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

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SECTION A. General description of the project

A.1. Title of the project:

Implementation of Energy Saving Equipment and Technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov"

Sectoral scope: 1 Energy industries (renewable / non-renewable sources)

PDD Version: 07, dated August 16, 2011

A.2. Description of the project:

The project main goal is reduction of fuel (natural gas, imported to Ukraine) and electricity consumption by means of implementation of energy-saving equipment and technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov". Such fuel and electricity saving will result in decreasing of anthropogenic greenhouse gas (mainly CO_2) emissions.

Situation existing prior to the starting date of the project

The enterprise started its production activity in 1944. The equipment used for provision of technological processes was installed mainly in 50-70th of the last century. The major part of equipment has large energy consumption and is morally outdated. Basic energy resources being consumed by enterprise (heat energy as hot water and steam, partly electricity and compressed air) were produced by CHP plant of the enterprise, which was put into operation in 1950. The CHP consumes natural gas. CHP equipment is obsolescent, and does not meet the modern requirements on energy efficiency.

The heat energy produced by the CHP is used also for covering the heat loads in neighboring to the enterprise urban residential areas of Dnipropetrovsk city.

The enterprise has the branched networks of heat, steam, water and compressed air pipelines.

Baseline scenario

The Baseline scenario is continuation of the current situation, i.e. business-as-usual scenario with minimum reconstruction works. Since there is no local legislation regarding the time of technological as well as energy equipment replacement and maximum lifetime permitted for such equipment, this scenario is in compliance with the valid mandatory laws and regulations. This Baseline scenario doesn't require the attraction of additional investments, and it represents the common practice in Ukraine – to continue operation of the equipment which was installed in 70th and even 50-60th and earlier, if it meets the technical needs and if necessary (for boilers, etc.) passes the technical examination by the authorized body.

Project scenario

The project was initiated in 2003 and started in 2004 to implement energy saving technologies and equipment at SE "Production Association Yuzhny Machine-Building Plant named after A. Makarov", including rehabilitation and modernization of the main and auxiliary CHP and technological plant equipment, rearrangement of the network (pipeline) equipment, etc. All technical equipment of the enterprise which is involved in production of the main core aerospace products and of the heat energy, is included into this project.

Energy saving will be achieved owing to:

1. Modernization of the main and auxiliary equipment, including:

- rehabilitation of CHP with replacement of the low-efficiency steam and hot water boilers by the modern high-efficiency ones, replacement and reconstruction of boiler units and auxiliary equipment;
- rehabilitation of electro generating equipment;
- rehabilitation and replacement of pumping equipment;
- replacement of compressor equipment;
- installation of the frequency regulation at the draught-blowing and pumping equipment drives.

2. Rearrangement of energy supply layout for technological processes, including:
- provision for possibility to stop and/or to reduce the load on boiler and compressor equipment during the technological processes time-off;
- switching of load from the low-efficiency boiler house;
- switching of steam generating equipment to the electrical drive;
- switching of compressor equipment to the electrical drive;
- approaching of sources of steam and compressed air production to the consumers, with enabling to exclude the steam distribution networks and to return condensate;
- concentration of the technological equipment for optimization of the heated area;
- implementation of automated systems for control and regulation of equipment and account of energy recourses.

3. Rearrangement of network (pipeline) equipment, including:
- liquidation and/or reduction of heat carrier, compressed air, fluidized gases and technical water leakages;
- reduction of pipelines' length;
- rehabilitation of pipelines and heat insulation.

4. Installation of the new technological equipment instead of the obsolescent one, including:
- metal-working machines from the leading world producers;
- unique equipment for contact butt welding;
- equipment for gas-thermal coating deposition;
- unique test camera for testing of the spacecrafts operation.

Estimated project annual reductions of GHG emissions, in particular CO_2, are from 150 to 360 thousand tons CO_2e in 2005-2007, and from 130 to 710 thousand tons in 2008-2012 and after 2012 comparing to business-as-usual or baseline scenario.

Environmental impact of the project is very positive, since emissions of CO_2, NO_x, and CO from boiler-houses are substantially reduced, as well as the emissions of CO_2, SO_x, NO_x, CO and particulate matter associated with the electricity generation at power plants operating mainly by coal, as a result of decreased electricity consumption from the state grid.

Short history (the main milestones) of the project including its JI component:

The project was initiated in 2003.

November, 2003 – the energy examination of the CHP facilities of the SE "Production Association Yuzhny Machine-Building Plant named after A. Makarov" was started in order to identify the reasonable ways for its rehabilitation and modernization.

October, 2004 - Agreement was signed between State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" and the Institute of Engineering Ecology on energetic and ecological survey of the enterprise and development of materials for the project on greenhouse gases emission reduction (№ 526 dated 11.10.2004). Namely this documented data is set as the project starting data.

November, 2010 – Emission Reduction Purchase Agreement was signed between the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" and the company VEMA SA (Switzerland), on purchasing the emission reductions generated from this JI project (dated 15.11.2010).

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)	State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov"	No
Switzerland	VEMA SA	No

- ***State Enterprise «Production Association Yuzhny Machine-Building Plant named after A. Makarov»:*** organization, which implements this project (**Supplier**). It operates equipment for production and distribution of heat, electric and mechanical energy, and for manufacturing of the engineering production. As far as this enterprise purchases all the necessary energy resources (fuel, electricity, etc), it has the primary interest in the reduction of specific fuel consumption that can be achieved by the implementation of the project. It is responsible for design, engineering and installation works execution by its own personnel or with the aid of subcontractors. It finances the project and obtains profit.

The enterprise is one of the world known scientific and industrial complexes involved in serial production of modern rocketry. Many of them are the embodiment of scientific development, that doesn't have analogs on the conception and the execution in the whole world.

Historical details:[1]

On July 21, 1944 the State Defense Committee ordered the construction of car plant in Dnepropetrovsk. The enterprise was founded in 1944. Its more than 60-year-long history reflects the entire progress of the world space rocketry, from creation of military strategic missile units up to the production of spacecrafts for peaceful development of space created on the basis of military missiles.

Some milestones are listed below:

1951 - Commencement of mass production of strategic military missiles.
1953 - The first batch of liquid jet engines for anti-aircraft missiles was produced. The first fire tests of the engine were completed.
1957 - The design-research works on creation of a carrier rocket for satellite launch are started.

[1] http://www.yuzhmash.com/ru/

1961 - The unified land-based rocket was launched in Baikonur cosmodrome.
1967 - Representatives of nine countries signed in Moscow the Program of Peaceful Space Exploration and Utilization.
1971 -Orion-1, created together with the French Space Center, was launched.
1986 -The process of contact butt-seam welding of shells was implemented for the first time in the world.
1995 -The Agreement between the USA, Russia, Ukraine and Norway was signed to produce and launch space carriers "Zeniths" under the "Sea Launch" Program.
1999 -The successful launch of "Zenith-3SL" missile with the US satellite on board was performed from the sea platform in the Pacific.
2002 - Production of the new generation of micro-satellites was commenced.
2004 - The first Ukrainian microsatellite "Micron" was launched together with "Sich-1M" satellite on "Cyclone-3" launch vehicle.
2006 - The highest quality of products manufactured by enterprise – assemblies of chassis, "Cyclone-2", "Zenith-3SL" and "Dnepr-2" missile carriers – was distinguished by four Honor Diplomas and awards as well as by the Golden Mark "The best Ukrainian goods of the year".
2007 -Prestigious international gold prize "For quality". Enterprise is awarded as the leader of space-rocket branch in Ukraine, constantly raising quality of its production.
2007 - The enterprise became the participant of the International air shows "Le-Bourget-2007" (France) and "Max-2007" (Russia).
2008 - The first launch of "Zenith-3SLB" missile from Baikonur cosmodrome in frames of the "Land launch" program was successfully performed.
2008 - The frame contract with "Orbital" company (USA) was signed on cooperation in development of the "Taurus II" missile.
2008 - The enterprise became the participant of the Air show "ILA—2008" (Germany).
2008 - The 5 launches of "Zenith-3SL" were successfully performed during the year.
2009 - The workers of the enterprise were awarded with the State prize of Ukraine in science and technology of 2009 for creation of the 3-stage "Zenith-3SL" missile carrier in frames of the "Sea Launch" Program.

During 65 years the four generations of carrier rockets (CR) and several types of spacecrafts have been created, at present the fifth generation of the CRs and the new generation of the spacecrafts are under creation. SE "PA Yuzhny Machine-Building Plant named after A. Makarov" has made an ecological two-stage CR under the title «Zenit» to realize the world-known international «Sea Launch» project.

According to the project program more than two scores of CRs were launched in the Pacific from a specially designed floating platform and a few scores of the satellites from different countries (Russia, USA, etc.) were put into the Earth orbit. Purposely to launch these CRs from the «Baikonur» cosmodrome a joint venture "Land Launch" has been established. Specially for this "Land Launch" program, the "Zenith-3SLB" missile was developed.

Within the frames of conversion for the orbiting the communication spacecrafts, the enterprise in cooperation with Russian enterprises has upgraded two types of strategic two-stage CRs (upper-stage rocket is installed and additional works are done).

There is currently creating a new CR modification, developed by the joint Ukrainian-Brazilian satellites launching project from «Alcântara» cosmodrome, Brazil.

Owing to enterprises successes in space exploration, Ukraine deservedly consolidated its status of a world space power. SE "PA Yuzhny Machine-Building Plant named after A. Makarov" with 11% of the worldwide launches can claim to be one of the five leading rocket and space enterprises in the world.

About four hundred spacecrafts orbited by enterprises CRs allowed to conduct researches for the national scientific and technical development and international cooperation.

The powerful industrial base created during decades, coupled with the high technology, allows the enterprise to produce the competitive at the world market production, but the technological equipment is already partly characterized by significant wear.

Through the policy of development and innovation, the company continues to create the new technologies including the more environmental friendly ones.

Since 2004, SE "PA Yuzhny Machine-Building Plant named after A. Makarov" applies considerable efforts for reduction of GHG emissions from the enterprise's main activity.

At present the enterprise has 86 workshops and 82 departments where about 12 thousand persons are employed.

The enterprise is one of leading manufacturers of rocket and space technical equipment in the world, owns a powerful base for implementation of the most difficult orders for defense and scientific purposes. The enterprise has own metallurgical, metal-working, welding, instrumental and other productions. A lot of technologies are unique, created specially for space activity, contain "Know-how" and does not have analogues. With using of the nanotechnologies, the unique test chamber for testing of spacecrafts functioning is created. The presence of unique technologies and technical solutions allow the enterprise to produce products which does not have analogues in the world. Thus, on the basis of transport-launch containers for "Satana" and "Scalpel" types rockets, the unique containers for storage of radioactive and highly toxic wastes, etc., are developed. The enterprise also produces equipment for various industries, as well as transport equipment.

With a glance to the above-said, SE "PA Yuzhny Machine-Building Plant named after A. Makarov" has the special security mode of its activity[2].

The total park of the enterprise equipment counts 10 518 units, mainly the machines of leading world manufacturers (OKUMA (Japan), WEILER, MaxMuller (Germany), DOOSAN (Korea), EBOSA, AGIE (Switzerland), OLIVETTI, TACCHI (Italy), HARTFORD (Taiwan), etc.)[3].

The main types of the enterprise products are[3]:

1. Aerospace products, including:

• Carrier rockets: CR `Zenith`, CR `Cyclone';
• Spacecrafts: Okean-O`, `Sich-1M`, AUOS SM KS5MF2, MS-1;
• Rocket engines RD120, RD8, DU802, RD-861-K;
• High pressure balloon containers;
• Transport-launch containers;
• Chassy for aircrafts AN-140 and AN-148;
• Another core industrial products, etc.

2. The non-core machine-building products, including:

• Tractors UMZ-6, UMZ 8040.2, UMZ 8244.2;
• Trolleybuses UMZ-T1, UMZ T2 and UMZ E186;
• Wind-driven energy installation.

3. Heat energy in form of the hot water.

[2] *Permission of the Security Service of Ukraine to pursue activity concerning the government secrets dated 31.05.2010, No. DP1-2010-39*

[3] *http://www.yuzhmash.com/ru/tech.php?page=park*

A.4. Technical description of the project:

A.4.1. Location of the project:

The Project is located in Dnipropetrovsk City, in the Eastern part of Ukraine (Fig.A1).

Fig. A1. The map of Ukraine with division into regions, the place of project implementation is marked with red circle

A.4.1.1. Host Party(ies):

The Host Party for the project is Ukraine.

Ukraine is an Eastern European country that ratified the Kyoto Protocol to UN FCCC on February 4, 2004, is listed in the Annex 1 to it and is eligible for the Joint Implementation projects.

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

The Project activity is located in Dnipropetrovsk City, the administrative centre of Dnipropetrovsk region – one of the most important industrial regions of Ukraine, in the Eastern part of the country at the Dnipro river.

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

The State enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" is situated in the South part of Dnipropetrovsk city.

Dnipropetrovsk city is one of the largest administrative, industrial and cultural centers of southern Ukraine. It is located at the main country water transport line - the river Dnipro, at the point of intersection of transport communicational corridor linking the south of Ukraine with the center of Russia, as well as Donbas with Kryvorizhzhia and Zakarpattia.
The climate is temperate continental. The average temperature in winter ranges from −5 °C to −6.5 °C, and in summer – from +22 °C to +23 °C. The average annual rainfall is 400–450 mm.

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

The physical location of the enterprise is shown at Figs.A2 and A3.

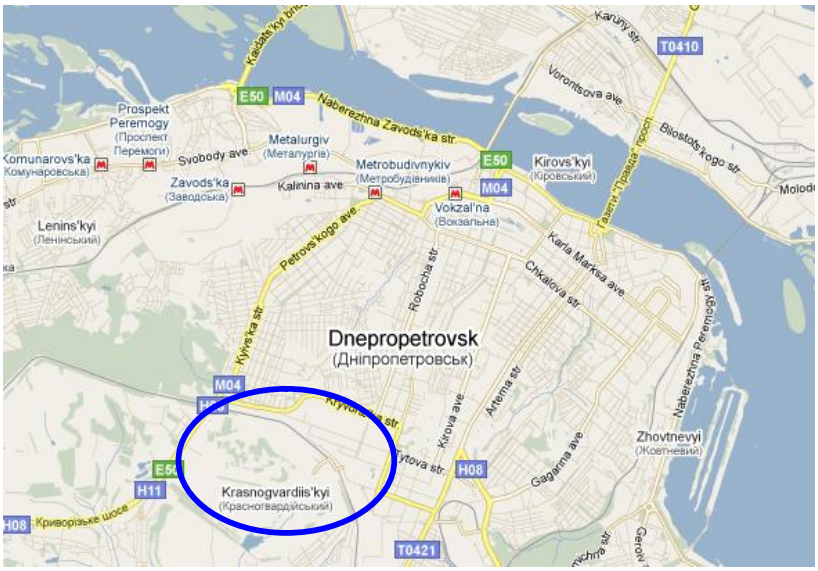

Fig. A2. Location of the enterprise at the map of Dnipropetrovsk city

Fig. A3. Territory of the State enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov"

Geographical coordinates of the enterprise: 48°43 N, 34°98 E [4].

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

The main direction of the project activity is energy-saving which is achieved owing to the increase of efficiency of processes of production of heat, electric and mechanical energy, and also its rational consumption; due to what reduction of greenhouse gases emissions will take place in relation to current practice.

To the time of project start (second half of 2004), the following main equipment was installed at the enterprise.

The following boiler and generation equipment was installed at the CHP plant:

Name of equipment	Year of installation	Capacity / steam rate
Boiler units:		
St. #1: Type «Sterling»	1950	110 t/hour
St. #2: Type «Sterling»	1950	110 t/hour
St. #3: Type «Stein Muller»	1952	75 t/hour
St. #4: Type «Stein Muller»	1953	75 t/hour
St. #5: Type TP-150	1955	150 t/hour
St. #6: Type TP-150	1957	150 t/hour
St. #7: Type TP-36	1960	150 t/hour
St. #8: Type TP-36	1961	150 t/hour
St. #9: Type TP-36	1966	150 t/hour
St. #10: Type PTVM-100	1972	100 Gcal/hour
St. #11: Type PTVM-100	1972	100 Gcal/hour
Turbogenerators:		
St. #1: Type AT-12	1950	12 MW

[4] http://wikimapia.org/#lat=48.4361198&lon=34.9897814&z=15&l=0&m=b

St. #2: Type AP-25-2	1952	25 MW
St. #5: Type AT-25-2	1957	25 MW
St. #7: Type AT-25-2	1961	25 MW

All boilers were natural gas fired. The total installed capacity of CHP plant's equipment amounted to:

- electric – 87.0 MW;.
- heat – 915.7 Gcal/hour.

