



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:**

Title of the project: "Retrofitting of Khabarovsk Power Plant"

The sectoral scope(s): (1) Energy industries (renewable/non-renewable sources)

PDD Version: 1.3

Date: 16/02/2011

A.2. Description of the project:**Brief description of the project**

The project involves fuel switch of eight coal-fired steam boilers No. 9-16 at Khabarovsk Combined Heat and Power Plant (hereinafter referred as Khabarovsk CHPP-1) to natural gas.

Purpose of the project

The purpose of the project is to provide the reliable and high quality heat and electricity supply to the residential and industrial consumers of Khabarovsk city. The project also allows to enhance the environmental situation in and near the city and to reduce pollutants emissions in the water basin of the Amur River. Implementation of the project results in lower greenhouse gas emissions and environmental pollution.

Situation existing prior to the starting date of the project

Khabarovsk CHPP-1 is one of the main sources of power and heat for the city of Khabarovsk.

Construction of Khabarovsk CHPP-1 started in 1949's. The first power unit of Khabarovsk CHPP-1 was put into operation in September, 1954. The last power unit was commissioned in 1972, the installed power capacity of the plant accounts for 435 MW.

Two groups of the boiler equipment are installed at the CHPP-1: with nominal pressure of steam in front of the turbines of 13 MPa and 9 MPa.

The group of equipment with steam pressure of 13 MPa includes: 8 boilers of BKZ-210-140-F (st. No 9-16), 2 turbines of T-100-130 and 1 turbine of T-105-130.

The group of equipment with steam pressure of 9 MPa includes: 4 boilers of TP-170-100 (st. No 1-4), 2 boilers of BKZ-160-100F (st. No 5, 6) and 2 boilers of BKZ -220-100F (st. No 7, 8), 1 turbine of PT/50-90/13, 1 turbine of PT-30-90/13, one turbine of T-27,5-90 and 2 turbines of PR-25-90/10/0.9.

Installed capacity of the plant¹:

- Power capacity – 435 MW;
- Heat capacity – 881 Gcal/hour.

Prior to the project implementation the main fuel of the plant was coal, brown and bituminous types.

Baseline scenario

The most realistic baseline scenario is continuation of the existing practice at the plant, i.e. steam generation by existing coal-fired steam boilers No 9-16 without any overhauls or retrofits. Steam generated by the boilers is used for power generation, but as the project does not influence general heat capacity of the boilers and power generation, only boilers and auxiliary equipment are included in the project's boundaries.

Before the project implementation the boilers were in sound condition, no investments were required to continue their operation. Moreover, the baseline scenario is not associated with any additional risks as compared to the project scenario. For more details for boilers please refer to Section A.4.2 below.

Project scenario

¹ http://www.dvgk.ru/?redirect=pages&main_action=35, retrieved on 22-11-2010



Under the project scenario, eight existing coal-fired boilers BKZ-210-140-F (st. No 9-16) will be switched to natural gas. The heat and power capacity of Khabarovsk CHPP-1 remains the same. The project does not influence other equipment at the plant e.g. steam turbines or other boilers.

The project also involves construction of mid and low-pressure natural gas pipelines and automatic process control system.

Khabarovsk CHPP-1 will be supplied with natural gas from the Sakhalin-1 oil and gas project on the shelf of Sakhalin Island via the main gas pipeline "Komsomolsk-on-the Amur – Khabarovsk". The date of the main gas pipeline commissioning is 2006.

Expected results of the project:

- Increased efficiency of heat and power generation;
- Optimization of energy generation due to reduction of auxiliary heat and power consumption;
- Mitigation of negative environmental impacts, including reduction of GHG emissions by the plant by 659,892 tonnes of CO₂/year.

Project costs

The cost of the project is approximately 950 mln. RUR.

Brief history of the Project (including its JI component)

"UES of Russia" (Unified Energy System of the Russian Federation) started preparation for implementation of the Kyoto mechanisms long before the ratification of Kyoto Protocol in Russia. An order regarding assessment of JI projects was issued on 04.03.2002.

First discussions of the possibility to switch the Khabarovsk CHPP-1 to natural gas were held since 2003. Kyoto benefits were considered for this and other fuel switch projects of JSC "Khabarovskenergo" since 2004. Critical importance of JI financing for the project was confirmed during the project's feasibility assessment in 2005. This assessment showed that running Khabarovsk CHPP-1 on natural gas is significantly more expensive as compared to running on coal. As fuel expenses are normally included in power and heat tariffs this financial unattractiveness was very important, but not critical. However, the project also required significant investments which could not be compensated through the tariffs. It was decided that revenues from ERU sales can cover the investment expenses. It is also worth noting that the project provides substantial externalities to the community including enhancement of the environmental situation in and near Khabarovsk city.

In May 2005 the meeting took place where decision to start the implementation of the JI project was finally made by the project owner². According to the decision the first boiler was due to be switched to natural gas by the end of 2006.

As per the initial plan the first gas-fired boiler was put into operation in December 2006. Facing increased gas prices, which for Khabarovsk CHPP-1 are tied to JCC oil price index and uncertainty regarding the progress with Kyoto mechanism in Russia, in April 2007 the company decided to postpone complete implementation of the project and limit 2007 investment program to conversion of three more boilers to natural gas, leaving the remaining 4 on coal.

Since recovery of investments in the fuel-switch project is reliant on JI financing, conversion of remaining 4 boilers has been postponed a number of times. In early 2010 when regulatory regime became more transparent and Sberbank announced the first contest for host-country JI project approval, JSC "FEGC" resumed activities on the JI project and subject to receipt of funding from ERU sales plans conversion of remaining 4 coal-fired boilers in 2012 and 2013.

A.3. <u>Project participants:</u>
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² The protocol of the meeting will be made available to the AIE.



<u>Party involved</u>	Legal entity <u>project participant</u> (as applicable)	Please indicate if the <u>Party involved</u> wishes to be considered as <u>project participant</u> (Yes/No)
Party A: Russian Federation (<u>host Party</u>)	Legal entity A1: OJSC “Far Eastern Generating Company”	No
Party B: To be determined	Legal entity B1: To be determined	No

Open Joint Stock Company “Far Eastern Generating Company” was registered on December 19, 2005 in Neryungri, Sakha (Yakutia) Republic and from the January 1, 2007 it started its operational activity. The Head office of JSC “FEGC” is located in Khabarovsk. The main assets of JSC “FEGC” are power and heat generating facilities and grids, which were owned by reorganised on 1 February 2007 so called AO-Energo: JSC “Khabarovskenergo”, CJSC “LuTEK”, JSC “Dalenergo”, JSC “South Yakutskenergo”, JSC “Amurenergo”.

The company’s power plants, with installed capacity accounting for 5840.58 MW of electric power, produce 21.5 billions kWh of electricity and 22.3 millions Gcal of heat a year. This fact makes JSC “FEGC” one of the largest TGK (territorial generating company) in Russia and the main participant of Energy market in the Far East of Russia covering about 67% of regional power consumption. At the same time, JSC “FEGC” executes the district heating function in five federal administrative subjects of Russian Federation (Khabarovsk territory, Primorsky territory, Amourskaya region, Jewish Autonomous region and the southern part of Sakha (Yakutia) Republic) and the function of the retailer of heat, delivering to the end consumer 18,2 millions Gcal a year.

The company employs 17 thousand people. JSC “FEGC” revenue in 2009 financial year reached 41,2 billions RUB.

The company’s organizational structure is formed on the territorial basis, i.e. the branches of JSC “FEGC” have been created in the regions where the separate, uncoordinated power companies operated before the restructuring of the Far Eastern power industry.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is carried out on the territory of Khabarovsk CHPP-1, located in Khabarovsk city, Khabarovsk region, Russian Federation.


A.4.1.1. Host Party(ies):

The Russian Federation

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

Khabarovsk Region

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

Khabarovsk city

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

Khabarovsk CHPP-1 is located in the city of Khabarovsk, Uzlovaya street, 15.

Today Khabarovsk city is considered to be a capital of the whole Russian Far East. Most of federal and regional institutions are located in Khabarovsk (the Far East military district headquarters, the Far East railway headquarters, Glavdalstroj, Dallesprom, Dallesstroj Holdings etc.)

Khabarovsk is the second largest city in the region and the fourth in terms of the territory. It is located on the right bank of the Amur River at its junction with the Ussuri River, and is 45 km long with total area about 37 thousand ha. The city is subdivided into five districts: Krasnoflotskiy, Kirovskiy, Tsentraliy, Zheleznodorozhniy and Promyshlenniy.

