branch pipeline to GDS Scherbinovcska poultry farm at km 27, passport #	30.11.2007	
404	Pipelines at #2-8 area on Vergunske UGS, passport #69	04.12.2007	
405	Branch pipeline to collective farm Kirova at km 13 at GDS Vladimirovka, passport #	05.12.2007	
406	Branch pipeline to collective farm Chapaeva at km 48, passport #	10.12.2007	

407	Branch pipeline to collective farm Kozachenko at km 18, passport #	15.12.2007	
408	Pipeline Petrovsk-Novopskov, Urengoy-Novopskov at km 605, passport #642	18.01.2008	
409	Branch pipeline to GDS Novopskov at km 0.2, passport #649	23.02.2008	
410	Branch pipeline to Shumsk at GDS Shumsk, passport #82	04.03.2008	
411	Branch pipeline to GDS Kolyadivka at km 3.2, passport #625	06.03.2008	
412	Pipeline Kyiv-Zahid Ukrainy II at km 419 Seredynky, passport #25	11.03.2008	
413	Pipeline Kyiv-Zahid Ukrainy II at km 431 Mlyntsi, passport #26	13.03.2008	
414	Pipeline Dashava-Kyiv at km 107 Hodachkiv, passport #10	21.03.2008	
415	Branch pipeline to GDS Budyliv at GDS area, passport #78	24.03.2008	
416	Water pipe at CS Dashava, passport #1	31.03.2008	
417	Branch pipeline to GDS Bilovodsk at km 28.5, passport #626	04.03.2008	
418	Trails bundle #3 and borehole, passport #14	15.04.2008	
419	Branch pipeline to Kolodno at GDS Kolodno, passport #79	22.04.2008	
420	UGS Krasnopopovskoe at Shlejf Malaya pojma , passport #53	30.04.2008	
421	Pipeline Krasnyy Luch at km 14, passport #3	16.05.2008	
422	Pipeline PKC at km 401, passport #32	20.05.2008	
423	Trails bundle #2 and borehole, passport #5	28.05.2008	
424	Pipeline Lugansk-Lysychansk at km 20, passport #4	30.05.2008	
425	Pipeline SOUZ, Novopskov-Shebelinka at km 1264, passport #601	10.06.2008	
426	Pipeline PKC at km 374, passport #20	12.06.2008	
427	Pipeline Amvrosievka-Donetsk at km 494, passport #10	12.06.2008	
428	Trails bundle #1 and borehole, passport #9	24.06.2008	
429	Trails bundle #7 and borehole, passport #10	26.06.2008	
430	Pipeline Gorlovka-Slavyansk at km 1846, Gorlovka-Kramatorsk at	30.06.2008	

	km 1179, passport		
431	Pipeline Shebelynka-Slavyansk at km 623, passport	30.06.2008	
432	Pipeline Taganrog-Mariupol at km 59, passport #1	05.07.2008	
433	Pipeline GDS1-GDS2 Mariupol at km 12.783 at GDS2, passport #44	10.07.2008	
434	Pipeline Amvrosievka-Gorlovka at km 33, passport #57	20.07.2008	
435	Branch pipeline to GDS Vladimirovka at km 110, passport #28	07.08.2008	
436	Branch pipeline to GDS Krasnyj Oktyabr at km 2.33, passport #1	14.08.2008	
437	Branch pipeline to GDS Piski at GDS Piski, passport	20.08.2008	
438	Pipeline Logachevo GKM – Vergunka GDS at km 20, passport #82	27.08.2008	
439	Vessel Automatic GDS at GDS, passport #18	27.08.2008	
440	Branch pipeline to TOK at km 28.5, passport #651	20.11.2008	
441	Branch pipeline to Khodakiv at km 5.54, passport #44	28.11.2008	
442	Branch pipeline to GDS Mangush at km 8.65, passport #18	10.12.2008	
443	Branch pipeline to Lokachi at km 11, passport #52	01.01.2009	
444	Pipeline Turijske-Rivne at km 34 Nemir, passport #65	01.01.2009	
445	AGDS Lutsk, at AGDS area, passport #76	01.01.2009	
446	Branch pipeline to GDS-1 Konstantynivka at km 16+6 GDS area, passport	28.02.2009	
447	Branch pipeline to collective farm Gorkogo at km 2+20 GDS Gorkogo, passport	28.02.2009	
448	Branch pipeline to GDS Selidovo at km 13+65 GDS area, passport #107	01.04.2009	
449	Branch pipeline to Goscha at km 5, passport #1	13.04.2009	
450	Pipeline Lugansk-Lysychansk-Krasnaya Popovka at km 87 GDS Verhnee, passport #19	15.04.2009	
451	Branch pipeline to GDS-2 Donetsk at km 384, passport #88	21.04.2009	

452	Branch pipeline to GDS Pantelemoynovka at km 66 GDS area, passport #78	12.05.2009	
453	AGDS Derno, at AGDS area, passport #73	25.05.2009	
454	Branch pipeline to GDS Avdeevka at km 210 GDS area, passport #84	28.05.2009	
455	Branch pipeline to GDS Zhovten at km 36 GDS area, passport	01.06.2009	
456	Branch pipeline to GDS Snezhnoe at km 140 GDS area, passport #4	02.06.2009	
457	Pipeline Kamyanka Buzka-Rivne leg 1 at km 161.9 GDS Kornin, passport #11	10.07.2009	
458	Branch pipeline to GDS Markivka at km 32.9 GDS Markivka, passport #618	16.07.2009	
459	Branch pipeline to Kramatorsk_Donetsk at km 114 Solovevo, passport #94	16.07.2009	
460	Pipeline Amrosievka-Gorlovka at km 728 'Uzel kranov', passport #50	17.08.2009	
461	AGDS Prilutsk, at AGDS area, passport #71	20.08.2009	
462	Pipeline Souz at km 1148, passport #593	17.09.2009	
463	Pipeline Lugansk-Lysychansk-Krasnaya Popovka at km 89.3 GDS Verhnee, passport #20	29.09.2009	
464	Pipelines group #1 at vergunzkoe underground storage facility, passport #71	01.10.2009	
465	Pipeline PKC at km 356.8, passport #12	22.10.2009	
466	Pipeline PKC at km 353,5, passport #11	23.10.2009	
467	Branch pipeline to GDS Rovenkovskiy at km 0.1 GDS Rovenkovskiy, passport #1	18.11.2009	
468	Branch pipeline to GDS Ovruch at GDS Ovruch, passport #18	01.12.2009	
469	Branch pipeline to GDS Krasnodon at km 17, passport #3	10.12.2009	
470	Branch pipeline to GDS Pobeda at km 11.25 GDS area , passport #5	18.12.2009	