Practically the following equipment was in operation at the CHP:

- one «Sterling» (Great Britain) steam boiler, st. #1;
- one «Stein Muller» (Germany) steam boiler, st. #3;
- two TP-36 (Russia) steam boilers, st. ## 7, 8;
- one PTVM-100 (Russia) hot water boiler, st. # 10;
- one AT-12 steam turbine (Thompson-Hawson), st. # 1;
- two AT-25-2 steam turbines (UTMZ), st. ## 5, 7.

In addition to CHP plant, the heat energy needs of the enterprise as a steam and hot water were provided by the boiler-house of the heat-power workshop, in which three DE-25-14 type steam boilers and three KV-GM-30 type hot water boilers were installed. The total installed heat capacity of the boiler-house equipment was 137.9 Gcal/hour.

The needs of the enterprise in electricity were partly covered with steam turbo generators listed in table above.
The needs of the enterprise in compressed air were covered with steam and electric compressors:

Compressor type	Model	Number	Capacity, кW	Productivity, m3/ hour
Steam powered				
Turbo compressor	AP-2,5	2	2500	18000
Turbo compressor	AP-5	1	5000	44000
Electricity powered				
Turbo compressor	K 250-61-2	4	1600	15000
High-pressure compressor	402VP-4-400	1	160	480
Compressor	CK135/8	1	1000	8100
High-pressure compressor	2RV-350	2	75	180

The technical water supply of the enterprise was provided by the own 14 km long water supply system from Dnipro river, with three water lifting pumping stations.

The heat generating equipment of CHP and boiler-house, as well as electro generating, compressor and pumping equipment, were in round-the-clock operation, without possibility of shutdown in non-working time (while the enterprise was working only in one shift).

Project provides installation of the new steam boiler of E-100-3.9-440GM type; installation of the new electric turbo-compressors - "Samsung" TM-1500 (4 units) and "Samsung" TM-400 (1 unit); installation of the two new "Gardner Denver" H280H-WL high pressure compressors; installation of the new hot water boiler KV-GM-116.3-150-1; installation of 26 APG local steam generators with total capacity 6069 kW, of 23 EKO local electric boilers with the total capacity 2400 kW and of 38 CFO local electric calorifers with the total capacity 2205 kW, with corresponding rearrangement of energy supply layout for technological processes; rehabilitation of the AP-25-2 and AT-25-2 steam turbine (st. ## 2, 5), installation of steam turbine with 12 MW capacity; reconstruction of two TP-36 boiler units st. ##7,8; installation of frequency controllers at electric drives of the draught-blowing and pump equipment;

rehabilitation and replacement of pumping equipment, pipelines and shutoff valves of the water supply system; rearrangement and rehabilitation of distribution networks, etc.

In details, the following measures are provided by the project to improve the overall efficiency of State Enterprise “Production Association Yuzhny Machine-Building Plant named after A. Makarov”:

- Old steam boiler TP-150 st. #6 with low efficiency is to be replaced by the new highly efficient steam boiler E-100-3,9-440GM that will result in efficiency increase. The E-100-3,9-440GM boiler is intended for the steam production by combustion of natural gas, and is equipped with the modern burners that allow to get the gaseous emissions substantially below the maximum allowed by normative documents for such boilers. Scheme of this boiler is presented at Fig. A4. Technical characteristics of boiler are presented at the website of the manufacturing company: http://oaozko.kazprom.net

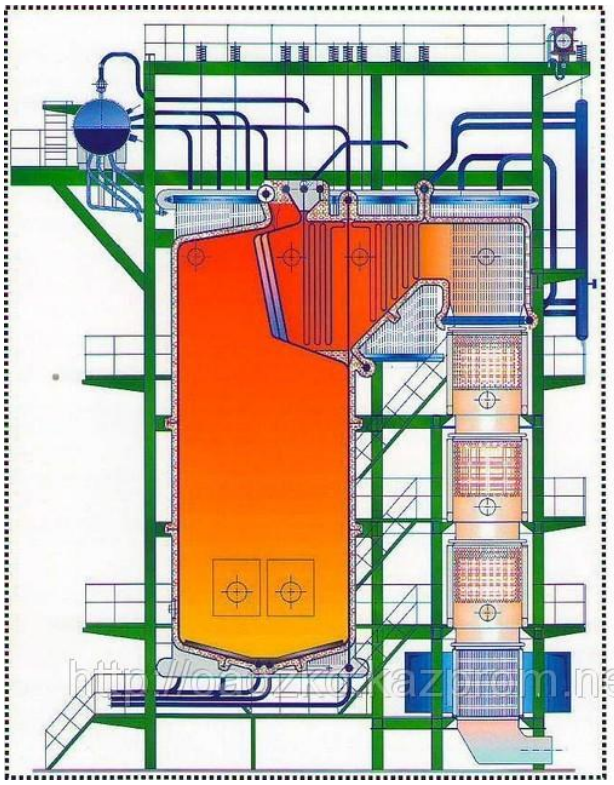

Fig.A4. Scheme of the E-100-3,9-440GM steam boiler

- Dismantling of the TP-36 (st.# 9) steam-boiler and installation of the new KV-GM-116,3-150-1 hot water boiler at this place. The technical characteristics of boiler are presented at the website of the company: http://oaozko.kazprom.net. The scheme of this boiler is presented at Fig. A5.

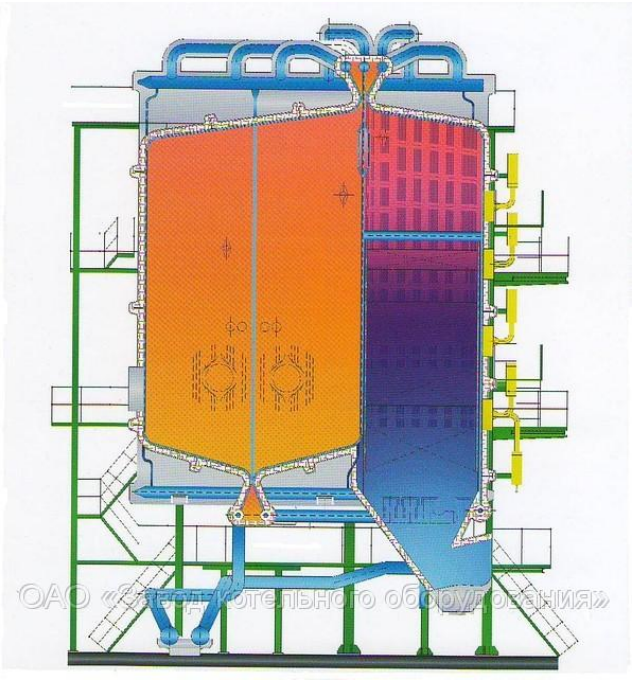

Fig. A5. Scheme of the KV-GM-116,3-150-1 hot water boiler

- Reconstruction of two TP-36 boiler units (st.## 7, 8), including full replacement of the fire chamber screen pipes.

- Rehabilitation of the AP-25-2 steam turbine (st.# 2), including partial replacement of steam pipelines, replacement and rehabilitation of valves and the high pressure heater with diaphragm.

- Rehabilitation of the AT-25-2 steam turbine (st.# 5), including replacement of turbine working blades, replacement of the main rotor system, replacement of the diaphragm.

- Installation of the new steam turbine of 12 MW capacity.

- Installation of four “Samsung” TM-1500 electric turbo-compressors instead of four old K-250-61-2 electric turbo-compressors, and installation of the electric turbo-compressor “Samsung” TM-400 instead of electric compressor CK-135/8. The TM Series TurboMaster centrifugal air compressor is a high-performance compressor utilizing modern aircraft engine technology and equipped with the automatic rate control meeting needs. Technical characteristics of such turbo-compressors are provided at the website of the manufacturing company: http://www.appliedairsystems.com. This new turbo-compressors is presented at the Fig. A6.

Fig. A6. "Samsung" TM electric turbo-compressor

The main technical characteristics of new compressors are represented in table below:

	Unit	TM 1500	TM 400
Capacity	ths m3/hr	13.5	6.0
Motor	kW	1100	325
Discharge Pressure	Bar	9	9
Dimensions (W x L x H)	m	4.0 x 2.1 x 2.0	2.9 x 1.6 x 1.8
Weight	ton	10.2	4.5

- Installation of two "Gardner Denver" H280H-WL high pressure compressors instead of the 402VP-4-400 high pressure compressor and two 2PB-350 high pressure compressors. Technical characteristics of such high pressure compressors are provided at the producer's website: http://www.gardnerdenver.com.

- Rehabilitation and replacement of pumping equipment, pipelines and shutoff valves of the own technical water supply system, including:

- Installation of two new D-1120 pumps with Q=1120 m^3/hour productivity powered by the 160 kW electric motor instead of 18NDS pump with Q=2700 m^3/hour powered by 400 kW electric motor, at the third water lifting pump station;

- Installation of two new K-90-30 pumps with Q=290 m^3/hour productivity powered by the 37 kW electric motor instead of D-800 pump with Q=800 m^3/hour powered by 220 kW electric motor, at the SHKL pumping station;

- Modernization of two 18NDS pumps with productivity of Q=1700 m^3/hour powered by 250 kW electric motor, and of two 10NMK-2 pumping aggregates with productivity of Q=1000 m^3/hour powered by 600 kW electric motor.

- Installation of 26 local steam generators of APG type, with capacity from 51 to 360 kW, with total capacity 6069 kW. Technical characteristics of such steam generators are provided at the producer's website: http://www.teplomash.com.ua. Being compact, mobile, fully autonomous and ecologically clean, they are an alternative to the traditional systems of steam generation, fossil fuel steam-boilers.

- Installation of 23 local electric boilers of EKO type with capacity 120 and 90 kW, with the total capacity 2400 kW produced by Teplomash (http://www.teplomash.com.ua). This new electric boilers are presented at Fig. A7.

Fig. A7. EKO electric boilers

- Installation of 38 local electric calorifers CFO with capacity 45, 60 and 75 kW, with the total capacity 2205 kW. Technical characteristics of such electric calorifers are provided at the producer's website: http://www.teplomash.com.ua.
- Installation of 50 local electric water heaters "Titan" of 45 kW capacity, with total capacity 2250 kW, water heater volume of 200 l, voltage 380 V. Technical characteristics are provided at the producer's website: http://www.teplomash.com.ua. This new water heater is shown at Fig. A8.

Fig. A8. Water heater "Titan"

Installation of these local APG steam generators, EKO electric boilers and CFO electric calorifers enables to switch the load from the low efficient CHP and boiler-house of the heat power workshop and to close the last one completely, as well as to approach the sources of steam and compressed air production to the consumers, thus to return condensate, to implement the automated systems for control and regulation of equipment and account of energy recourses, to concentrate the technological equipment for optimization of the heated area, and to reduce substantially and even eliminate the steam, hot water and compressed air distribution networks across the territory of the enterprise.

Such rearrangement of energy supply layout for technological processes, with implementation of the described new equipment, gives also the possibility to stop and/or to reduce the load on boiler and compressor equipment during the technological processes time-off, which was impossible previously when the heat generating equipment of CHP and boiler-house, as well as electro generating, compressor and pumping equipment, were in round-the-clock operation, without possibility of shutdown in non-working time (while the enterprise was working only in one shift).

- Rearrangement and rehabilitation of distribution networks, including substantial decreasing of length and/or liquidation of the steam, hot water, compressed air, fluidized gases and technical water main and distribution networks across the territory of the enterprise, as well as rehabilitation of the remaining pipelines with liquidation and/or substantial reduction of the corresponding leakages, and rehabilitation of the heat insulation of the heat supply pipelines.

- Installation of frequency controllers at electric drives of the draught-blowing and pump equipment. Such regulators enable to change the actual capacity and correspondingly electricity consumption of the motors depending on connected load, that will result in substantial electricity saving.

- Installation of the new technological equipment instead of the obsolescent one, including:
  - Metal-working machines from the leading world manufacturers:
  - modern high-speed milling centers with computer numerical control (CNC) made by firms Okuma (Japan) and Hartford (Taiwan) for treatment of the precision parts;
  - precision lathe machines with CNC made by companies WEILER (Germany) and TOS a.s. (Czech Republic);
  - high-performance lathe machines with CNC made by DOOSAN (Korea) firm;
  - electric erosion machins made by AGIE (Switzerland) firm, etc.

Using of this equipment can significantly reduce the amount of the necessary tool set and laboriousness of manufacturing of component parts, and thereby decrease the energy consumption correspondingly.

- unique equipment for contact butt welding, application of which allows to improve the quality and performance of products, and in so doing to reduce energy consumption significantly.
- equipment for gas-thermal coating deposition, application of which allows to change the technological processes of parts manufacturing, in particular to apply the thin coatings instead of making the special additional parts such as anti-friction bushings, to increase wear resistance and to decrease the quantity of required parts, and in result to lower significantly the material and energy consumption;
- unique test camera for testing of the spacecrafts operation, created with using of nanotechnologies, that allows to reduce significantly the energy consumption for testing of products.

The generalized schedule of implementation of these overall efficiency improving measures will be the following:

Stage	Activity	Period, years
1	Dismantling of the steam boiler TP-150 st. # 6, and installation of the new steam boiler E-100-3.9-440GM at this place; Rehabilitation and replacement of pumping equipment, pipelines and shutoff valves of the water supply system; Installation of four "Samsung" TM-1500 electric turbo-compressors instead of four K-250-61-2 electric turbo-compressors; Rehabilitation of distribution networks; Installation of the new technological equipment	2004-2007
2	Installation of local steam generators of the total capacity 6069 kW; Installation of local electric boilers of the total capacity 2400 kW and local electric calorifers of the total capacity 2205 kW; Closing of the boiler-house of the heat power workshop; Installation of the electric turbo-compressor "Samsung" TM-400 instead of electro-compressor CK-135/8; Installation of the "Gardner Denver" H280H-WL high pressure compressor instead of the 402VP-4-400 high pressure compressor ; Installation of the "Gardner Denver" H280H-WL high pressure compressor instead of the two 2PB-350 high pressure compressors; Rehabilitation of distribution networks; Installation of the new technological equipment	2008-2009
3	Dismantling of the steam-boiler TP-36 st. #9, and installation of the new hot water boiler KV-GM-116.3-150-1 at this place; Rehabilitation of distribution networks; Installation of the new technological equipment	2008-2010
4	Installation of frequency controllers at electric drives of the draught-blowing and pump equipment; Rehabilitation of distribution networks; Reconstruction of two TP-36 boiler units st. ##7, 8; Rehabilitation of the AP-25-2 (st. #2) and AT-25-2 (st.# 5) steam turbines; Installation of the new steam turbine of 12 MW capacity	2011-2012

The majority of these technologies and equipment are already approved, but some of them are not widespread. Therefore, there might be some bottlenecks, which are typical when implementing the new technologies and equipment.

Taking into account the overall economic situation, it is not likely that the project technology will be substituted with any more efficient technology in the following 20 - 30 years. As to the first commitment period from 2008 to 2012, it is ensured that there is absolutely no risk that this technology will be substituted by any other technology during this time.

As far as the main activity of the enterprise will not change in course of the JI project implementation, the special technical trainings for personnel are not necessary. The technical personnel of the enterprise has sufficient knowledge and experience for implementation of the project activity and maintenance of the usual equipment.

In cases of the new (never used at this enterprise before) equipment installation, the company - producer of this equipment should provide trainings for personnel.

The enterprise provides personnel retraining according to the labour protection norms. The enterprise has the Labour protection department and Training department, which are responsible for raising the level of personnel skills and trainings.

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 project activity will lead to increasing of the overall energy efficiency of the State Enterprise «Production Association Yuzhny Machine-Building Plant named after A. Makarov» due to implementation of the energy saving measures described above.

Implementation of these measures will enable to reduce fuel and electricity consumption by the enterprise, and such fuel and electricity saving will result in decreasing of anthropogenic greenhouse gas (mainly CO_2) emissions.

In the absence of the proposed project, all equipment, including the old low efficient one but still workable for a long life period, will operate in as-usual mode, and any emission reductions will not occur.

The main laws and regulatory for this branch are the following.

The Law of Ukraine "On energy saving" dated 01.07.1994, № 74/94 VR[5]. This Law determines legal, economic, social and ecological basis for energy saving for all enterprises, associations and organizations located on territory of Ukraine, and also for citizens. It claims the fuel consumption efficiency increasing as a priority of the national energy-saving policy, but does not envisage any ways for its financing.