Khabarovsk city is the largest industrial, transport, cultural and scientific center of the Russian Far East. There are about 100 enterprises of mechanical engineering, metallurgy, construction, food, light and other industries in the city. The Khabarovsk railway hub is the largest in the region, and its river port is the largest on the Amur River.

Geographical coordinates: latitude - 48° 29' 0" N, longitude - 135° 4' 0" E³.

³

[http://toolserver.org/~geohack/geohack.php?pagename=Khabarovsk¶ms=48_29_N_135_4_E_region:RU_type:city\(583,072\)](http://toolserver.org/~geohack/geohack.php?pagename=Khabarovsk¶ms=48_29_N_135_4_E_region:RU_type:city(583,072))



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

Prior to the project implementation the installed power and heat capacities of the Khabarovsk CHPP-1 amounted to 435 MW and 881 Gcal/h correspondingly. The plant consumes a mixture of black and brown coals as a main fuel.

Two groups of the equipment are installed at the CHPP-1: with nominal pressure of steam in front of the turbines of 13 MPa and 9 MPa.

The group of equipment with steam pressure of 13 MPa includes: 8 boilers of BKZ-210-140-F (st. No 9-16) produced by Barnaul Boiler Factory, 2 turbines of T-100-130 and 1 turbine of T-105-130 produced by Ural Turbine Motor Factory.

The group of equipment with steam pressure of 9 MPa includes: 4 boilers of TP-170-100 (st. No 1-4) produced by Taganrog Boiler Factory, 2 boilers of BKZ-160-100F (st. No 5, 6) and 2 boilers of BKZ - 220-100F (st. No 7, 8), 1 turbine of PT/50-90/13, 1 turbine of PT-30-90/13, one turbine of T-27,5-90 and 2 turbines of PR-25-90/10/0.9.

Besides, 3 peak hot-water boilers of PTVM-100 (st. No 18-20) are installed in the boiler department of Khabarovsk CHPP-1.

The project envisages conversion of eight coal fired high-pressure boilers BKZ-210-140F (13 MPa) No 9-16 to natural gas with installation of appropriate gas supply, burning and control equipment. The project covers only one type of boilers: BKZ-210-140-F (st. No 9-16). The project does not influence general heat capacity of the boilers. After the project's implementation the output of heat energy from the reconstructed boilers will remain the same. Thus, electric and heat capacity of the CHPP will also not be changed. All other boilers as well as turbines are not included in the project boundary. Prior to the project implementation the boilers No 9-16 were in sound condition and had sufficient remaining lifetime. The technical condition of the boilers are presented in the Table A.4.2-1 below.

Table A.4.2-1. Technical condition of the steam boilers before reconstruction

Station No.	Type	Manufacturer	Year of commissioning	Operating time from the date of commissioning, thous. hours	Individual lifetime (IL), thous. hours	Year of reaching of IL
1	2	3	4	5	6	7
	13 MPa					
9	BKZ-210-140-F	Barnaul boiler manufacturing works	1966	242	300	2016
10	BKZ-210-140-F		1967	237	300	2017
11	BKZ-210-140-F		1968	212	300	2022
12	BKZ-210-140-F		1970	220	300	2020
13	BKZ-210-140-F		1971	204	300	2022
14	BKZ-210-140-F		1972	216	300	2024
15	BKZ-210-140-F		1972	193	300	2028
16	BKZ-210-140-F		1973	242	300	2016

The relevant technical parameters of the project boilers are presented in the Table A.4.2-2.

Table A.4.2-2. The relevant technical parameters of the project boilers⁴.

Station No.	Type	Efficiency of the boilers before reconstruction ⁵	Efficiency of the boilers after reconstruction ⁶	Heat capacity (t. of steam/hour)
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⁴ Only data from official sources - boiler passports, boiler flow charts are used.

⁵ Values for the boilers #9,10,11,16 are factual values estimated before their switch to natural gas. Efficiency for boilers # 12,13,14,15 are estimated average values. For more details please refer to the Section B.1 below.



1	2	4	5	6
	13 MPa			
9	BKZ-210-140-F	90.4%	95.1%	210
10	BKZ-210-140-F	90.67%	93.51%	210
11	BKZ-210-140-F	92.0%	93.4%	210
12	BKZ-210-140-F	90.5%	93.93%	210
13	BKZ-210-140-F	90.5%	93.93%	210
14	BKZ-210-140-F	90.5%	93.93%	210
15	BKZ-210-140-F	90.5%	93.93%	210
16	BKZ-210-140-F	88.94%	93.7%	210

Eight high-pressure boilers BKZ-210-140F (13 MPa) No. 9-16 should be switched to gas with installation of appropriate equipment. Other eight low-pressure (9 MPa) boilers No. 1-8 will be put in the reserve. Coal remains the main fuel for these boilers. Reallocation of the load between the groups of equipment of high and low pressure will occur following the project implementation: most of the load from boilers No. 1-8 will be transferred to the boilers No. 9-16. This reallocation is possible due to sufficiently low capacity utilization of Khabarovsk CHPP-1. For example, in 2005 capacity utilization factor for electricity amounted to 41%. The group of equipment of 13 MPa has considerable heat and power reserve to replace the group of equipment of 9 MPa without decline in power production.

After the load redistribution from low-pressure equipment of 9 MPa (130 MW) to high-pressure equipment group of 13 MPa (305 MW) the load factor will increase to approximately 60%. This load level allows efficient operation of the high-pressure equipment group of 13 MPa.

As a result of the project implementation the efficiency of the high-pressure group of equipment, specifically, boilers No.9-16 will increase. There are three main reasons for it:

- The coal preparation system requires significant amount of electricity for the crushing the coal in the pulverizers. Gas preparation system (e.g. pressure control) does not require significant amount of power. Besides, the coal has a lower heat value, in comparison to natural gas, and in order to produce specific amount of power or heat it is necessary to supply the greater volume of fossil fuel. This leads to the higher energy consumption for the air supply and disposal of exhaust gases. Therefore, the auxiliary electricity consumption during operation on natural gas is lower, than on coal.
- The second source of efficiency is the higher burning effectiveness of the gas due to the implementation of modern burners which leads to further increase of the boiler efficiency.
- The third reason is associated with the load increase at the equipment group of 13MPa. The efficiency of power generation at turbines is higher on equipment with higher operating pressure. Concentration of load on more efficient equipment leads to higher overall efficiency of the whole plant.

GHG emission reductions due to the implementation of measures specified above are slightly lower in comparison with reductions, achieved due to the conversion from coal to natural gas.

According to the forecast, the load of the CHPP-1 is not expected to change significantly. During the period from 2005 to 2009 the load of Khabarovsk CHPP-1 gradually reduced due to the gradual launch of Bureiskaya HPP. Stable demand for electricity and heat will make it possible to keep the coal boilers No 1-8 in reserve.

As a result of retrofitting of the Khabarovsk CHPP-1 with conversion to natural gas while maintaining existing boiler capacity, the labor conditions at the facility and ecological situation in the city will improve significantly - the emissions of ash and sulfur from gas-fired boilers will be fully eliminated.

⁶ Values for the boilers #9,10,11,16 are factual values estimated after their switch to natural. Efficiency for boilers # 12,13,14,15 are forecasted values. For more details please refer to the Section B.1 below.



The Khabarovsk CHPP-1 is supplied with natural gas from the Sakhalin-1 oil and gas project via the main gas pipeline "Komsomolsk-on-the Amur – Khabarovsk". The pipeline was commissioned in 2006. The Khabarovsk CHPP-1 is supplied with natural gas via the city high-pressure branch pipeline from the gas distribution substation (GDP) No. 1. The maximum gas pressure in the gas pipeline connected to the Khabarovsk CHPP-1 is 0.6 MPa. No natural gas storage tanks are envisaged on the site of the Khabarovsk CHPP-1. The natural gas pressure reduction and control at the specified level in the gas supply system of the Khabarovsk CHPP-1 will be provided by the equipment located on the factory-made gas distribution point (GDP).

The technological complex of the gas supply to the Khabarovsk CHPP-1 includes:

- high pressure gas pipeline to the gas distribution substations;
- factory-assembled gas distribution substations;
- gas flow commercial accounting system installed at the gas distribution substation;
- gas flow process accounting for each boiler;
- two medium pressure gas lines located on the territory of the Khabarovsk CHPP-1 over the existing and designed trestles running from the gas distribution substation to the main building;
- gas pipelines within each boiler (inlet and control units) located in the boiler department;
- provision of gas equipment for the burners per each boiler;
- installation of gas burners;
- air inlet to boiler burners;
- gas firing process control system.

