

JOINT IMPLEMENTATION PROJECT

"Reconstruction of the power units at the "Kryvorizka TPP" of the
"Dniproenergo" JSC."
(project title)

Position of the head of the company,
project developer

Director "Elta-Eco" LLC
(position)



Rogoviy Maksym
Ivanovich
(surname, name and
patronymic of the person)

Position of the head of the company,
project owner, owner of the source

General Director
"Dniproenergo" JSC.
(position)



Magera Yuriy
Mikhaylovych
(surname, name and
patronymic of the person)

A handwritten signature in blue ink, likely belonging to Magera Yuriy Mikhaylovych.

Kharkiv, January 2012



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:**

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Title: Reconstruction of the units at the “Kryvorizka TPP” of the “Dniproenergo” JSC.

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

Version: 1.3.1

Date: 31 January 2012

A.2. Description of the project:

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The Kryvorizka TPP is a structure unit of the “Dniproenergo” JSC. This TPP is one of the largest in Ukraine.

The overall project installed capacity of the TPP was 2820 MW (10 generating units 282 MW each).

In 1991 the installed capacity of the energy units of the TPP were reduced from 300 MW to 282 MW due to physical deterioration of the equipment.



Figure 1. The Turbine Hall of the Kryvorizka TPP.

The generating units were constructed for the coal (type P) combustion.

The construction of the Kryvorizka TPP was implemented in 2 parts:

I part – generating units № 1 - 4;

II part – generating units № 5 - 10.

Today units № 1, 2, 4, 5, 6, 8, 10 are in operation and the units № 7 and 9 are in the long-term reserve.



The Unit #3 is under the reconstruction.

The list of the installed equipment of the units № 1 - 4:

4 boilers of the P-50 type (one boiler per Unit), produced by the S. Ordzhonikidze Podilsky Mashinery Plant.

4 steam turbines of the K-300-240-2 type, produced by the Kharkiv SPC "Turboatom".

4 turbo-generators of the TGV-300 type, produced by the Kharkiv SPC "Electrovazhmash".

The list of the installed equipment of the units № 5 – 10:

6 boilers of the TPP-210a type (one boiler per Unit), produced by by the Taganrog Boiler Plant "Krasnyi Kotelschik".

6 steam turbines of the K-300-240 type, produced by the Kharkiv SPC "Turboatom".

6 turbogenerators of the TGV-300 type, produced by the Kharkiv SPC "Electrovazhmash".

Project foresees modernization of the main and the auxiliary equipment of the all power generating units of the TPP according to the attached schedule.

Table 1. Project Schedule.

All Units Servicing and Preparations for the Reconstruction	2006-2016
Unit №1	2012
Unit №2	2014
Unit №3	2007-2011
Unit №4	2016
Unit №5	2013
Unit №6	2017
Unit №7	-
Unit №8	2018
Unit №9	2019
Unit №10	2015

It includes replacement of control, automatic systems, and electro-technical system, modernization of the boiler equipment, outdated turbine equipment, electric separation system, cooling system, etc.

Thermal energy delivery in project scenario will remain the same as in the baseline scenario. That is why the thermal energy delivery was not taken into account in the project scenario and in the baseline scenario.

The main objective of the Project is to make the existing power equipment of the TPP more efficient and reliable. The increased efficiency will provide a higher output and lower fuel consumption.

The increased capacity of the TPP is due to the better efficiency of the existing equipment. It will reduce the fuel consumption per unit of the energy produced by the station. Thus the GHG emission per the energy unit produced will be lowered.

Prior to the starting date of the Project the Kryvorizka TPP had been working using it's equipment without any major repairs or reconstructions. That kind of working lead to the continuous working parameters deterioration. The continuation of this situation would have been the Baseline Scenario and the Project Scenario foresees the full-scale reconstruction of all generating equipment, and the all working parameters improvement.

For this purpose in 2006 the contract for the TEA of the on of the Units' reconstruction was signed. That was the first major step under way to the Project implementation and, as Ukraine was the party of the Kyoto Protocol, one of the main arguments in favor of the Project was the possibility of it's registration as the JI Project.

Other goals of the project are to:



- lower greenhouse gases emission;
- improve stability and reliability of generation and transmission of electricity;
- implement safety measures;
- improve health and safety on site

A.3. Project participants:

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<u>Party involved</u> (*)	Legal entity <u>project participants</u> (as applicable)	Please indicate if the <u>Party involved</u> wishes to be considered as <u>project participant</u> (Yes/No)
Ukraine (Host Party)	Dniproenergo JSC.	No
Ukraine	Elta-Eco LLC.	No
Netherlands	ING Bank N.V.	No

* Please indicate if the Party involved is a host Party.

- Dniproenergo JSC.
Project Owner, Owner of the emission reduction units
- Elta-Eco LLC.
Project Developer.
- ING Bank N.V.
The potential buyer of the emission reduction units.

A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

>>
Ukraine



Figure 2. Ukraine

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

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Dnipropetrovsk region, Eastern Part of Ukraine

**Figure 3. Dnipropetrovsk region¹**

¹ http://www.business-assistant-ua.eu/cont/img/Dnipropetrovsk_region_large.png

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

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Zelenodolsk town, Apostolovsky district, Dnipropetrovsk region, Ukraine

**Figure 4. Zelenodolsk town and Kryvorizka TPP²**

² <http://google.earth.com>

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

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Figure 5. Kryvorizka TPP

The project is located in Apostolivsky district of the Dnipropetrovsk region, Zelenodolsk town. Zelenodolsk town is located at the following coordinates: 47°32'N and 33°39'E³.

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

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10 of the units at the Kryvorizka Thermal Power Plant have a design capacity of 282 MW. Each unit consists of a boiler, steam turbine, electric generator, feed-water heaters, condensate and boiler feed pumps, condenser, circulating water pumps, steam generator, main and auxiliary electrical transformer and auxiliaries. The steam generator is designed to operate on coal. The electricity generated is conveyed to the grid via 330 kV and 110 kV transmission lines. All major equipment was manufactured in the former Soviet Union.

The “Dniproenergo” JSC became an owner of the Kryvorizka TPP in 1998. Straight after that several urgent energy efficiency and ecological measures were implemented on the TPP. In 2008 after the signing

³ <http://google.earth.com>



of the Contract №87-723-2841-DPO/05 dated 28.12.06 for the technical and economic assessment of the Unit №3 of the Kryvorizka TPP Rehabilitation the preparation actions for the TPP Units rehabilitation and the rehabilitation itself were started. Also, the measures for the JI registration and the potential ERUs calculations were started.

Project foresees modernization of the main and the auxiliary equipment of the all power generating units of the TPP according to the attached schedule (see Table 2).

Table 2. Project Schedule.

All Units Servicing and Preparations for the Reconstruction	2006-2016
Unit №1	2012
Unit №2	2014
Unit №3	2007-2011
Unit №4	2016
Unit №5	2013
Unit №6	2017
Unit №7	-
Unit №8	2018
Unit №9	2019
Unit №10	2015

Within this project the following packages of measures will be undertaken on the each unit:

- the preparations for the rehabilitation, including repairs, servicing, optimisation of the regimes and the fuel preparation;
- the rehabilitation of the turbine equipment to restore its initial efficiency and modernize its command & control system;
- the improvement of the designed parameters of the turbine equipment;
- the rehabilitation (reconstruction) of the regulation system;
- the rehabilitation (reconstruction) of the boiler;
- the boiler binding reconstruction to use natural gas as reserve fuel instead of the heavy fuel oil;
- the reconstruction (change) of the control system of the of the Unit;
- the reconstruction of the generator and the cooling system;
- the rehabilitation (reconstruction) of the electric filters with the change of the electric and control systems;
- the rehabilitation of the feed-pump;
- the rehabilitation (reconstruction) of the electric equipment of the Unit (including unit transformer).

The detailed description of the rehabilitation:

A. Turbine equipment

1. Steam turbine:

- Modernization of the high, middle and low pressure setting cylinder;
- Reconstruction of the high and low pressure regeneration system;
- Working and entrance blades replacement;
- Change of the end seals;
- Replacement of the diaphragms, ends and diaphragm seals;
- High, middle and low pressure rotors replacement;
- Overhaul and repair of the deaerating-feeding system: replacement of the turbine feed pump and its regulation system, feed electric pump replacement, deaerators replacement, repair of the pipelines and fittings of the system;



- Overhaul and replacement of the supporting and thrust bearings;
 - Barring gear replacement;
 - Modernization of the turbine steam-distribution system: replacement of the high pressure cutout valve, high and middle pressure regulative valve, shut-off valves, valve safety devices and drivers, regulating diaphragms, pipelines and fittings;
 - Reconstruction of the steam turbine automatic regulation hydraulic system into electro-hydraulic system;
 - Overhaul and replacement of the safeguard regulation system;
 - Modernization of the drainage-scavenging system;
 - Modernization of the oil system: oil cooler repair, oil container and oil-duck replacement, bearing case and oil fittings replacement, overhaul of the working and broken oil pumps of the oil system;
 - Modernization of the condensing system: condenser pump and starting ejector pump replacement, water supply circulation pump repair, pipelines and fittings of the system replacement;
 - Circulating flumes replacement with condenser filter installation;
 - Modernization of the regeneration system: low pressure heater replacement, discharge pump of the low pressure heater system replacement, pipelines and fittings replacement;
 - Grid heaters installation;
 - Overhaul and repair of the cooler generator system: chiller of the circulating pump gas coolers replacement, gas cooler generator pump replacement service water pump replacement;
 - Overhaul of the check valves with hydraulic drive;
 - Rotor hydraulic system installation.
2. Steam-pipelines
- Overhaul and repairs.
3. Pumping equipment
- Change of the inner casing of the feed pump;
 - Overhaul and repair of all pumping equipment.
4. Fittings
- Overhaul and in case of need – repair and replacement of the fittings.
5. Insulation
- Overhaul and rehabilitation of the high and middle pressure equipment insulation;
 - Repair of the feed-water pipeline insulation.
6. Control system
- Equipping of the turbine with the electronic control, monitor and regulation system.
7. Electric filters
- Replacement of the electrodes;
 - Replacement of the gas distribution grates;
 - Replacement of the high-voltage units of the electric field and replacement control regulator of the system;
 - Carriage and bracket girder replacement;
 - Bearing insulator and insulator boxes replacement;
 - Corona-forming and precipitation electrode jog units and jog drivers replacement;
 - High-voltage cable replacement;
 - Revision of the thermal insulation and anti-corrosion protection of the cases metal construction renewal;
 - Bunkers and cases defects removal;
 - Ashes level indicator installation;
 - Dusting sensors, gas analysers and smoke fumes sensors installation;
 - Fire-warning and fire-fighting system installation.
- B. Boiler equipment**
- Repair of the boiler unit and supporting equipment;



- Heating surface modernization in the boiler unit fire-chamber and convection shaft;
- Top radiation part replacement;
- Ceiling super-heater replacement;
- Replacement of the high- and low-pressure convection super-heater surfaces;
- Burners reconstruction;
- Fire-protection equipment installation;
- Fire and burner device repair;
- Overhaul and repair of the evaporation draining system;
- Repair of different equipment in the boiler unit: repair of the separator, injection attemperator, reduction-cooler equipment, main safety valves, cyclones, etc.;
- Replacement (repair) of the slag-removal bunkers and slag duct screw;
- Modernization of the main equipment of the boiler unit powder-gas-air flow track: replacement of the oil system rattler, dust-system separators repair, mill fan and hot blast fans replacement, draft system replacement, cleaning of the regenerative air-heater with oil-stations, replacement of the raw coal and dust feeding devices, replacement of the blow fans and of the induced-draught fans with oil-stations;
- Repair of the powder-gas-air flow duct parts and of the separate units;
- Overhaul and repair of the hydraulic ash removal system;
- Replacement of the spray-water and removal-water pipelines;
- Total replacement of the water-wall tubes and water economizer;
- Overhaul and repair of the live steam pipelines, cool and hot reheat pipelines;
- Overhead-bearing system replacement.