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

In course of project execution, the following emission reductions are and will be achieved, at the stages of project implementation:

Period before January 1, 2008:

	Years
Length of the crediting period	**3**
Year	**Estimate of annual emission reductions in tonnes of CO_2 equivalent**
2005	154 974
2006	334 451
2007	359 647
Subtotal 2005 – 2007	**849 072**
Annual average of estimated emission reductions over the pre-commitment period 2005 – 2007 (tonnes of CO_2 equivalent)	283 024

Table A1. Estimated amount of CO_2e Emission Reductions before the start of the commitment period

[5] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=74%2F94-%E2%F0

The First Kyoto Commitment period 2008 – 2012:

	Years
Length of the crediting period	**5**
Year	**Estimate of annual emission reductions in tonnes of CO_2 equivalent**
2008	392 881
2009	244 236
2010	129 187
2011	714 243
2012	714 243
Subtotal 2008 - 2012	**2 194 790**
Annual average of estimated emission reductions over the first commitment period 2008 – 2012 (tonnes of CO_2 equivalent)	438 958

Table A2. Estimated amount of CO_2e Emission Reductions during the first commitment period

The post- first commitment period 2013 – 2024:

	Years
Length of the crediting period	**12**
Year	**Estimate of annual emission reductions in tonnes of CO_2 equivalent**
2013	714 243
2014	714 243
2015	714 243
2016	714 243
2017	714 243
2018	714 243
2019	714 243
2020	714 243
2021	714 243
2022	714 243
2023	714 243
2024	714 243
Subtotal 2013 – 2024	**8 570 916**
Annual average of estimated emission reductions over the post-first commitment period 2013 – 2024 (tonnes of CO_2 equivalent)	714 243

Table A3. Estimated amount of CO_2e Emission Reductions during the post-first commitment period

Total amount of CO_2e Emission Reductions over the crediting period:

	Years
Length of the crediting period	**20**
	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Total estimated emission reduction over the crediting period 2005 – 2024 (tonnes of CO_2 equivalent)	**11 614 778**
Annual average of estimated emission reductions over the crediting period 2005 – 2024 (tonnes of CO_2 equivalent)	580 739

Table A4. Estimated total amount of CO_2e Emission Reductions

Thus the estimated amount of emission reductions over the commitment period (2008-2012) is **2 194 790** tonnes of CO_2e; over the whole crediting period (2005-2024) - is **11 614 778** tonnes of CO_2e.

Description of formulae used to estimate emission reductions is represented in section D.1.4. Calculations are presented in **Appendixes A, B, C.**

The lifetime of the project in accordance with normative equipment operation period is at least 20 years since the moment of putting into operation of the first project equipment, i.e. since 2005 till at least 2024. Generation of GHG emissions reduction units will take place at the project level during the validity of international agreements on GHG emission limitation over the whole period of project lifetime.

A.5. Project approval by the Parties involved:

The project is already supported by the central and local administrations, namely by the Cabinet of Ministers of Ukraine, the leaders of the Dnipropetrovsk Regional State Administration, and the National Environmental Investment Agency of Ukraine (the responsible authority for activities associated with the Kyoto Protocol in Ukraine for that time).

Some details:

December, 2004 - Decision of the Scientific-technical council of the State Enterprise “Production Association Yuzhny Machine-Building Plant named after A. Makarov” “On the endorsement of the regulation of the Cabinet of Ministers of Ukraine "On approval of the project and the title of the construction "The rehabilitation and upgrading of equipment of the CHP station of “Production Association Yuzhny Machine-Building Plant named after A. Makarov” (No. 65 dated 10.12.2004).

January, 2005 - The regulation of the Cabinet of Ministers of Ukraine "On approval of the project and the title of the construction "The rehabilitation and upgrading of equipment of the CHP station of “Production Association Yuzhny Machine-Building Plant named after A. Makarov” was issued (No. 19-p dated January 21, 2009).[6]

[6] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=19-2005-%F0

April, 2009 - The decree of the Cabinet of Ministers of Ukraine "On approval of the Governmental program of development of the state enterprises “Production Association Yuzhny Machine-Building Plant named after A. Makarov” and “Design Bureau “Yuzhnoye” named after M. Yangel” (No. 491 dated April 10, 2009).[7]

December, 2010 - Ukrainian DFP – the National Environmental Investment Agency of Ukraine has issued the Letter of Endorsement for this project (No. 2113/23/7 dated 09.12.2010).

According to the approved procedure, the LoAs by Parties involved will be issued after the project determination.

[7] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=491-2009-%EF

SECTION B. Baseline

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

According to the "Guidelines for users of the JI PDD form" version 04[8], the baseline shall be established on a project-specific basis, or where applicable, project participants may opt to apply approved clean development mechanism (CDM) baseline and monitoring methodologies.

In course of development of the project "Implementation of Energy Saving Equipment and Technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov", in accordance with paragraph 9(a) of the "Guidance on criteria for baseline setting and monitoring"[9], the project specific approach was used, developed in accordance with appendix B "Criteria for baseline setting and monitoring" of the JI guidelines.

This project specific approach is in the main similar to the project specific approach developed by the Institute of Engineering Ecology for the JI projects on rehabilitation of District Heating systems in Ukrainian conditions and already approved by TUV SUD and Bureau Veritas Certification AIEs for several such JI projects in regions and cities of Ukraine (AR Crimea, Chernihiv, Donetsk and Dnipropetrovsk regions, Kharkiv, Sevastopol, Rivne, Luhansk cities), the main idea of which is to build the dynamic baseline for each reported year, with taking into account the actual changes of internal and external factors.

The whole project activity is composed from the two complementary main parts:

- implementation of the measures, equipment and technologies for fuel and electricity saving in processes of the secondary (heat, electrical and mechanical) energy production at the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" that is to be consumed for the manufacture of the main core machine-building products of the enterprise;
- implementation of the energy saving measures, equipment and technologies for decreasing of the specific fuel and energy consumption for manufacturing of the unit of the enterprise main core products.

Both these parts should be considered and reflected in the baseline and monitoring approach applied.

Thereby, the primary indicator of operation level energy efficiency of such large machine-building enterprise, as the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" as a whole, is the specific consumption of fuel and energy resources per unit of manufactured products.

Thus, the developed project specific approach is based on continuous monitoring of fuel and electricity consumption by the enterprise for manufacturing of its main core products, and consideration of effect of other internal and external factors such as change in production activity level of the enterprise, change in net calorific value of purchased fuel, change in amount of delivered heat energy to external consumers, etc.

Among the types of products manufactured by the SE "PA Yuzhny Machine-Building Plant named after A. Makarov", there is only one which can be singled out and calculated in absolute units, this is the delivery of heat energy to external consumers which are outside of the enterprise borders.

Delivery of heat energy is measured in heat units with the heat energy meters, which are placed at the border of the enterprise and the external consumers, that is at the boundaries of this JI project. Thereby, it is possible to single out production and delivery of heat energy separately from the main core products, and to calculate the corresponding GHG emissions for the base and reported years.

[8] http://ji.unfccc.int/Ref/Documents/Guidelines.pdf

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

The other products of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" through their wide various, variable and specific assortment can not be calculated in absolute units, and the single indicator that can actually represent the results of production activity of the enterprise, is the level of production output.

The term "Production output" is proposed in Appendix B "List of standard variables" to the "Guidance on criteria for baseline setting and monitoring"[10], where it is expressed in absolute units – tonnes or m^3. Unfortunately, these units can't be used in frames of this project, as well as such units as pieces, since the enterprise's products on the one hand are quite non-uniform, variable and in many cases very science intensive, and on the other hand are unique and highly classified, and all these information is not widely available.

Analysis of several other potentially possible bases for comparison, such as fuel and electricity consumption for secondary energy production, the total heated area of the technological equipment workshops, the number of workers at the enterprise, amount of expended standard hours of work, etc., has shown that either only the first part of the whole project activity is taken into account, or such parameters are not proportional to the enterprise production output, and thereby no of them can be applied for this project.

It should be noted that such situation is fairly common and typical for large enterprises worldwide, in particular for the machine building ones.

According to the "Base regulations on setting of the specific consumption of the fuel-energy resources in social production", approved by the Order of the State Committee of Ukraine for Energy Conservation No. 112 dated 22.10.2002 (§ 4.7), at manufacturing facilities that manufacture products of a wide and unstable assortment, when it is practically impossible to choose only one indicator of production scope in natural or simulated units, the norms for consumption of the fuel-energy resources may be expressed in value terms, brought to the constant prices. [11].

This approach corresponds also to the "Methodology for calculation of norms for specific consumption of the fuel-energy resources for products of the enterprises belonging to the machine-building complex of the Ministry for Industrial Policy of Ukraine", approved by the Order of the Ministry for Industrial Policy of Ukraine No. 184 dated 22.05.2006, that is used at the SE "PA Yuzhny Machine-Building Plant named after A. Makarov", according to the item 1.1.18 of which at the enterprises, when it is practically impossible to choose only one indicator of production scope in natural or simulated units, the norms for consumption of the heat energy and electricity are established for products on 1000 UAH, that is in value terms.

Taking into account the peculiarities of product mix of SE "PA Yuzhny Machine-Building Plant named after A. Makarov", and according to the regulations accepted at the enterprise, the only available information which may reflect the actual production output is official accounting data that are to be submitted to the respective state authorities. Thus, the volume of the enterprise's production output may be determined in value terms, and in fact this is the only indicator that can actually display the results of production activity of the enterprise.

Accounting of products of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" in value terms is represented by indicators of gross, commodity and sold products. The sold products reflect only products that are paid by the buyer in the concerned year, the commodity products are products that are completed by manufacturing and prepared for sale, the gross products include commodity products and the difference of non-completed products at the end and at the beginning of the year concerned. Therefore, for calculations namely the gross products - the value indicator of the volume of production that describes the overall results of manufacturing activity of the enterprise for a certain period must be used.

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

[11] *http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0878-02*

Assortment of the enterprise products (see Section A.3) includes core aerospace products and other industrial products. Assortment of the non-core products is not fixed for years, and its share and the share of energy consumption for its production at the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" are relatively small. Moreover, according to the Governmental program of development of the state enterprises "Production Association Yuzhny Machine-Building Plant named after A. Makarov" and "Design Bureau "Yuzhnoye" named after M. Yangel", approved by the Cabinet of Ministers of Ukraine № 491 dated April 10, 2009)[12], the structural units at which the non-core products are produced, are planned to be transformed into separate legal entities. Therefore, production of non-core products is taken out of the boundaries of this project, the question of the analysis and account of influencing of possible change of commodity products structure onto GHG emission reduction is not examined, and in the following only production of the core aerospace products at the enterprise will be considered in this project.

This main core activity of the enterprise is "almost one hundred percent export-oriented"[12]. The enterprise has long-term contracts (contract period is usually 2 to 3 years) with fixed constant price in foreign currency (US dollars). Therefore account calculations of commodity and gross products at the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" are also presented in US dollars. For the same reason as well, the Methodology for products price formation that is accepted at the enterprise by the Order No. 78 dated 21.02.2007[13], which would be able to be useful in case of using of the commodity products with variable price in the calculations, for introduction into calculations of any special coefficients for reducing the cost equivalent of commodity products to the comparable sizes in the base and reported years, in this project is not used.

According to the above, for correct comparison of amounts of the baseline and project GHG emissions, the dynamic baseline should be calculated with taking into consideration of the specific natural gas and electricity consumption per unit of the gross core aerospace products.

The developed approach takes into account all activities and measures included in the project as well as peculiarities of the enterprise activity.

The baseline study will be fulfilled for every reported year. For more detailed information see section D.1.

Identification of the Baseline Scenario

There were three different possible versions of Baseline scenario for this project.

The first version of Baseline scenario was a business-as-usual scenario. For this Baseline scenario there are no barriers (no investment barrier since this scenario doesn't require the attraction of additional investments, and no technological barrier since the equipment is operated by existing skilled personnel, and additional re-training is not required), and it represents the common practice in Ukraine.

The second version of Baseline scenario was to make rehabilitation activity without JI mechanism. In this case there exist both investment barrier since this scenario requires the attraction of large additional investments, and due to large payback time and high risks it is not attractive for investments, and as well the technological barrier since operation of the new modern equipment will require additional re-training of personnel. Rehabilitation of equipment only in order to improve its efficiency is not a common practice in Ukraine.

The third version of Baseline scenario was the shortened project activity, without any of the non-key type of activity, for example elimination of frequency controllers installation, etc., from the project. This makes project economically less attractive, with the longer pay back period.

[12] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=491-2009-%EF

[13] *Order of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" No. 78 dated 21.02.2007 "On implementation of the Methodology for calculating the price for products (works, services)*

Thus, the first version was chosen for Baseline scenario.

Calculation of Baseline Carbon Emissions

The State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" for manufacture of its products consumes 2 basic types of the purchased energy carriers: fuel (natural gas) and electricity.

Thus, there are 2 types of greenhouse gas emissions which are included in the baseline scenario:

1) GHG emissions from combustion of natural gas in the boilers which are operated at SE "PA Yuzhny Machine-Building Plant named after A. Makarov";
2) GHG emissions from generation of electricity by the traditional thermal power generating units consuming the fossil fuel, which is supplied to the state electricity grid, and consumption of which by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" will be reduced due to implementation of the energy saving measures at the enterprise.

Identification of the Baseline Carbon Emission Factors for these kinds of GHG emissions:

For natural gas, the Carbon emission factors from the data table provided in IPCC 1996 "Guidelines for national inventories of greenhouse gases"[14] is used:

Cef (natural gas) = 0.0561 $ktCO_2/TJ$.

We assume that CO_2 emission factors for the natural gas will be the same for the project lifetime period 2003 - 2024.

For calculations in PDD it is assumed also that the Net Calorific Value (NCV) of the natural gas doesn't change during that time, however in the Monitoring Plan the NCV change factor will be taken into account for the baseline correction for any reported year.

Net Calorific Value of the natural gas used by the enterprise usually does not change significantly from year to year. Table B1 gives the average NCV for the natural gas that was used by the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" in the base 2003 year:

Type of fuel	Average Net calorific value of fuel	
	$kcal/m^3$	MJ/m^3
Natural gas	8058	33.74

Table B1. Net calorific value of fuel used by the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" in 2003

For estimation of Net Calorific Value of the natural gas, the enterprise uses data, provided by the gas supply organization on the base of physical-chemical indexes passports. These passports are transferred monthly and contain as many values of NCV as many times it has changed during the period.

For GHG emissions from generation of electricity by the traditional thermal power generating units, since Ukraine has the united state power grid, the averaged values for Carbon Emission Factors (CEF) for electricity production for JI projects reducing electricity consumption should be used.

[14] http://www.ipcc-nggip.iges.or.jp/public/gl/pdfiles/rusch1-1.pdf

For calculations in this PDD the values of the Carbon Emission Factors according to the adopted sources as following were used (see details in **Annex 2 "Baseline information"**):

Year	2003	2004	2005	2006-2007	2008	2009	2010	2011-2024
CEFc, t CO_2/MWh	0.936	0.916	0.896	0.896	1.082	1.096	1.093	1.090

Table B2. The baseline Carbon Emission Factors (CEF) used for calculations in PDD

In course of development of the Monitoring reports for this project, if available, the valid at that time values of the carbon emission factors for corresponding period will be used.

Both setting of the baseline for this project, and all calculations of greenhouse gas emissions and their reductions in result of the project activity, are based on information provided to the project developer by the applicant of the project - the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov".

The key information and data used to establish the baseline are provided in tabular form below:

Data / Parameter:	B_b
Data unit:	ths m^3
Description:	Natural gas consumption by the enterprise equipment in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	111 826.292 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BH_b
Data unit:	ths m^3
Description:	Natural gas consumption for heat energy production for external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	40 360.728 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recalculated from the data of the heat energy meters of heat energy production for external consumers. Summarized data for the year.
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BPG_b
Data unit:	ths m^3
Description:	Natural gas consumption for electricity generation for external and other consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	11 906.626 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recalculated from the data of the electricity meters of electricity production for external and other consumers. Summarized data for the year.
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BNP_b
Data unit:	ths m^3
Description:	Natural gas consumption for production of the non-core products in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	943,000 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	$BOUT_b$
Data unit:	ths m^3
Description:	Delivery of natural gas to the external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	99,533 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	$ECAS_b$
Data unit:	MWh
Description:	Electricity consumption by the enterprise equipment for production of the aerospace products in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	74 503.217 MWh (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by electricity meters
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	NCV_b
Data unit:	MJ/ m^3
Description:	Average Net Calorific Value of natural gas in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Natural gas supplier or an independent chemical laboratory
Value of data applied (for ex ante calculations/determinations)	33.74 MJ/ m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Accepted in accordance with messages from natural gas supplier or independent chemical lab analysis report. Independent chemical lab analysis is used in contentious cases. This is used rarely
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	Cef_{ngb}
Data unit:	t CO_2/GJ
Description:	Carbon emission factor for natural gas in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	0.0561 t CO_2/GJ (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Table 1-2 of Volume 2 "Energy" of IPCC 1996 "Guidelines for National Greenhouse Gas Inventories". Vol.2 Energy[15]
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	$CEFc_b$
Data unit:	t CO_2e/MWh
Description:	Carbon emission factor for JI projects reducing electricity consumption in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	0.936 t CO_2/MWh (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines, Version 2.3. The Netherlands, 2004[16]
QA/QC procedures (to be) applied:	n/a
Any comment:	-

[15] http://www.ipcc-nggip.iges.or.jp/public/gl/pdfiles/rusch1-1.pdf

[16] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

Data / Parameter:	HD_b
Data unit:	Gcal
Description:	Delivery of heat energy for external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	278 504.680 Gcal (in the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement with heat energy meters.
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	P_b
Data unit:	ths USD
Description:	Gross production output of aerospace products at the enterprise in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	44 779,4 ths USD (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The enterprise reporting
QA/QC procedures (to be) applied:	n/a
Any comment:	-

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:

Anthropogenic GHG emissions will be reduced due to the above described complex modernization of the main and auxiliary equipment of the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" (CHP and technological equipment), reorganization of the energy supply scheme for technological processes, rehabilitation of network equipment, etc.