471	Pipeline Shebelynka-Slovyansk at km 413 Grushevaha, passport	30.12.2009	
472	Branch pipeline to AGDS, at km 9 Postupel, passport #11	01.01.2010	
473	Pipeline Ivatsevichi-Dolyna at km 293 Cherchychi, passport #47	01.01.2010	
474	Pipeline Ivatsevichi-Dolyna at km 249 Turijske, passport #37	01.01.2010	
475	Branch pipeline to GDS-1 Donetsk at km 563, passport #11	22.01.2010	
476	Pipeline Kyiv-Zahid Ukrainy I at Ladyno, passport #12	08.02.2010	
477	Pipeline Dashava-Dolyna leg 2 at km 480, passport #54	16.03.2010	
478	Pipeline Kamyanka Buzka-Rivne leg 1 and 2 at km 73.5, passport #1	25.03.2010	
479	Pipeline Donetsk-Mariupol at km 429+50 Kirilivka, passport #112	01.04.2010	
480	Branch pipeline to GDS Vladimirivka at km 264 GDS area , passport #23	05.04.2010	
481	Pipeline Kamyanka Buzka-Rivne leg 1 and 2 at km 145 Grushvytsya, passport #9	08.04.2010	
482	Pipeline Amrosievka-Gorlovka at km 933 Krynka, passport #52	10.04.2010	
483	Branch pipeline to GDS Olenivskiy at km 0+56 GDS , passport #32	13.04.2010	
484	Pipeline PKC at km 381, passport #23	21.04.2010	
485	Branch pipeline to PTF Enakievo at km 1+80 GDS area , passport #71	21.04.2010	
486	Pipeline PKC at km 520, passport #548	22.04.2010	
487	Pipeline PKC at km 367.3, passport #15	11.05.2010	
488	Branch pipeline to GDS Ilovaysk at km 12 GDS area, passport #66	20.05.2010	
489	Pipeline Lugansk-lysychansk at km 82 GDS M.Dolyna, passport #18	28.05.2010	
490	Branch pipeline to kremenets at Kornii str, passport #10	28.05.2010	
491	Pipeline PKC at km512, passport #539	31.05.2010	
492	Branch pipeline to Gorynka at Gorynka, passport #3	15.06.2010	

493	Pipeline Dashava-Kyiv at km 28 Knyagynychi, passport #1	16.06.2010	
494	Branch pipeline to Rogatyn at km 57, passport #45	18.06.2010	
495	Branch pipeline to GDS Stirol at km 27 GDS area, passport #79	30.06.2010	
496	Underground storage station Dashava trails bundle #1, passport #4	18.08.2010	
498	Pipeline PKC at km 525, passport #554	20.08.2010	
499	Pipeline Torzhok-Dolyna at km 3578, passport #10	20.08.2010	
500	Pipeline Souz at km 1233, passport #599	20.08.2010	
501	Branch pipeline to Gorodnytsy at km 10.16, passport #42	25.08.2010	
502	Pipeline PKC at km 545, passport #577	27.08.2010	
503	Pipeline Novopskov-Loskutovskaya CS at km 112.3 GDS m.Dolyna, passport #94	27.08.2010	
504	Branch pipeline to GDS Gorodnytsa at GDS Gorodnytsa, passport #27	01.09.2010	
505	Pipeline Novopskov-Kramatorsk at km 24.5, passport #84	09.10.2010	
506	Branch pipeline to GDS Pervomajsk at km 11.5 GDS area, passport #44	20.09.2010	
507	Branch pipeline to Lutugino at GDS Lutugino, passport #3	22.09.2010	
508	Branch pipeline to GDS Dokuchaevska at km 221 GDS area, passport #24	22.09.2010	
509	Pipeline Shebelynka-Slovyansk at km 772 Kurulka, passport	27.09.2010	
510	Pipeline Gorlivka-Slovyansk at km 1982, passport	27.09.2010	
511	Branch pipeline to GDS Dokuchaevska at km 54 treatment facilities, passport #23	30.09.2010	
512	Pipeline Souz at km 1214, passport #598	21.10.2010	
513	Pipeline Lugansk-lysychansk at km 50, passport #12	22.10.2010	
514	Trails bundle and borehole, passport #13	28.10.2010	

515	Pipeline Krasnyy Luch at km 31, passport #4	17.11.2010	
516	Pipeline PKC at CS Volna, passport #609	21.11.2010	
517	Pipeline PKC at CS Volna, passport #610	21.11.2010	

Subproject 3 Innovative pipe repair methods			
05L01	466,8 km p/l Ivatsevichi-Dolyna, Bibrske	2005	
05L02	241,66 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L03	284,9 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L04	284,55 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L05	277,45 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L06	277,38 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L07	276,07 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L08	272,05 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L09	290,15 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L10	303,45 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L11	305,63 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L12	298,51 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L13	290,55 km p/l Ivatsevichi-Dolyna-II, Volynske	2005	
05L16	357,915 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2005	
05P01	4232,08 km; 4212,23 km p/l UPU, Bogorodchanske	2005	
05P02	4169,42 km; 4167,5 km; 4159,0 km p/l UPU, Bogorodchanske	2005	
05P03	4141,73 km; 4112,5 km p/l UPU, Bogorodchanske	2005	
05P04	133,97 km; 108,141 km p/l Soyuz, Bogorodchanske	2005	
05P05	4442,5 km p/l UPU Zakarpatske	2005	
05P06	141,611 km; 142,152 km p/l Soyuz, Hustske	2005	
05P07	125,828 km p/l Soyuz, Hustske	2005	
05P08	4463,31 km p/l Progres, Hustske	2005	