The project envisages provision for boilers No. 9-16 of natural gas equipment ensuring automatic fuel control and ignition. The gas pipelines located on the territory of Khabarovsk CHPP-1 plant are laid over the existing and designed trestles running from the gas distribution substation to the main building.

The automation and alarm system of the reduction block includes:

- block compartment gas content alarm;
- monitoring of gas flow, pressure and temperature;
- alarm on the trip of the relevant reduction lines;
- fire and block door opening alarms;
- installation of the gas flow metering system.

The gas flow metering system is installed in the gas distribution substation at the inlet of the pressure-reduction block-box.

The management of the personnel training and retraining at Khabarovsk CHPP-1 is carried out by the Chief Engineer, and the general control of implementation thereof – by the General Director of the enterprise.

Operating personnel of the plant underwent special training at Komsomolsk CHPP-2. The workers of this plant have been operating on the natural gas for a long time and they have sufficient experience to help to the workers of Khabarovsk CHPP-1 to cope with the operation of the plant on new fuel without complications and problems.

Implementation schedule of the project

	Implementation schedule	Date of completion of works	
1.	Gas distribution station (GDS)		
	High pressure gas pipeline from fence of CHPP-1 to GDS		05.10.2006
	Gas distribution substation No 1	15.09.2006	01.12.2006
	System for Commercial accounting of natural gas usage	25.09.2006	01.12.2006
	Middle pressure gas pipe line from GDS No 1	15.09.2006	01.12.2006
2.	Boiler No. 11		
	Upgrade of steam boiler for gas usage, including:	01.04.2006	15.09.2006



	- internal gas-pipelines within the boilers,	01.04.2006	01.09.2006
	- set up of gas-jets and manifold by the gas equipment,	01.08.2006	01.09.2006
	- installation of gas burners	01.07.2006	01.08.2006
	- Date of commissioning		22.12.2006
3.	Boilers No. 10, 16		
	Upgrade of steam boiler for gas usage, including:	01.11.2006	01.04.2007
	- internal gas-pipelines within the boilers,	01.11.2006	15.01.2007
	- set up of gas-jets and manifold by the gas equipment,	01.02.2007	20.03.2007
	- installation of gas burners	15.01.2007	15.02.2007
	- Date of commissioning		27.12.2007
4.	Boiler No. 9		
	Upgrade of steam boiler for gas usage, including:	01.06.2007	27.12.2007
	- internal gas-pipelines within the boilers,	01.06.2007	10.09.2007
	- set up of gas-jets and manifold by the gas equipment,	15.12.2007	17.12.2007
	- installation of gas burners	11.09.2007	15.12.2007
	- Date of commissioning		27.12.2007
6.	Boiler No. 12	2012	2012
6.	Boiler No. 13	2012	2012
7.	Boiler No. 14	2012	2012
8.	Boiler No. 15	2013	2013

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:

Overall, the project implementation will lead to reduction of the GHG emissions, out of which the primary one is CO₂.

Reduction of GHG emissions as a result of the project implementation will occur due to conversion of the main heat-generating fossil fuel at Khabarovsk CHPP-1 from coal to less carbon-intensive natural gas, simultaneously improving the overall thermal efficiency. Implementation of the project will also lead to energy saving due to the reduction of auxiliary electricity and heat consumption.

The project does not influence general heat capacity of the boilers No. 9-16. After the project implementation the output of heat energy from the retrofitted boilers will remain the same. Electric and heat capacity of the CHPP will not be changed. Therefore steam turbines and other boilers installed at the plant and used for electricity generation are excluded from the project boundary.

Only emissions attributable to the boilers No. 9-16, fuels (including extraction, processing and transportation) and auxiliary equipment are considered for the purposes of emissions reduction estimation.

The specified GHG emission reductions would not occur in the absence of the proposed project, since:

- Khabarovsk CHPP-1 would continue to operate, using the existing coal-fired boilers No. 9-16 and auxiliary equipment which are in sound condition;
- No additional investments are necessary to run existing coal-fired boilers No. 9-16;
- In the absence of the project it would be possible to avoid risks associated with the lack of professional experience in handling of natural gas equipment at the plant;
- No significant changes in the Russian environmental legislation are foreseen, which could force the enterprise to avoid operating the coal-fired boilers;
- There are no limitations on the GHG emissions for the companies in Russia and none are expected in the foreseeable future.



For more information please refer to Section B.2 below.

The project will also lead to reduction of pollutants emissions such as nitrogen dioxide, nitrogen monoxide, sulphur dioxide, carbon monoxide, dust and soot into the atmosphere. Therefore, the ecological situation near the CHPP will improve.

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

Table.A.4.3.1-1. Estimated amount of emission reduction over the first crediting period

	Years
Length of the <u>crediting period</u>	5 years
Year	Estimates of annual emission reductions in tonnes of CO ₂ equivalent
2008	666,545
2009	653,226
2010	659,896
2011	659,896
2012	659,896
Total estimated emission reductions over the <u>crediting period</u> (tonnes of CO ₂ equivalent)	3,299,458
Annual average of estimated emission reductions over the <u>crediting period</u> (tonnes of CO ₂ equivalent)	659,892

A.5. Project approval by the Parties involved:

According to the Russian legislation, the letter of approval will be issued by the Russian Government based on an expert statement issued by the AIE. Once the Approval is received, both the PDD and the determination report will be updated and the determination will become final.

**SECTION B. Baseline****B.1. Description and justification of the baseline chosen:**

According to paragraph 9 of the “Guidance on criteria for the baseline setting and monitoring”, version 02 (hereinafter referred to as “Guidance”), the project participants may select either:

- (a) An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach); or
- (b) A methodology for baseline setting and monitoring approved by Executive Board of clean development mechanism (CDM).

PDD developers choose Option (a) – JI specific approach to establish a baseline scenario for the current project. Baseline is set up in accordance with the Decision 9/CMP.1, Guidelines for the implementation of Article 6 of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.2. 30 March 2006 and on the basis of “Guidance on criteria for baseline setting and monitoring”, Version 02.

In order to justify the most plausible and realistic baseline scenario, detailed analyses of plausible alternatives are carried out below.

Application of the approach chosen : Identification of a baseline based on the selection of the most plausible alternative scenario**Identification and listing of plausible baseline scenarios**

The proposed project envisages fuel switch of eight steam boilers installed at Khabarovsk CHPP-1. Steam generated by the boilers is used further for power generation, but as the project does not influence general steam capacity of the boilers and power generation, only steam boilers and auxiliary equipment are included in the project’s boundary. The project owner runs eight coal-fired boilers of BKZ-210-140-F type, each with steam capacity of 210 t/hour. Only plausible alternatives for the project owner, OJSC “Far Eastern Generating Company”, which are connected with the main activity i.e. combustion of fossil fuel for the purposes of steam generation are considered. Hypothetical alternatives for the project scenario like installation of biofuel fired boilers, geothermal, solar and nuclear steam generation are excluded from further consideration due to price and availability constraints.

There are no special national and/or sectoral policies and circumstances which influence the baseline for the current project. There is no legislation or regulation restricting the use of coal or natural gas at Khabarovsk CHPP-1. In general the Russian government has taken a number of steps to encourage use of coal and increase of coal share in the state fuel balance. According to the “General scheme of location of power-generating objects till 2020 and with perspective till 2030” the share of coal in the fuel balance of Russia should increase from 27% to 31-35% by 2030.

Consistency of plausible alternative scenarios with relevant national and/or sectoral policies and circumstances is analyzed in Sub-step 1b in Section B.2 below.

Alternative scenarios available for the project owner are listed below:

- Alternative scenario 1: Implementation of the project without involving of JI mechanism;
- Alternative scenario 2: Business-as-usual scenario, i.e. operation of existing coal fired boilers of BKZ-210-140-F type for the purpose of steam generation without any retrofitting.

Identification of the most plausible alternative scenario

Alternative scenario 1: Implementation of the project without involving of JI mechanisms

Project implementation without involving JI mechanism is not a plausible and credible baseline scenario because this alternative is not financially attractive and is prevented from implementation by significant financial barriers. Please refer to the Section B.2 below for the details of barrier analysis.