All technical equipment of the enterprise which is used for production of the main core aerospace products of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov", and for production of heat energy for delivery to the external consumers, is included into this project.

The more obvious description of how the GHG anthropogenic emissions are reduced below those that would have occurred in the absence of the JI project, may be represented graphically (Fig. B1).

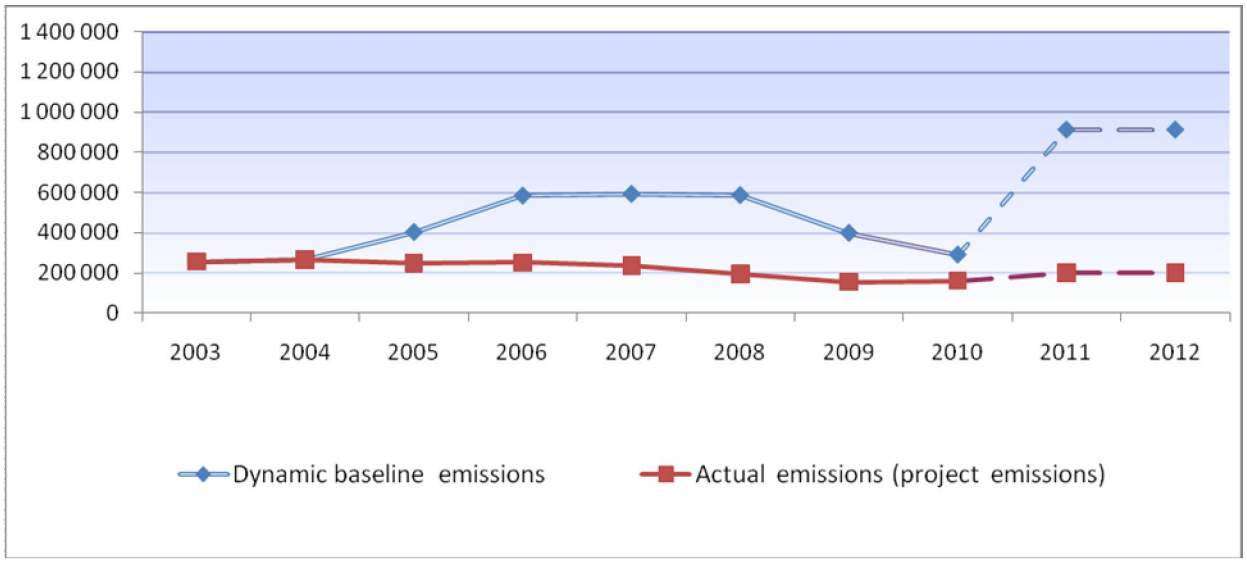

Fig. B1. Dynamic baseline and project GHG emissions

Dynamic baseline for 2005 – 2012 is calculated with taking into account the specific fuel and electricity consumption per unit of gross aerospace products output.

In particular, the dynamic baseline for 2005 – 2010 is calculated according to the available data on actual energy consumption, heat energy delivery to the external consumers and the gross aerospace products output.

Significant decrease of production output in 2009 – 2010 is associated with reduction of level of financing of orders for the core enterprise products in 2009, as well as with long time period of manufacturing of the core enterprise products – up to 2 – 3 years.

At this time the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" increases its stock of orders, in particular the contracts on production of the first stages of RC "Tauras II" and "Cyclone-4", on the production of units to the chassis of AN-140 and AN-148 aircrafts, etc., are already signed. However, although the enterprise has already received in 2010 the

much larger volume of orders for its core products, but due to the long time period of manufacturing the large share of products is not completed (is not brought to the state of commodity products), and completion is expected in the following years.

Dynamic baseline for 2011 is calculated predictively according to available data on actual energy consumption, heat energy delivery to the external consumers and the gross aerospace products output for the first half of the year (January – June, 2011). The present significant increase of the dynamic baseline indicators is fully complying with the adopted industrial and financial plan of the enterprise, which provides grounded significant increase of the core production (according to the Governmental program of development of the state enterprises "Production Association Yuzhny Machine-Building Plant named after A. Makarov" and "Design Bureau "Yuzhnoye" named after M. Yangel"[17] – "more than in 5 times – about USD 800 mln per year"). The enterprise, in particular, has won the tender for five launches of products in accordance with the Russian federal program [Newspaper "Facts", 02/12/2011].[18]

Prediction of the dynamic baseline and project emissions for 2012 and subsequent years of the project life time, for prognosis estimations is determined at the level of estimations for 2011.

[17] *http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=491-2009-%EF*

[18] *http://fakty.ua/127972-ukrainskaya-raketa-sovershila-pervyj-v-etom-godu-pusk-kosmicheskogo-apparata*

Additionality of the project

The additionality of the project activity is demonstrated and assessed below with using the "Tool for the demonstration and assessment of additionality" (Version 5.2)[19] (Fig. B2). This tool was originally developed for CDM projects but may be applied to JI projects as well.

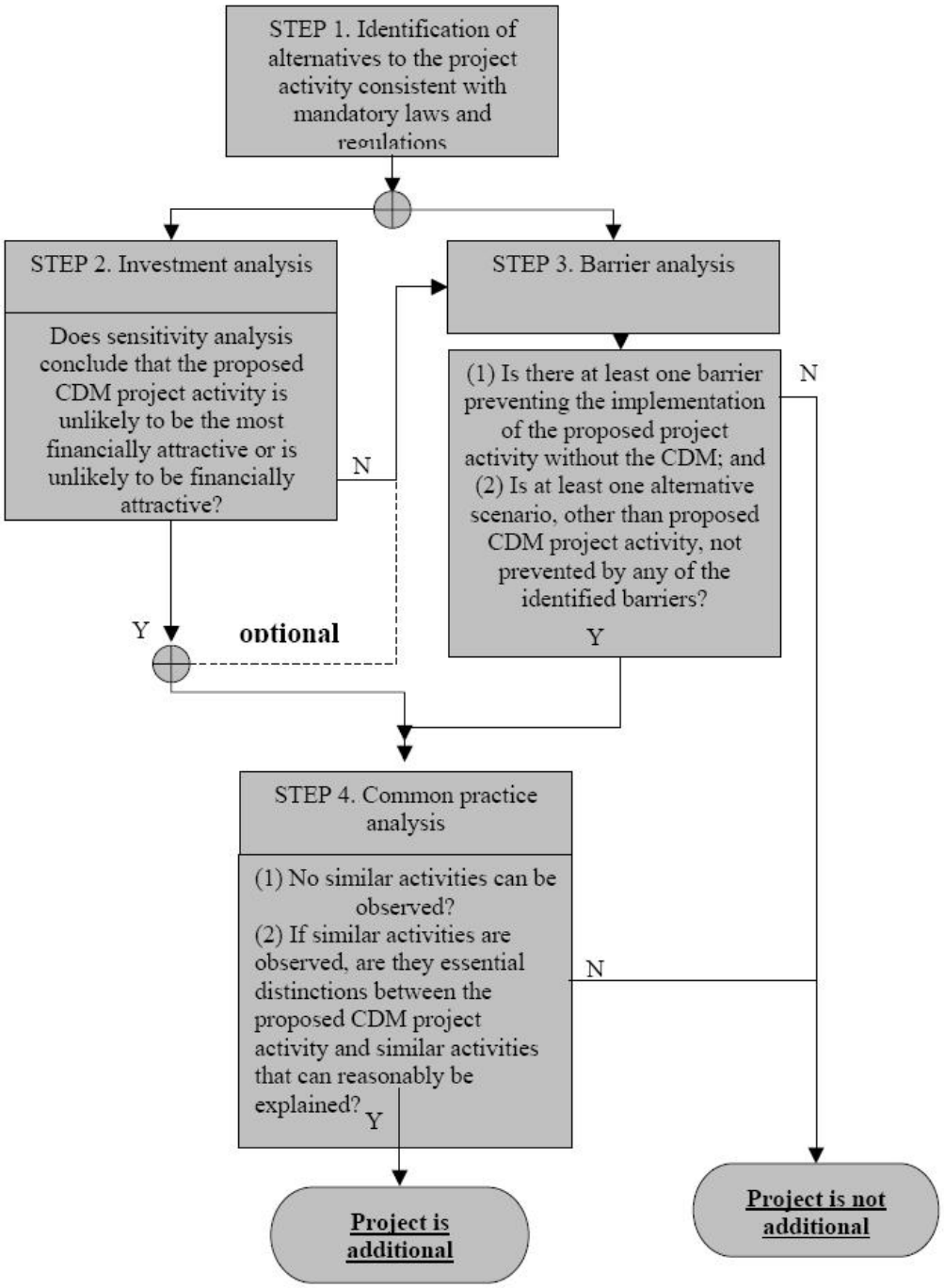

Fig. B2. Steps for demonstration of additionality

[19] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

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

There are three alternatives to this project (as was already discussed in section B1).
1. The first alternative is continuation of the current situation (no project activity or other alternatives undertaken), i.e. business-as-usual scenario with minimum reconstruction works.

2. The second alternative is to make reconstruction works (the proposed project activity) without JI mechanism.

3. The third alternative is the shortened project activity, without any of the non-key type of activity, for example elimination of frequency controllers installation, etc., from the project.

Outcome of Step 1a: Three realistic and credible alternative scenarios to the project activity are identified.

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

Business-as-usual scenario is consistent with mandatory laws and regulations, since there is no local legislation regarding the time of technological as well as energy (boilers, turbines, etc.) equipment replacement and maximum lifetime permitted for such equipment. It is common practice to continue to exploit such equipment which was installed in 70^{th} of the XX century and even in $50\text{-}60^{th}$ and earlier in Ukraine, if it meets the technical needs and if necessary (for boilers, etc.) passes the technical examination by the authorized body ("Derzhnagliadohoronpratsi").

The planned activity on project «Implementation of Energy Saving Equipment and Technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" is consistent with valid Ukrainian mandatory laws and regulations in this field, including the Law of Ukraine dated 01.07.1994 No. 74/94-VR "On energy saving" with changes and additions made according to the Laws of Ukraine "On changes in The Law of Ukraine "On energy saving" dated 05.04.2005 No. 2509-IV, dated 22.12.2005 No. 3260-IV, dated 09.02.2006 No. 3421-IV, etc.

Outcome of Step 1b: The alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to implement shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.

Hence, the Step 1 is satisfied.

According to the "Tool for the demonstration and assessment of additionality" (Version 5.2), for further additionality analysis it is possible to follow the Step 2 (Investment analysis) or Step 3 **(**Barrier analysis), or both.

We shall follow the Step 3.

Step 3: Barrier analysis

Sub-step 3a: Identification of barriers that would prevent the implementation of the proposed project activity

Investment barriers

All project activities require substantial investment – about 360.91 million UAH. The prices for the new equipment, that is planned to be installed in the project, are based on the averaged prices of the manufacturers. Operational and maintenance costs are not included in the project because it is assumed that they will remain at the previous level or even decreased due to less such costs for the new equipment.

The ownership of the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" is 100% the State one. The project on reconstruction and renovation of the equipment of the enterprise's CHP plant was developed by OJSC "Institute DniproVNDPIenergoprom" in 2004, and the PIN for the corresponding JI project was developed by the Institute of Engineering Ecology. The technical project was approved by the Order of Cabinet of Ministries of Ukraine No. 19-r dated January 21, 2005[20], with specified capacity of the CHP plant after renovation and estimate calculation of cost (572.329 million UAH) and term (60 months) of project implementation.

Nevertheless, even with this special Order of Cabinet of Ministries of Ukraine, only a small part of the required scheduled financing was actually allocated from the State budget for this project. The SE "PA Yuzhny Machine-Building Plant named after A. Makarov" has no own funds for implementation of such project; during last years its production activity is unprofitable, mainly due to a number of objective factors. In particular, due to the world financial crisis and resulting lack of the state financing and shortening of the commercial programs including the business failure of the international project "Sea Launch", the orders for the main production of the enterprise were cut down. For these reasons the realization of the project was quite slow, and even the scope of the planned works was changed towards decreasing of the required costs, that caused the corresponding changes in the JI project.

Since the source of financing for this project activity is mainly the state budget of Ukraine, and not the profit of the enterprise, this project can not be considered as commercially profitable activity.

The JI mechanism will enable to obtain the additional funds for financing the project implementation, thereby to accelerate its realization.

Technological barriers

1. Not all proposed technologies are widely approved already. Qualification of operational personal for implementation of the new technologies may be not sufficient to provide proper activity implementation in time.

2. Efficiency of installed equipment could be lower than was claimed by producers or equipment may have substantial defects.

Organizational barriers

The management experience in implementation of JI projects at such large and specific machine building enterprises is absent, including international collaboration, determination, verification, registration, monitoring of project activity, etc.

Outcome of Step 3a: Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity.

[20] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=19-2005-%F0

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

One of the alternatives is to continue business-as-usual scenario. Therefore, as the barriers mentioned above are directly related to investing into modernization of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" production and energy equipment, there is no obstacles for the enterprise to continue business maintain the district heating system at its present level.

Outcome of Step 3b: The identified barriers would not prevent the implementation of at least one of the alternatives – the business-as-usual scenario.

Hence, the Step 3 is satisfied.

Step 4: Common practice analysis

Sub-step 4a. Analysis of other activities similar to the proposed project activity.

The proposed project activity includes comprehensive implementation of fuel and energy saving measures, equipment and technologies at the large world-known machine building State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov". This is a unique enterprise in Ukraine with the air-space oriented products.

Any similar project activity at such large and specific machine building enterprise in Ukraine is not known. The proposed project activity does not reflect a widely observed and commonly carried out activity.

Outcome of Step 4a: Since the similar projects are not observed in the region, there is no basis for analysis of similar activities.

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

All other known activities on implementation of fuel and energy saving measures, equipment and / or technologies in Ukraine are only partly similar to the proposed project activity, since they have different (smaller) volumes, are not so radical and comprehensive, and/or are provided at different type enterprises.

Outcome of Step 4b: Based on the available facts, the following conclusions may be made:

- Activities similar to this Project are not known in Ukraine.
- The project activity is not conditioned by regulations.

Thus, the Project activities do not fall under the category of *common practice.*

Hence, the Step 4 is satisfied.

Conclusion:

The results of the above discussed analysis lead to the conclusion that the project activity is additional.

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

Project boundaries include energy generating, water supplying, distributive and resource consuming (technological and other) equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov".

The boundaries for the baseline scenario are outlined with the black rectangle at Fig. B3.