05P09	4316,59 km p/l Soyuz, Hustske	2005	
05P10	46,8 km; 67,8 km p/l Soyuz, Hustske	2005	
05K01	54,2 km p/l Boyarka-Ivankiv, Boyarske	2005	
05K02	518,067 km p/l ShDK, Boyarske	2005	
05K03	518,067 km p/l ShDK, Boyarske	2005	
05K04	85,8 km p/l Boyarka-Ivankiv, Boyarske	2005	
05K05	7,45 km t.Vorzel, Boyarske	2005	
05K06	3578 km p/l Progress, Sumske	2005	
05K07	p/l EKKr, Sumske	2005	
05K08	Tap 6D, KS-1, Sumske	2005	
05K09	30 km GRS Bobrovytsa, Chernigivske	2005	
05K10	0 km p/l TShK, Chernigivske	2005	
05K11	240 km p/l DKBM, Chernigivske	2005	
05K12	155 km p/l DKBM, Chernigivske	2005	
05K13	139 km p/l DKBM, Chernigivske	2005	
05K14	97,6 km p/l TShK, Chernigivske	2005	
05K15	Valve 16, p/l ShPK, Yagotynske	2005	
05K16	404,85 km p/l EKK, Yagotynske	2005	
05K17	Tap 6E, Boyarska KS, Boyarske	2005	
05C01	3688,6 km p/l UPU, Zolotoniske	2005	
05C02	173 km p/l KAB, Oleksandrivske	2005	
05C03	1826 km p/l Soyuz, Oleksandrivske	2005	
05C04	1308 km p/l Soyuz, Pervomayske	2005	
05C05	1380 km, 1386 km, p/l Soyuz, Pervomayske	2005	
05C06	1421 km, p/l Soyuz, Pervomayske	2005	

05C07	33,3 km p/l DKK, Oleksandrivske	2005	
05C08	4067,5 km p/l UPU, Barske	2005	
05H01	1,2 km p/l ShDO, Dnipropetrovske	2005	
05H02	25,0km p/l ShDO, Dnipropetrovske	2005	
05H03	152,6 km p/l ShDO, Dnipropetrovske	2005	
05H04	26,25 km p/l ShDO, Dnipropetrovske	2005	
05H05	0,0 km GRS Verbky, Dnipropetrovske	2005	
05H06	0,0 km VO Azot, Dnipropetrovske	2005	
05H07	193,2 km p/l ShDO, Dnipropetrovske	2005	
05H08	186,8 km p/l ShDO, Dnipropetrovske	2005	
05H09	45,5 km p/l PHG-ShDKRI-1, Dnipropetrovske	2005	
05H10	25,6 km p/l PHG-ShDKRI-2, Dnipropetrovske	2005	
05H11	95,1 km p/l ShDKRI, Dnipropetrovske	2005	
05H12	139,4 km p/l ShDKRI, Dnipropetrovske	2005	
05H13	174,5 km p/l Ostrogojsk-Shebelinka, Kupianske	2005	
05H14	Tap 34-1, KU Kupiansk, Kupianske	2005	
05H15	155,5 km p/l Ostrogojsk-Shebelinka, Kupianske	2005	
05H16	183 km p/l Ostrogojsk-Shebelinka, Kupianske	2005	
05H17	RU-64, Volohivska GRS, Kupianske	2005	
05H18	Tap 54, DN 500, Mykolayivske	2005	
05H19	55 km, p/l Kherson-Krim, Khersonske	2005	
05H20	60,1 km p/l ShDKRI, Shebelinske	2005	
05H21	75 km p/l ShDKRI Paniutino-Dnipropetrovsk, Shebelinske	2005	
06L01	400 km p/l Ivatsevichi-Dolyna, Bibrske	2006	
06L02	289,7 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	

06L03	289,8 p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L04	289,01 p/l Ivatsevichi-Dolyna-II, Volynske	2006	
06L05	289,06 p/l Ivatsevichi-Dolyna-II, Volynske	2006	
06L06	283,4 p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L07	233,1 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L08	244,075 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L09	256,5 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L10	244,062 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L11	231,031 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L12	186,5 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L13	233,141 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L14	246,7 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L15	244,08 km p/l Ivatsevichi-Dolyna-II, Volynske	2006	
06L16	209,065 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L17	208,817 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L18	208,818 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L19	229,9 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L20	210,2 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L21	209,013 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L22	297,5 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L23	322,013 km p/l Ivatsevichi-Dolyna-III, Volynske	2006	
06L25	3477,8 km p/l Torjok-Dolyna,Novograd-Volynske	2006	
06L26	3475,28 km p/l Torjok-Dolyna,Novograd-Volynske	2006	
06L27	3505,93 km p/l Torjok-Dolyna,Novograd-Volynske	2006	
06L28	410,46 km p/l KZU-II, Ternopilske	2006	

06L29	466,46 km p/l KZU-II, Ternopilske	2006	
06L30	433,8 km p/l KZU-II, Ternopilske	2006	
06L31	484,8 km p/l KZU-II, Ternopilske	2006	
06L32	485,06 km p/l KZU-II, Ternopilske	2006	
06L33	439,92 km p/l KZU-II, Ternopilske	2006	
06L34	3785 km p/l Torjok-Dolyna, Ternopilske	2006	
06L35	3692 km p/l Torjok-Dolyna, Ternopilske	2006	
06L36	424,58 km p/l KZU-II, Ternopilske	2006	
06L37	427,6 km p/l KZU-II, Ternopilske	2006	
06L38	489,93 km p/l KZU-II, Ternopilske	2006	
06L39	478,56 km p/l KZU-II, Ternopilske	2006	
06L40	410,46 km p/l KZU-II, Ternopilske	2006	
06P01	685 km p/l AChB, Bogorodchanske	2006	
06P02	125,776 km p/l Souz, Bogorodchanske	2006	
06P03	126,112km p/l Souz, Bogorodchanske	2006	
06P04	27,063 km p/l DUD-II, Zakarpatske	2006	
06P05	90,838 km p/l DUD-II, Zakarpatske	2006	
06P06	60,636 km p/l DUD-II, Zakarpatske	2006	
06P07	88,861 km p/l DUD-II, Zakarpatske	2006	
06P08	96,077 km p/l DUD-II, Zakarpatske	2006	
06P09	92,17 km p/l ATI, Odeske	2006	
06P10	276,5 km p/l ATI, Odeske	2006	
06P11	329,8 km p/l ATI, Odeske	2006	
06P12	53,5 km GRS Vizirka, Odeske	2006	
06P13	8,15 km GRS Vizirka, Odeske	2006	