Alternative scenario 2: Business-as-usual scenario, i.e. operation of existing coal fired boilers of BKZ-210-140-F type for the purposes of steam generation without any retrofitting. This scenario is the most plausible and credible alternative for the project scenario because:

- All boilers are in sound condition. All boilers were installed from the late 60s to the 70s. The individual life of installed coal boilers is about 300,000 hours according to the technical documentation. The total runtime period of the oldest boiler #1 is about 242,000 hours. Thus, all boilers have sufficient remaining operating life. The end of remaining lifetime of the oldest boiler is 2016. All boilers undergo regular repairs and maintenance service. Furthermore, it is a common practice in Russia to extend operating lifetime by conducting major repairs or reconditioning of equipment at the end of certified operating period;
- All boilers provide very high efficiency of coal combustion. According to the regime charts all boilers provide gross efficiency of more than 89%. This is very close to the efficiency of new boilers of the same types⁷ and is slightly less than efficiency of the boilers after switching to natural gas. For more details of boilers' condition before the project implementation please refer to Section A.4.2 above;
- As all boilers are in sound condition and have long remaining lifetimes this alternative does not require any investment as compared with alternative one;
- Khabarovsk CHPP-1 historically uses coal as the main fuel, it has well trained personnel and well organized logistics of coal supply and storage.

Conclusion

Based on the analysis above and investment analysis presented in Section B.2 below it is considered that alternative 2 is the most plausible and credible baseline scenario.

Leakages

Increase of methane emissions during gas extraction, processing, transportation and distribution

According to the IPCC data, net fugitive methane emissions for countries with transitional economics have the following spread of values (Table B.1-1):

Table B.1-1 Fugitive CH₄ due to natural gas extraction, processing, transportation and distribution⁸

Category ⁹	Sub-category	CH ₄			Unit
		Minimum value	Maximum value	Average value	
Gas production	3,80E-04	2,30E-03	0,00134	3,80E-04	Gg/10 ⁶ m ³
	7,60E-07	7,60E-07	0,00000076	7,60E-07	Gg/10 ⁶ m ³
Gas transmission	Fugitives	0.000166	0.0011	0.000633	Gg/10 ⁶ m ³
	Venting	0.000044	0.00074	0.000392	Gg/10 ⁶ m ³
Gas distribution	All	0.0011	0.0025	0.0018	Gg/10 ⁶ m ³
Total	-			0.0042	Gg/10⁶ m³

It is assumed that total fugitive methane emissions are at the average level i.e. equals 0.0042 Gg/10⁶ m³.

The annual consumption of natural gas due to the project implementation (with 4 boilers switched to natural gas) will be about 368 mln. m³. Methane leakages amount 1,548 tonnes of CH₄ or 32,513 tonnes of CO₂-e.

⁷ <http://www.sibenergomash.com/ru/production-boilers-steams-energy/#id15>, retrieved on 24-10-2010

⁸ IPCC 2006 Guidelines for National Greenhouse Gas Inventories V2 Ch4 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf

⁹ For natural gas transmission and distribution categories values for developing countries are taken. For gas production category values for developed countries are taken as natural gas consumed by Khabarovsk CHPP-1 is produced by Sakhalin-1 project. Sakhalin-1 project is operated by Exxon Mobil, world's leading company in sphere of oil and gas production. Moreover for developing of Sakhalin-1 project the company implemented state-of-art modern, effective and environmentally friendly technologies are applied. http://www.sakhalin1.com/Sakhalin/Russia-English/Upstream/about_technology.aspx

Decrease of methane emissions from coal mining and handling

Annual decrease of the coal consumption as a result of the project implementation will be about 782 thousand tonnes. Main types of coal used at Khabarovsk CHPP-1 are lignite and bituminous coal. All of lignite is mined at surface mines. Bituminous coal is mined in underground mines. According to the IPCC data¹⁰ the average CH₄ emission factor during the surface coal mining amounts to 1.2 m³ per tonne. Post mining emission factor for surface mining amounts to 0.1 m³ per tonne¹¹. Thus the emission factor for surface mining equals 1.3 m³ of CH₄ per tonne of coal. According to the IPCC data¹² the average CH₄ emission factor during the underground coal mining amounts to 18 m³ per tonne. Post mining emission factor for underground mining amounts to 2.5 m³ per tonne¹³. Thus the emission factor for underground mining equals 20.5 m³ of CH₄ per tonne of coal.

The baseline leakage factor is calculated as a weighted average value based on quantities of different types of coal and fuel oil consumed by Khabarovsk CHPP-1 during 2003-2005. The baseline scenario also includes combustion of a small amount of fuel oil for coal fired boilers start-ups. The weighted average share of fuel oil in fuel mix at Khabarovsk CHPP-1 (for years 2003-2005) is less than 0.25%. To simplify calculations and achieve conservatism the leakage factor for fuel oil is taken as 0.

The baseline methane weighted average leakage factor for Khabarovsk CHPP-1 equals 7.84 m³ per tonne¹⁴. Methane emissions due to coal mining and handling in the baseline scenario will be reduced by 4,109 tonnes of CH₄ or by 86,279 tonnes of CO₂-e.

Key factors for the baseline setting

Monitored parameters

Data/Parameter	$FC_{NG,y}$																				
Data unit	ths. m ³ /year																				
Description	Quantity of natural gas consumed by reconstructed gas-fired boilers at Khabarovsk CHPP-1 in year y.																				
Time of determination/monitoring	Continuously																				
Source of data (to be) used	Data from gas meters																				
Value of data applied (for ex ante calculations/determinations)	<table><tr><th>Amount of natural gas consumed</th><th>Year</th><th>Source</th></tr><tr><td>372,859.384</td><td>2008</td><td>Factual data</td></tr><tr><td>364,395.323</td><td>2009</td><td>Factual data</td></tr><tr><td>368,627.354</td><td>2010</td><td>Average of 2008-2009 data</td></tr><tr><td>368,627.354</td><td>2011</td><td>Average of 2008-2009 data</td></tr><tr><td>368,627.354</td><td>2012</td><td>Average of 2008-2009 data</td></tr></table>			Amount of natural gas consumed	Year	Source	372,859.384	2008	Factual data	364,395.323	2009	Factual data	368,627.354	2010	Average of 2008-2009 data	368,627.354	2011	Average of 2008-2009 data	368,627.354	2012	Average of 2008-2009 data
Amount of natural gas consumed	Year	Source																			
372,859.384	2008	Factual data																			
364,395.323	2009	Factual data																			
368,627.354	2010	Average of 2008-2009 data																			
368,627.354	2011	Average of 2008-2009 data																			
368,627.354	2012	Average of 2008-2009 data																			

¹⁰ http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf page 4.18

¹¹ http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf page 4.19

¹² http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf page 4.12

¹³ http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf page 4.12

¹⁴ The calculations of the baseline leakage factor will be provided to verifiers for review.



Justification of the choice of data or description of measurement methods and procedures (to be) applied	Four out of eight coal boilers were switched to natural gas before 2008 and the remaining boilers are planned for switching in 2012 it is assumed that natural gas consumption for years 2010-2012 will remain at the same level as in years 2008 and 2009.
QA/QC procedures (to be) applied	Gas meters are checked and calibrated according to the Russian legislation.
Any comment	

Data/Parameter	$NCV_{NG,y}$			
Data unit	GJ/ths. m ³			
Description	Weighted average net calorific value of natural gas in year y.			
Time of determination/monitoring	Monthly			
Source of data (to be) used	Gas certificates from fuel supplier			
Value of data applied (for ex ante calculations/determinations)		Average NCV of natural gas	Year	Source
		8.677 Gcal/ths. m ³ (36.33 GJ/ths. m ³)	2008	Factual data
		8.7 Gcal/ths. m ³ (36.43 GJ/ths. m ³)	2009	Factual data
		8.688 Gcal/ths. m ³ (36.38 GJ/ths. m ³)	2010	Average of 2008-2009 data
		8.688 Gcal/ths. m ³ (36.38 GJ/ths. m ³)	2011	Average of 2008-2009 data
		8.688 Gcal/ths. m ³ (36.38 GJ/ths. m ³)	2012	Average of 2008-2009 data
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The values for 2008 and 2009 are actual observed values. Average of 2008-2009 data used as the forecasted value for 2010-2012.			
QA/QC procedures (to be) applied	Gas certificates are provided by a state-certified laboratory.			
Any comment	The weighted average value is determined at the end of the year as a weighted average of 12 monthly values.			