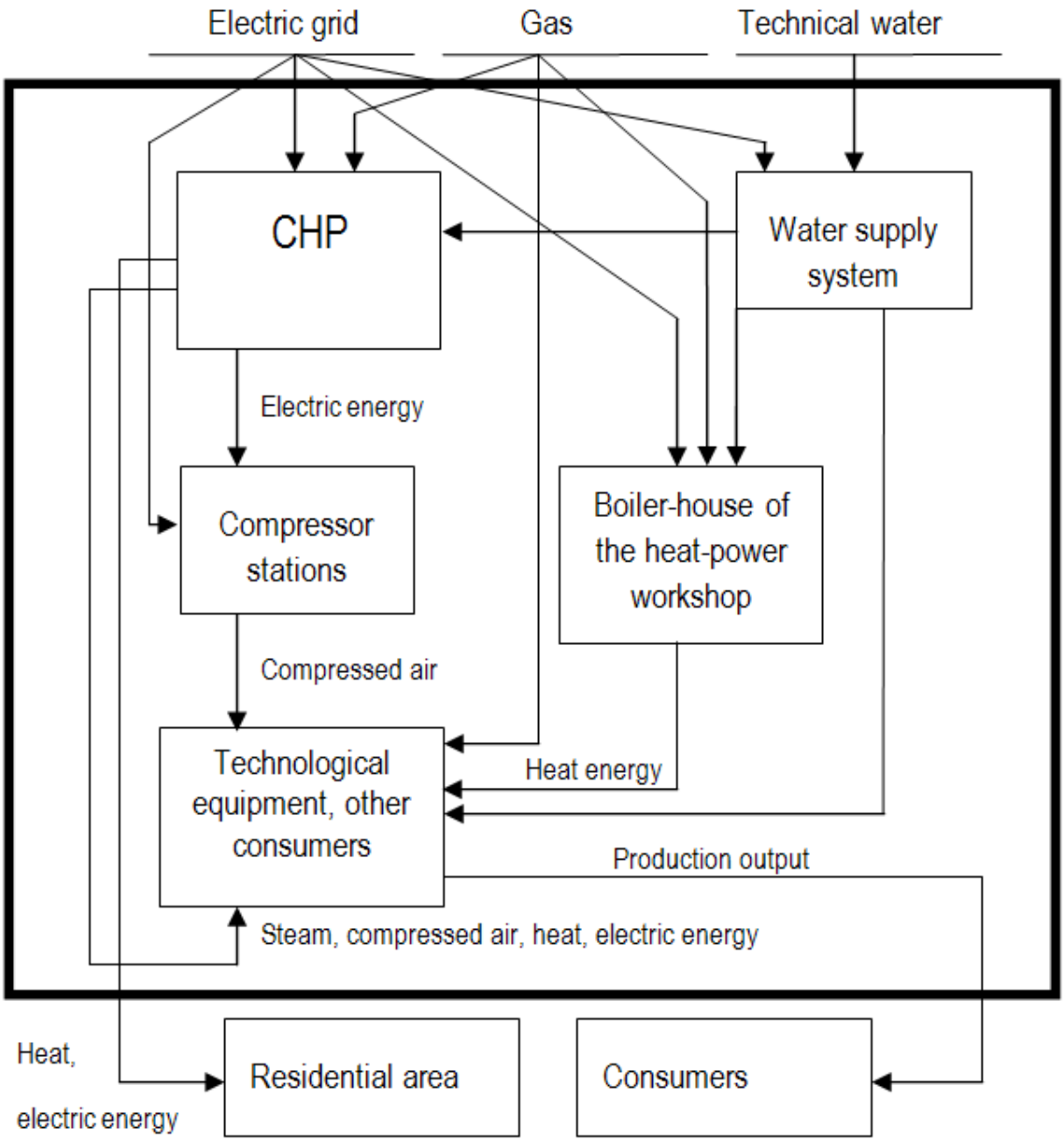

Fig.B3. Boundaries for the baseline scenario

As it may be seen from the Fig. B3, project boundaries for Baseline scenario include CHP plant, boiler-house of the heat-power workshop, compressor stations, technical water supply system as well as technological production equipment and other energy and resource consumers of the enterprise.

Project boundaries for the project scenario are represented by black rectangle on the graphical picture at Fig. B4.

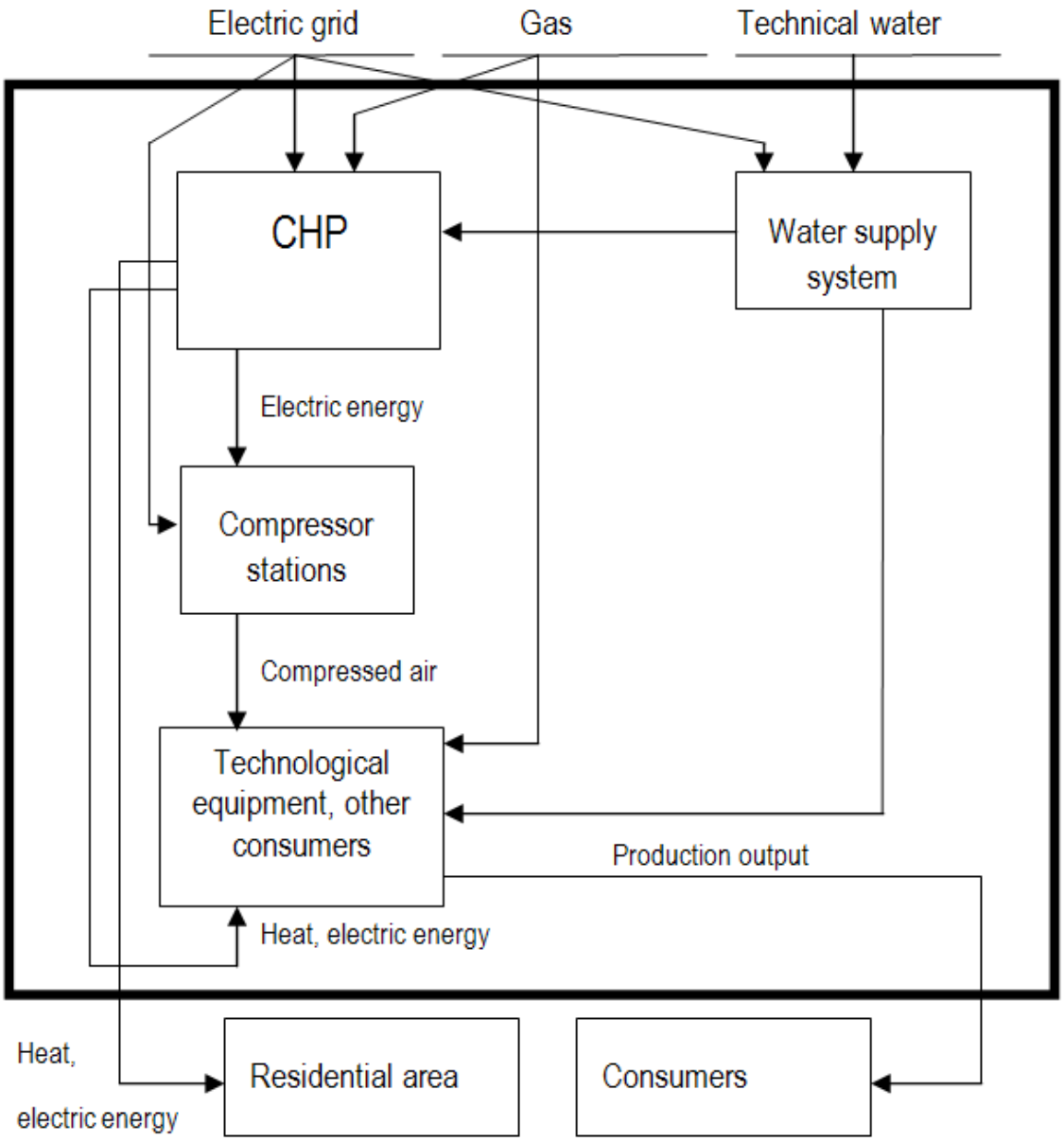

Fig.B4. Project boundaries for the project scenario

Project boundaries for Project scenario are in general the same, but the boiler-house of the heat power workshop is to be closed and excluded.

Also, supply of steam and compressed air from CHP to the technological equipment and other consumers of the enterprise is to be excluded, with elimination of the major part of pipelines across the enterprise territory.

Direct and Indirect Emissions

Direct on-site emissions:

CO_2, NO_x and CO emissions from fuel (natural gas) combustion in boilers and technological equipment of the enterprise.

CH_4 and N_2O emissions from fuel combustion are negligible minor sources, and are excluded from considerations for simplification.

Direct off-site emissions:
CO_2e emissions from power plants due to electricity production to the grid, that is consumed by the enterprise.

Indirect on-site emissions: none.

Indirect off-site emissions: CO_2 emissions from fuel extraction and transportation.

On-site emissions			
Current situation	Project	Direct or indirect	Included or excluded
CO_2 emissions from fuel combustion in boilers and technological equipment of the enterprise	Reduced CO_2 emissions from fuel combustion in boilers and technological equipment due to increased efficiency and fuel saving	Direct	Included
NO_x and CO emission from fuel combustion in boilers and technological equipment of the enterprise	Reduced NO_x and CO emissions from fuel combustion due to increased efficiency and fuel saving	Direct	Excluded. NO_x and CO are not GHGs.
Off-site emissions			
Current situation	Project	Direct or indirect	Included or excluded
CO_2e emissions from power plant(s) due to electricity production to the grid, that is consumed by the enterprise	Reduced CO_2e emissions from power plant(s) due to reduction of electricity consumption by the enterprise	Direct	Included
CO_2 emissions from fuel extraction and transportation.	Reduced CO_2 emissions from fuel extraction and transportation due to fuel saving	Indirect	Excluded, not under control of project developer

Table B3. Emissions sources included in or excluded from the project boundaries

No GHG leakages are expected for this project activity, since the project does not lead to a shift of pre-project activities outside the project boundary.

Any occasional material leakages (for example, caused by pipes' leakages, etc.) should be eliminated as soon as possible.

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

The date of baseline setting is 12/08/2011.

The baseline is determined by the Institute of Engineering Ecology, project developer, in collaboration with the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov", project participant – applicant.

Institute of Engineering Ecology
2a, Zheliabova street, Kyiv,
03057, Ukraine.
Tel.: +38-044-453-2862
Tel/Fax; +38-044-456-9262
E-mail: engeco@kw.ua
Dmytro Yu. Paderno
Deputy Director, PhD.

State Enterprise "Production Association Yuzhny Machine-Building Plant named after A.Makarov"
1, Kryvoriz'ka Str.,
Dnipropetrovsk,
49047, Ukraine
Tel.: +38 0562 34 98 08,
Tel/Fax: +38 0562 34 37 52
E-mail: energo@yuzhmash.com
Yuriy O. Pashchenko
Deputy General Director

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project: October 11, 2004 (11/10/2004).

(The date when the Agreement between State Enterprise «Production Association Yuzhny Machine-Building Plant named after A. Makarov» and the Institute of Engineering Ecology on energetic and ecological survey of the enterprise and development of materials for the project on greenhouse gases emission reduction was signed).

C.2. Expected operational lifetime of the project:

Expected operational lifetime of the project is at least 20 years (the nominal minimum lifecycle for energy equipment) from the moment of putting in operation. According to conservative approach, for further calculations we assume operational lifetime for the project equal to 20 years or 240 months (2005-2024) from the moment of putting into operation of the first project equipment.

C.3. Length of the crediting period:

Earning of the ERUs corresponds to the first commitment period of 5 years (January, 1, 2008 – December, 31, 2012).

The starting date of the crediting period is set to the date when the first emission reductions were expected to be generated from the project that is January, 2005. The end of the crediting period is the end of the expected operational lifetime of the main equipment installed during project implementation, that is at least December, 2024.

Thus, the length of the crediting period is 20 years (240 months), 2005 - 2024.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Monitoring plan is chosen according to the project specific approach described in Section B1.

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

Indicator of project performance

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *fuel and electricity saving.* It can be identified as the difference between baseline fuel and electricity consumption (and corresponding GHG emissions) and fuel and electricity consumption (and corresponding GHG emissions) after project implementation.

Monitoring of project performance indicators

SE "PA Yuzhny Machine-Building Plant named after A. Makarov" collects data on fuel and electricity purchasing for its production activity as electronic files and / or paper documents, in forms of meter's readings records and fuel and electricity bills. Information on consumed fuel and electricity will be included into the monitoring reports, scheduled on annual basis (till April 1st for the previous (reported) year of project implementation/ lifetime).

Monitoring of the emissions in the project and baseline scenarios

The following specific project approach is proposed to be used for monitoring of GHG emissions for this project "Implementation of Energy Saving Equipment and Technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov":

GHG emission reductions due to the project activity in a reported year y:

$ER_y = BE_y - PE_y$, (D.1)

where:

ER_y - emission reductions in year y, t CO_2e;
BE_y - baseline emissions in year y, t CO_2e;
PE_y - project emissions in year y, t CO_2e.

SE "PA Yuzhny Machine-Building Plant named after A. Makarov" consumes two basic types of the purchased energy carriers: fuel (natural gas) and electricity.

Thus, there are 2 kinds of greenhouse gas emissions which are included in the baseline scenario:

1) GHG emissions from the fuel consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov";
2) GHG emissions from production to the state electric grid of the electricity, consumption of which by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" will be reduced due to implementation of the energy saving measures at the enterprise.

The baseline GHG emissions:

$BE = BE_{ngc} + BE_{ecas} + BE_{hg}$, (D.2)

where:

BE_{ngc} - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in the base year, t CO_2;

BE_{ecas} - GHG emissions from production to the state electric grid of the electricity that is consumed by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in the base year, t CO_2e.

BE_{hg}, - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the heat energy for external consumers in the base year, t CO_2.

Baseline greenhouse gas emissions in the reported year *y* will be adjusted to the conditions of the project activity in the reported year, that is the dynamic baseline will be built.

The project scenario GHG emissions include the same basic types of emissions which were included in the baseline scenario.
Thus, GHG emissions in Project scenario:

$PE_y = PE_{ngc,y} + PE_{ecas,y} + PE_{hg,y}$ (D.3)

where:

$PE_{ngc,y}$ - GHG emissions from consumption of fuel by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in a reported year *y*, t CO_2;

$PE_{ecas,y}$ - GHG emissions from production to the state electric grid of the electricity that is consumed by SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in a reported year *y*, t CO_2e;

$PE_{hg,y}$ - GHG emissions from consumption of fuel by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the heat energy for external consumers in a reported year *y*, t CO_2.

In this section, the general approach to Monitoring of emissions in the project and baseline scenarios is described. The details are presented in corresponding sections below.

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
1	Fuel (natural gas) consumption by the enterprise equipment **(B_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Every day	100%	Registered in the paper and/or electronic forms	
2	Fuel (natural gas) consumption for production of the heat energy for external consumers **(BH_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m, c	Once per month	100%	Registered in the paper and/or electronic forms	
3	Natural gas consumption for electricity generation for external and other consumers **(BPG_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m, c	Once per month	100%	Registered in the paper and/or electronic forms	
4	Fuel (natural gas) consumption for production of the non-core products **(BNP_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once per month	100%	Registered in the paper and/or electronic forms	

5	Natural gas delivery to external consumers **($BOUT_r$)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once per month	100%	Registered in the paper and/or electronic forms	
6	Electricity consumption for production of the aerospace products **($ECAS_r$)**	SE "PA Yuzhny Machine-Building Plant named after A. Makarov"	MWh	m	Once per month	100%	Registered in the paper and/or electronic forms	
7	Average Net Calorific Value of natural gas **(NCV_r)**	Fuel Supplier's Report or Chem. Lab Analysis Report	MJ/m^3	m, c	Once per year	100%	Registered in the paper and/or electronic forms	
8	Carbon emission factor for natural gas **(Cef_{ngr})**	Normative documents	t CO_2/ GJ	c	Once per year	100%	Registered in the paper and/or electronic forms	
9	Carbon emission factor for JI projects reducing electricity consumption **($CEFc_r$)**	Normative documents	t CO_2e/ MWh	c	Once per year	100%	Registered in the paper and/or electronic forms	
10	Heat energy delivery to external consumers **(HD_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	Gcal	m	Once per month	100%	Registered in the paper and/or electronic forms	

11	Gross production output of aerospace products **(P_r)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths USD	c	Once per year	100%	Registered in the paper and/or electronic forms	
12	Aerospace products price change index (J_r)	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	-	c	Once per year	100%	Registered in the paper and/or electronic forms	

According to the valid regulation, all measuring equipment in Ukraine should meet the specified requirements of the national standards (State Standard of Ukraine № 2708:2006 "Metrology. Calibration of measuring equipment. The organization and procedure"[21]), and is subject to the periodical verifying and calibration (usually once per two - three years, for some types and models of devices from once per year and up to once per sixteen years).

In case of failure of measurement equipment, it should be replaced or repaired as soon as possible. Such cases should be noted in monitoring reports.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Project GHG emissions:

$$PE_r = PE_{ngc,r} + PE_{ecas,r} + PE_{hg,r}, \quad (D.4)$$

where:

$PE_{ngc,r}$ - GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in a reported year, t CO_2;

$PE_{ecas,r}$ - GHG emissions from production to the state electric grid of the electricity that is consumed by SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in a reported year, t CO_2e;

$PE_{hg,r}$ - GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the heat energy for external consumers in a reported year, t CO_2.

[21] hths.tp://oscill.com/files/27082006.pdf

1) GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in a reported year:

$PE_{ngc,r} = BAS_r * NCV_r * Cef_{ngr}$, (D.5)

where:
BAS_r – fuel (natural gas) consumption for production of the aerospace products in a reported year, ths m^3;
NCV_r – Net Calorific Value of fuel (natural gas) in a reported year, MJ/m^3;
Cef_{ngr} – Carbon Emission Factor for natural gas in a reported year, $Cef_{ng} = 0.0561$ t CO_2/GJ is taken (see Section B1).