06P14	195,79 km p/l ATI, Odeske	2006	
06K01	30,83 km GRS Narodichi, Boyarske	2006	
06K02	0,155 km p/l ShPK-2, Boyarske	2006	
06K03	0,01 km GRS Irpen, Boyarske	2006	
06K04	162,5 km p/l EDK, Dikanske	2006	
06K05	247,3 km , Krasilivske	2006	
06K06	0,995 km p/l Glinsk-ShPK, Lubenske	2006	
06K07	3643,91 km p/l Progres, Lubenske	2006	
06K08	46,5 km p/l ChPPSG, Chernigivske	2006	
06K09	103,2 km p/l TShK, Chernigivske	2006	
06K11	Tap A3, A3-B2 , p/l EKK, Yagotynske	2006	
06K12	Tap 20 ChK p/l ShPK, Yagotynske	2006	
06K13	Tap 1,2,3,6AD,6BD KS Glushkivska, Yagotynske	2006	
06K14	Tap 65 KS Yagotyn, Yagotynske	2006	
06C01	2157,7 km p/l Soyuz, Barske	2006	
06C02	2178,8 km p/l Soyuz, Barske	2006	
06C03	2207 km p/l Soyuz, Barske	2006	
06C04	2229 km p/l Soyuz, Barske	2006	
06C05	2197,09 km p/l Soyuz, Barske	2006	
06C06	3827,7 km p/l UPU, Gaysinske	2006	
06C07	4011,4 km p/l Progress, Gaysinske	2006	
06C08	2063,4 km p/l Soyuz, Gaysinske	2006	
06C09	25 km p/l KAB, Kremenchutske	2006	
06C10	661 km p/l EKKR, Kremenchutske	2006	
06C11	553,4 km p/l EKKR, Kremenchutske	2006	

06C12	1675 km p/l Soyuz, Kremenchutske	2006	
06C13	238,7 km p/l KAB, Oleksandrivske	2006	
06C14	237,4 km p/l KAChB, Oleksandrivske	2006	
06C15	1354 km p/l Soyuz, Pervomayske	2006	
06C16	Tap B KS-12 p/l Soyuz, Pervomayske	2006	
06C17	1826 km p/l Soyuz, Pervomayske	2006	
06H01	2,1 km PO Azot, Dnipropetrovske	2006	
06H02	Tap 81 p/l ShDO-2, Dnipropetrovske	2006	
06H03	130,9 km p/l ShDKRI, Dnipropetrovske	2006	
06H05	79,307 km p/l ShDKRI, Kryvorizke	2006	
06H06	68,653 km p/l ShDKRI, Kryvorizke	2006	
06H07	69,974 km p/l ShDKRI, Kryvorizke	2006	
06H08	180,4 km p/l Ostrogozk-Shebelinka, Kupianske	2006	
06H09	219,3 km p/l Ostrogozk-Shebelinka, Kupianske	2006	
06H10	199,6 km p/l Ostrogozk-Shebelinka, Kupianske	2006	
06H11	161,95 km p/l ShDO-1, Mykolayivske	2006	
06H12	227,2 km p/l Ostrogozk-Shebelinka, Shebelinske	2006	
06H13	68,8 km p/l ShDKRI, Shebelinske	2006	
07L01	400,45 km p/l Ivatsevichi-Dolyna, Bibrske	2007	
07L02	214,314 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L03	218,7 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L04	304,97 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L05	211,24 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L06	211,31 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L07	211,32 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	

07L08	211,322 kmp/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L09	219,819 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L10	214,34 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L11	240,4 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L12	219,02 km p/l Ivatsevichi-Dolyna-II, Volynske	2007	
07L13	60,8 km p/l Komarno-Derjkordon, Komarnivske	2007	
07L14	45,23 km p/l Komarno-Derjkordon, Komarnivske	2007	
07L15	3503,04; 3510,9 km p/l Torjok-Dolyna, Novograd-Volynske	2007	
07L17	415,6 km p/l KZU-2, Ternopilske	2007	
07L18	412,7 km p/l KZU-2, Ternopilske	2007	
07L19	406,6 km p/l KZU-2, Ternopilske	2007	
07L20	427,6 km p/l KZU-2, Ternopilske	2007	
07L21	432 km p/l KZU-2, Ternopilske	2007	
07L22	417,1 km p/l KZU-2, Ternopilske	2007	
07L23	427,8 km p/l KZU-2, Ternopilske	2007	
07L24	435,6 p/l KZU-2, Ternopilske	2007	
07P01	20,420 km p/l UPU, Bogorodchanske	2007	
07P02	14,622 km p/l Progress, Bogorodchanske	2007	
07P03	117345,01 m p/l Soyuz, Bogorodchanske	2007	
07P04	2920,78 m p/l Soyuz, Bogorodchanske	2007	
07P05	394,82 m p/l Soyuz, Bogorodchanske	2007	
07P06	20631,12 m p/l DUD-2, Zakarpatske	2007	
07P07	93532,34 m p/l DUD-2, Zakarpatske	2007	
07P08	63141,33 m p/l DUD-2, Zakarpatske	2007	
07P09	241,455 km p/l ATI, Odeske	2007	

07P10	36,234 km p/l ATI, Odeske	2007	
07P11	219,15 km p/l ATI, Odeske	2007	
07P12	183,07 km p/l ATI, Odeske	2007	
07P13	2,176 km p/l ATI, Odeske	2007	
07P14	4070,25 m p/l p/l Soyuz, Hustske	2007	
07P15	50843,12 m p/l Soyuz, Hustske	2007	
07K01	103,6 km p/l KZU-II, Berdychivske	2007	
07K02	81,5 km p/l KZU-II, Berdychivske	2007	
07K04	72,73 km p/l KZU-I, Boyarske	2007	
07K05	181 km p/l EDK, Dykanske	2007	
07K06	236 km p/l Dashava-Kyiv, Krasylivske	2007	
07K09	328,56 km p/l EKK, Lubenske	2007	
07K10	3506,0 km p/l UPU, Lubenske	2007	
07K11	305,7 km p/l ShPK, Lubenske	2007	
07K12	299,8 km p/l EKD, Sumske	2007	
07K13	90,2 km p/l EKK, Sumske	2007	
07K14	3323,0 km p/l UPU, Sumske	2007	
07K15	296,8 km p/l EKK, Sumske	2007	
07K16	68,8 km p/l ChPPSG, Chernigivske	2007	
07K17	385,4 km p/l EKK, Yagotynske	2007	
07K18	456,517 km p/l EKK, Yagotynske	2007	
07K19	382,5 km p/l EKK, Yagotynske	2007	
07K20	38,5 km p/l m.Cherkasy, Yagotynske	2007	
07C01	4077,12 km p/l UPU, Barske	2007	
07C02	2143 km p/l Soyuz, Barske	2007	