C. Electric generator and electric equipment

- Replacement of the stator winding;
- Reconstruction or replacement of the rotor;
- Modernization of the generator cooling system with the replacement of the gas condensers;
- Modernization of the unit transformer;
- Modernization of the cooling system of the transformer;
- Reconstruction of the generator conduction;
- Reconstruction of the generator thyristor excitation system;
- Emergency event registrar installation;
- Reconstruction of the boxes of the distribution and complete devices;
- Reconstruction of the standby and working transformer;
- Reconstruction of the power gate;
- Storage battery modernization;
- Installation of the diesel generator for own requirements;
- Electric motor modernization;
- Modernization of the electric motors of the blow fans, mills, hot blast fans, induced-draught fans, etc.;
- Frequent electric driver installation;
- Reconstruction of the electric raceways, replacement of the power and control cable;
- Reconstruction of the illumination system of the all sections.

In 2009 - 2010 the advanced repairs of the Units #1, 2, 3, 4, 5, 6, 8, 9 and 10 were implemented at the TPP as the Servicing and Preparation for the Reconstruction. The main packages of measures of these repairs are (more detailed explanation will be provided in the Monitoring Report for this period):

- the repairs of the heating surfaces of the boiler units;
- the inspection and repairs of the High-, Mid-, and Low-Pressure Cylinders;
- the control and the replacement of the fittings;
- the inspection and the replacement of the pipelines;
- the repairs and the replacement of the burners at the boiler unit;



- the advanced repairs of the pumping equipment;
- the control and the replacement of the blades of the turbine;
- the repairs of the dust system;
- the repairs of the generator winding.

The duration of the repairs is practically the same for every year and the influence of the off-operation time on the TPP's working parameters can be neglected.

For the reconstruction and rehabilitation at Kryvorizka TPP the technology that is common in Europe will be used. The Project is one of the first projects of this kind in Ukraine. The TPP has one of the best fuel consumption coefficients among the coal-fired TPPs in Ukraine now and the rehabilitation will lower the GHG emission coefficient of the TPP. The technology is unlikely to be substituted during the lifetime of the Project. No special training for the personnel is needed.

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:

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Energy generation is one of the most important sectors of the Ukrainian economy. It has been showing a significant growth since 1999. The Nuclear power plants and Thermal power plants are generating the main part of the energy produced in Ukraine⁴. Nuclear power plants are able to work only with the fixed (basic) load whereas TPPs are mainly work with the flexible (manoeuvre) load.

That is why one of the main targets of the energy system development is to increase the reliability of the existing equipment with the increase of its installed capacity.

The proposed Project provides emission reductions by lowering of the amount of fuel used per energy unit produced (MW, Gcal, etc.). This Project would never have occurred without JI registration and a good will of the Project owner. There are several legal acts in Ukraine to regulate the energy sector. The main ones are described below with the description of the existing situation.

SECTOR BACKGROUND

Ukrainian Law on Power Industry from 16 October 1997, N 575/97-BP⁵ is the basic law in Ukraine that determines legal, economic, and organizational activities relevant to electricity and regulates the relationships linked with generation, distribution and consumption of power, energy security of Ukraine, competition and other aspects of power industry. The law stimulates and ensures sustainability issues related to the power industry: such as rational fuel consumption, technological development, and environmental safety.

In 1996, Ukraine adopted the National Energy Program until 2010⁶, designed to rehabilitate working thermal power plants to allow them to continue operating for the next 25 years. As a way to reach this objective, the program's mandate specified technological improvements, use of renewable energy sources and modernization of the power plants, including making them more environmentally friendly. The program also specified that combined cycle-gas turbine equipment- as well as most of the auxiliary equipment - needed to be improved to reach acceptable safety levels. Good-quality coal was to be used to reduce environmental damage. However, many of these reconstruction and modification projects have been seriously delayed because of the shortage of state budget financing, weak legislation, and the lack of private investment.

⁴ <http://ukrrudprom.com/data/htmls/cvjfddh09012008.php>

⁵ <http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0>

⁶ <http://www.uazakon.com/document/spart91/inx91184.htm>



To make the country less dependent on energy imports, the President has issued a Decree on measures to increase energy security of Ukraine (21 October 2005), and called for the elaboration of an Energy Strategy covering the period until 2030. The Cabinet of Ministers Resolution No. 145-p approved the new Energy Strategy up to 2030 in March 2006⁷.

The Strategy focuses on traditional energy sectors, i.e. gas, oil, nuclear and coal. It briefly mentions renewable energies, and does not cover new energy technologies.

The Strategy mentioned covers many of the Ukrainian TPPs with the plans of the rehabilitation and energy efficiency increase. Nevertheless, only few of the TPPs mentioned in the Strategy have been implementing the measures described in it. One of the main reasons that the Project “Reconstruction of the power units at the “Kryvorizka TPP” of the “Dniproenergo” JSC.” is implemented is that the Project has been developed as a JI project. All the energy generated by the TPP is sold to the State network and the government is setting the price of the energy. It means that the price does not show the real situation for the energy sector. It does not cover any repair and particularly, rehabilitation. Only additional cash flow can help the project to be implemented. Furthermore, in the conditions of the world financial crisis and the change in the cost of money, the JI development and possibility of the additional cash flow from the selling of the ERUs were the main reasons to not to cancel the Project implementation.

If project is not implemented, the baseline scenario would look like "business-as usual" scenario. That means, that the Kryvorizka TPP would continue to operate as before or would increase the production of the energy by the extension of the operating time. In this case a slight decrease in energy efficiency each year would occur. This situation is the most plausible.

The common practice in Ukraine includes repairs of the generating equipment and the scope of these repairs is given in the GKD 34.20.661-2003 "The Rules for the Organization of the Power Plants and the Networks Equipment, Buildings and Constructions Servicing and Repairs" approved by the Ministry of the Fuel and Energy of Ukraine in 2004. All the measures described as the Project Scenario are beyond them.

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

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During the Project crediting period, monitoring data will be used to determine the actual realized emission reductions in compliance with the annual energy production value. For the period 2006 – 2010 the actual data of the electricity supply, Specific Fuel Rate (*SFR*), the fuel consumption and the net caloric values of the different fuel types was used. To calculate the emissions and emission reductions during 2011 – 2028 the planned data was used.

The period of 20 years was taken because the reconstruction of the generating equipment extends its operational lifetime to 20 years.

The calculations provided for the two periods: 2009-2012 (48 months), 2013-2028 (192 months). The calculations for 2009-2012 covers the energy efficiency measures implemented on the TPP in these years. These measures allowed achieving the lowering of the specific fuel rate and, as the result, the emission reductions. The calculations for 2013-2028 were made with the assumption of the continuation of the JI mechanisms in these years.

Table 3. Annual estimation of emission reductions in the crediting period

	Years
Length of the period	4
Years	Estimate of annual emission reductions in tonnes of CO2 equivalent
2009	9 408

⁷ <http://zakon.rada.gov.ua/signal/kr06145a.doc>



2010	59 574
2011	130 902
2012	100 556
Total estimated emission reductions over the period (tonnes of CO2 equivalent)	300 441
Annual average of estimated emission reductions over the period (tonnes of CO2 equivalent)	75 110

The total amount of emissions reduction is 300 441 tonnes of CO2 equivalent.

The annual average amount of GHG emissions is 75 110 tonnes of CO2 equivalent.

The example of the Emission Reduction calculation for the 2009:

In 2009 Kryvorizka TPP plans to supply 4 699 813 MWh of the electricity to the Ukrainian Grid. The Specific Fuel Rate (*SFR_y*) in this year is planned to be 11,2395 GJ per MWh (0,3836 tonnes of the equivalent fuel per MWh). The fuel is planned to be combusted in such a proportion (*SF_{iy}*): coal – 98.8%, heavy fuel oil – 0.6%, natural gas – 0,6%.

The values of the emission factor (*EF_{iy}*) and the oxidation coefficient (*OXID_{iy}*) defined in the IPCC 1996 Guidelines for National Greenhouse Gas Inventories⁸ and the “National GHG Inventory Report” (Inventory) of Ukraine for 1990 - 2009⁹ were used for the calculations:

***EF_{iy}* for the coal – 0,0946 tonnes of CO2 per GJ** (according to the Inventory, the carbon emission factor of the coal, used at the Kryvorizka TPP in 2009 (the latest reported year) was **25,8** tonnes of C / TJ¹⁰. To calculate the carbon dioxide (CO2) emission factor we use the transformation coefficient CO2/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO2 emission factor **94,6** tonnes of CO2/TJ, or **0,0946** tonnes of CO2/GJ was used for the coal);

***EF_{iy}* for the heavy fuel oil – 0,0774 tonnes of CO2 per GJ** (according to the IPCC 1996 Workbook, the carbon emission factor of heavy fuel oil is **21,1** tonnes of C / TJ. To calculate the carbon dioxide (CO2) emission factor we use the transformation coefficient CO2/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO2 emission factor **77,366** tCO2/TJ, or **0,0774** t CO2/GJ was used for the heavy fuel oil);

***EF_{iy}* for the natural gas – 0,0554 tonnes of CO2 per GJ** (according to the Inventory, the carbon emission factor of natural gas used in Ukraine in 2009 (the latest reported year) was **15,11** tonnes of C / TJ¹¹. To calculate the carbon dioxide (CO2) emission factor we use the transformation coefficient CO2/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO2 emission factor **55,4** tonnes of CO2/TJ, or **0,0554** tonnes of CO2/GJ was used for the natural gas). According to the Inventory *OXID_{iy}* for the coal used at the Kryvorizka TPP in 2009 (the latest reported year) was **0,945**¹²;

***OXID_{iy}* for the heavy fuel oil is 0,99** (IPCC data);

***OXID_{iy}* for the natural gas is 0,995** (IPCC data). These coefficients show the amount of the CO2 emission from the combustion of the specific fuel type and the oxidation level of the specific fuel type when combusted.

⁸ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>

⁹ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

¹⁰ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 379, table. P2 10

¹¹ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 376, table. P2 6

¹² http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13



According to the Baseline defined in the Annex 2, the Specific Fuel Rate in the Baseline Scenario was 11,2619 GJ per MW (0,3844 tonnes of the equivalent fuel per MW).

In that way the Baseline emission in 2009 has to be:

$$BE_y = 11.2619 * ((0.988*0.0946*0.945)+(0.006*0.0774*0.99)+(0.006*0.0554*0.995)) * 4699813 = 4\ 716\ 757 \text{ tonnes of CO}_2 \text{ equivalent.}$$

Project Emission in 2009 will be:

$$PE_y = 11,2395 * ((0.988*0.0946*0.945)+(0.006*0.0774*0.99)+(0.006*0.0554*0.995)) * 4699813 = 4\ 707\ 349 \text{ tonnes of CO}_2 \text{ equivalent.}$$

Emission Reductions in 2009 are planned to be:

$$ER_y = 4\ 716\ 757 - 4\ 707\ 349 = 9\ 408 \text{ tonnes of CO}_2 \text{ equivalent}$$

Table 4. Annual estimation of emission reductions for the post-Kyoto period

	Years
Length of the crediting period	16
Years	Estimate of annual emission reductions in tonnes of CO ₂ equivalent
2013	160 259
2014	235 089
2015	295 491
2016	366 301
2017	436 964
2018	564 185
2019	622 060
2020	663 540
2021	663 540
2022	663 540
2023	663 540
2024	663 540
2025	663 540
2026	663 540
2027	663 540
2028	663 540
Total estimated emission reductions over the crediting period (tonnes of CO ₂ equivalent)	8 652 210
Annual average over the crediting period of estimated reductions (tonnes of CO ₂ equivalent)	540 763

The total amount of emissions reduction is 8 652 210 tonnes of CO₂ equivalent

The annual average amount of GHG emissions is 540 763 tonnes of CO₂ equivalent

A.5. Project approval by the Parties involved:

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The Letter of Endorsement #10/23/7 dated 05.01.2011 has been received from the National Environmental Investments Agency of Ukraine.