Total consumption of natural gas (**B**) at SE "PA Yuzhny Machine-Building Plant named after A. Makarov" consists of gas consumption for production of the aerospace products (**BAS**), gas consumption for production of the heat energy for external consumers (**BH**), gas consumption for electricity generation for external and other consumers (**BPG**), gas consumption for production of the non-core products (**BNP**) and delivery of natural gas to the external consumers (**BOUT**). Thus, consumption of natural gas for production of the aerospace products, which is distributed through workshops and is not measured directly, is determined as the difference between total gas consumption by the enterprise and its consumption for production of the heat energy for external consumers, for production of the non-core products and delivery of natural gas to the external consumers (these values are measured directly by gas flow meters and heat energy meters, respectively):

$BAS_r = B_r – BH_r – BPG_r - BNP_r – BOUT_r$. (D.6)
where:

B_r - total fuel (natural gas) consumption in a reported year, ths m^3;
BH_r – fuel (natural gas) consumption for production of the heat energy for external consumers in a reported year, ths m^3;
BPG_r - fuel (natural gas) consumption for electricity generation for external and other consumers in a reported year, ths m^3;
BNP_r – fuel (natural gas) consumption for production of the non-core products in a reported year, ths m^3;
$BOUT_r$ – fuel (natural gas) delivered to the external consumers in a reported year, ths m^3.

2) GHG emissions from production to the state electric grid of the electricity that is consumed by SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in a reported year:

$PE_{ecas,r} = ECAS_r * CEFc_r$ (D.7)

where:
$ECAS_r$ - electricity consumption by the enterprise equipment for production of the aerospace products in a reported year, MWh;

$CEFc_r$ - Carbon Emission Factor for JI projects reducing electricity consumption in a reported year, t CO_2e/MWh.

3) GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the heat energy for external consumers in a reported year:

$PE_{hg,r} = BH_r * NCV_r * Cef_{ngr}$, (D.8)

where:

BH_r – fuel (natural gas) consumption for production of the heat energy for external consumers in a reported year, ths m^3;

NCV_r – averaged Net Calorific Value of natural gas in a reported year, MJ/m^3;

Cef_{ngr} – Carbon Emission Factor for natural gas in a reported year, t CO_2/GJ.

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
1	Fuel (natural gas) consumption by the enterprise equipment in the base year (**B_b**)	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	

2	Fuel (natural gas) consumption for production of the heat energy for external consumers in the base year **(BH_b)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m, c	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
3	Natural gas consumption for electricity generation for external and other consumers in the base year **(BPG_b)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
4	Fuel (natural gas) consumption for production of the non-core products in the base year **(BNP_b)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
5	Natural gas delivery to external consumers in the base year **($BOUT_b$)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths m^3	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
6	Electricity consumption for production of the aerospace products in the base year **($ECAS_b$)**	SE "PA Yuzhny Machine-Building Plant named after A. Makarov"	MWh	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	

7	Average Net Calorific Value of natural gas in the base year (**NCV_b**)	Fuel Supplier's Report or Chem. Lab Analysis Report	MJ/m^3	m, c	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
8	Carbon emission factor for natural gas in the base year **(Cef_{ngb})**	Normative documents	t CO_2/ GJ	c	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
9	Carbon emission factor for JI projects reducing electricity consumption in the base year **($CEFc_b$)**	Normative documents	t CO_2e/ MWh	c	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
10	Heat energy delivery to external consumers in the base year (**HD_b**)	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	Gcal	m	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	
11	Gross production output of aerospace products in the base year **(P_b)**	SE "PA Yuzhny Machine-Building Plant named after A.Makarov"	ths USD	c	Once after the end of the base year	100%	Registered in the paper and/or electronic forms	

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The baseline GHG emissions (for the base 2003):

$BE = BE_{ngc} + BE_{ecas} + BE_{hg}$, (D.9)

where:

BE_{ngc} - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2;

BE_{ecas} - GHG emissions from production to the state electric grid of the electricity that is consumed by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2e.

BE_{hg}, - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the heat energy for external consumers in the base year, t CO_2.

As it was already marked above, the primary indicator of operation level energy efficiency of the enterprise as a whole is the specific consumption of fuel and energy resources per unit of manufactured products. Thus, for correct comparing of amounts of GHG emissions, the dynamic baseline should be calculated with taking into consideration the actual amounts of manufactured products by the enterprise for a year (reported period), etc.

With taking into account the peculiarities of product mix of SE "PA Yuzhny Machine-Building Plant named after A.Makarov", and according to noted in the sections A.3 and B.1, the dynamic baseline may be calculated for two types of products:

- production of the aerospace products;
- production of the heat energy for external consumers.

Thus, the dynamic baseline emissions for reported years are composed of the two parts:

$BE_{dbr} = BE_{dbras} + BE_{dbrhg}$; (D.10)

where:

BE_{dbr} - dynamic baseline emissions at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e;

BE_{dbras} - dynamic baseline emissions from production of the aerospace products at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e;

BE_{dbrhg} - dynamic baseline emissions from production of the heat energy for external consumers at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e.

1) $BE_{dbras} = (BE_{ngc} + BE_{ecas}) * (P_r / P_b) * J_r$; (D.11)

where:

BE_{ngc} - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2;

BE_{ecas} - GHG emissions from production to the state electric grid of the electricity that is consumed by the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2e.

P_r – gross aerospace products in the reported year, ths USD;

P_b – gross aerospace products in the base year, ths USD;

J_r - aerospace products price change index in the reported year.

Correct comparison of the cost parameters of production of gross aerospace products in the base and reported years must take into account the possible price, or «cost» factor, changes.

The International Accounting Standard IAS 15 "Information reflecting the effects of changing prices"[22] represents conception based on application of individual price indexes for a commodity or commodity group. In so doing, the method of adjustment according to the price change index (J) for the group of uniform commodities (works, services) or industry as a whole, is adopted.

Prices at the world market of aerospace products remain stable and do not change during long time, and even diminish as a result of development of competition. Therefore the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" is not able to change prices for its products by own free will. Thus, and this is represented both in the documents of the enterprise and in the above mentioned Government program of development of the state enterprises "Production association Yuzhny Machine-Building Plant named after A.Makarov" and "Designer bureau "Yuzhnoje" named after M.Yangel", although as a result of increasing prices for raw products, materials and componentry, production expenses increase, but prices for the aerospace products, that is delivered by the long-term contracts, for products in equal bundling remain permanent.[23] Moreover, as a result of inflation (though not large) of currency of contracts (US dollars), the actual prices even diminish.

Thereby, according to the conservative considering, the price change index for SE "PA Yuzhny Machine-Building Plant named after A.Makarov" is taken as equal to one (J = 1). In course of development of the Monitoring reports for this project, the valid for the proper period values of the J_r index will be used.

[22] *http://www.iasplus.com/standard/ias15.htm*x0

[23] *http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=491-2009-%EF*

$BE_{ngc} = BAS_b * NCV_b * Cef_{ngb}$, (D.12)
where:
BAS_b – fuel (natural gas) consumption for production of the aerospace products in the base year, ths m^3;
NCV_b – Net Calorific Value of fuel (natural gas), is taken from the averaged data of the enterprise in the base year, and makes 8058 kcal/m^3 (33.74 MJ/m^3) (see Section B1);
Cef_{ngb} – Carbon Emission Factor for natural gas in the base year, Cef_{ngb} = 0.0561 t CO_2/GJ is taken (see Section B.1).

$BAS_b = B_b – BH_b - BPG_b – BNP_b – BOUT_b$ (D.13)
where:

B_b - total fuel (natural gas) consumption in the base year, ths m^3;
BH_b – fuel (natural gas) consumption for production of the heat energy for external consumers in the base year, ths m^3;
BPG_b – fuel (natural gas) consumption for electricity generation for external and other consumers in the base year, ths m^3;
BNP_b – fuel (natural gas) consumption for production of the non-core products in the base year, ths m^3;
$BOUT_b$ – fuel (natural gas) delivered to external consumers in the base year, ths m^3.

$BE_{ecas} = ECAS_b * CEFc_b$ (D.14)
where:
$ECAS_b$ - electricity consumption for production of the aerospace products in the base year, MWh;
$CEFc_b$ - Carbon Emission Factor for JI projects reducing electricity consumption in the base year, t CO_2e/MWh.

2) $BE_{dbrhg} = BH_b * NCV_b * Cef_{ngr} * K_1$, (D.15)

where:
BH_b – fuel (natural gas) consumption for production of the heat energy for external consumers in the base year, ths m^3;
NCV_b – Net Calorific Value of fuel (natural gas) in the base year, MJ/m^3;
Cef_{ngb} – Carbon Emission Factor for natural gas in the base year, t CO_2/GJ;
K_1 – delivered heat energy for external consumers change factor.

The delivered heat energy for external consumers change adjustment factor:

$K_1 = HD_r / HD_b$, (D.16)

where:
HD_r – delivered heat energy for external consumers in the reported year, GJ (Gcal);
HD_b – delivered heat energy for external consumers in the base year, GJ (Gcal).

The dynamic baseline study will be fulfilled for every reported year (or other reported period).

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

This section is left blank for purpose. Option 1 is chosen.

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

This section is left blank for purpose. Option 1 is chosen.

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

No leakage is expected. Dynamic baseline (based on collected monitoring data) will exclude all possible leakages.

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

Any occasional leakage emissions (for example, caused by pipes' leakages, etc.) should be eliminated as soon as possible.

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

No leakages are expected

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):

Estimated emission reductions for the project activity in a reported year:

$$ER_r = BE_{dbr} - PE_r, \quad (D.17)$$

where:

ER_r - emission reductions due to the project activity in a reported year, t CO_2e;
BE_{dbr} - dynamic baseline emissions in a reported year, t CO_2e;
PE_r - project emissions in a reported year, t CO_2e.

Formulae presented in sections D.1.1 - D.1.4 are used for estimation of emission reductions in PDD when data are available, that is for the past years. The emission reductions in 2011 are estimated on the base of the actual data for the first half of the year (see Section B.2). Results of the corresponding calculations made with using of these formulae as well as prognostic estimations are provided in **Appendices A, B, C.**

The same formulae will be used for monitoring of the project activity results and achieved actual emission reductions in development of Monitoring reports during the lifetime of the project.

The baseline is dynamic and depends on actual conditions in every reported year. Therefore it is impossible to predict in PDD the actual values of emission reductions for future years because there are no data (net calorific value of fuel, gross production output, etc.) available for future reported years yet.

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:

According to the common Ukrainian practice for projects on implementation of the energy saving equipment and technologies, the environmental impact of the project will be estimated essentially by fuel consumption and combustion.

The main relevant Ukrainian regulations:

- Law of Ukraine # 1264-XII "On environmental protection" dated 25.06.1991
- Law of Ukraine # 2707-XII "On atmospheric air protection" dated 16.10.1992.
- Actual rules on emissions limitation: "Norms of limit admissible emissions of pollution agents from stationary sources" – adopted by Ministry for Environmental Protection of Ukraine on 27.06.2006, #309 and registered in Ministry of Justice of Ukraine on 01.09.2006, #912/12786.

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.
D.1.1.1. 1. Fuel (natural gas) consumption by the enterprise (**B**)	Low	Measuring instruments (gas flow meters) must be calibrated according to national regulations
D.1.1.1. 2. Fuel (natural gas) consumption for production of the heat energy for external consumers (**BH**)	Low	Amount of the consumed fuel (natural gas) for production of the heat energy for external consumers is rercalculated by the enterprise from the amount of the delivered heat energy to the external consumers, which is measured by the heat energy meters. Measuring instruments (heat energy meters) must be calibrated according to national regulations
D.1.1.1. 3. Fuel (natural gas) consumption for electricity generation for external and other consumers (BPG)	Low	Amount of the consumed fuel (natural gas) for electricity generation for external and other consumers is rercalculated by the enterprise from the amount of the delivered electricity to the external and other consumers, which is measured by the electricity meters. Measuring instruments (electricity meters) must be calibrated according to national regulations
D.1.1.1. 4. Fuel (natural gas) consumption for production of the non-core products **(BNP)**	Low	Measuring instruments (gas flow meters) must be calibrated according to national regulations

D.1.1.1. 5. Natural gas delivery to external consumers **(BOUT)**	Low	Measuring instruments (gas flow meters) must be calibrated according to national regulations
D.1.1.1. 6.Electricity consumption for production of the aerospace products (**ECAS**)	Low	Measuring instruments (electricity meters) must be calibrated according to national regulations
D.1.1.1. 7. Average Net Calorific Value of natural gas (**NCV**)	Low	Fuel supplier's and/or chem. lab measuring instruments must be calibrated according to national regulations
D.1.1.1. 8. Carbon emission factor for natural gas **(Cef_{ng})**	Low	Data from normative documents. QA/QC procedures are not necessary.
D.1.1.1. 9. Carbon emission factor for JI projects reducing electricity consumption **(CEFc)**	Low	Data from normative documents. QA/QC procedures are not necessary.
D.1.1.1. 10. Heat energy delivery to external consumers (**HD**)	Low	Measuring instruments (heat energy meters) must be calibrated according to national regulations
D.1.1.1. 11.Gross production output of aerospace products **(P)**	Low	Data on Gross production output of aerospace products are based on account documents. QA/QC procedures are not necessary.

D.1.1.1. 12. Aerospace products price change index (**J**)	Low	Data on aerospace products price are based on account documents. QA/QC procedures are not necessary.

If expected data on NCV will be unavailable, the historical average value will be applied.
If expected data on fuel/energy consumption will be unavailable from the enterprise, the data from fuel/energy sellers will be applied.
If expected data on gross production output will be unavailable, the reasonable calculated data from commodity production output and products in process will be applied.
If expected data on heat energy delivery for external consumers will be unavailable, the historical average value will be applied.

If any of these procedures will be also unavailable, no emission reduction will be claimed for those period.

All data monitored and required for verification are to be kept through the crediting period and for two years after the last transfer of ERUs for the project.

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

The operational structure will include operation departments (production, operational, metrological, adjustment and alignment, etc.) of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov".

The management structure will include management departments of SE "PA Yuzhny Machine-Building Plant named after A. Makarov".
Operational and management structure and responsibilities are presented in more details in **Annex 3.**

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

The monitoring plan is determined by the Institute of Engineering Ecology, project developer, and SE "PA Yuzhny Machine-Building Plant named after A. Makarov", project participant - Supplier.

Institute of Engineering Ecology
2a, Zheliabova street, Kyiv,
03057, Ukraine.
Tel.: +38-044-453-2862
Tel/Fax; +38-044-456-9262
E-mail: engeco@kw.ua
Dmytro Yu. Paderno
Deputy Director, PhD.

State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov"
1, Kryvoriz'ka Str.,
Dnipropetrovsk,
49047, Ukraine
Tel.: +38 (0562) 34 98 08,
Tel/Fax: +38 (0562) 34 37 52
E-mail: energo@yuzhmash.com
Yuriy O. Pashchenko
Deputy General Director

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Project Carbon emission factors are considered to be equal to the baseline Carbon emissions factors.

Estimation of Direct Project Emissions

The estimated project annual emissions after project implementation (2012) by sources are presented in Table E1 (see Appendix C).

Project emissions from production of aerospace products	Project emissions from heat energy production for external consumers	Total project emissions
t CO_2e	t CO_2e	t CO_2e
134 365	66 031	200 396

Table E1. Estimated project energy resources consumption and emissions

The estimated project annual emissions after project implementation (2012) are: 200 396 t CO_2e.

E.2. Estimated leakage:

The possible leakage is assumed to be negligible. These indirect emissions are not under control of project developer, so they are not included in calculations.

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

Project Emissions + Leakages = 200 396 + 0 = 200 396 t CO_2e.

E.4. Estimated baseline emissions:

Adjusted amount of annual dynamic baseline emissions (2012) by sources are presented in Table E2 (see Appendix C):

Dynamic baseline emissions from production of aerospace products	Dynamic baseline emissions from heat energy production for external consumers	Dynamic baseline emissions
t CO_2e	t CO_2e	t CO_2e
855 110	59 529	914 639

Table E2. Dynamic baseline emissions

Annual dynamic baseline emissions (2012) are estimated as 914 639 t CO_2e.

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

Project emissions reduction = Dynamic baseline emissions in reported year – Project emissions in reported year.
For 2012: **912 639 – 200 396 = 714 243** t CO_2e.