07C03	4079,9km p/l Soyuz, Barske	2007	
07C04	4089,7 km p/l UPU, Barske	2007	
07C05	2140,6 km p/l Soyuz, Barske	2007	
07C06	2142,08km p/l Soyuz, Barske	2007	
07C07	2078,7 km p/l Soyuz, Gaysynske	2007	
07C08	1997,2 km p/l Soyuz, Gaysynske	2007	
07C09	1999 km p/l Soyuz, Gaysynske	2007	
07C10	2001 km p/l Soyuz, Gaysynske	2007	
07C11	1987,2 km p/l Soyuz, Gaysynske	2007	
07C12	4071,35 km p/l Soyuz, Gaysynske	2007	
07C13	1746 km p/l Soyuz, Kremenchutske	2007	
07C14	622,3 km p/l EKKR, Kremenchutske	2007	
07C15	671,1 km p/l EKKR, Kremenchutske	2007	
07C16	1787,3 km p/l Soyuz, Oleksandrivske	2007	
07C17	122,9 km p/l KAB, Oleksandrivske	2007	
07C18	238,5 km p/l AKB, Oleksandrivske	2007	
07C19	347,8 km p/l AKB, Oleksandrivske	2007	
07C20	123,9 km p/l AKB, Oleksandrivske	2007	
07C21	1496,5 km p/l Soyuz, Pervomayske	2007	
07H01	38,7 km p/l ShDKRI, Dnipropetrovske	2007	
07H02	18,2km p/l ShDKRI, Dnipropetrovske	2007	
07H04	10,0 km GRS Pavlograd, Dnipropetrovske	2007	
07H05	10,4 km GRS Pavlograd, Dnipropetrovske	2007	
07H06	Tap 2 GRS Marfovka, Kryvorizke	2007	
07H07	Tap 2 GRS GRS Lozovatka, Kryvorizke	2007	

07H08	Tap 33 p/l ShDKRI, Kryvorizke	2007	
07H09	Tap 42/1 p/l ShDKRI, Kryvorizke	2007	
07H10	53 km p/l ShDKRI, Kryvorizke	2007	
07H11	Tap 1 GRS Kazanka, Kryvorizke	2007	
07H12	176,3 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H13	172,5 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H14	181,5 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H15	216,0 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H16	182,1 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H17	190,4 km p/l Ostrogozk-Shebelinka, Kupianske	2007	
07H19	73,3 km p/l Kherson-Krim, Khersonske	2007	
07H20	Tap 352 p/l ShDKRI, Shebelinske	2007	
07H21	62 km p/l ShDO-2, Shebelinske	2007	
07H22	54 km p/l ShDKRI, Shebelinske	2007	
08L01	Tap K-1 p/l Ivatsevichi-Komarno, Bibrske	2008	
08L02	Tap K-2 p/l Ivatsevichi-Komarno, Bibrske	2008	
08L03	Tap 3-29 PZG-Dovge, Bibrske	2008	
08L04	Tap 2-14 p/l Ivatsevichi-Dolyna, Bibrske	2008	
08L05	Tap 28 P p/l Ivatsevichi-Dolyna, Bibrske	2008	
08L08	226,9 km p/l Ivatsevichi-Dolyna-III, Volynske	2008	
08L09	77,839 km p/l Turiysk-Rivne, Volynske	2008	
08L10	14,57 km p/l Turiysk-Rivne, Volynske	2008	
08L11	116,699 km p/l Turiysk-Rivne, Volynske	2008	
08L12	220,31 km p/l Ivatsevichi-Dolyna-II, Volynske	2008	
08L13	240,91 km p/l Ivatsevichi-Dolyna-II, Volynske	2008	

08L14	223,7 km p/l Ivatsevichi-Dolyna-III, Volynske	2008	
08L15	337,063 km p/l Ivatsevichi-Dolyna-III, Kamiano-Buzke	2008	
08L16	334,082 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2008	
08L17	370,482 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2008	
08L18	347,406 km p/l Ivatsevichi-Dolyna-III, Kamiano-Buzke	2008	
08L19	336,773 km p/l Ivatsevichi-Dolyna-III, Kamiano-Buzke	2008	
08L20	322,717 km p/l Ivatsevichi-Dolyna-III, Kamiano-Buzke	2008	
08L21	13,66 km p/l Turiysk-Rivne, Volynske	2008	
08L22	59,1 km p/l Komarno-Derjkordon, Komarnivske	2008	
08L23	p/l Komarno-Derjkordon, Komarnivske	2008	
08L25	3430,9 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L26	3464,1km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L27	3433 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L28	3416, 1km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L29	3458,1 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L30	3462,1 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L31	3433,9 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L32	3458,7 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L33	3463,9 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L34	3416,7 km p/l Torjok-Dolyna, Novograd-Volynske	2008	
08L35	446,5 km p/l KZU-II, Ternopilske	2008	
08L36	447 km p/l KZU-II, Ternopilske	2008	
08L37	405,55 km p/l KZU-II, Ternopilske	2008	
08L38	405,12 km p/l KZU-II, Ternopilske	2008	
08L39	405,54 km p/l KZU-II, Ternopilske	2008	

08L40	459,3 km p/l KZU-II, Ternopilske	2008	
08L41	436,1 km p/l KZU-II, Ternopilske	2008	
08L42	34,2 km p/l KZU-II, Ternopilske	2008	
08L43	437,42 km p/l KZU-II, Ternopilske	2008	
08L44	437,45 km p/l KZU-II, Ternopilske	2008	
08L45	408,7 km p/l KZU-II, Ternopilske	2008	
08L46	407,65 km p/l KZU-II, Ternopilske	2008	
08L47	438,9 km p/l KZU-II, Ternopilske	2008	
08P01	109124,51 m p/l Soyuz, Bogorodchanske	2008	
08P02	120884 m p/l Soyuz, Bogorodchanske	2008	
08P03	19864,13 m p/l Soyuz, Bogorodchanske	2008	
08P04	16761 m p/l Soyuz, Bogorodchanske	2008	
08P05	80733 m p/l KAChB, Bogorodchanske	2008	
08P06	3692,69 m p/l Bogorodchany-Dolyna, Bogorodchanske	2008	
08P07	303,68 m p/l DUD-II, Zakarpatske	2008	
08P09	358,937 km p/l AChB, Odeske	2008	
08P10	51788,08 m p/l Soyuz, Hustske	2008	
08D01	1263 km p/l Soyuz, Novopskovske	2008	
08K01	89,073 km p/l KZU-II, Berdychivske	2008	
08K02	127,48 km p/l KZU-II, Berdychivske	2008	
08K03	506,559 km p/l Kursk-Kyiv, Boyarske	2008	
08K04	308,08 km p/l KZU-II, Krasylivske	2008	
08K05	344,48 km p/l KZU-II, Krasylivske	2008	
08K06	337,6 km p/l ShPK, Lubenske	2008	
08K07	3447 km p/l UPU, Sumske	2008	