Not monitored parameters

Data/Parameter	EF_{NG,CO_2}
Data unit	kg CO ₂ /GJ
Description	Emission factor for natural gas combustion.
Time of determination/monitoring	Annually



Source of data (to be) used	Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006
Value of data applied (for ex ante calculations/determinations)	56.1 kg CO ₂ /GJ
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	EF_{BL,CO_2}
Data unit	kg CO ₂ /GJ
Description	Baseline emission factor.
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006
Value of data applied (for ex ante calculations/determinations)	97.6 kg CO ₂ /GJ
Justification of the choice of data or description of measurement methods and procedures (to be) applied	<p>The main type of fuel at Khabarovsk CHPP-1 is coal (more than 99%), mainly lignite type. The baseline scenario also includes combustion of a small amount (about 0.22%) of fuel oil for coal fired boilers start-ups.</p> <p>The baseline CO₂ emission factor is calculated as a weighted average value based on quantities of coal of different types and fuel oil consumed by Khabarovsk CHPP-1 during 2003-2005. For lignite coal type the CO₂ emission factor 101 kg CO₂/GJ was applied in calculations. For all other types of coal distinct from lignite type the CO₂ emission factor 94.6 kg CO₂/GJ was applied (to provide conservatism the lowest CO₂ emission factor among different types of coal listed in the IPCC Guidelines was applied). For fuel oil the CO₂ emission factor 77.4 kg CO₂/GJ was applied</p>
QA/QC procedures (to be) applied	
Any comment	The excel spreadsheet with calculations of this parameter has been provided to verifiers.

Data/Parameter	$\eta_{boilers,gas}$
Data unit	%
Description	Efficiency of natural gas fired boilers
Time of determination/monitoring	Fixed ex-ante.



Source of data (to be) used	Boiler flow charts of four boilers after their switch on natural gas.		
Value of data applied (for ex ante calculations/determinations)	93.93%		
Justification of the choice of data or description of measurement methods and procedures (to be) applied	After switch of four boilers on natural gas efficiency of updated boilers was measured and flow charts were prepared. The lowest efficiency among four boilers was taken to provide conservatism.		
	Boiler #	Efficiency	Source
	K-9	95.1%	Boiler flow chart
	K-10	93.51%	Boiler flow chart
	K-11	93.4%	Boiler flow chart
	K-16	93.7%	Boiler flow chart
	Average	93.93%	
QA/QC procedures (to be) applied	Boiler flow charts are calculated and compiled on site by qualified staff. Boiler flow charts are approved by the chief engineer of Khabarovsk CHPP-1.		
Any comment			

Data/Parameter	$\eta_{boilers,coal}$			
Data unit	%			
Description	Efficiency of coal fired boilers			
Time of determination/monitoring	Fixed ex-ante.			
Source of data (to be) used	Boiler flow charts before switch of boilers on natural gas. The average value was applied.			
Value of data applied (for ex ante calculations/determinations)	90.5%			
Justification of the choice of data or description of measurement methods and procedures (to be) applied				
QA/QC procedures (to be) applied	Boiler flow charts are calculated and compiled on site by qualified staff. Boiler flow charts are approved by the chief engineer of Khabarovsk CHPP-1.			
Any comment		Boiler #	Efficiency	Source
		K-9	90.4%	Boiler flow chart
		K-10	90.67%	Boiler flow chart
		K-11	92.0%	Boiler flow chart
		K-16	88.94%	Boiler flow chart
		Average	90.5%	

**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:**

According to the paragraph 2 of the Annex I to the “Guidance on criteria for baseline setting and monitoring” version 02, additionality can be demonstrated, inter alia, by using one of the following approaches:

- (a) Provision of traceable and transparent information showing that the baseline was identified on the basis of conservative assumptions, that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources or enhancements of net anthropogenic removals by sinks of GHGs;
- (b) Provision of traceable and transparent information that an accredited independent entity has already positively determined that a comparable project (to be) implemented under comparable circumstances (same GHG mitigation measure, same country, similar technology, similar scale) would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and a justification why this determination is relevant for the project at hand;
- (c) Application of the most recent version of the “Tool for the demonstration and assessment of additionality” approved by the CDM Executive Board (allowing for a grace period of two months when the PDD is submitted for publication on the UNFCCC JI website), or any other method for proving additionality approved by the CDM Executive Board.

Approach (c) is used here to demonstrate additionality of the project. The latest version 05.2 of the “Tool for the demonstration and assessment of additionality” (further referred as “the Tool”) is applied.

The following steps are stipulated by the tool:

- Step 1: Identification of alternatives to the project activity consistent with current laws and regulations;
- Step 2: Investment analysis (including the sensitivity analysis);
- Step 3: Barrier analysis (optional);
- Step 4: Common practice analysis.

Steps 1, 3 and 4 are applied here to assess additionality of the project according to the Tool.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations.***Sub-step 1a: Define alternatives to the project activity:***

Described below are the alternatives for the JI project “Fuel switch at Khabarovsk CHPP-1”.

Among the possible alternatives are the following:

- Alternative 1 - The proposed project activity undertaken without being registered as a JI project activity (fuel switch to natural gas of 8 coal-fired steam boilers);
- Alternative 2 - Continuation of the current situation (business-as-usual scenario, i.e. production of steam for power generation on the existing 8 coal boilers).

Although, there are other hypothetical alternative scenarios such as fuel switch to fuel oil, different kinds of biofuel, etc. they are not plausible options for project owners due to price and availability considerations and thus are not included here.

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

There are no special national and/or sectoral policies and circumstances which influence the alternatives listed above. There is no legislation restricting or encouraging use of coal or natural gas at Khabarovsk CHPP-1.

Step 2. Investment analysis

This step is omitted.

Step 3. Barrier analysis



According to the Tool if this Step is used, determine whether the proposed project activity faces barriers that:

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

The Tool also stipulates that the identified barriers are only sufficient grounds for demonstration of additionality if they would prevent potential project proponents from carrying out the proposed project activity undertaken without being registered as a JI project activity.

If the JI does not alleviate the identified barriers that prevent the proposed project activity from occurring, then the project activity is not additional.

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

One key barrier which prevents the implementation of the proposed project activity was identified. Financial barrier prevents implementation of the project without its JI component.

In 2005 the comparison analysis was conducted to assess which fuel is more financially attractive for Khabarovsk CHPP-1. The comparison analysis showed that running of Khabarovsk CHPP-1 on natural gas even disregarding investment expenditures is substantially more expensive as compared to running of the plant on coal. The annual economic effect of fuel switch excluding investment expenditures is presented in Table B.2-1 below¹⁵.

Table B.2-1. Total economic effect

#	Type of economic effect from fuel switch to natural gas	Units	Value
1	Fuel economy (accounting for increase in efficiency and reduction of auxiliary consumption)	mln. RUR	-202,483
2	Operational economy (including decrease of environmental fees, labor, repair and maintenance costs)	mln. RUR	74,662
3	Total economic effect	mln. RUR	-127,821

As it is shown in the Table B.2-1 above the economic effect of higher efficiency of natural gas fired boilers, reduction of auxiliary fuel consumption when operating on gas, and reduction of operational costs does not cover the difference in the price of fuels.

The is only supplier of natural gas in the region is Exxon Neftegas Limited, operator of Sakhalin-1 oil and gas project. Unlike other Russian regions where gas tariff is set by the government for a year, the price of gas for Far Eastern Generating Company is linked to the JCC oil price index¹⁶ and determined in US dollars.

Project activity exposed the company to a new set of risks: international oil price volatility and currency fluctuations. In the baseline scenario, Khabarovsk CHPP-1 dealt with predictable coal prices established under contracts for a year in advance, which were accordingly included in tariff. With unpredictable gas prices and RUB/USD exchange rate it is more difficult for a company to plan its budget and establish a proper tariff.

Taking into account that fuel switch of Khabarovsk CHPP-1 substantially improves the environmental situation in the city of Khabarovsk, and plans of the regional administration for further gasification of the region, the project owner expected that increased fuel cost would be included in the tariff. This will ensure break-even operation of Khabarovsk CHPP-1 after the fuel switch.

¹⁵ Calculation of the total economic effect is based on the forecast of following annual production: 1600 million kWh and 3400 ths. Gcal.

¹⁶ <http://www.paj.gr.jp/english/statis/index.html>



However, project implementation is connected not only with higher cost of operation on natural gas but also with significant capital investments in the amount of 950 mln. RUR. Despite expectation that higher operating costs on natural gas will be compensated to the project owner through the tariff by regional authorities, there are no sources to compensate for investments expenditures. Thus, the project faces substantial financial barrier.

Project implementation does not generate any additional cash-flows or economies that can cover the capital expenditure. Significant amount of capital expenditure and additional risks described above linked with lack of economic incentives makes the project implementation financially unattractive for the project owner.