After finishing of project determination report, the PDD and Determination Report will be presented to State Environmental Investments Agency of Ukraine for receiving of the Letter of Approval. The Letter of Approval from the country - investor will be provided after approval of project by Ukraine.

[State Environmental Investment Agency of Ukraine](#)

35, Urytskogo str.

03035 Kiev

Ukraine

Email: info.neia@gmail.com

SECTION B. Baseline

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

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

A baseline for a JI project has to be set in accordance with Appendix B of the Annex to decision 9/CMP.1 (JI guidelines), and with the “Guidance on criteria for baseline setting and monitoring, version 0.2”¹¹ developed by the Joint Implementation Supervisory Committee (JISC) (hereinafter referred to as “Guidance”). A JI specific approach regarding baseline setting and monitoring has been developed in accordance with Appendix B of the JI Guidelines and with the JISC Guidance.

For the Project the own specific approach will be used. Project will use a baseline in accordance with the “Tool for the demonstration and assessment of additionality” (Version 05.2.1)¹³.

In the proposed project CO₂ emissions to the atmosphere will be reduced through the efficiency increase of the power generation at the Kryvorizka TPP after the optimisation of the regimes, servicing, fuel preparations, reconstruction of the boiler, the turbine equipment, the control and regulation system, the electro-generation and the cooling system.

The energy production depends on the demand of the market. The TPP can increase the energy production at any time. It means that all the additional energy produced during the Project period will substitute the energy, which would have been produced by the TPP, but with the less efficiency and higher GHG emission.

The proposed Approach for the emission reductions’ calculation uses the specific fuel rate (*SFRy*) parameter. This parameter (described in the Annex 2) shows the efficiency level of the fuel combustion at the TPP and, consequently, the emissions from the fuel combustion. This parameter is being calculated in

¹³ <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v5.2.1.pdf>



the energy units and allows seeing the actual picture of the energy efficiency measures provided at the TPP.

$$SFR_y = \frac{\sum (F_{iy} * NCV_{iy})}{7} / AELS_y \quad (1)$$

Where

SFR_y – specific fuel rate of the power plant in year y , t.e.f./MWh. (GJ/MWh);

F_{iy} – the amount of the fuel i consumed by the power plant for the electricity production in year y , tonnes (th.m3);

NCV_{iy} – net caloric value of the fuel i in year y , Gcal/tonne (th.m3);

7 - the net caloric value of one ton of the equivalent fuel, Gcal;

$AELS_y$ - annual energy supply of the power plant in year y , MWh.

The Baseline Scenario for the Project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity. For the proposed Project activity the JI specific approach was used.

For the proposed Project the Baseline Scenario is the continuation of the TPP operation without any major repairs or reconstructions of the generating equipment. The calculation of the Baseline Emission is based on the assumption that the Specific Fuel Rate parameter of the TPP will remain the same for the whole Project lifetime.

$$BE_y = \sum (SFR_b * SF_{iy} * OXID_{iy} * EF_{iy}) * AELS_y \quad (2)$$

where:

BE_y – Baseline emission in year y , tonnes of CO2 equivalent;

SFR_b – specific fuel rate of the power plant in the Baseline Scenario, GJ/MWh;

SF_{iy} – share of fuel i (coal, natural gas or a heavy fuel oil), consumed by the project activity power plant in year y in comparative units;

$OXID_{iy}$ – oxidation factor of the fuel i in year y in comparative units;

EF_{iy} - emission factor of the fuel i consumed in year y , tonnes of CO2 /GJ;

$AELS_y$ - the amount of the electricity supplied by the power plant to the electricity grid in year y , MWh.

It is determined in the Annex 2 according to the data for three years prior to the Project (2005, 2006 and 2007).



$$SFRb = \frac{\sum_{i=1}^n SFRyi}{n}, \quad (3)$$

Where:

$SFRb$ – a specific fuel rate of the power plant in the baseline scenario, GJ/MWh;

$SFRyi$ – a specific fuel rate of the power plant in years, prior to the Project Implementation, GJ/MWh;

n - number of years ($n \geq 3$).

The other parameters, such as Annual Electricity Supply ($AELS_y$), Share of the each fuel type in the fuel mix (SFi_y), the Carbon Emission Factor of the each fuel type (EFi_y), the Oxidation Factor of the each fuel type ($OXIDi_y$) are the same in the Baseline and the Project Scenarios.

Step 2: Application of the approach chosen.

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

The alternatives to the project activity's energy efficiency measures are:

Alternative 1. The proposed project activity not undertaken as a JI project (the technical description of the activities within this alternative is shown in the section A.4.2.);

Alternative 2. The reconstruction of the boiler equipment without the rehabilitation of the turbine and power generator:

- Repair of the boiler unit and supporting equipment;
- Heating surface modernization in the boiler unit fire-chamber and convection shaft;
- Top radiation part replacement;
- Cealing super-heater replacement;
- Replacement of the high- and low-pressure convection super-heater surfaces;
- Burners reconstruction;
- Fire-protection equipment installation;
- Fire and burner device repair;
- Overhaul and repair of the evaporation draining system;
- Repair of different equipment in the boiler unit: repair of the separator, injection attemperator, reduction-cooler equipment, main safety valves, cyclones, etc.;
- Replacement (repair) oa the slag-removal bunkers and slag duct screw;
- Modernization of the main equipment of the boiler unit powder-gas-air flow track: replacement of the oil system rattler, dust-system separators repair, mill fan and hot blast fans replacement, draft system replacement, cleaning of the regenerative air-heater with oil-stations, replacement of the raw coal and dust feeding devices, replacement of the blow fans and of the induced-draught fans with oil-stations;
- Repair of the powder-gas-air flow duct parts and of the separate units;
- Overhaul and repair of the hydraulic ash removal system;
- Replacement of the spray-water and removal-water pipelines;
- Total replacement of the water-wall tubes and water economizer;
- Overhaul and repair of the live steam pipelines, cool and hot reheat pipelines;



- Overhead-bearing system replacement.

Alternative 3. The reconstruction of the steam turbine without the rehabilitation of the generator and the boiler:

1. Steam turbine

- Modernization of the high, middle and low pressure setting cylinder;
- Reconstruction of the high and low pressure regeneration system;
- Working and entrance blades replacement;
- Change of the end seals;
- Replacement of the diaphragms, ends and diaphragm seals;
- High, middle and low pressure rotors replacement;
- Overhaul and repair of the deaerating-feeding system: replacement of the turbine feed pump and its regulation system, feed electric pump replacement, deaerators replacement, repair of the pipelines and fittings of the system;
- Overhaul and change of the supporting and thrust bearings;
- Barring gear replacement;
- Modernization of the turbine steam-distribution system: replacement of the high pressure cutout valve, high and middle pressure regulative valve, shut-off valves, valve safety devices and drivers, regulating diaphragms, pipelines and fittings;
- Reconstruction of the steam turbine automatic regulation hydraulic system into electro-hydraulic system;
- Overhaul and change of the safeguard regulation system;
- Modernization of the drainage-scavenging system;
- Modernization of the oil system: oil cooler repair, oil container and oil-duck replacement, bearing case and oil fittings replacement, overhaul of the working and broken oil pumps of the oil system;
- Modernization of the condensing system: condenser pump and starting ejector pump replacement, water supply circulation pump repair, pipelines and fittings of the system replacement;
- Circulating flumes replacement with condenser filter installation;
- Modernization of the regeneration system: low pressure heater change, discharge pump of the low pressure heater system replacement, pipelines and fittings change;
- Grid heaters installation;
- Overhaul and repair of the cooler generator system: chiller of the circulating pump gas coolers replacement, gas cooler generator pump replacement service water pump replacement;
- Overhaul of the check valves with hydraulic drive;
- Rotor hydraulic system installation.

2. Steampipelines

- Overhaul and repairs.

3. Pumping equipment

- change of the inner casing of the feed pump;
- overhaul and repair of all pumping equipment.

4. Fittings

- overhaul and in case of need – repair and change of the fittings.

5. Insulation

- overhaul and rehabilitation of the high and middle pressure equipment insulation;
- repair of the feed-water pipeline insulation.

6. Control system

- equipping of the turbine with the electronic control, monitor and regulation system.

7. Electric filters

- Change of the electrodes;
- Change of the gas distribution grates;



- Replacement of the high-voltage units of the electric field and replacement control regulator of the system;
- Carriage and bracket girder replacement;
- Bearing insulator and insulator boxes replacement;
- Corona-forming and precipitation electrode jog units and jog drivers replacement;
- High-voltage cable replacement;
- Revision of the thermal insulation and anti-corrosion protection of the cases metal construction renewal;
- Bunkers and cases defects removal;
- Ashes level indicator installation;
- Dusting sensors, gas analysers and smoke fumes sensors installation;
- Fire-warning and fire-fighting system installation.

Alternative 4. The rehabilitation of the power generator without the rehabilitation of the boiler and the turbine equipment:

- Replacement of the stator winding;
- Reconstruction or replacement of the rotor;
- Modernization of the cooling system of the generator with the replacement of the gas condensers;
- Modernization of the unit transformer;
- Modernization of the cooling system of the transformer;
- Reconstruction of the generator conduction;
- Reconstruction of the generator thyristor excitation system;
- Emergency event registrar installation;
- Reconstruction of the boxes of the distribution and complete devices;
- Reconstruction of the standby and working transformer;
- Reconstruction of the power gate;
- Storage battery modernization;
- Installation of the diesel generator for own requirements;
- Electric motor modernization;
- Modernization of the electric motors of the blow fans, mills, hot blast fans, induced-draught fans, etc.;
- Frequent electric driver installation;
- Reconstruction of the electric raceways, replacement of the power and control cable;
- Reconstruction of the illumination system of the all sections.

Alternative 5. The servicing of the equipment, optimisation of the working regimes, and optimisation of the fuel parameters without the rehabilitation. These measures include minor changes in the technology, the replacement of some details and components. The fuel parameters optimisation means higher level of the incoming inspection of the fuel parameters: oxidation, ash content, net caloric value, etc. The optimisation of the working regimes is the most efficient working regime of the Unit (the temperature, the load, etc.).

Alternative 6. The investments in new generation capacity. This alternative includes the termination of the existing equipment operation and it's conservation with the installation of the absolute new boiler, turbine and generating equipment on the same site;

Alternative 7. The continuation of the existing situation. The existing situation is the situation of the equipment usage without any major investments in the reliability and repairs. The repairs are being provided on occasion, if some emergency accidents occur. There would not be any schedule for the repairs or major repairs. The fuel consumption would consist of a low-grade coal use with a view to achieve the financial economy. But the usage of the low-grade fuel results in the lower efficiency and the equipment



life time. In this situation the TPP would continue its operation with the constant lowering of the efficiency.