08K08	299,8 km p/l EKD, Sumske	2008	
08K09	3365,2 km p/l UPU, Sumske	2008	
08K10	356,2 km p/l EKD, Sumske	2008	
08K11	339,1 km p/l EKD, Sumske	2008	
08K12	90,8; 109,3 km p/l ChPPSG-Kyiv;ShPK, Chernigivske	2008	
08K13	382,5 km p/l EKK, Yagotynske	2008	
08C01	3979,4 km p/l UPU, Barske	2008	
08C02	4221,3 km p/l Progres, Barske	2008	
08C03	2141,95 km p/l Soyuz, Barske	2008	
08C04	3935,45 km p/l UPU, Barske	2008	
08C05	4076,3 km p/l UPU, Barske	2008	
08C06	4243,47 km p/l Progres, Barske	2008	
08C07	3953,15 km p/ l UPU, Barske	2008	
08C08	3828,9 km p/l UPU, Gaysynske	2008	
08C09	2011,8 km p/l Soyuz, Gaysynske	2008	
08C10	3908,4 km p/l UPU, Gaysynske	2008	
08C11	3854,238 km p/l UPU, Gaysynske	2008	
08C12	2007 km p/l Soyuz, Gaysynske	2008	
08C13	3788,48 p/l Progres, Zolotoniske	2008	
08C14	3954,64 km p/l Progres, Zolotoniske	2008	
08C15	3737,41 km p/l UPU, Zolotoniske	2008	
08C16	3641,31 km p/l UPU , Zolotoniske	2008	
08C17	3770,87 km p/l UPU, Zolotoniske	2008	
08C18	1623,42 km p/l Soyuz, Kremenchutske	2008	
08C19	1680,18 km p/l Soyuz, Kremenchutske	2008	

08C20	579,5 km p/l KAB, Kremenchutske	2008	
08C21	1649 km p/l Soyuz, Kremenchutske	2008	
08C22	315,8 km p/l KAB, Oleksandrivske	2008	
08C23	118,22 km p/l KAB, Oleksandrivske	2008	
08C24	1764,95 km p/l Soyuz, Oleksandrivske	2008	
08C25	37,2 km p/l KAB, Oleksandrivske	2008	
08C26	1469 km p/l Soyuz, Pervomayske	2008	
08C27	1528 km p/l Soyuz, Pervomayske	2008	
08H01	134,6 km p/l ShDKRI, Dnipropetrovske	2008	
08H02	122,3 km p/l ShDKRI, Dnipropetrovske	2008	
08H03	219 km p/l Ostrogozk-Shebelinka, Kupianske	2008	
08H04	57 km p/l Kherson-Krim, Khersonske	2008	
08H05	15167,91 m p/l ShDO-2, Shebelinske	2008	
08H06	43,693 km p/l ShDKRI, Kryvorizke	2008	
08H07	26,890 km p/l ShDKRI, Kryvorizke	2008	
08H08	4,798 km p/l ShDKRI, Kryvorizke	2008	
08H09	359 km p/l Ostrogozk-Shebelinka, Kupianske	2008	
09L01	404 km p/l Ivatsevichi-Dolyna, Bibrske	2009	
09L02	426 km p/l Ivatsevichi-Dolyna, Bibrske	2009	
09L03	223,7 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	
09L04	307,243 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	
09L05	272,15 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	
09L06	278,36 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	
09L07	307,235 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	
09L08	306,384 km p/l Ivatsevichi-Dolyna-II, Volynske	2009	

09L09	13,97 km p/l Turiysk-Rivne, Volynske	2009	
09L10	111,714 km p/l Turiysk-Rivne, Volynske	2009	
09L12	6 repairs, p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2009	
09L13	352,57 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2009	
09L16	5,7 km p/l Komarno-Derjkordon, Komarnivske	2009	
09L18	3433,3 km p/l Torjok-Dolyna, Novograd-Volynske	2009	
09L19	64,78 km p/l Komarno-Drozdovichi, Komarnivske	2009	
09L23	457,3 km p/l KZU-II, Ternopilske	2009	
09L24	477,54 km p/l KZU-II, Ternopilske	2009	
09L25	476,94 km p/l KZU-II, Ternopilske	2009	
09L26	474,3 km p/l KZU-II, Ternopilske	2009	
09L28	371,2 km p/l KZU-II, Ternopilske	2009	
09L29	475,33 km p/l KZU-II, Ternopilske	2009	
09L30	479,39 km p/l KZU-II, Ternopilske	2009	
09L31	480,5 km p/l KZU-II, Ternopilske	2009	
09L32	482,61 km p/l KZU-II, Ternopilske	2009	
09L33	478,04 km p/l KZU-II, Ternopilske	2009	
09P01	826,084 km p/l KAChB, Bogorodchanske	2009	
09P02	846,605 km p/l KAChB, Bogorodchanske	2009	
09P03	848,774 km p/l KAChB, Bogorodchanske	2009	
09P04	4394,867 km p/l Progres, Bogorodchanske	2009	
09P05	4232 km p/l UPU, Bogorodchanske	2009	
09P06	32-47 km p/l Bogorodchany-Dolyna, Dolynske	2009	
09P07	369,694 km p/l AChB, Odeske	2009	
09P08	332,947 km p/l ATI, Odeske	2009	