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2005	248 731	0	403 705	154 974
2006	251 625	0	586 076	334 451
2007	235 377	0	595 024	359 647
Subtotal (2005 - 2007)	**735 733**	**0**	**1 584 805**	**849 072**
Annual average of estimated emission reductions over 2005 – 2007 (tonnes of CO_2 equivalent)				283 024
2008	195 766	0	588 647	392 881
2009	155 429	0	399 665	244 236
2010	161 821	0	291 008	129 187
2011	200 396	0	914 639	714 243
2012	200 396	0	914 639	714 243
Subtotal (2008 – 2012)	**913 808**	**0**	**3 108 598**	**2 194 790**
Annual average of estimated emission reductions over 2008 – 2012 (tonnes of CO_2 equivalent)				438 958
2013	200 396	0	914 639	714 243
2014	200 396	0	914 639	714 243
2015	200 396	0	914 639	714 243
2016	200 396	0	914 639	714 243
2017	200 396	0	914 639	714 243
2018	200 396	0	914 639	714 243
2019	200 396	0	914 639	714 243
2020	200 396	0	914 639	714 243
2021	200 396	0	914 639	714 243
2022	200 396	0	914 639	714 243
2023	200 396	0	914 639	714 243
2024	200 396	0	914 639	714 243
Subtotal (2013 – 2024)	**2 404 752**	**0**	**10 975 668**	**8 570 916**
Annual average of estimated emission reductions over 2013 – 2024 (tonnes of CO_2 equivalent)				714 243
Total (2005 – 2024) (tonnes of CO_2 equivalent)	**4 054 349**	**0**	**15 669 071**	**11 614 778**
Annual average of estimated emission reductions over the crediting period 2005 – 2024 (tonnes of CO_2 equivalent)				580 739

Table E3. Estimated project CO_2e emission reductions

SECTION F. Environmental impacts

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:

According to Ukrainian official regulations, not all types of emissions are subject to regulations.
For emissions of GHG – there are no official regulations in Ukraine for monitoring GHG.
For harmful emissions (gaseous and dust), including toxic ones – monitoring is provided according to the following official regulations:
The Law of Ukraine No. 1264-XII dated 25.06.1991 «On the environmental protection»;
The Law of Ukraine No. 2707-XII dated 16.10.1992 «On the atmospheric air protection».

According to these laws, Ukrainian national requirements for EIA are listed in the following regulatory documents:

State Building Norms of Ukraine (DBN) A.2.2-1-2003. «Structure and content of materials on environmental impact assessment (EIA) at planning and building of enterprises, constructions and buildings».

"Regulations on structure and content of materials on assessment of the projected activity impact on the state of environment and natural resources (EIA) at different stages of solving of tasks of building of the new, expansion, reconstruction, technical re-equipment of operating industrial and other objects". Approved by the Order of Ministry of environmental protection of Ukraine No. 59 dated 8.07.92.

As to this project:

1. Project implementation will enable to reduce the direct CO_2e emissions.
2. Due to fuel and electricity saving, project implementation will reduce emissions of SO_x, NO_x, CO and particulate matter (co-products of fuel combustion by grid connected power plants).

Project activity is in full compliance with the environmental legislation of Ukraine.

DBN A.2.2-1-2003 do not contain any requirements in relation to the obligatory analysis of the transboundary environmental impact, according to this the EIA usually does not contain such special analysis. However, for this project transboundary effect is not expected, with taking into account the insignificant emissions which are localized not far away from the sources.

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:

Impact to the water medium

The existing technology for heat energy production used at the objects of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" provides discharging of waste water to the sewage network with obligatory control in accordance to Water Code of Ukraine, GOST 28.74-82 "Drinking water. Hygienic regulations and quality control", SNiP 4630-92 on determining maximum concentration limits for internal water bodies.

Project implementation will have positive environmental effect. It will allow to decrease the water consumption and as a result – to decrease the amount of waste water.

Effects on the ambient air

The project implementation will have positive effect on ambient air:

1) Reduction of NO_x and CO emissions and heat impact onto the atmosphere due to fuel (natural gas) saving;

2) Reduction of electricity consumption results in lower emissions of NO_x, SO_x, CO and PM emissions from fuel combustion by grid connected power plants.

Effects on land use

Impact on the land medium is not present.

Relevant regulation is the sphere of land use is presented by the Land Code of Ukraine. National technological practice / standard: GOST 17.4.1.02.-83 “Protection of Nature, Soils. Classification of chemical substances for pollution control”.

Effects on biodiversity

Impact on biodiversity is not present.

Waste generation, treatment and disposal

Waste generation, treatment and disposal are present. In the process of project implementation the generation of waste will occur after disassembling of morally and physically obsolete equipment. Also there will occur some amount of construction waste due to destruction of boiler lining, etc.

Possible recycling of the old equipment will by definition have a positive effect on the environment.

According to the Law of Ukraine “On waste products”, article 17 ”Obligations of economical activity subjects in branch of waste treatment”:
- enterprises must apply statistic reports on waste creating, gathering, transporting keeping, treating, utilizing, decontaminating and excreting.
- provide complete gathering, appropriate keeping and non-admission waste destruction and spoilage, for utilization of which there is an appropriate technology in Ukraine.

Taking into account the above mentioned, the enterprise transfers the old dismounted equipment, etc. for treatment.

SECTION G. Stakeholders' comments

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

As the project activity won't provide negative environmental impact and negative social effect, special public discussion was not hold.

Project «Implementation of Energy Saving Equipment and Technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov" was presented at the XV (Sevastopol, June 13-16, 2005) and XVI (Sevastopol, June 6-10, 2006) NIS Conferences with international participation, and XXI (Yalta, Koreiz, June 7-11, 2011) International conference "Problems of Ecology and Exploitation of Energy Objects", where it was comprehensively discussed with representatives of governmental, district heating and industrial organizations.

No comments have been received from the stakeholders,

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Project participant - Supplier:

Organisation:	State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov"
Street/P.O.Box:	Kryvoriz'ka Str.
Building:	1
City:	Dnipropetrovsk
State/Region:	Dnipropetrovsk region
Postal code:	49047
Country:	Ukraine
Phone:	+ 38 0562 34 98 08
Fax:	+ 38 0562 34 37 52
E-mail:	energo@yuzhmash.com
URL:	
Represented by:	
Title:	Deputy General Director
Salutation:	Mr.
Last name:	Pashchenko
Middle name:	Oleksandrovych
First name:	Yuriy
Department:	
Phone (direct):	+38 0562 34 98 08
Fax (direct):	+38 0562 34 37 52
Mobile:	
Personal e-mail:	

Project participant - Buyer:

Organisation:	VEMA SA
Street/P.O.Box:	Route de Thonon
Building:	45
City:	Geneva
State/Region:	Vesenaz
Postal code:	CH-1222
Country:	Switzerland
Phone:	+41 22 735 3744
Fax:	
E-mail:	info@vemacarbon.com
URL:	
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Knodel
Middle name:	
First name:	Fabian
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	
Personal e-mail:	

Annex 2

BASELINE INFORMATION

The main Baseline information is listed in **Section B.** In this Annex 2 some detailed are represented.

Information on the state electricity grid Baseline situation:

Ukraine has united state power grid, therefore the averaged values for Carbon Emission factors (CEF) for electricity production in Ukraine should be used for the JI project calculations.

For calculations the values of the carbon emission factors at the combined approach base are used:

- for 2003-2005– according to the Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines Version 2.3. Ministry of Economic Affairs of the Netherlands, 2004 (ERUPT 4, Senter, the Netherlands) [24]:

Year	2003	2004	2005
CEF_c tCO_2e/MWh	0.936	0.916	0.896

Table An2-1. Carbon Emission factors (CEF) for projects reducing electricity consumption in Ukraine, for 2003 – 2005

- for 2006-2007 – according to the Table 8 "Emission Factors for the Ukrainian grid 2006-2012" of Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", confirmed by TUV SUD Industrie Service GmbH 17.08.2007[25]:

Type of project	Parameter	tCO2/MWh
JI project producing electricity	CEFgrid, produced	0.807
JI projects reducing electricity	CEFgrid, reduced	0.896

Table An2-2. Carbon Emission factors (CEF) for electricity generation and consumption in Ukraine, 2006 – 2007

- for 2008-2012 and for the later period – according to the Orders of the National Environmental Investment Agency of Ukraine, for consumption of electricity by the consumers that are rated to the 1st class in accordance with the Procedure for definition of classes of the consumers, approved by the Order of the National commission on electric energy regulation of Ukraine dated August 13, 1998, # 1052[26] (for 2008 – Order # 62 dated 15.04.2011[27]; for 2009 – Order # 63 dated 15.04.2011[28]; for 2010 – Order # 43 dated 28.03.2011[29]; for 2011 (and for the later period in the prognostic calculations in PDD as well) – Order # 75 dated 12.05.2011[30].

[24] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/GuidVol2.doc
[25] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[26] http://www.nerc.gov.ua/control/uk/publish/article?showHidden=1&art_id=100925&cat_id=34446
[27] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[28] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[29] http://www.neia.gov.ua/nature/doccatalog/document?id=126006
[30] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

Year	2008	2009	2010	2011-2024
CEFc, t CO_2/MWh	1.082	1.096	1.093	1.090

Table An2-3. Carbon Emission factors (CEF) for projects reducing electricity consumption in Ukraine, for consumption of electricity by the consumers that are rated to the 1st class, for 2008 – 2012 and for the later period

Therefore, the following CEF values are used in calculations in PDD:

Year	2003	2004	2005	2006-2007	2008	2009	2010	2011-2024
CEFc, t CO_2/MWh	0.936	0.916	0.896	0.896	1.082	1.096	1.093	1.090

Table An2-4. The Carbon Emission factors (CEF) used for calculations in PDD

In course of development of the Monitoring reports for this project, if available, the valid at that time CEF values for corresponding period will be used.

For correct comparison of amounts of the base and project GHG emissions, the dynamic baseline is calculated, with taking into account of the calculated specific natural gas and electricity consumption per unit of the gross core aerospace products represented in the value term (US dollars).

The detailed calculations of the dynamic baseline are presented in **Appendixes A, B, C.**

The key information and data used to establish the baseline are provided in tabular form below:

Data / Parameter:	$\boldsymbol{B_b}$
Data unit:	ths m^3
Description:	Natural gas consumption by the enterprise equipment in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	111 826.292 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BH_b
Data unit:	ths m^3
Description:	Natural gas consumption for heat energy production for external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	40 360.728 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recalculated from the data of the heat energy meters of heat energy production for external consumers. Summarized data for the year.
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BPG_b
Data unit:	ths m^3
Description:	Natural gas consumption for electricity generation for external and other consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	11 906.626 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Recalculated from the data of the electricity meters of electricity production for external and other consumers. Summarized data for the year.
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	BNP_b
Data unit:	ths m^3
Description:	Natural gas consumption for production of the non-core products in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	943,000 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	$BOUT_b$
Data unit:	ths m^3
Description:	Delivery of natural gas to the external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	99,533 ths m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	$ECAS_b$
Data unit:	MWh
Description:	Electricity consumption by the enterprise equipment for production of the aerospace products in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	74 503.217 MWh (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by electricity meters
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	NCV_b
Data unit:	MJ/ m^3
Description:	Average Net Calorific Value of natural gas in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Natural gas supplier or an independent chemical laboratory
Value of data applied (for ex ante calculations/determinations)	33.74 MJ/ m^3 (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Accepted in accordance with messages from natural gas supplier or independent chemical lab analysis report. Independent chemical lab analysis is used in contentious cases. This is used rarely
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	Cef_{ngb}
Data unit:	t CO_2/GJ
Description:	Carbon emission factor for natural gas in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	0.0561 t CO_2/GJ (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC 1996 "Guidelines for National Greenhouse Gas Inventories". Vol.2 "Energy", Table 1-2 [31]
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	$CEFc_b$
Data unit:	t CO_2e/MWh
Description:	Carbon emission factor for JI projects reducing electricity consumption in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	0.936 t CO_2/MWh (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines, Version 2.3. The Netherlands, 2004[32]
QA/QC procedures (to be) applied:	n/a
Any comment:	-

[31] http://www.ipcc-nggip.iges.or.jp/public/gl/pdfiles/rusch1-1.pdf

[32] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

Data / Parameter:	HD_b
Data unit:	Gcal
Description:	Delivery of heat energy for external consumers in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	278 504.680 Gcal (in the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement with heat energy meters
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	-

Data / Parameter:	P_b
Data unit:	ths USD
Description:	Gross production output of aerospace products at the enterprise in the base year
Time of determination/ monitoring	Once after the end of the base year
Source of data (to be) used	The enterprise management
Value of data applied (for ex ante calculations/determinations)	44 779,4 ths USD (for the base 2003 year)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Summarized data for the year.
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Annex 3

MONITORING PLAN

In this Monitoring Plan the specific project approach is described, which will be used for calculation of the achieved GHG emission reductions during realization of the JI project "Implementation of energy-saving equipment and technologies at the State Enterprise "Production Association Yuzhny Machine-Building Plant named after A. Makarov".

The main Monitoring plan information is presented in **Section D.**

Formulae for monitoring

Formulae used for calculating project emissions, baseline emissions and the total emission reductions are presented in the tables below.

Formula 1 – Emission reduction in a reported year	
	$ER_r = BE_{dbr} - PE_r$, [t CO_2e]
	ER_r - emission reductions due to the project activity in a reported year, t CO_2e; BE_{dbr} - dynamic baseline emissions in a reported year, t CO_2e; PE_r - project emissions in a reported year, t CO_2e.

Formula 2 – Baseline emissions	
	$BE = BE_{ngc} + BE_{ecas} + BE_{hg}$ [t CO_2e]
	BE_{ngc} - GHG emissions from fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in the base year, t CO_2; BE_{ecas} - GHG emissions from production to the state electric grid of the electricity that is consumed by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in the base year, t CO_2e; BE_{hg} - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the heat energy for external consumers in the base year, t CO_2.

Formula 3 – Dynamic baseline emissions	
	$BE_{dbr} = BE_{dbras} + BE_{dbrhg}$ [t CO_2e]
	BE_{dbr} - dynamic baseline emissions at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e; BE_{dbras} - dynamic baseline emissions from production of the aerospace products at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e; BE_{dbrhg} - dynamic baseline emissions from production of the heat energy for external consumers at the SE "PA Yuzhny Machine-Building Plant named after A.Makarov", t CO_2e.

Formula 4 – Dynamic baseline emissions from production of the aerospace products	
	$BE_{dbras} = (BE_{ngc} + BE_{ecas}) * (P_r / P_b) * J_r$ [t CO_2e]
	BE_{ngc} - GHG emissions from the fuel (natural gas) consumption by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2; BE_{ecas} - GHG emissions from production to the state electric grid of the electricity that is consumed by the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in the base year, t CO_2e. P_r – gross aerospace products in the reported year, ths USD; P_b – gross aerospace products in the base year, ths USD; J_r - aerospace products price change index in the reported year.

Formula 5 – Emissions from fuel (natural gas) consumption for production of the aerospace products in the base year	
	$BE_{ngc} = BAS_b * NCV_b * Cef_{ngb}$ [t CO_2e]
	BAS_b – fuel (natural gas) consumption for production of the aerospace products in the base year, ths m^3; NCV_b – Net Calorific Value of fuel (natural gas), is taken from the averaged data of the enterprise in the base year, MJ/m^3; Cef_{ngb} – Carbon Emission Factor for natural gas in the base year, t CO_2/GJ.

Formula 6 – Fuel (natural gas) consumption for production of the aerospace products in the base year	
	$BAS_b = B_b – BH_b – BPG_b - BNP_b – BOUT_b$ [ths m^3]
	B_b - total fuel (natural gas) consumption in the base year, ths m^3; BH_b – fuel (natural gas) consumption for production of the heat energy for external consumers in the base year, ths m^3; BPG_b – fuel (natural gas) consumption for electricity generation for external and other consumers in the base year, ths m^3; BNP_b – fuel (natural gas) consumption for production of the non-core products in the base year, ths m^3; $BOUT_b$ – fuel (natural gas) delivered to external consumers in the base year, ths m^3.

Formula 7 – Emissions from production to the state electric grid of the electricity that is consumed for production of the aerospace products in the base year	
	$BE_{ecas} = ECAS_b * CEFc_b$ [t CO_2e]
	$ECAS_b$ - electricity consumption for production of the aerospace products in the base year, MWh; $CEFc_b$ - Carbon Emission Factor for JI projects reducing electricity consumption in the base year, t CO_2e/MWh.

Formula 8 – Dynamic baseline emissions from production of the heat energy for external consumers	
	$BE_{dbrhg} = BH_b * NCV_b * Cef_{ngr} * K_1$ [t CO_2e]
	BH_b – fuel (natural gas) consumption for production of the heat energy for external consumers in the base year, ths m^3; NCV_b – Net Calorific Value of fuel (natural gas) in the base year, MJ/m^3; Cef_{ngb} – Carbon Emission Factor for natural gas in the base year, t CO_2/GJ; K_1 – delivered heat energy for external consumers change factor.