At the stage of the project assessment it was concluded that implementation of the project with involvement of JI mechanism allows the project owner to recover the investment expenditures. It was forecasted that sale of the ERU will earn about 1,850 mln. RUR which is more than enough to compensate capital expenditures in the amount of 950 mln. RUR. Therefore, it can be concluded that Kyoto benefits help the project to alleviate the identified financial barrier.

At the time of PDD preparation¹⁷ four boilers were already switched to natural gas. Total expenditures amounted 924 mln. RUR¹⁸. With four boilers switched to natural the project will generate about 3.2 MtCO₂e for the crediting period 2008-2012. Sale of this amount of ERUs will give about 32 mln EUR or 1,287 mln. RUR what is enough to compensate investment expenditures for four boilers.

Outcome of Step 3a: The identified financial barrier prevents implementation of the Alternative 1 - The proposed project activity undertaken without being registered as a JI project activity.

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

The identified financial barrier does not prevent implementation of the Alternative 2 - Continuation of the current situation as this Alternative does not require any investments.

“If both Sub-steps 3a – 3b are satisfied, proceed to Step 4 (Common practice analysis)”.

Step 4. Common practice analysis

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

The project is located in Khabarovsk region where coal industry is highly developed. Historically coal was the main fuel for all CHHPs and district boiler houses located in Khabarovsk city. Natural gas was expected to become available for industrial usage in Khabarovsk city since 2006 together with commissioning of high pressure pipeline “Komsomolsk-na-Amure - Khabarovsk”¹⁹. “Sakhalin-1” oil and gas project provides natural gas to consumers in the region. However, “Sakhalin-1” project is intended mainly for oil and natural gas export. Natural gas infrastructure is still under construction in the region and local officials plan to preserve the efficient coal power plants²⁰. For many local enterprises, which use fossil fuel until late 2006 it was unclear whether natural gas alternative will become available.

Due to rapid growth in natural gas prices, this fuel has become less viable than it was in early 2000’s. Many industrial customers in newly connected regions including Altai and Arkhangelsk decided to use other fuels. For instance, despite preliminary agreement between Gazprom and BiyskEnergo in Altai region and development of gas infrastructure, large Biysk CHPP (535MW power capacity) decided to

¹⁷ End of 2010

¹⁸ Acts of commissioning which confirms cost have been provided to verifiers.

¹⁹ <http://www.sibgazovik.ru/field/technology/practices/2009-11-25/>, retrieved on 13-12-2010

²⁰ <http://www.khabkrai.ru/about/complex.html>, retrieved on 13-12-2010



keep coal as main fuel²¹. On the other hand, in Arkhangelsk region many companies decided to switch to biomass instead of natural gas²².

Coal remains and will remain the main fuel for the Russian Far East. Despite active gasification coal accounts for about 80% of the total fuel consumption²³ and gas for about 15%. Several power stations including Amursk CHPP that are switched from coal or fuel oil to natural gas are also seeking JI financing.

Natural gas is a relatively “new” fuel for the region, therefore any company, which decides to connect to natural gas supplies faces lack of professional service and trained labor.

Taking all of the above into account, it can be concluded that the project activity is not common practice in Khabarovsk region and especially in Khabarovsk city.

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

As it is said in Sub-step 4a, similar activities cannot be observed in Khabarovsk region.

Conclusion

Based on the analysis provided above it can be concluded that the project activity is additional.

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

Under the project, eight coal-fired boilers BKZ-210-140-F (st. No. 9-16) will be switched to natural gas. The heat and electricity capacity of the Khabarovsk CHPP-1 will remain the same. Steam generated by the boilers is used for electricity generation, but as the project does not influence general steam capacity of the boilers and power generation, only boilers No. 9-16 and auxiliary equipment are included in the project's boundaries.

CO2 emissions reduction due to the electricity consumption decrease

Electricity consumption of coal fired and natural gas fired boilers is almost equal. But compared to the gas fired boilers, coal fired boilers require operation of additional power consuming equipment such as coal transporting system (belt conveyors), ash removal system and exhaust filters. Hence, electricity consumption in the baseline scenario is higher than in the project scenario and the project also provides the decrease of emissions due to reduction of auxiliary electricity consumption.

To provide simplicity of calculations and monitoring plan and according to the conservatism principles emission reductions due to the electricity consumption decrease are excluded from the project boundary.

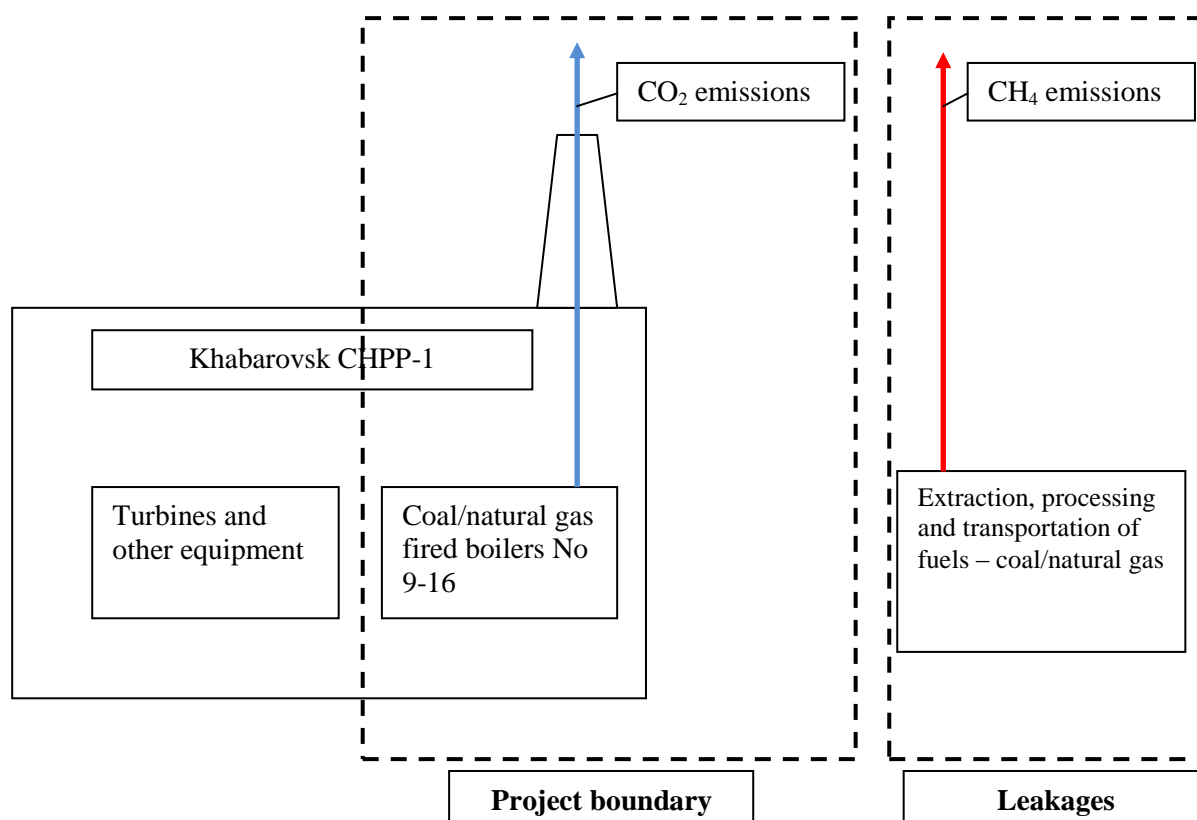
Sources of emissions included or excluded from the project boundary are presented in the Table B.3-1 below.

Figure B.3-1 Project boundary.

²¹ <http://www.biysk.su/building/gaz-biyskenergo>, retrieved on 13-12-2010

²² <http://lesprominform.ru/jarchive/articles/itemprint/538>, <http://www.energohelp.net/articles/alternate/62551/>, retrieved on 13-12-2010

²³ <http://primamedia.biz/press/show.php?id=41488&p=>, retrieved on 13-12-2010


Table B.3-1 Emissions sources included or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	On-site coal combustion	CO ₂	Included	Main emission source
		CH ₄	Excluded	CH ₄ and N ₂ O emissions are excluded both in the baseline and in the project scenario for simplification. It is conservative since baseline CH ₄ and N ₂ O emissions are higher than in the project scenario.
		N ₂ O	Excluded	
Project activity	On-site natural gas combustion	CO ₂	Included	Main emission source
		CH ₄	Excluded	CH ₄ and N ₂ O emissions are excluded both in the baseline and in the project scenario for simplification. It is conservative since baseline CH ₄ and N ₂ O emissions are higher than in the project scenario.
		N ₂ O	Excluded	
Leakages	Leakages due to fuels (coal and natural gas) extraction, processing and transportation	CH ₄	Included	Main emission sources



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: 13/12/2010

Monitoring plan was developed by “Mardo International”

E-mail: mardoint@gmail.com

“Mardo International” is not a project participant listed in Annex 1.