09P09	330,15 km p/l ATI, Odeske	2009	
09P10	182,55 km p/l ATI, Odeske	2009	
09P11	29,01 km p/l ATI, Odeske	2009	
09P12	329,6km p/l ATI, Odeske	2009	
09P13	8,95 km p/l ATI, Odeske	2009	
09P14	3,899 km p/l ATI, Odeske	2009	
09P15	2514,6 km p/l Soyuz, Hustske	2009	
09P16	4657,93 km p/l DUD-II, Zakarpatske	2009	
09D01	1239 km p/l Soyuz, Novopskovske	2009	
09D02	1237,96 km p/l Soyuz, Novopskovske	2009	
09K01	426,3 km p/l Dashava-Kyiv, Berdychivske	2009	
09K02	86,055 km p/l KZU-2, Berdychivske	2009	
09K03	180,74 km p/l KZU-2, Berdychivske	2009	
09K04	209,9 km p/l KZU-2, Berdychivske	2009	
09K05	26,226 km p/l TShK, Boyarske	2009	
09K06	438,726 km p/l ShPK, Boyarske	2009	
09K07	438,9 km p/l ShPK-1, Boyarske	2009	
09K08	27,96 km p/l KZU-2, Boyarske	2009	
09K09	42,3 km p/l ShDK, Dykanske	2009	
09K10	438,2 km p/l EKKr, Dykanske	2009	
09K11	264,984 km p/l KZU-2, Krasylivske	2009	
09K12	3415,22 km p/l UPU , Sumske	2009	
09K13	110,1 km p/l K-K, Sumske	2009	
09K14	392,19 km p/l EKKr, Sumske	2009	
09K15	19,77 km GRS m.Desna, Chernigivske	2009	

09K16	292,59 km GRS m.Shostka, Chernigivske	2009	
09K17	0,52 km GRS Kirovo, Chernigivske	2009	
09C01	4239,39 km p/l Progres, Barske	2009	
09C02	4137,65 km p/l Progres, Barske	2009	
09C03	4223,25 km p/l Progres, Barske	2009	
09C04	3994,4 km p/l UPU, Barske	2009	
09C05	4076,31 km p/l UPU, Barske	2009	
09C06	4011,86 km p/l UPU, Barske	2009	
09C07	2274,271 km p/l Soyuz, Barske	2009	
09C08	1956 km p/l Soyuz, Gaysynske	2009	
09C09	2018 km p/l Soyuz, Gaysynske	2009	
09C10	2015 km p/l Soyuz, Gaysynske	2009	
09C11	3921,5 km p/l UPU, Gaysynske	2009	
09C12	3833,44 km p/l UPU, Gaysynske	2009	
09C13	3717,95 km p/l UPU, Zolotoniske	2009	
09C14	3669,88 km p/l UPU, Zolotoniske	2009	
09C15	3929,72 km p/l Progres, Zolotoniske	2009	
09C16	3595,152 km p/l UPU, Zolotoniske	2009	
09C17	3738,11 km p/l Progres, Zolotoniske	2009	
09C18	565,69 km p/l EKKr, Kremenchutske	2009	
09C19	1683,32 km p/l Soyuz, Kremenchutske	2009	
09C20	1580,6 km p/l Soyuz, Kremenchutske	2009	
09C21	1579,4 km p/l Soyuz, Kremenchutske	2009	
09C22	114,2 km p/l KAB, Oleksandrivske	2009	
09C23	124,4 km p/l KAB, Oleksandrivske	2009	

09C24	1469,86 p/l Soyuz, Pervomayske	2009	
09C25	1454,65 km p/l Soyuz, Pervomayske	2009	
09C26	1295,33km p/l Soyuz, Pervomayske	2009	
09C27	1355 km p/l Soyuz, Pervomayske	2009	
09H01	66,7 km p/l ShDKRI, Dnipripetrovske	2009	
09H02	142,282 km p/l ShDKRI, Dnipripetrovske	2009	
09H03	6,6 km p/l ShDKRI, Kryvorizke	2009	
09H04	112 km p/l ShDKRI, Kryvorizke	2009	
09H05	740 km p/l EKKR, Kryvorizke	2009	
09H06	722 km p/l EKKR, Kryvorizke	2009	
09H07	761 km p/l EKKR, Kryvorizke	2009	
09H08	4,209 km p/l ShDKRI, Mykolayivske	2009	
09H09	32,292 km p/l ShDKRI, Mykolayivske	2009	
09H10	17030,31 m p/l ShDKRI, Shebelinske	2009	
09H11	249 km p/l O-Sh, Shebelinske	2009	
09H12	248,824 km p/l O-Sh, Shebelinske	2009	
09H13	74523,14 m p/l O-Sh, Shebelinske	2009	
10L03	16,23 km p/l Komarno-Derjkordon, Bibrske	2010	
10L04	71,334 km p/l Komarno-Derjkordon, Bibrske	2010	
10L05	425 km p/l Ivatsevichi-Dolyna-II, Bibrske	2010	
10L06	413,1 km p/l Komarno-Derjkordon, Bibrske	2010	
10L07	185,8 km p/l Ivatsevichi-Dolyna-II, Volynske	2010	
10L08	214,68 km p/l Ivatsevichi-Dolyna-III, Volynske	2010	
10L09	215,6 km p/l Ivatsevichi-Dolyna-IIi, Volynske	2010	
10L10	209,097 km p/l Ivatsevichi-Dolyna-III, Volynske	2010	

10L11	215,284 km p/l Ivatsevichi-Dolyna-III, Volynske	2010	
10L12	209,1 km p/l Ivatsevichi-Dolyna-II, Volynske	2010	
10L13	207,6 km p/l Ivatsevichi-Dolyna-II, Volynske	2010	
10L14	378,275 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2010	
10L15	398,891 km p/l Ivatsevichi-Dolyna-II, Kamiano-Buzke	2010	
10L18	410,62 km p/l KZU-II, Ternopilske	2010	
10L19	415,92 kmp/l KZU-II, Ternopilske	2010	
10L20	427,67 km p/l KZU-II, Ternopilske	2010	
10L21	413,589 km p/l KZU-II, Ternopilske	2010	
10L22	486,85 km p/l KZU-II, Ternopilske	2010	
10L23	487,299 km p/l KZU-II, Ternopilske	2010	
10L24	415,243 km p/l KZU-II, Ternopilske	2010	
10L25	379,13 km p/l KZU-II, Ternopilske	2010	
10P01	714,882 km p/l KAChB, Bogorodchanske	2010	
10P02	751,527 km p/l KAChB, Bogorodchanske	2010	
10P03	878,234 km p/l KAChB, Bogorodchanske	2010	
10P04	875,709 km p/l KAChB, Bogorodchanske	2010	
10P05	22,8 km p/l DUD-II, Dolynske	2010	
10P06	47 km p/l Bogorodchany-Dolyna, Dolynske	2010	
10P07	28 km p/l Bogorodchany-Dolyna, Dolynske	2010	
10P08	38407,31 m p/l DUD-II, Zakarpatske	2010	
10P09	33,448 km p/l DUD-II, Zakarpatske	2010	
10P10	306,06 km p/l ATI, Odeske	2010	
10P11	178,14 km p/l ATI, Odeske	2010	
10P12	276,07 km p/l ATI, Odeske	2010	