Sub-step 2b. Assessment of the alternative scenarios

1. The financial parameters are eliminating the *Alternative 1* (see **section B.2**). Only a JI registration can push the rehabilitation forward and allow the Project to be implemented. It also can stimulate the project owner to provide this kind of projects on the other TPPs.
2. The *Alternative 2* will allow the Project Owner to save financial resources for the Project implementation and the efficiency of the boiler part of the Power-Generating Unit will be improved. But, at the same time, the boiler cannot be rehabilitated without getting the whole Power-Generating Unit off the operation. It means that the losses will be the same as for the whole unit rehabilitation. And the efficiency of the unit after this kind of partial rehabilitation will be significantly lower than after the whole Unit rehabilitation. So, the *Alternative 2* is technically possible, but not reasonable and feasible.
3. The *Alternative 3* will also allow the Project Owner to save financial resources for the Project implementation and the efficiency of the steam turbine within the Power-Generating Unit will be improved. But, at the same time, the steam turbine, just as the boiler or the power generator cannot be rehabilitated without getting the whole Power-Generating Unit off the operation. It means that power-generating unit will be out of the operation during the time of the steam turbine rehabilitation. And the efficiency of the unit after this kind of partial rehabilitation will be significantly lower than after the whole Unit rehabilitation. So, the *Alternative 3* is technically possible, but not reasonable and feasible.
4. The *Alternative 4* is not feasible for the same reasons as the *Alternatives 2 and 3*.
5. The *Alternative 5* allows saving the finances in the short-term perspective but the effectiveness of these measures without the rehabilitation will be limited. Optimisation of the working regimes is limited by the technical condition of the equipment. Without the rehabilitation, the work at the optimal regime and manoeuvring is possible in a very small range. Consequently, it results in the fuel consumption and GHG emission increase. Thus, the *Alternative 5* is only possible in a short-term perspective and is not feasible or reasonable.
6. The financial barrier also eliminates the *Alternative 6*. The cost of the new power generating plant with the same approximate capacity would cost around 1 000 USD/kW¹⁴. It means that the construction of the new TPP with the same loading capacity as Kryvorizka TPP will cost around 2,8 Billion USD. Even the JI registration does not allow accumulating the amount of money to build a new generation capacity.
7. The continuation of the existing situation is the most plausible alternative (*Alternative 7*). The existing situation in the Ukrainian Power Sector has already been described in the “SECTOR BACKGROUND” in section A.4.3. of the PDD. It shows that even the existence of the National Programs or other official documents can't guarantee the implementation of the energy efficiency measures in the Power sector. The main part of them remains on paper.

Outcome of Step 2b:

¹⁴ http://www.necin.com.ua/teplo_elektro_energy/parogaz.htm



There is only one alternative scenario that is not prevented by any barrier, and this alternative is not the proposed project activity undertaken without being registered as a JI project. This scenario is *Alternative 7*. The continuation of the existing situation. The existing situation is the situation of the equipment usage without any major investments in the reliability and repairs. The repairs are being provided on occasion, if some emergency accidents occur. There would not be any schedule for the repairs or major repairs. The fuel consumption would consist of a low-grade coal use to achieve the financial economy. But the usage of the low-grade fuel results in the lower efficiency and the equipment lifetime. In this situation the TPP would continue its operation with the constant lowering of the efficiency.

Demonstration of additionality

Please, see section B.2.

Key Parameters used to identify the Baseline Scenario:

<u>Data/ Parameter</u>	<i>SF_iy</i>
Data unit	Comparative data
Description	The share of fuel <i>i</i> combusted by the power plant for the electrical energy production in year <i>y</i> , taken in the energy units.
Time of determination/monitoring	Should be calculated at least once a year. Monitored throughout the Crediting Period.
Source of data (to be) used	Scales, gas meters, fuel meters. The power plant management on the basis of the natural fuel consumption makes the calculations and it's net caloric value, 3-tech form.
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	-
QA/QC procedures (to be) applied	All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions.
Any comment	-

<u>Data/ Parameter</u>	<i>AELS_y</i>
Data unit	MWh



Description	The amount of the electricity supplied by the power plant to the electricity grid in year y
Time of determination/monitoring	Should be calculated at least once a year. Monitored throughout the Crediting Period.
Source of data (to be) used	Electricity meters, 3-tech form.
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	-
QA/QC procedures (to be) applied	All measurement equipment should be calibrated and regularly maintained and checked for it's functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions.
Any comment	-

<u>Data/ Parameter</u>	<i>OXID_{iy}</i>
Data unit	Comparative data
Description	Oxidation factor of the fuel <i>i</i> in year y
Time of determination/monitoring	Determined in the PDD. Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	The values of the oxidation coefficient (<i>OXID_{iy}</i>) were defined in the IPCC 1996 Guidelines for National Greenhouse Gas Inventories ¹⁵ and the "National GHG Inventory Report" (Inventory) of Ukraine for 1990 - 2009 ¹⁶
Value of data applied (for ex ante calculations/determinations)	According to the Inventory <i>OXID_{iy}</i> for the coal used at the Kryvorizka TPP in 2009 (the latest reported year) was 0,945 ¹⁷ ; According to the Inventory The <i>OXID_{iy}</i> coefficient for the coal for the previous years was:

¹⁵ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>

¹⁶ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

¹⁷ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13



	<p>2006 – 0,951; 2007 – 0,948; 2008 – 0,957¹⁸.</p> <p>The value from the latest version of the Inventory will be used for the Monitoring Reports.</p> <p>OXIDiy for the heavy fuel oil is 0,99 (IPCC data); OXIDiy for the natural gas is 0,995 (IPCC data).</p>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The <i>OXIDiy</i> parameter shows the share of the fossil fuel fully oxidised during the combustion
QA/QC procedures (to be) applied	-
Any comment	-

<u>Data/ Parameter</u>	<i>EFiy</i>
Data unit	tonnes of CO ₂ /TJ
Description	CO ₂ emission factor of the fuel <i>i</i> in year <i>y</i>
Time of determination/monitoring	Determined in the PDD. Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	The values of the emission factor (<i>EFiy</i>) were defined in the IPCC 1996 Guidelines for National Greenhouse Gas Inventories ¹⁹ and the “National GHG Inventory Report” (Inventory) of Ukraine for 1990 - 2009 ²⁰
Value of data applied (for ex ante calculations/determinations)	<i>EFi</i> for the coal – 0,0946 tonnes of CO ₂ per GJ (according to the Inventory, the carbon emission factor of the coal, used at the Kryvorizka TPP in 2009 (the latest reported year) was 25,8 tonnes of C / TJ ²¹ . To calculate the carbon dioxide (CO ₂) emission factor we use the transformation coefficient CO ₂ /C = 44 / 12 . Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO ₂ emission factor 94,6 tonnes of CO ₂ /TJ, or 0,0946 tonnes of CO ₂ /GJ was used for the coal); According to the Inventory, the emission factor of the coal

¹⁸ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13

¹⁹ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>

²⁰ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

²¹ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 379, table. P2 10



	<p>cobusted at the Kryvorizka TPP in the previous years was: 2006 – 0,0946 tonnes of CO₂/GJ; 2007 – 0,0946 tonnes of CO₂/GJ; 2008 – 0,0946 tonnes of CO₂/GJ²².</p> <p>For the other years the latest value of the parameter was used. The value from the latest version of the Inventory will be used for the Monitoring Reports.</p> <p>EFi for the heavy fuel oil – 0,0774 tonnes of CO₂ per GJ (according to the IPCC 1996 Workbook, the carbon emission factor of heavy fuel oil is 21,1 tonnes of C / TJ. To calculate the carbon dioxide (CO₂) emission factor we use the transformation coefficient CO₂/C = 44 / 12. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO₂ emission factor 77,366 tonnes of CO₂/TJ, or 0,0774 tonnes of CO₂/GJ was used for the heavy fuel oil);</p> <p>EFi for the natural gas – 0,0554 tonnes of CO₂ per GJ (according to the Inventory, the carbon emission factor of natural gas used in Ukraine in 2009 (the latest reported year) was 15,11 tonnes of C / TJ²³. To calculate the carbon dioxide (CO₂) emission factor we use the transformation coefficient CO₂/C = 44 / 12. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO₂ emission factor 55,4 tonnes of CO₂/TJ, or 0,0554 tonnes of CO₂/GJ was used for the natural gas).</p> <p>According to the Inventory, the emission factor of the natural gas cobusted at the Kryvorizka TPP in the previous years was: 2006 – 0,05566 tonnes of CO₂/GJ; 2007 – 0,0554 tonnes of CO₂/GJ; 2008 – 0,05544 tonnes of CO₂/GJ²⁴.</p> <p>For the other years the latest value of the parameter was used. The value from the latest version of the Inventory will be used for the Monitoring Reports.</p>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The <i>EFi</i> parameter shows the CO ₂ emission from the combustion of the fossil fuel of different types.
QA/QC procedures (to be) applied	-
Any comment	-
Data/ Parameter	SFRb

²² http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 379, table. P2 10

²³ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 376, table. P2 6

²⁴ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 376, table. P2 6



Data unit	tonnes of the equivalent fuel per MWh or GJ/MWh
Description	Specific Fuel Rate of the power plant in the Baseline Scenario
Time of determination/monitoring	Determined in the PDD. Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	Historical data for at least three years prior to the project implementation. The data is usually calculated by the power plant management
Value of data applied (for ex ante calculations/determinations)	For the Baseline Scenario the value is 0,3844 tef/MWh (11,2619 GJ/MWh)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per unit of the electric energy supplied to the electricity grid. The calculation of the <i>SFR</i> shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up. The use of the <i>SFR</i> parameter shows the real fuel efficiency of the TPP independent of the fuel quality and the net caloric value and allows comparing the fuel efficiency data of the different time periods.
QA/QC procedures (to be) applied	The calculation of the SFR parameter is being made in accordance with the GKD-34.09.103-96, approved by the Ministry of Energy and Electrification of Ukraine in 1996 and the GKD 34.08.108-98, approved by the Ministry of the Fuel and Energy of Ukraine in 1998. These documents are the basic ones for the calculation and monitoring of the work parameters of the power plants in Ukraine. All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions.
Any comment	-

<u>Data/ Parameter</u>	<i>n</i>
Data unit	Years
Description	The number of years of the period, previous to the project to calculate the average data of the parameters to set the Baseline Scenario.
Time of	Determined in the PDD.



determination/monitoring	Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	Historical data for at least three years prior to the project implementation.
Value of data applied (for ex ante calculations/determinations)	3 years ($n \geq 3$)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The data for the at least 3 years allows seeing the main tendencies and the dynamic of the parameters values.
QA/QC procedures (to be) applied	-
Any comment	-

Data/ Parameter	<i>F_{iy}</i>
Data unit	tonnes, thousand of m3
Description	The amount of the fuel <i>i</i> consumed by the power plant for the electricity production in year <i>y</i>
Time of determination/monitoring	Determined in the PDD. Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	Historical data for at least three years prior to the project implementation.
Value of data applied (for ex ante calculations/determinations)	The data for the each fuel type (coal, natural gas and the heavy fuel oil) is taken from the meters and scales (see Annex 3)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The data for the at least 3 years allows seeing the main tendencies and the dynamic of the parameters values.
QA/QC procedures (to be) applied	All measurements will use calibrated measurement equipment.
Any comment	-

Data/ Parameter	<i>NCV_{iy}</i>
Data unit	Gcal/tonne (th.m3)
Description	The net caloric value of the fuel <i>i</i> in year <i>y</i> of the Baseline Scenario
Time of determination/monitoring	Determined in the PDD. Not monitored throughout the Crediting Period. Available at the Determination.
Source of data (to be) used	Historical data for at least three years prior to the project implementation.
Value of data applied	The data for the each fuel type (coal, natural gas and the heavy



(for ex ante calculations/determinations)	fuel oil) is taken from the supplier of the fuel and checked by the TPP's accredited chemical laboratory (see Annex 3)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The data for the at least 3 years allows seeing the main tendencies and the dynamic of the parameters values.
QA/QC procedures (to be) applied	All measurements will use calibrated measurement equipment.
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:

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For the Project the own JI Specific approach is used The Project will use a baseline in accordance with the "Tool for the demonstration and assessment of additionality" (Version 05.2.1) ²⁵.

Identification of the most plausible baseline scenario for the rehabilitation and/or energy efficiency improvement of the power plant through the application of the following steps:

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

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

See section B.1

Outcome of Step 1a:

Alternative 1. The proposed project activity not undertaken as a JI project;

Alternative 2. The reconstruction of the boiler equipment without the rehabilitation of the turbine and power generator;

Alternative 3. The reconstruction of the steam turbine without the rehabilitation of the generator and the boiler;

Alternative 4. The rehabilitation of the power generator without the rehabilitation of the boiler and the turbine equipment;

Alternative 5. Servicing of the equipment, optimisation of the working regimes, and optimisation of the fuel parameters without the rehabilitation.