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

05/05/2005 (date of the meeting when it was decided to implement the JI project)

C.2. Expected operational lifetime of the project:

At least 12 years/140 months (05/05/2005-2016). The operational lifetime is set according to the remaining individual lifetimes of the boilers. The operational lifetime can be extended in future based on the actual conditions of the boilers or implemented overhauls.

C.3. Length of the crediting period:

5 years / 60 months. 01/01/2008 – 31/12/2012.

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

The JI specific approach is chosen to establish the monitoring plan for the project, taking into account demands of the “Guidance on criteria for baseline setting and monitoring” and given the requirements of Decision 9/CMP.1, Appendix B “Criteria for baseline setting and monitoring”.

The monitoring plan is designed to calculate and record the GHG emission reductions at Khabarovsk CHPP-1 operated by OJSC “Far Eastern Generating Company” in a full and transparent manner. Monitoring is performed in accordance with the existing fuel and energy metering systems and environmental impact assessment.

The monitoring process will not require introduction of any changes in the existing system of data collection and storage. All necessary data is processed and registered in course of business-as-usual operation of the plant. The monitoring plan data should be stored for at least 2 years after the last transfer of ERUs for the project.

Short description regarding project and baseline scenario and components to be monitored are presented below:

I. Project line description

According to the project concept, eight coal-fired boilers BKZ-210-140-F (st. No 9-16) will be switched to natural gas. The heat and electricity capacity of the Khabarovsk CHPP-1 will remain the same. The project does not influence other equipment on the plant e.g. steam turbines. Thus, only emissions related to natural gas combustion at the new boilers (st. No 9-16) are included in the monitoring plan.

Besides, the project realization will enhance the environment near the plant.

Project Emissions are based on the following parameters required to be monitored:

- *Total quantity of gas consumed by CHPP during the year (m3);*
- *Net calorific value of natural gas during the year (GJ/m3);*
- *Emission factor for natural gas combustion (kg CO₂/GJ).*

II. Baseline line description

Baseline scenario represents the continuation of the current practice at the enterprise, i.e. combustion of coal in eight BKZ-210-140-F (st. No 9-16) boilers for the purposes of heat energy generation.

Baseline Emissions are based on the following parameters required to be monitored:

- *Total quantity of gas consumed by CHPP during the year (m3).*
- *Baseline emission factor (kg CO₂/GJ).*

Key factors, determining the GHG emissions



The key factors, determining the GHG emissions in both baseline and project scenarios are:

- *Burning of fossil fuels for generation of heat energy;*
- *Leakages due to fuels extraction, processing, transportation and distribution.*

There are no special national monitoring standards applicable to the project except federal law #102-FZ dated 11.06.2008 “about standardisation of measurements”. This law is applicable only for one parameter monitored – natural gas consumption as it is the only one parameter of trade (article 1, clause 3, point 7 of the law). All legislation requirements regarding monitoring of this parameter are implemented.

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
1. $FC_{NG,y}$	Quantity of natural gas consumed by reconstructed gas-fired boilers at Khabarovsk CHPP-1 in year y.	Gas flow meters	ths. m ³	m	continuously	100%	Electronic and paper	Gas meters readings
2. $NCV_{NG,y}$	Weighted average net calorific value of natural gas in year y.	Gas certificates from fuel supplier	GJ/ths. m ³	m	monthly	100%	Electronic and paper	The weighted average value is determined at the end of the year as a weighted average of 12 monthly values.
3. EF_{NG,CO_2}	Emission factor for natural gas combustion	IPCC data	kg CO ₂ /GJ	-	annually	100%	Electronic	Guidelines for National Greenhouse Gas Inventories,



								Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006
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D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO₂ equivalent):

The project activity envisages on-site combustion of natural gas for the purposes of heat energy (in form of steam and hot water) generation. The project CO₂ emissions from heat generation (PE_y) are calculated as follows:

$$PE_y = FC_{NG,y} * NCV_{NG,y} * EF_{NG,CO_2}/1000 \quad (D.1.1.2-1)$$

Where:

PE_y – Project emissions in year y (t.CO₂);

$FC_{NG,y}$ – Is the total volume of natural gas combusted in the project plant in year y (ths. m³);

$NCV_{NG,y}$ – is the net calorific value of natural gas in year y, GJ/ths. m³. This parameter is calculated as a weighted average value derived from 12 monthly natural gas certificates from the fuel supplier;

EF_{NG,CO_2} – natural gas emission factor, (kg CO₂/GJ). EF_{NG,CO_2} equals 56.1 (kg CO₂/GJ), and is taken constant, for the whole crediting period according to IPCC data (2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 chapter 1, Table 1.4).

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



1. $FC_{NG,y}$	Quantity of natural gas consumed by reconstructed gas-fired boilers at Khabarovsk CHPP-1 in year y.	Gas flow meters	ths. m^3	m	continuously	100%	Electronic and paper	Gas meters readings
2. $NCV_{NG,y}$	Weighted average net calorific value of natural gas in year y.	Gas certificates from fuel supplier	GJ/ths. m^3	m	monthly	100%	Electronic and paper	The weighted average value is determined at the end of the year as a weighted average of 12 monthly values.
3. $\eta_{boilers,gas}$	Efficiency of gas fired boilers	Project documentation	%	e	—	—	—	The efficiency of BKZ-210-140-F type boilers after switch on natural gas. For more details please refer to Section B.1 above. This parameter is fixed ex-ante.
4. $\eta_{boilers,coal}$	Efficiency of coal fired boilers	Data from boiler manufacturer.	%	e	—	—	—	The efficiency of BKZ-210-140-F type boilers before switch on natural gas. For more details please refer to Section B.1 above. This parameter is fixed ex-ante.



5. EF_{BL,CO_2}	Baseline emission factor	IPCC data	kg CO ₂ /GJ	c	-	100%	Electronic	The baseline CO ₂ emission factor is calculated as a weighted average value based on quantities of coal of different types and crude oil consumed by Khabarovsk CHPP-1 during 2003-2005. For more details please refer to the Section B.1 above. This parameter is fixed ex-ante.
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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 scenario envisages on-site combustion of coal gas for the purposes of heat (in form of steam and hot water) generation. The baseline CO₂ emissions from heat generation (BE_y) are calculated as follows:

$$BE_y = FC_{NG,y} * NCV_{NG,y} * \eta_{boilers,gas} / \eta_{boilers,coal} * EF_{BL,CO_2} / 1000 \quad (D.1.1.4-1)$$

Where:

BE_y – Baseline emissions in year y (t.CO₂);

$FC_{NG,y}$ – Is the total volume of natural gas combusted in the project plant in year y (ths. m³);

$NCV_{NG,y}$ – is the net calorific value of natural gas in year y, GJ/ths. m³. This parameter is calculated as a weighted average value derived from 12 monthly natural gas certificates from the fuel supplier;



$\eta_{boilers,gas}$ – Efficiency of boilers BKZ-320-140 type after their switch to natural gas (%). For more details please refer to the Section B.1 above.

$\eta_{boilers,coal}$ – Efficiency of boilers BKZ-320-140 type before their switch to natural gas (%). For more details please refer to the Section B.1 above.

EF_{BL,CO_2} – Baseline emission factor, (kg CO₂/GJ). EF_{BL,CO_2} equals 97.6 (kg CO₂/GJ), and is taken constant, for the whole crediting period. This is a weighted average value based on quantities of coal of different types and crude oil consumed by Khabarovsk CHPP-1 during 2003-2005. For more details please refer to the Section B.1 above.

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

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

ID number (Please use numbers to ease cross-referencing to D.2.)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

This option is not applicable.

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

This option is not applicable.