10P13	329,69 km p/l ATI, Odeske	2010	
10P14	200,9 km p/l ATI, Odeske	2010	
10P15	40,275 km p/l ATI, Odeske	2010	
10P16	31,7 km p/l ATI, Odeske	2010	
10P17	71,266 km p/l ATI, Odeske	2010	
10P18	330,811 km p/l ATI, Odeske	2010	
10P19	176,24 km p/l ATI, Odeske	2010	
10P20	411,37 km p/l AChB, Odeske	2010	
10P21	391,95 km p/l AChB, Odeske	2010	
10P22	50,695 km GRS Izmail, Odeske	2010	
10P23	2478,2 km p/l Soyuz, Hustske	2010	
10P24	2518,75 km p/l Soyuz, Hustske	2010	
10D01	443,2 km p/l Novopskov-Aksay-Mozdok, Luganske	2010	
10D02	456,1 km p/l Novopskov-Aksay-Mozdok, Luganske	2010	
10D03	345,5 km p/l Novopskov-Aksay-Mozdok, Luganske	2010	
10D04	1255,462 km p/l Soyuz, Novopskovske	2010	
10D05	1262,938 km p/l Soyuz, Novopskovske	2010	
10D06	1263,186 km p/l Soyuz, Novopskovske	2010	
10D07	1263,406 km p/l Soyuz, Novopskovske	2010	
10D08	1238,110 km p/l Soyuz, Novopskovske	2010	
10K01	158,324 km p/l KZU-2, Berdychivske	2010	
10K02	158,036 km p/l KZU-3, Berdychivske	2010	
10K03	199,647 km p/l KZU-2, Berdychivske	2010	
10K04	180,29 km p/l KZU-2, Berdychivske	2010	
10K05	170,4 km p/l KZU-2, Berdychivske	2010	

10K06	32,351 km p/l KZU-1, Boyarske	2010	
10K07	23,777 km p/l KZU-2, Boyarske	2010	
10K08	11,394 km p/l KZU-2, Boyarske	2010	
10K09	36,512 km p/l KZU-1, Boyarske	2010	
10K10	482,8 km p/l EKKr, Dykanske	2010	
10K11	237,679 km p/l KZU-2, Krasylivske	2010	
10K12	236,342 km p/l KZU-2, Krasylivske	2010	
10K13	233,328 km p/l KZU-2, Krasylivske	2010	
10K14	248,825 km p/l KZU-2, Krasylivske	2010	
10K15	277,947 km p/l KZU-2, Krasylivske	2010	
10K16	3568,5 km p/l UPU, Lubenske	2010	
10K17	3365,21 km p/l UPU, Sumske	2010	
10K18	3412,62 km p/l UPU, Sumske	2010	
10K19	3418,52 km p/l UPU, Sumske	2010	
10K20	3479,95 km p/l UPU, Sumske	2010	
10K22	90,8 km p/l ChPPSG, Chernigivske	2010	
10K23	Tap 12,2; 12,6 GRS Desna, Chernigivske	2010	
10K24	Tap 93,6 GRS Slavutych, Chernigivske	2010	
10C01	4176,35 km p/l Progres, Barske	2010	
10C02	4247,217 km p/l Progres, Barske	2010	
10C03	3981,85 km p/l UPU, Barske	2010	
10C04	4065,093 km p/l UPU, Barske	2010	
10C05	2241,64 km p/l Soyuz, Barske	2010	
10C06	2189,721 km p/l Soyuz, Barske	2010	
10C07	3899,4 km p/l UPU, Gaysynske	2010	

10C08	3852,223 km p/l UPU, Gaysynske	2010	
10C09	2086,6 km p/l Soyuz, Gaysynske	2010	
10C10	3621,203 km p/l UPU, Zolotoniske	2010	
10C11	1632,24 km p/l Soyuz, Kremenchutske	2010	
10C12	1746,855 km p/l Soyuz, Kremenchutske	2010	
10C13	18,6 km p/l KAB, Kremenchutske	2010	
10C14	216,62 km p/l KAB, Oleksandrivske	2010	
10C15	294,9 km p/l KAB, Oleksandrivske	2010	
10C16	275,09 km p/l KAB, Oleksandrivske	2010	
10C17	266,08 km p/l KAB, Oleksandrivske	2010	
10C18	72,1 km p/l KAB, Oleksandrivske	2010	
10C19	71,6 km p/l KAB, Oleksandrivske	2010	
10C20	1282,42 km p/l Soyuz, Pervomayske	2010	
10H01	118,6 km p/l ShDO-2, Zaporizke	2010	
10H02	54 km p/l ShDKRI, Kryvorizke	2010	
10H03	23,6 km GRS Zelenodolsk, Kryvorizke	2010	
10H04	97 km p/l ShDKRI, Kryvorizke	2010	
10H05	676 km p/l EKKR, Kryvorizke	2010	
10H06	83 km p/l ShDKRI, Kryvorizke	2010	
10H07	23,85 km GRS Zelenodolsk, Kryvorizke	2010	
10H08	685,2 p/l EKKR, Kryvorizke	2010	
10H09	184,4 p/l Ostrogozk-Shebelinka, Kupianske	2010	
10H10	195,5 km p/l Ostrogozk-Shebelinka, Kupianske	2010	
10H11	212,4 km p/l Ostrogozk-Shebelinka, Kupianske	2010	
10H12	176,6 km p/l Ostrogozk-Shebelinka, Kupianske	2010	

10H13	59,463 km p/l ShDKRI, Mykolayvske	2010	
10H14	183,41 km p/l ShDO-1, Mykolayvske	2010	
10H15	91,95 km p/l ShDKRI, Mykolayvske	2010	
10H16	133,165 km p/l ShDO-2, Mykolayvske	2010	
10H17	44,968 km p/l ShH, Kharkivske	2010	
10H18	35357 m p/l ShDO-2, Shebelinske	2010	
10H19	12635,02 p/l ShDO-2, Shebelinske	2010	