Formula 9 – Project emissions in a reported year	
	$PE_r = PE_{ngc,r} + PE_{ecas,r} + PE_{hg,r}$ [t CO_2e]
	$PE_{ngc,r}$ - GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the aerospace products in a reported year, t CO_2; $PE_{ecas,r}$ - GHG emissions from production to the state electric grid of the electricity that is consumed by SE "PA Yuzhny Machine-Building Plant named after A. Makarov" for production of the aerospace products in a reported year, t CO_2e; $PE_{hg,r}$ - GHG emissions from consumption of fuel (natural gas) by equipment of the SE "PA Yuzhny Machine-Building Plant named after A.Makarov" for production of the heat energy for external consumers in a reported year, t CO_2.

Formula 10 – Emissions from consumption of fuel for production of the aerospace products in a reported year	
	$PE_{ngc,r} = BAS_r * NCV_r * Cef_{ngr}$ [t CO_2e]
	BAS_r – fuel (natural gas) consumption for production of the aerospace products in a reported year, ths m^3; NCV_r – Net Calorific Value of fuel (natural gas) in a reported year, MJ/m^3; Cef_{ngr} – Carbon Emission Factor for natural gas in a reported year, t CO_2/GJ.

Formula 11 – Fuel consumption for production of the aerospace products in a reported year	
	$BAS_r = B_r – BH_r - BPG_r – BNP_r – BOUT_r$. [ths m^3]
	B_r - total fuel (natural gas) consumption in a reported year, ths m^3; BH_r – fuel (natural gas) consumption for production of the heat energy for external consumers in a reported year, ths m^3; BPG_r – fuel (natural gas) consumption for electricity generation for external and other consumers in a reported year, ths m^3; BNP_r – fuel (natural gas) consumption for production of the non-core products in a reported year, ths m^3; $BOUT_r$ – fuel (natural gas) delivered to the external consumers in a reported year, ths m^3.

Formula 12 – Emissions from production to the state electric grid of the electricity that is consumed for production of the aerospace products in a reported year	
	$PE_{ecas,r} = ECAS_r * CEFc_r$ [t CO_2e]
	$ECAS_r$ - electricity consumption by the enterprise equipment for production of the aerospace products in a reported year, MWh; $CEFc_r$ - Carbon Emission Factor for JI projects reducing electricity consumption in a reported year, t CO_2e/MWh.

Formula 13 – Emissions from consumption of fuel for production of the heat energy for external consumers in a reported year	
	$PE_{hg,r} = BH_r * NCV_r * Cef_{ngr}$ [t CO_2e]
	BH_r – fuel (natural gas) consumption for production of the heat energy for external consumers in a reported year, ths m^3; NCV_r – averaged Net Calorific Value of natural gas in a reported year, MJ/m^3; Cef_{ngr} – Carbon Emission Factor for natural gas in a reported year, t CO_2/GJ.

Formula 14 – Delivered heat energy for external consumers change factor	
	$K_2 = HD_r / HD_b$
	HE_r – delivered heat energy for external consumers in the reported year, GJ (Gcal); HE_b – delivered heat energy for external consumers in the base year, GJ (Gcal).

Monitoring of the baseline and project emissions

Parameters to be monitored

The applied project specific monitoring approach identifies and takes into account the parameters that are to be measured or monitored at regular intervals. These parameters will then be input into the project Tracking Database, which will be an Excel based spreadsheets that will calculate and track GHG emission reductions.

List of parameters to be monitored is presented in the Table An3-1 below.

	Symbol	Data variable	Data unit	Measured (m), calculated (c), estimated (e)
1	$\mathbf{B_b}$ and $\mathbf{B_r}$	Natural gas consumption by the enterprise equipment	ths m^3	m
2	$\mathbf{BH_b}$ and $\mathbf{BH_r}$	Natural gas consumption for heat energy production for external consumers	ths m^3	m, c
3	$\mathbf{BPG_b}$ and $\mathbf{BPG_r}$	Natural gas consumption for electricity generation for external and other consumers	ths m^3	m, c
4	$\mathbf{BNP_b}$ and $\mathbf{BNP_r}$	Natural gas consumption for production of the non-core products	ths m^3	m
5	$\mathbf{BOUT_b}$ and $\mathbf{BOUT_r}$	Delivery of natural gas to the external consumers	ths m^3	m
6	$\mathbf{ECAS_b}$ and $\mathbf{ECAS_r}$	Electricity consumption by the enterprise equipment for production of the aerospace products	MWh	m
7	$\mathbf{NCV_b}$ and $\mathbf{NCV_r}$	Average Net Calorific Value of natural gas	MJ/ m^3	m, c
8	$\mathbf{Cef_{ngb}}$ and $\mathbf{Cef_{ngr}}$	Carbon emission factor for natural gas	t CO_2/GJ	Normative document [33]
9	$\mathbf{CEFc_b}$ and $\mathbf{CEFc_r}$	Carbon emission factor for JI projects reducing electricity consumption	t CO_2e/MWh	Normative documents: for 2003-2005[34], for 2006-2007[35], for 2008[36], for 2009[37], for 2010[38], for 2011 and later period[39]

[33] http://www.ipcc-nggip.iges.or.jp/public/gl/pdfiles/rusch1-1.pdf
[34] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html
[35] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[36] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[37] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[38] http://www.neia.gov.ua/nature/doccatalog/document?id=126006
[39] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

10	$\mathbf{HD_r}$ and $\mathbf{HD_r}$	Delivery of heat energy for external consumers	GJ (Gcal)	m
11	$\mathbf{P_b}$ and $\mathbf{P_r}$	Gross production output of aerospace products at the enterprise	ths USD	c
12	$\mathbf{J_r}$	Aerospace products price change index	-	c

Table An3-1. List of parameters to be monitored

Data and parameters to be monitored

Data / Parameter:	**1. B**
Data unit:	ths m^3
Description:	Natural gas consumption
Time of determination/ monitoring	Continuous measurement and every day recording
Source of data (to be) used	The enterprise management
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	Measurement by Gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**2. BH**
Data unit:	ths m^3
Description:	Natural gas consumption for heat energy production for external consumers
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Recalculated from the data of the heat energy meters on heat energy production for external consumers
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**3. BPG**
Data unit:	ths m^3
Description:	Natural gas consumption for electricity generation for external and other consumers
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Recalculated from the data of the electricity meters of electricity production for external and other consumers. Summarized data for the year.
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**4. BNP**
Data unit:	ths m^3
Description:	Natural gas consumption for production of the non-core products
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**5. BOUT**
Data unit:	ths m^3
Description:	Delivery of natural gas to the external consumers
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Measurement by gas flow meters
QA/QC procedures (to be) applied:	Measuring instruments (gas flow meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**6. ECAS**
Data unit:	MWh
Description:	Electricity consumption by the enterprise equipment for production of the aerospace products
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Measurement by electricity meters
QA/QC procedures (to be) applied:	Measuring instruments (electricity meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**7. NCV**
Data unit:	MJ/ m^3
Description:	Average Net Calorific Value of natural gas
Time of determination/ monitoring	Once per year (reported period)
Source of data (to be) used	Natural gas supplier or an independent chemical laboratory
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	Accepted in accordance with messages from natural gas supplier or independent chemical lab analysis report. Independent chemical lab analysis is used in contentious cases. This is used rarely
QA/QC procedures (to be) applied:	n/a
Any comment:	Weighted average value per year (reported period)

Data / Parameter:	**8. Cef_{ng}**
Data unit:	t CO_2/GJ
Description:	Carbon emission factor for natural gas
Time of determination/ monitoring	Once per year (reported period)
Source of data (to be) used	Normative documents
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	The new valid data if available. If the new valid data will not be available – the data from Table 1-2 of Volume 2 "Energy" of IPCC 1996 "Guidelines for National Greenhouse Gas Inventories"[40] will be used
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	**9. CEFc**
Data unit:	t CO_2e/MWh
Description:	Carbon emission factor for JI projects reducing electricity consumption
Time of determination/ monitoring	Once per year (reported period)
Source of data (to be) used	Normative documents

[40] http://www.ipcc-nggip.iges.or.jp/public/gl/invs5a.html

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	Data in accordance with (for corresponding years): - Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines, Version 2.3. The Netherlands, 2004[41]; - Table 8 "Emission Factors for the Ukrainian grid 2006-2012" of Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", confirmed by TUV SUD Industrie Service GmbH 17.08.2007[42]; - the Orders of the National Environmental Investment Agency of Ukraine, # 62 dated 15.04.2011[43]; # 63 dated 15.04.2011[44]; # 43 dated 28.03.2011[45]; # 75 dated 12.05.2011[46]. The new valid data will be used if available.
QA/QC procedures (to be) applied:	n/a
Any comment:	-

Data / Parameter:	**10. HD**
Data unit:	Gcal
Description:	Delivery of heat energy for external consumers
Time of determination/ monitoring	Continuous measurement and monthly recording
Source of data (to be) used	The enterprise management
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	Measurement with heat energy meters
QA/QC procedures (to be) applied:	Measuring instruments (heat energy meters) must be calibrated according to national regulations
Any comment:	Summarized data for a year (reported period)

[41] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html
[42] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[43] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[44] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[45] http://www.neia.gov.ua/nature/doccatalog/document?id=126006
[46] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

Data / Parameter:	**11. P**
Data unit:	ths USD
Description:	Gross production output of aerospace products at the enterprise
Time of determination/ monitoring	Once per year (reported period)
Source of data (to be) used	The enterprise management
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	The enterprise reporting
QA/QC procedures (to be) applied:	n/a
Any comment:	Summarized data for a year (reported period)

Data / Parameter:	**12. J**
Data unit:	-
Description:	Aerospace products price change index
Time of determination/ monitoring	Once per year (reported period)
Source of data (to be) used	The enterprise management
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	The enterprise reporting
QA/QC procedures (to be) applied:	n/a
Any comment:	Summarized data for a year (reported period)

Monitoring system and equipment

The control and monitoring system comes to fuel (natural gas) and electricity consumption measurements, as well as of heat energy and natural gas delivery measurements. Other parameters are defined by calculations or taken from statistic data.

Natural gas consumption measurements are realized at the gas distributing unit of the enterprise. Gas registration is carrying out in volume units reduced to standard conditions by means of automatic correction for temperature and pressure. The double check of gas consumption is made by commercial gas flow meters of the gas suppliers installed at GDS-7 and GDP-10.

Natural gas consumption for production of the non-core products measurements are realized with gas flow meters at the corresponding workshops of the enterprise.

Delivery of natural gas to the external consumers measurements are realized with gas flow meters at the borders of the enterprise and the external consumers.

Electricity consumption for production of the aerospace products measurements are realized with electricity meters of the technical account of electricity consumption at the corresponding units of the enterprise.

Delivery of heat energy for external consumers measurements are realized with 4 heat energy meters placed at the borders of the enterprise and the external consumers: village Nyzhne, village Verkhne, hospital No.6 and technical school.

The equipment (to be) used for conducting the above measurements for monitoring of the relevant parameters is summarized in **Appendices D, E and F**.

In case of measuring equipment failure, such case should be immediately reported to the main metrology engineer, and then to the project manager responsible for data measurement and collection. If failure is not removed by own efforts within 48 hrs, the equipment supplier should be ordered for repair. After any repair, calibration should be provided. If repair is not possible, equipment should be replaced by equivalent calibrated item. Failure events will be recorded in the site events log book.

Level of uncertainty and errors

Possible uncertainties and errors for such type project may arise from two main reasons: measurement and stipulation. Measurement error is due to metering equipment inaccuracies. Stipulation occurs when some values are required to complete calculations, but these values cannot be measured directly. In these cases estimates are used in place of actual measurements, and therefore error may be introduced. The stipulation error itself may be estimated based on the expected accuracy of the stipulated values.

The project error can be calculated from the two error components described above. The total project error (Standard Error, SE) can be calculated by taking the square root of the sum of the squares of the individual error components, as below:

$SE = \sqrt{[(\text{measurement error})^2 + (\text{stipulation error})^2]}$

The monitoring plan developed for this project does not rely on any estimates and is therefore free of any stipulation errors.

Thus, $SE = \sqrt{[(\text{measurement error})^2 + (0)^2]} = (\text{measurement error})$

The project has 12 monitoring parameters. Five of them (amounts of total consumption of natural gas by the enterprise, natural gas consumption for production of the non-core products, delivery of natural gas to the external consumers, electricity consumption for production of the aerospace products, delivery of heat energy for external consumers) are measured directly, two (gross aerospace products and aerospace products price change index) are taken from accounting department data, two (natural gas consumption for heat energy production for external consumers and electricity production for external and other consumers) are recalculated by the enterprise from the directly measured amounts of heat energy and electricity delivered to external consumers, and the remaining three parameters used in calculation of the baseline and project emissions (net calorific value of natural gas, carbon emission factors for natural gas and for consumption of electricity) are taken as statistic data from external sources and normative documents.

For the first five parameters, the measurement errors (maximal values) which impact on the Standard Error and their level of accuracy are presented in Table An3-2.

ID number and data variable	Measurement error (maximal)	Comment
1. Natural Gas consumption	± 1.0%	Accuracy of data is high due to necessity of information for commercial account purposes
2. Natural gas consumption for production of the non-core products	± 2.0%	Accuracy of data is close to high due to using for technical account purposes
3. Delivery of natural gas to the external consumers	± 1.0%	Accuracy of data is high due to necessity of information for commercial account purposes
4. Electricity consumption for production of the aerospace products	± 2.0%	Accuracy of data is close to high due to using for technical account purposes
5. Delivery of heat energy for external consumers	± 2.5%	Accuracy of data is high due to necessity of information for commercial account purposes

Table An3-2. Measurement errors

Project management planning

The overall responsibility for the project management and implementation is carried out by the Deputy General Director of SE "Production Association Yuzhny Machine-Building Plant named after A. Makarov", Mr. Yuriy Pashchenko. The main specialist of SE "PA Yuzhny Machine-Building Plant named after A. Makarov", Mr. Yakiv Takhterin, is appointed as responsible person for the project management. The managers of SE "PA Yuzhny Machine-Building Plant named after A. Makarov": Mr. Oleksandr Nikolaenko, the executing director of the energy complex, Mr. Mykhailo Korobov, the main energy engineer, Mr. Anatoliy Lobashov, the main metrology engineer, are responsible for project activity.

Possible bottlenecks and problems in project implementation should be identified and solved by responsible stuff of SE "PA Yuzhny Machine-Building Plant named after A. Makarov".

Responsibilities for data collection

The main specialist of SE "PA Yuzhny Machine-Building Plant named after A. Makarov", Mr. Yakiv Takhterin, is responsible for the implementation and management of the monitoring process at the enterprise. He is responsible for supervising data collection, measurements, data recording and storage.

The deputy director of Institute of Engineering Ecology, Dr. Dmytro Paderno, is responsible for baseline and monitoring specific project approach development.

The engineers of Institute of Engineering Ecology, Mr. Dmytro Kirzhner and Mr. Valery Logvyn, are responsible for data processing and development of Monitoring reports.

Responsibilities for data management

All collected data will be transferred to Mr. Yakiv Takhterin, who will be responsible for data storage and archiving, entry of the data into the monitoring spreadsheets. Mr. Valery Logvyn will be responsible for the data processing according to specific project approach and for development of Monitoring Reports. Support in co-ordination of verification process will be undertaken by Dr. Dmytro Paderno.

Responsibilities for data management are presented in Table An3-3.

Activity	Responsible person	
	Name	Position and department
Data monitoring, reporting, storage and archiving, filling up the spreadsheets for Monitoring Report, coordination of verification process	Yakiv Takhterin	Main specialist of SE "PA Yuzhny Machine-Building Plant named after A. Makarov"
Support in coordination of monitoring and verification processes	Yuriy Pashchenko	Deputy General Director of SE "PA Yuzhny Machine-Building Plant named after A. Makarov"
Data processing according to methodology, development of Monitoring Reports	Valery Logvyn	Engineer of Institute of Engineering Ecology
Support in coordination of verification process	Dmytro Paderno	Deputy Director of Institute of Engineering Ecology

Table An3-3: Responsibilities for data management

Trainings

As far as the main activity of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" will not change in course of the JI project implementation, the special technical trainings for personnel are not necessary. The technical personnel of the enterprise has sufficient knowledge and experience for implementation of the project activity and maintenance of the usual equipment.

Whenever the new equipment will be installed, the manufacturers of this equipment will provide the special technical trainings for operating personnel.

The enterprise has the Labour protection department and Training department, which are responsible for raising the level of personnel skills and trainings according to protection of labour norms.

In course of the JI project development, specialists of Institute of Engineering Ecology have carried out a comprehensive consultations and trainings for involved representatives of SE "PA Yuzhny Machine-Building Plant named after A. Makarov" on the necessary data collection according to Monitoring plan for the project.