Alternative 6. The investments in the new generation capacity;

Alternative 7. The continuation of the existing situation.

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

²⁵ <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v5.2.1.pdf>



All the alternatives to the project outlined in Step 1a above are in compliance with applicable laws and regulations. Any major reconstructions in the energy sector of Ukraine have to consist the environmental impacts assessments and all the measures, described as the alternatives should also have such an assessment. Generally, the power sector of Ukraine is being regulated by such laws:

Ukrainian Law on Power Industry dated 16 October 1997, N 575/97-BP²⁶ is the basic law in Ukraine that determines legal, economic, and organizational activities relevant to electricity and regulates the relationships linked with generation, distribution and consumption of power, energy security of Ukraine, competition and other aspects of power industry. The law stimulates and ensures sustainability issues related to the power industry: such as rational fuel consumption, technological development, and environmental safety.

In 1996, Ukraine adopted the National Energy Program until 2010²⁷, designed to rehabilitate working thermal power plants to allow them to continue operating for the next 25 years. As a way to reach this objective, the program's mandate specified technological improvements, use of renewable energy sources and modernization of the power plants, including making them more environmentally friendly. The program also specified that combined cycle-gas turbine equipment- as well as most of the auxiliary equipment - needed to be improved to reach acceptable safety levels. Good-quality coal was to be used to reduce environmental damage. However, many of these reconstruction and modification projects have been seriously delayed because of the shortage of state budget financing, weak legislation, and the lack of private investment.

To make the country less dependent on energy imports, the President has issued a Decree on measures to increase energy security of Ukraine (21 October 2005), and called for the elaboration of an Energy Strategy covering the period until 2030. The Cabinet of Ministers Resolution No. 145-p approved the new Energy Strategy up to 2030 in March 2006²⁸.

Outcome of Step 1b:

Alternative 1. The proposed project activity not undertaken as a JI project;

Alternative 2. The reconstruction of the boiler equipment without the rehabilitation of the turbine and power generator;

Alternative 3. The reconstruction of the steam turbine without the rehabilitation of the generator and the boiler;

Alternative 4. The rehabilitation of the power generator without the rehabilitation of the boiler and the turbine equipment;

Alternative 5. Servicing of the equipment, optimisation of the working regimes, and optimisation of the fuel parameters without the rehabilitation;

Alternative 6. The investments in the new generation capacity;

Alternative 7. The continuation of the existing situation.

Step 2. Investment Analysis

²⁶ <http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0>

²⁷ <http://www.uazakon.com/document/spart91/inx91184.htm>

²⁸ <http://zakon.rada.gov.ua/signal/kr06145a.doc>



The purpose of the investment analysis is to determine whether the proposed project activity is not:

- (a) The most economically or financially attractive; or
- (b) Economically or financially feasible, without the revenue from the sale of emission reductions.

The investment analysis has been carried out by the project participants in accordance with the “Guidance on the Assessment of Investment Analysis” (Version 05)²⁹.

Sub-step 2a: Determine appropriate analysis method

The proposed project generates cost savings, so cost analysis (sub-step 2b Option I) of the Additionality Tool cannot be used.

In line with the CDM Additionality Tool version 05.2.1 Option III – benchmark analysis – has been chosen. The project participants have chosen to use Project NPV as the assessment indicator. In order to select a proper benchmark for the indicator chosen project participants have assessed options contained in the Additionality Tool.

The 4b approach of the Option III was selected. Project participants have taken the average commercial lending rates (factual data for the TPP rehabilitation projects in 2007-2008) relevant for the decision making context of this project as a benchmark for the Project NPV.

Sub-step 2b. Application of the benchmark analysis

The benchmark for this project’s NPV is the average commercial lending rate in Ukraine. This means that the project owner would not consider the investment if the project is generating cash flow with an IRR less than the benchmark.

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

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

- The benchmark is the average commercial lending rate in Ukraine due in 2007-2008. It is equal to 15%.
- Cash flow calculation was made for the period 2007-2020 (14 years).

The total investment costs of the Project are 10 027 750 000 UAH.

The decision to start the reconstruction was made in 2006.

The calculations are made, taking into account only the price of the coal, as it is the main fuel for the TPP and the investment decision was made for the fuel mix, where the part of the coal was about 98 – 99%. Thus, the parameters of the other fuel types could have been neglected.

Due to a higher expected electrical efficiency of the unit after the reconstruction, less fuel would be spent to generate the same amount of electricity, thus the project generates cost saving resulting from fuel saving.

The resulting **Project NPV is equal to – 2 465 501 000 UAH (-236 204 350 Euro)**. The project would not have been financially attractive without the JI component. Even the JI registration of the Project would not make the Project financially attractive. If the ERU price is 10 Euro, the Project NPV is – **2 361 423 060 UAH (-226 233 280 Euro)**.

Sub-step 2d. Sensitivity analysis

In the Sensitivity Analysis two most important factors fluctuations were considered:

²⁹ http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf



- Scenario 1 - Coal (the main type of fuel at the TPP) price up 20%.
- Scenario 2 - Investment costs down 20%.

The result of the Sensitivity Analysis:

Scenario 1: NPV – 2 382 263 000 UAH.

Scenario 2: NPV – 1 889 163 000 UAH.

Outcome of Step 2: After the sensitivity analysis it is concluded that the proposed JI project activity is unlikely to be financially/economically attractive. Proceeding to Step 4 (Common practice analysis).

Step 3. Barrier analysis (optional)

Not applicable

Step 4. Common practice analysis

Currently in Ukraine, there are the following energy efficiency improvement initiatives underway at the country's various power producing facilities.

During past 15 years only few projects for the TPP rehabilitation were implemented in Ukraine on the state-owned TPPs and were financed by the grants and the government financing.

The main measures of the governmental policy have already been described in the Sector Background in Section A.4.3. Main activities described in the Strategy are similar to the Project Activity with minor differences. All these activities are not implemented because of the lack of financial resources. The situation in the energy sector of Ukraine leads to the situation, when most of the TPPs are going to be privatised, but no special targets or activities are going on because of the political and financial uncertainty. The Reconstruction of the Units of the Kryvorizka TPP is one of few projects implementing only because the TPP is a private enterprise and the possibility of the development as JI Project.

The common practice in Ukraine includes repairs of the generating equipment and the scope of these repairs is given in the GKD 34.20.661-2003 "The Rules for the Organization of the Power Plants and the Networks Equipment, Buildings and Constructions Servicing and Repairs" approved by the Ministry of the Fuel and Energy of Ukraine in 2004. All the measures described as the Project Scenario are beyond them.

Sub-step 4 is satisfied because the similar activities are observed but there are essential distinctions between the proposed JI project activity and similar activities occurs. Then the proposed project activity is additional.

The Baseline Scenario is the amount GHG that would have otherwise been generated by the Kryvorizka TPP at the absence of the Project and it was described in the Section B.1. The national regulations for the energy production are described in the "SECTOR BACKGROUND" in section A.4.3. of the PDD.

The Project consists of the full rehabilitation of the Power-Generating Units of the TPP (detailed description is provided in the section A.4.2.).

The greenhouse gases emission in the Project Scenario is reduced by the more efficient use of the fuel. The provision of the TPP rehabilitation will reduce the amount of the fuel combusted for production of the energy unit (MW, Gcal). That means that each MW of energy produced will contain less fuel that means that the greenhouse gases emission per MW (or Gcal) will be less than it would have occurred in the absence of the JI project.

For the four year period (2009 - 2012), a total of **25 365 933 tonnes of CO2 equivalent** is expected to be produced in the project activity.

For a four (2009 - 2012) year period, a total of **25 666 374 tonnes of CO2 equivalent** is expected to be produced in the baseline scenario.

The total emission reductions of the four year period are **300 441 tonnes of CO2 equivalent**.

For the sixteen year period (2013 - 2028), a total of **147 622 608 tonnes of CO2 equivalent** is expected to be produced in the project activity.

For a sixteen year period, a total of **156 274 818 of CO2 equivalent** is expected to be produced in the baseline scenario.

The total emission reductions of the sixteen year period are **8 652 210 tonnes of CO2 equivalent**.

Assumptions:

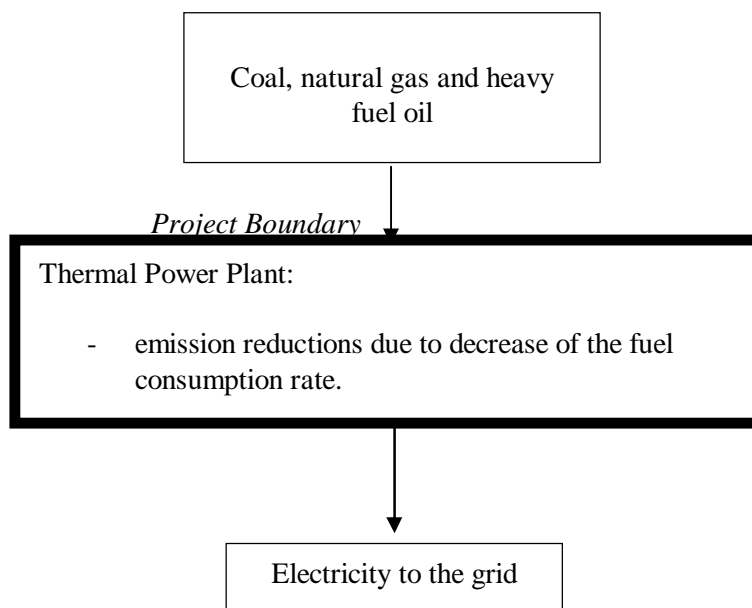
The calculations of the Baseline Emissions, Project Emissions and the Emission Reductions for the 2009 – 2010 were based on the actual data for these years. The calculations for the 2011 – 2028 are based on the planned data. During the project the actual data for will be used for the calculations.

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

>>

The project activity encompasses efficiency improvements in the Kryvorizka Power Plant. The spatial extent of the project boundary includes the project site and all the Units of the Kryvorizka TPP.

Figure 6. Project boundary



Sources and gases included in the project boundary are indicated in the table below.

Table 5. Sources of emission in the Baseline Scenario and in the Project

	Source	Gas	Included	Justification / Explanation
Baseline	Baseline Power plant emission	CO ₂	Yes	CO ₂ is formed with the combustion of fuels.
		CH ₄	No	Minor source, can be neglected (conservative approach).



	(Under control of the Project Owner)	N ₂ O	No	Minor source, can be neglected.
Project Activity	Project Power Plant emission (Under control of the Project Owner)	CO ₂	Yes	CO ₂ is formed with the combustion of fuels.
		CH ₄	No	Minor source, can be neglected (conservative approach).
		N ₂ O	No	Minor source, can be neglected

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

>>

Date of the baseline setting: 12/05/2011

Name of the person(s)/entities setting the baseline: "Elta-Eco" LLC (not a Project Participant)

Rogovoy Maksym Ivanovich, Director.

Tel: +38 050 595 0311

Fax: +38 057 713 41 02

E-mail: m_rogovoy@elta.kharkov.ua

Detailed contact information in Annex 1.

**SECTION C. Duration of the project / crediting period****C.1. Starting date of the project:**

>>

28/12/2006 (Contract for the technical and economical assessment of the Unit #3 rehabilitation № 87-723-2841-DPO/05 dated 28.12.06).

C.2. Expected operational lifetime of the project:

>>

20 years (240 months).

The rehabilitations provided as the Project Scenario provides the operational lifetime increase for 20 years.

C.3. Length of the crediting period:

>>

The beginning of the crediting period is 01/01/2009 – the first day of the ERUs generation by the Project.
The end date is 31/12/2012.

The crediting period after the end of the first commitment period of the Kyoto Protocol is 16 years (192 months).

Starting date of the period is – 01/01/2013.

The end date of the period is – 31/12/2028.

The status of the emission reductions made by project in post Kyoto period will be determined by respective decision of the UNFCCC parties.

**SECTION D. Monitoring plan****D.1. Description of monitoring plan chosen:**

>>

The JI specific approach is used for monitoring in accordance with paragraph 9 (a) of the “Guidance on criteria for baseline setting and monitoring”. According to the Baseline chosen the Monitoring plan supposes the measurement of the fuel (coal, natural gas, heavy fuel oil) consumption, electricity production, supply and heat supply during a year with the monthly calculation of the emission reductions. Thermal energy delivery is minor and getting lower only because of the energy efficiency measures and lowering of the losses (the demand for the thermal energy is constant – heating for the Zelenodolsk town). We make a conservative assumption that in the project scenario the thermal energy delivery and production will remain around 1% of the fuel consumption and do not take it into account in the calculations. The Specific fuel rate (*SFR_y*) coefficient is also calculated separately for the electricity and the thermal energy. The calculations of the fuel consumption by the TPP are being made in the tonnes of the equivalent fuel (According to the GKD-34.09.103-96, approved by the Ministry of Energy and Electrification of Ukraine in 1996). One ton of the equivalent fuel is 7 Gcal or 29,3076 GJ (see Annex 2). This method takes the NCV of the fuel into account and allows comparison of the parameters for the different years. The *SFR* coefficient shows the fuel consumption per the electricity supplied to the grid. It means, that the own consumption of the TPP is taken into account. The average rate of the *SFR* parameter or the period of 2006 – 2008 (before the start of the Project) was taken as the Baseline *SFR_b* coefficient (see Annex 2).

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:**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
P1 <i>PE_y</i>	Project emission in year y	calculations	tonnes of CO2 equivalent	c	yearly	100%	electronic, paper	Calculated by formulae (4) in chapter D.1.1.2., see below
P2 <i>SFR_y</i>	Specific Fuel Rate in year y	Calculations, 3-tech form	GJ/MWh	c	monthly	100%	electronic, paper	Measured, then calculated



								monthly in accordance with the GKD-34.09.103-96, approved by the Ministry of Energy and Electrification of Ukraine in 1996. (see. Annex 2, formula (7)) and fixed in the “3-tech” form.
P3 <i>SF_iy</i>	The share of fuel <i>i</i> consumed for energy production in year <i>y</i>	Scales, gas meter, fuel meters, 3-tech form	Comparative units	m/c	monthly	100%	electronic, paper	The meters measure the amount of fuel used in a real time, then the parameter is calculated according to the NCV of the fuel <i>i</i> .
P4 <i>OXID_iy</i>	Oxidation factor of the fuel <i>i</i> in year <i>y</i>	the IPCC 1996 Guidelines for National Greenhouse Gas Inventories ³⁰ and the “National GHG Inventory	Comparative units	e	Before start	100%	electronic, paper	According to the Inventory <i>OXID_iy</i> for the coal used at the Kryvorizka TPP in 2009 (the latest reported

³⁰ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>



		Report” (Inventory) of Ukraine for 1990 - 2009 ³¹						year) was 0,945 ³² ; For the previous years was: 2006 – 0,951; 2007 – 0,948; 2008 – 0,957 ³³ . The value from the latest version of the Inventory will be used for the Monitoring Reports. OXIDiy for the heavy fuel oil is 0,99 (IPCC data); OXIDiy for the natural gas is 0,995 (IPCC data).
P5 <i>EF_{iy}</i>	The CO2 emission factor of the fuel <i>i</i> in year <i>y</i>	the IPCC 1996 Guidelines for National Greenhouse Gas Inventories ³⁴ and the “National GHG Inventory	Tonnes of CO2/TJ	e	Before start	100%	electronic, paper	See Chapter B.1.

³¹ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

³² http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13

³³ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13

³⁴ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>



		Report ³⁵ (Inventory) of Ukraine for 1990 - 2009 ³⁵						
P6 <i>AELS_y</i>	The amount of the electricity supplied to the grid in year y	Electricity meters, 3-tech form	MWh	m	Continuously	100%	electronic, paper	Monitored constantly and archived daily, monthly and annually

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

>>

The calculation of the Project Emissions is provided by the getting of the specific greenhouse gas emission factor of the energy unit supplied to the Grid and then by the multiplication of this parameter by the annual electricity supply to the Grid in the accounting year. The emissions from the combustion of each fuel type (coal, heavy fuel oil and natural gas) is calculated by the multiplication of the Specific Fuel Rate (*SFR_y*) parameter (in energy units), the share of this specific fuel combusted in the accounting year (*SF_{iy}*), the defined emission factor of this fuel type (*EF_{iy}*) and the oxidation coefficient of the fuel type (*OXID_{iy}*)³⁶. The greenhouse gas emissions coefficients achieved for the each fuel type are summed up and then multiplied by the annual electricity supplied to the grid in the accounting year.

The Project emission is being calculated as follows:

$$PE_y = \sum(SFR_y * SF_{iy} * OXID_{iy} * EF_{iy}) * AELS_y \quad (4),$$

where:

PE_y – Project emission in year y, tonnes of CO₂ equivalent;

SFR_y – specific fuel rate of the station in year y, GJ/MWh;

³⁵ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

³⁶ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>



SFi_y – share of fuel i (coal, natural gas or a heavy fuel oil), consumed in year y , comparative values;

$OXIDiy$ – oxidation factor of the fuel i , comparative values;

EFi_y – emission factor of the fuel i consumed, tonnes of CO₂ /GJ;

$AELS_y$ – the amount of the electricity supplied to the electricity grid in year y , MWh.

D.1.1.3. Relevant data necessary for determining the <u>baseline</u> of anthropogenic emissions of greenhouse gases by sources within the <u>project boundary</u>, 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
B1 <i>BE_y</i>	Baseline emission	monitoring	t of CO ₂ equivalent	c	Yearly	100%	electronic, paper	Calculated by formulae (5) in chapter D.1.1.4., see below
B2 <i>SFR_b</i>	Specific Fuel Rate in the Baseline Scenario	Historical data	GJ/MW	c	Before start	100%	electronic, paper	Measured, then calculated using the historical data (Annex 2, formula (8))

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

>>

The Baseline emission is being calculated for the situation, when the specific fuel rate of the TPP remains the same as if there were no reconstruction or rehabilitation of the equipment of the TPP. The Baseline emission is being calculated as follows:



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$$BE_y = \Sigma (SFR_b * SF_{iy} * OXID_{iy} * EF_{iy}) * AELS_y \quad (5)$$

where:

BE_y – Baseline emission in year y , tonnes of CO₂ equivalent;

SFR_b – specific fuel rate of the power plant in the Baseline Scenario, GJ/MWh;

SF_{iy} – share of fuel i (coal, natural gas or a heavy fuel oil), consumed by the project activity power plant in year y in energy units;

$OXID_{iy}$ – oxidation factor of the fuel i in year y ;

EF_{iy} – emission factor of the fuel i consumed in year y , tonnes of CO₂ /GJ;

$AELS_y$ – the amount of the electricity supplied by the power plant to the electricity grid in year y , MWh.

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

This section left blank. No direct monitoring expected.

D.1.2.1. Data to be collected in order to monitor emission reductions from the <u>project</u>, and how these data will be archived:								
ID number <i>(Please use numbers to ease cross-referencing to D.2.)</i>	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

See sec. D.1.2.

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

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reductions in units of CO₂ equivalent):

>>

See sec. D.1.2.

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

This section is left blank, as due to the Project implementation the fuel consumption is lowered, so the Leakages due to the fugitive CH₄ emission are also lowered³⁷. Moreover, this value is vanishingly small and we use the conservative assumption, that the leakage is left the same as in the Baseline Scenario.

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 <i>(Please use numbers to ease cross-referencing to D.2.)</i>	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

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO₂ equivalent):

See sec. D.1.3

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 CO₂ equivalent):

>>

The emission reductions achieved during the project period are calculated as a difference between annual baseline emission and annual project emission. It is shown by the formula:

$$ER_y = BE_y - PE_y \quad (6)$$

³⁷ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>



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where:

ER_y – emission reductions achieved by the project activity in year *y*, tonnes of CO₂ equivalent;

BE_y – baseline CO₂ emission in year *y*, tonnes of CO₂ equivalent;

PE_y – project CO₂ emission in year *y*, tonnes of CO₂ equivalent.

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:

>>

For the purposes of the safe and reliable operation and monitoring of the installed equipment the quality control and quality assurance measures are implemented on the TPP in accordance with the current legislation and requirements. According to these requirements of the quality control system regular servicing and test mode of the instrumentation is provided. All the measurement equipment is being regularly calibrated. The information of the calibration is being stored and to be checked by the independent entity annually. The check for the data accuracy and calculation of the emission reductions shall be made and collected monthly. According to the current Ukrainian laws and requirements the measurement of the pollution of dust, soot, NO_x, CO, etc. should be monitored and documented. These parameters are reflected in the standard form 2TP-Air (the latest edition was approved by the National Statistics Committee of Ukraine Order №223 dated 30.06.2009). The TPP also receives the Pollution Permission from the Ministry of the Environmental Protection of Ukraine. The main legal acts ruling the Project activities are: The Law of Ukraine “For the Environmental Protection” #1264-XII issued 25.06.1991³⁸; The Law of Ukraine “For the Atmosphere Air Protection” #2707-XII issued 16.10.1992³⁹; International Standart “Environmental Management System” ISO 14001-2004⁴⁰.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data <i>(Indicate table and ID number)</i>	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.

³⁸ <http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1264-12>

³⁹ <http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2707-12>

⁴⁰ http://www.iso.org/iso/catalogue_detail?csnumber=31807



<p>P3 <i>SFi</i> The amount of fuel used for energy production</p>	<p>Low</p>	<p>The data from the belt-conveyer weigher (for coal) are controlled after installation and regularly controlled and calibrated in accordance with the service instruction of the producer. All defects should be rectified with the consequent calibration. The gas meter is controlled and calibrated by the gas supplying company in accordance with its procedures and current legislation. The defected meter should be replaced. The Levels of the accuracy of the meters are shown in the Annex 3.</p>
<p>P6 <i>AELS</i> The annual electricity supply</p>	<p>Low</p>	<p>The data from the electric counters are controlled after installation and regularly controlled and calibrated in accordance with the service instruction of the producer and the legislation requirements. The defected counter should be replaced.</p>

Regardless of Monitoring Plan all the data from the meters and weighs should be controlled daily. In addition to the parameters mentioned, other data should be read to control the operation of the equipment.

Any defective equipment should be replaced or repaired as soon as possible.

According to the current Ukrainian laws and requirements the measurement of the pollution of dust, soot, NOx, CO, etc. should be monitored and documented.

The monitoring of the Fuel Consumption is provided daily and reflected in the reports.

The monitoring of the NCV of the fuel is provided in the certified TPP laboratory.

The monitoring of the electricity supply to the Grid is provided continuously and reflected in the daily reports.

All the data measured and the SFR calculated value is reflected in the monthly reports and in the yearly “3-tech” form.

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

>>

The project is implemented on the TPP in accordance with technical standards of Ukraine. All the equipment has monitoring and security equipment according to the national energy sector requirements. All the data, needed for the monitoring is collected in the production department of the TPP and accumulated in a specific standard table called “3-tech Form” and also the data from the meters will be collected. The main parameters of the Station are measured by the meters and shown in graphs in a real time. The data of the fuel consumption is measured and collected for the whole TPP and the energy produced is measured per each unit separately. This allows to measure the average emission for all the TPP and to see the influence of the Project activity while some of the units are out of operation. All the starts and stops of each Unit are monitored and also shown in the technical documentation alongside with the working time hours for each Unit of the TPP. That means, that even when some unit will be out of operation, all the measures will continue to be collected and the overall project emission will still be calculated. All the calibrations and checks of the equipment are also documented.



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The electricity supply is being monitored by the Electricity Department of the TPP at the central electric pane of the TPP and sent to the Technical Production Department (TPD).

For the electricity supply data collection 16 electricity meters SL761B071-type (accuracy class – 0,5) are used. All the meters are regularly calibrated by the approved organizations. The calibration date and the next calibration date will be provided at the Monitoring Reports for every reporting period.

The coal consumption is being monitored daily by the Fuel-Transport Department. The reports are also sent to the TPD.

The weighers used for the coal consumption monitoring are regularly calibrated by the approved organizations. The calibration date and the next calibration date will be provided at the Monitoring Reports for every reporting period.

The heavy fuel oil consumption is being monitored daily by the Boiler-Turbine Department of the TPP. The reports are sent to the TPD.

The Gas Distribution System is monitoring the natural gas consumption. The daily reports are also sent to the TPD.

The data of the Net Caloric Value of the fuel is being provided to the TPD by the certified laboratory of the TPP daily.

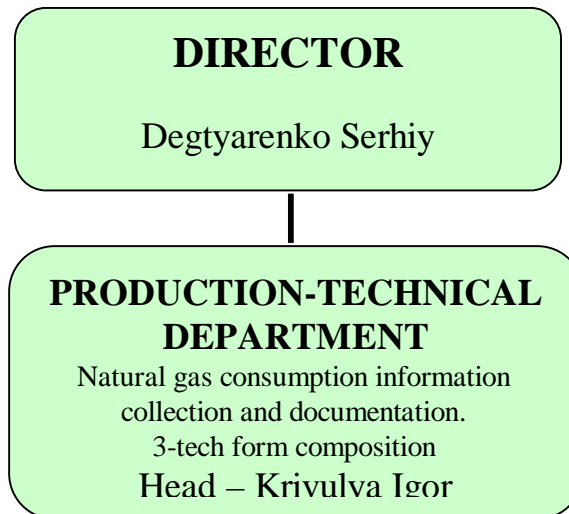
The TPD collects all the data and calculate the Specific Fuel Rate daily. After that, the data is being summarized in the monthly reports and in the annual report called “3-tech” Form.

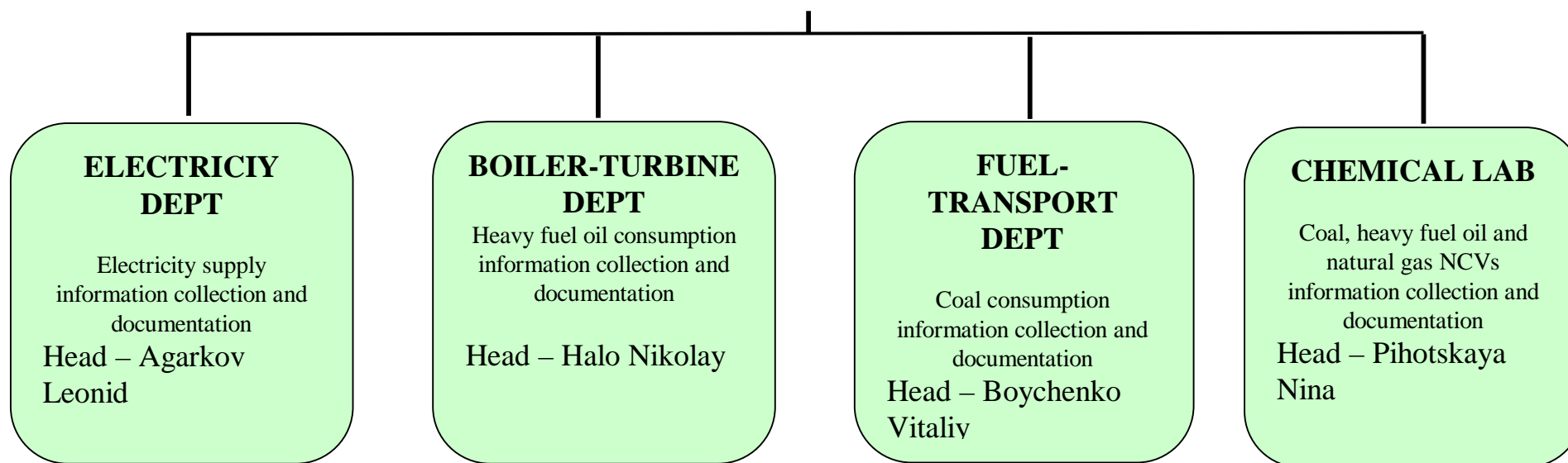
All the measures will be send to the project manager of the “Elta-Eco” company, who will collect the data, calculate emission, emission reductions and create a monitoring report.

All the data shall be stored in the paper and electronic form at the TPP and in the data base of the “Elta-Eco” company during all lifetime of the project and for at least two years after the last transfer of ERUs for the Project.

The project manager from the «Elta-Eco» company checks the reliability of the data and calculates emission reductions at least monthly. The project manager of the “Elta-Eco” prepares the annual report to be confirmed by the Independent Entity.

The Project operator - «Dniproenergo», provides all the maintenance work and services. The Project manager of the “Elta-Eco” company provides monitoring and data collection





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

>>

Date of the completion of the Monitoring plan: 15.08.2011

Mr. Maksym Rogovoy

ELTA-ECO LLC (Not a Project Participant)

14/3, Stadionny proezd str.

Kharkov, Ukraine

61091

Telephone: + 38 050 5950311



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Fax: + 38 057 392 0045

M_rogovoy@elta.kharkov.ua

The detailed contact information see in the Annex 1.

**SECTION E. Estimation of greenhouse gas emission reductions****E.1. Estimated project emissions:**

>>

The following calculations are based on the baseline determined in the Section B.2. and formulas (4), (5), and (6) in the Sections D.1.1.2, D.1.1.4. and D.1.4. The energy produced after the rehabilitation has a lower emission factor compared to the one before the rehabilitation. Higher efficiency of the TPP Units reflects in lower fuel consumption per GJ of the energy produced by the TPP. We calculate emission per MW of the electricity supplied to the grid. The conservative assumptions are used in all the calculations. All the uncertainties of the measures were taken into account in the calculation of the Specific fuel rate of the TPP in accordance with the Ukrainian laws and regulations. All the data used for the calculations consists the precision and accuracy of the measuring equipment. For the Project the JI Specific Approach will be used.

Table E-1. Estimated project emissions (see formula (1) in Section D.1.1.2)

Estimated project emissions [tonnes of CO2 equivalent], crediting period	
Year	Year
2009	4 707 349
2010	6 185 389
2011	7 566 364
2012	6 906 831
Total 2010 – 2012	25 365 933

Estimated project emissions [tonnes of CO2 equivalent], post-Kyoto period	
Year	Estimated project emission (tonnes of CO2 equivalent)
2013	7 412 771
2014	8 290 776
2015	8 581 975
2016	8 385 229
2017	8 809 450
2018	9 265 400
2019	9 359 932
2020	9 724 119
2021	9 724 119
2022	9 724 119
2023	9 724 119
2024	9 724 119
2025	9 724 119
2026	9 724 119
2027	9 724 119
2028	9 724 119
Total 2013 - 2028	147 622 608

E.2. Estimated leakage:

>>

This section is left blank. See. Section D.1.3.

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

>>

Table E-2. Estimated project emissions plus leakages.

Estimated project emissions plus leakage [tonnes of CO2 equivalent], crediting period	
Year	Estimated project emission plus leakage (tonnes of CO2 equivalent)
2009	4 707 349
2010	6 185 389
2011	7 566 364
2012	6 906 831
Total 2010 – 2012	25 365 933

Estimated project emissions plus leakage [tonnes of CO2 equivalent], post-Kyoto period	
Year	Estimated project emission plus leakage (tonnes of CO2 equivalent)
2013	7 412 771
2014	8 290 776
2015	8 581 975
2016	8 385 229
2017	8 809 450
2018	9 265 400
2019	9 359 932
2020	9 724 119
2021	9 724 119
2022	9 724 119
2023	9 724 119
2024	9 724 119
2025	9 724 119
2026	9 724 119
2027	9 724 119
2028	9 724 119
Total 2013 - 2028	147 622 608

E.4. Estimated baseline emissions:

>>

Table E-3. Estimated baseline emissions (see formula (5) Section D.1.1.4)

Estimated baseline emissions [tonnes of CO2 equivalent], crediting period	
Year	Estimated baseline emission (tonnes of CO2 equivalent)
2009	4 716 757
2010	6 244 962
2011	7 697 267
2012	7 007 388
Всего 2010 – 2012	25 666 374

Estimated baseline emissions [tonnes of CO2 equivalent], post-Kyoto period	
Year	Estimated baseline emission (tonnes of CO2 equivalent)
2013	7 573 031



2014	8 525 866
2015	8 877 466
2016	8 751 530
2017	9 246 414
2018	9 829 585
2019	9 981 992
2020	10 387 659
2021	10 387 659
2022	10 387 659
2023	10 387 659
2024	10 387 659
2025	10 387 659
2026	10 387 659
2027	10 387 659
2028	10 387 659
Всього 2013 - 2028	156 274 818

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

>>

Table E-4. Emission reductions of the project (formula (6) from Section D.1.4)

Estimated emission reductions of the project [tonnes of CO2 equivalent], crediting period	
Year	Estimated emission reductions (tonnes of CO2 equivalent)
2009	9 408
2010	59 574
2011	130 902
2012	100 556
Total 2010 – 2012	300 441

Estimated emission reductions of the project [tonnes of CO2 equivalent], post-Kyoto period	
Year	Estimated emission reductions (tonnes of CO2 equivalent)
2013	160 259
2014	235 089
2015	295 491
2016	366 301
2017	436 964
2018	564 185
2019	622 060
2020	663 540
2021	663 540
2022	663 540
2023	663 540
2024	663 540
2025	663 540
2026	663 540
2027	663 540
2028	663 540
Total 2013 - 2028	8 652 210

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

>>

Table E-5. Project emissions and emission reductions of the crediting period (2009-2012)

Year	Estimated <u>project</u> emissions (tonnes of CO2 equivalent)	Estimated <u>leakage</u> (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2009	4 707 349	0	4 716 757	9 408
2010	6 185 389	0	6 244 962	59 574
2011	7 566 364	0	7 697 267	130 902
2012	6 906 831	0	7 007 388	100 556
Total (tonnes of CO2 equivalent)	25 365 933	0	25 666 374	300 441
Annual average value of the CO2 emission reductions (tonnes of CO2 equivalent)	6 341 483	0	6 416 594	75 110

Table E-6. Project emissions and emission reductions of the post-Kyoto period (2013-2028).

Year	Estimated <u>project</u> emissions (tonnes of CO2 equivalent)	Estimated <u>leakage</u> (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2013	7 412 771	0	7 573 031	160 259
2014	8 290 776	0	8 525 866	235 089
2015	8 581 975	0	8 877 466	295 491
2016	8 385 229	0	8 751 530	366 301
2017	8 809 450	0	9 246 414	436 964
2018	9 265 400	0	9 829 585	564 185
2019	9 359 932	0	9 981 992	622 060
2020	9 724 119	0	10 387 659	663 540
2021	9 724 119	0	10 387 659	663 540
2022	9 724 119	0	10 387 659	663 540
2023	9 724 119	0	10 387 659	663 540
2024	9 724 119	0	10 387 659	663 540
2025	9 724 119	0	10 387 659	663 540
2026	9 724 119	0	10 387 659	663 540
2027	9 724 119	0	10 387 659	663 540
2028	9 724 119	0	10 387 659	663 540
Total (tonnes of	147 622 608		156 274 818	8 652 210



CO2 equivalent)		0		
Annual average value of the CO2 emission reductions (tonnes of CO2 equivalent)	9 226 413	0	9 767 176	540 763

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:

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The rehabilitation of each Unit of the TPP consists the description of the Environmental impacts. For today only the Unit №3 has been developed. All the others will also have the description of the Environmental Impact, which is usually the part of the Technical and Economical Assessment of the Project

The environmental impacts of the Project are described in the Explanatory Note “Environmental Impact Assessment of the Kryvorizka TPP Unit № 3 Rehabilitation Project”, prepared by the SRI “Teploenergooproekt” of the “Donbassenergo” JSC in 2010.

No transboundary or an adverse environmental impacts are expected.

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:

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No negative environmental impacts of the project are expected and there are no special procedures required by Ukraine for this Project.

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

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The Project was presented to the Government of Ukraine and to the Local Authorities as a Project Idea and, later, as the Technical Documentation. The Government and Local Authorities has approved the Project. The Letter of Endorsement has been received from the National Environmental Investments Agency of Ukraine.

The information concerning the Project was published in the local newspaper "Apostolivsky Novyny" №41 dated 21-27.05.07.

All the comments received were positive.

Annex 1**CONTACT INFORMATION ON PROJECT PARTICIPANTS****PROJECT OWNER**

Organisation:	Dniproenergo JSC.
Street/P.O.Box:	Dobrolyubova str.
Building:	20
City:	Zaporizhzhya
State/Region:	
Postal code:	69006
Country:	Ukraine
Phone:	+38 (061) 286 -73-59
Fax:	+38 (061) 286-71-55, 286-71-12
E-mail:	
USREOU code	00130872
URL:	www.dniproenergo.ua
Represented by:	Serdyukov Roman
Title:	The Chairman of Board
Salutation:	Mister
Last name:	Serdyukov
Middle name:	Petrovich
First name:	Roman
Department:	
Phone (direct):	+38 (061) 286 -73-59
Fax (direct):	+38 (061) 286-71-55, 286-71-12
Mobile:	
Personal e-mail:	kanc@gc.dnepr.energy.gov.ua

**PROJECT DEVELOPER**

Organisation:	Elta-Eco LLC
Street/P.O.Box:	Stadionny proezd
Building:	14/3
City:	Kharkov
State/Region:	
Postal code:	61091
Country:	Ukraine
Phone:	+38 (057) 713 4102
Fax:	+38 (057) 392 0045
E-mail:	elta@elta.kharkov.ua
URL:	www.elta.kherkov.ua
Represented by:	Rogovoy Maksym
Title:	Director
Salutation:	Mister
Last name:	Rogovoy
Middle name:	Ivanovich
First name:	Maksym
Department:	
Phone (direct):	
Fax (direct):	+38 062 713 41 02
Mobile:	+38 050 595 0311
Personal e-mail:	m_rogovoy@elta.kharkov.ua

**THE POTENTIAL BUYER OF THE EMISSION REDUCTION UNITS**

Organisation:	ING Bank N.V.
Street/P.O.Box:	Bijlmerplein 888
Building:	AMP D.05.007
City:	Amsterdam
State/Region:	
Postal code:	1102 MG
Country:	The Netherlands
Phone:	-
Fax:	-
E-mail:	-
URL:	www.ing.com
Represented by:	Peter van Eindhoven
Title:	Director
Salutation:	Mister
Last name:	van Eindhoven
Middle name:	-
First name:	Peter
Department:	Commercial Banking Structure Finance
Phone (direct):	+31 20 565 82 07
Fax (direct):	+31 20 565 82 07
Mobile:	+31 65 021 30 41
Personal e-mail:	Peter.van.eindhoven@ingbank.com



Annex 2

BASELINE INFORMATION

The Project emission reductions are achieved due to lowering of the fuel consumption per MW of the energy supplied. The rehabilitation of the equipment allows increasing the efficiency of the fuel usage by the TPP. This allows lowering the emission coefficient of the energy supplied from 1,005 tonnes of CO₂/MWh to 0,9395 tonnes of CO₂/MWh.

The values of the emission factor (*EF_i*) and the oxidation coefficient (*OXID_i*) defined in the IPCC 1996 Guidelines for National Greenhouse Gas Inventories⁴¹ and the “National GHG Inventory Report” (Inventory) of Ukraine for 1990 - 2009⁴² were used for the calculations:

The CO₂ emission factor (*EF_i*):

***EF_i* for the coal – 0,0946 tonnes of CO₂ per GJ** (according to the Inventory, the carbon emission factor of the coal, used at the Kryvorizka TPP in 2009 (the latest reported year) was **25,8** tonnes of C / TJ⁴³. To calculate the carbon dioxide (CO₂) emission factor we use the transformation coefficient CO₂/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO₂ emission factor **94,60** tonnes of CO₂/TJ, or **0,0946** tonnes of CO₂/GJ was used for the coal); According to the Inventory, the emission factor of the coal combusted at the Zaporizka TPP in the previous years was:

2006 – 0,0946 tonnes of CO₂/GJ;

2007 – 0,0946 tonnes of CO₂/GJ;

2008 – 0,0946 tonnes of CO₂/GJ⁴⁴.

***EF_i* for the heavy fuel oil – 0,0774 tonnes of CO₂ per GJ** (according to the IPCC 1996 Workbook, the carbon emission factor of heavy fuel oil is **21,1** tonnes of C / TJ. To calculate the carbon dioxide (CO₂) emission factor we use the transformation coefficient CO₂/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO₂ emission factor **77,366** tonnes of CO₂/TJ, or **0,0774** tonnes of CO₂/GJ was used for the heavy fuel oil);

***EF_i* for the natural gas – 0,0554 tonnes of CO₂ per GJ** (according to the Inventory, the carbon emission factor of natural gas used in Ukraine in 2009 (the latest reported year) was **15,11** tonnes of C / TJ⁴⁵. To calculate the carbon dioxide (CO₂) emission factor we use the transformation coefficient CO₂/C = **44 / 12**. Thus, for the Project and Baseline emission and the Emission reductions calculation for the Project the CO₂ emission factor **55,4** tonnes of CO₂/TJ, or **0,0554** tonnes of CO₂/GJ was used for the natural gas). According to the Inventory, the emission factor of the natural gas combusted at the Kryvorizka TPP in the previous years was:

2006 – 0,05566 tonnes of CO₂/GJ;

2007 – 0,0554 tonnes of CO₂/GJ;

⁴¹ <http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm>

⁴² http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php

⁴³ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 379, table. P2 10

⁴⁴ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 379, table. P2 10

⁴⁵ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 376, table. P2 6



2008 – 0,05544 tonnes of CO₂/GJ⁴⁶.

The oxidation factor (*OXID_{iy}*) of the fuel used:

According to the Inventory *OXID_{iy}* for the coal used at the Kryvorizka TPP in 2009 (the latest reported year) was **0,945**⁴⁷;

According to the Inventory The *OXID_{iy}* coefficient for the coal for the previous years was:

2006 – 0,951;

2007 – 0,948;

2008 – 0,957⁴⁸.

OXID_{iy} for the heavy fuel oil is **0,99** (IPCC data);

OXID_{iy} for the natural gas is **0,995** (IPCC data).

For calculations of the baseline emissions the historical data of the years 2006, 2007 and 2008 was used.

During these years the all Units were in operation and this data allows seeing the average parameters of the TPP in the baseline scenario:

Annual electricity supply by the TPP:

AELS2006 = 5 730 649 MWh;

AELS2007 = 5 844 270 MWh;

AELS2008 = 5 853 349 MWh;

AELSubl = (5 730 649 + 5 844 270 + 5 853 349)/3 = **5 809 423** MWh.

The electricity generation by the TPP will substitute the less carbon effective, which would have occur in the Baseline Scenario. For the Calculations of the Baseline emission the value of the Specific Fuel Rate (*SFR*) was used. This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per the electric energy supplied to the grid.

$$SFR_y = \frac{\sum (F_{iy} * NCV_{iy})}{7} / AELS_y \quad (7)$$

Where

SFR_y – specific fuel rate of the power plant in year y, t.e.f./MWh. (GJ/MWh);

⁴⁶ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 376, table. P2 6

⁴⁷ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13

⁴⁸ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php, p. 381, table. P2 13



F_{iy} – the amount of the fuel i consumed by the power plant for the electricity production in year y , tonnes (th.m3);

NCV_{iy} – net caloric value of the fuel i in year y , Gcal/tonne (th.m3);

γ - the net caloric value of one ton of the equivalent fuel, Gcal;

$AELS_y$ - annual energy supply of the power plant in year y , MWh.

All the data achieved in the calculations is being lowered by the uncertainties and accuracy level of the measuring equipment. (According to the GKD-34.09.103-96, approved by the Ministry of Energy and Electrification of Ukraine in 1996 and the GKD 34.08.108-98, approved by the Ministry of the Fuel and Energy of Ukraine in 1998).

The fixed value of the SFR parameter in the Baseline scenario allows taking into account the effect of the planned repairs at the TPP (in accordance with the 34.08.108-98, approved by the Ministry of the Fuel and Energy of Ukraine in 1998). In the other case, the parameter would have been lowering every year.

It is usually measured in the grams of the equivalent fuel per kWh (tonnes per MWh) of the energy supplied to the grid. One ton of the equivalent fuel (tef) is 29,3076 GJ or 7 Gcal. The calculation of the SFR shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up. The use of the SFR parameter shows the real fuel efficiency of the TPP independent of the fuel quality and the net caloric value and allows comparing the fuel efficiency data of the different time periods.

The energy efficiency of the power plant has to be determined prior to the implementation of the project activity. For this purpose, the value of the SFR parameter in the baseline scenario should be calculated taking into account the value of the parameter in at least 3 (three) years prior to the project implementation:

$$SFR_b = \frac{\sum_{i=1}^n SFR_{yi}}{n} \quad (8),$$

Where:

SFR_b – a specific fuel rate of the power plant in the baseline scenario, GJ/MWh;

SFR_{yi} – a specific fuel rate of the power plant in years, prior to the Project Implementation, GJ/MWh;

n - number of years ($n \geq 3$).

For the Baseline Emission calculation the historical data was used:

$$SFR_{2006} = 0,3835 \text{ tef/Mwh (11,2366 GJ/MWh)}$$

$$SFR_{2007} = 0,3835 \text{ tef/Mwh (11,2366 GJ/MWh)}$$



$SFR_{2008} = 0,3861 \text{ tef/Mwh (11,3127 GJ/MWh)}$

$SFR_b = (SFR_{2006} + SFR_{2007} + SFR_{2008}) / 3 = \mathbf{0,3844 \text{ tef/Mwh (11,2619 GJ/MWh)}}$

The Baseline Emissions are calculated for each year in accordance with the electricity supply and the changes of the fuel mix. The fixed parameters are the IPCC default values and the Specific Fuel Rate for the Baseline Scenario, which is defined for the TPP without the Project activities.

Annex 3

MONITORING PLAN

As emission reductions from the project are determined by the amount of each fuel used, and the electricity supplied to the grid by the power plant a monitoring system to monitor the fuel usage and the electricity production implemented on the TPP will be used. All the data will be documented and stored in electronic and paper view during the lifetime of the project.

Meter reading and calculation of the emission reductions is carried out on a monthly basis.

The meters will be examined, tested, debugged and calibrated every, lead sealed after checking and accepting and must not unseal without the permission. As the instruments are calibrated and marked at regular intervals, the accuracy of measurement can be assured at all times.

The fuel usage system involves measuring of the coal, natural gas, and heavy fuel oil consumption. All measurements will use calibrated measurement equipment.

Coal supply metering is provided by two belt-conveyer weighers with the accuracy class $0,5 \div 1$ and relative precision of $\pm 0,5 \div 1\%$.

The natural gas supply metering to the project is provided using the meter "Leader-VG-1" with the accuracy class 0,2 and relative precision of $\pm 0,2\%$. The meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the gas supply company.

The electricity measuring system involves several meters, which are located at the power plant side on the transformer substation. The types of meters are: 16 electricity meters SL761B071-type (accuracy class – 0,5).

The heavy fuel oil consumption is being calculated using the calibration line at the heavy fuel oil tanks. The calculations are made daily.

The heat supply to the network is measured by the ergometer Type 125 «A» with the accuracy class 2,5 and relative precision of $\pm 1\%$.

All the uncertainties are taken into account.

If the monitoring data is unavailable the calculation of the emission reduction interrupts and the all-necessary documents will be presented to the AIE, SEIA and JISC.