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

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number (Please use numbers to ease cross-referencing to D.2.)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $FC_{NG,y}$	Quantity of natural gas consumed by	Gas flow meters	ths. m ³	m	continuously	100%	Electronic and paper	Gas meters readings



	reconstructed gas-fired boilers at Khabarovsk CHPP-1 in year y.							
2. $NCV_{NG,y}$	Weighted average net calorific value of natural gas in year y.	Gas certificates from fuel supplier	GJ/ths. m^3	m	monthly	100%	Electronic and paper	The weighted average value is determined at the end of the year as a weighted average of 12 monthly values.
3. $\eta_{boilers,gas}$	Efficiency of gas fired boilers	Project documentation	%	e	—	—	—	The efficiency of BKZ-210-140-F type boilers after switch on natural gas. For more details please refer to Section B.1 above. This parameter is fixed ex-ante.
4. $\eta_{boilers,coal}$	Efficiency of coal fired boilers	Data from boiler manufacturer.	%	e	—	—	—	The efficiency of BKZ-210-140-F type boilers before switch on natural gas. For more details please refer to Section B.1 above. This parameter is fixed ex-ante.
5. $LF_{baseline}$	Leakage factor for baseline	IPCC data	m^3 per tonne	e	-	-	-	For calculation of this parameter



								please refer to Section B.1 above.
6. $LF_{NG,y}$	Leakage factor for natural gas	IPCC data	Gg/10 ⁶ m ³	e	-	-	-	For calculation of this parameter please refer to Section B.1 above.

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

According to the approach described in Section B.1 and Section D.1 above, emission reductions generated by the project comprise leakages outside the project boundary. These are:

- CH₄ emissions associated with coal extraction, processing and transportation. Coal would be used in the absence of the proposed project activity, consequently this type of leakages will be reduced as a result of the project implementation;
- Fugitive CH₄ emissions associated with natural gas extraction, processing, transportation and distribution of natural gas. As a result of the project's implementation, natural gas consumption will increase, thereby the associated with natural gas leakages will also increase.

As leakages in the baseline are higher than in the project scenario LE_y is negative.

Leakages associated with the project implementation are calculated as follows:

$$LE_y = FC_{NG,y} * NCV_{NG,y} * \eta_{boilers,gas} / \eta_{boilers,coal} * LF_{baseline} - FC_{NG,y} * LF_{NG,y} * GWP_{CH4} \quad (D.1.3.2-1)$$

where:

LE_y – leakages associated with the project implementation in year y (t.CO₂eq). According to the ex-ante emission reduction estimation, leakages in the baseline are higher as compared to the leakages in the project scenario, thereby this value will be negative;

$FC_{NG,y}$ – total volume of natural gas combusted in the project plant in year y (ths. m³);

$NCV_{NG,y}$ – is the net calorific value of natural gas in year y, GJ/ths. m³. This parameter is calculated as a weighted average value derived from 12 monthly natural gas certificates from the fuel supplier;

$\eta_{boilers,gas}$ – Efficiency of boilers BKZ-210-140-F type after their switch to natural gas (%). For more details please refer to the Section B.1 above.

$\eta_{boilers,coal}$ – Efficiency of boilers BKZ-210-140-F type before their switch to natural gas (%). For more details please refer to the Section B.1 above.



$LF_{baseline}$ – leakage factor for coal (t. CO₂-eq/GJ). This parameter is calculated according to the formula D.1.3.2-2 below.

$LF_{NG,y}$ – leakage factor for natural gas according to the IPCC data (Gg/10⁶ m³). For calculation of this parameter please refer to Section B.1 above;

GWP_{CH_4} – Global warming potential for CH₄, (21 tCO₂e/tCH₄).

$$LF_{baseline} = LF_{IPCC} * density_{CH_4} / NCV_{coal} * 10^{-3} * GWP_{CH_4} \quad (D.1.3.2-2)$$

where:

LF_{IPCC} – combined leakage factor for coal is calculated according to the IPCC data (7.84 m³ per tonne). For calculation of this parameter please refer to Section B.1 above;

$density_{CH_4}$ – density of natural gas (0.67 kg/m³). This parameter is taken according to the IPCC data²⁴;

NCV_{coal} – the net calorific value of tonne of coal used at Khabarovsk CHPP-1, (GJ/t). Few main types of coal are used at Khabarovsk CHPP-1. The highest NCV among all coal types used during 2003-2005 was taken for calculations to provide conservatism. The highest NCV of one tonne of coal at Khabarovsk CHPP-1 equals 4.2 Gcal per tonne or 17.8 GJ/tonne;

GWP_{CH_4} – Global warming potential for CH₄, (21 tCO₂e/tCH₄).

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 following formula is applied to estimate emission reductions generated by the project:

$$ER_y = BE_y - PE_y + LE_y \quad (D.1.4-1)$$

Where:

BE_y – Baseline emissions in year y (t.CO₂);

PE_y – Project emissions in year y (t.CO₂);

LE_y – leakages associated with the project implementation in year y (t.CO₂e)²⁵.

²⁴ http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf page 4.12

²⁵ This value is negative as leakages in the baseline are higher than in the project scenario.

**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:**

At the OJSC “Far Eastern Generating Company” there is a department of industrial safety and environment, which is responsible for the company’s operations in terms of environmental protection and monitoring. The department has well-trained staff, all required technical equipment and is able to handle information on the environmental impacts of the project.

During the project realization the analytical control over various kinds of environmental impacts, as it being done now, will be carried out in compliance with the existing regulations.

According to Russian legislation the company submits the following annual official statistical forms:

- 2-TP (air). *Data on the atmospheric air protection*, including the information on the amount of the collected and neutralized atmospheric pollutants, detailed emissions of specific contaminants, number of emission sources, measures for reduction of emissions into the atmosphere and emissions from separate groups of contamination sources, (prepared according to the resolution of the Russian State Statistical Committee date July 27th of 2001 # 53 "On the establishment of the statistical tools for the arrangement of statistical monitoring over the environment and agriculture"(version from 14.07.2004)²⁶;
- 2-TP (water management) *Data on the water usage*, including the information on the water consumption from natural sources, discharge of waste water and content of contaminants in the water, capacity of water treatment facilities etc. (prepared according to the resolution of the Russian State Statistical Committee dd. November 13th of 2000 # 110 "On the establishment of statistical tools for the arrangement by the MNR of Russia of the statistical monitoring over the mineral reserves, geologic exploration operations and their funding, use of water and the accrued payments for environmental contamination” (version from 19.10.2009)²⁷;
- 2-TP (wastes) *Data on the generation, use, neutralization, transportation and emplacement of production and consumption wastes*, including the annual balance of the wastes management separately for their types and hazard classes, (prepared according to the resolution of the Russian State Statistical Committee dd. January 17th of 2005 #1 “The order of filling out and submission of the form of federal statistical monitoring N 2-TP (wastes)²⁸).

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

Data (Indicate table and ID number)	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
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²⁶ <http://infopravo.by.ru/fed2001/ch04/akt16181.shtm>

²⁷ <http://infopravo.by.ru/fed2000/ch02/akt12385.shtm>

²⁸ <http://www.mnogozakonov.ru/catalog/date/2005/1/17/11478/>



D.1.1.1, D.1.1.3 and D.1.3.1 - $FC_{NG,y}$	low	Amount of natural gas consumed by the project is measured continuously by commercial gas flow meters installed at the plant. Only certified meters will be used. All certified meters have factory calibration. The chief metrologist is responsible for further calibration and checking of meters. Calibration and checking will be done on terms prescribed by meters passports by specialized accredited metrology organizations. A calibration schedule will also be established.
D.1.1.1, D.1.1.3 and D.1.3.1 - $NCV_{NG,y}$	low	Certificates from the fuel supplier. The fuel supplier provides certificates for each fuel shipment with the specification of basic thermal performance.
D.1.1.1 - EF_{NG,CO_2}	low	No QA or QC procedures are implemented to this parameter. Data from Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006 will be used.
D.1.1.3 - EF_{BL,CO_2}	low	No QA or QC procedures are implemented to this parameter. Data from Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006 is used.
D.1.3.1 - $LF_{baseline}$	low	Default IPCC values are used for calculation of this parameter. No QA/QC procedures are applicable for this parameter.
D.1.3.1 - $LF_{NG,y}$	low	Default IPCC value. No QA/QC procedures are applicable for this parameter.

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

The monitoring plan and control structure fully correspond to the already existing production monitoring and control system at the OJSC «Far Eastern Generating Company». Monitoring of natural gas consumption and NCV of natural gas is a common daily-to-day process and is carried out by on-duty power engineers. Records and reports of measurements are carried out under accepted instructions and submitted to the Deputy chief engineer of Khabarovsk CHPP-1.

The main monitored parameters are:

- Natural gas consumption by reconstructed boilers – monitoring of this parameter is based on the direct measuring of natural gas consumption by each of the gas boilers. This data is double-checked with data from the gas metering station installed at the central gas distribution point;
- NCV of natural gas – this data is obtained from gas supplier's "gas certificates". This figure also appears on monthly invoices issued by gas supplier.

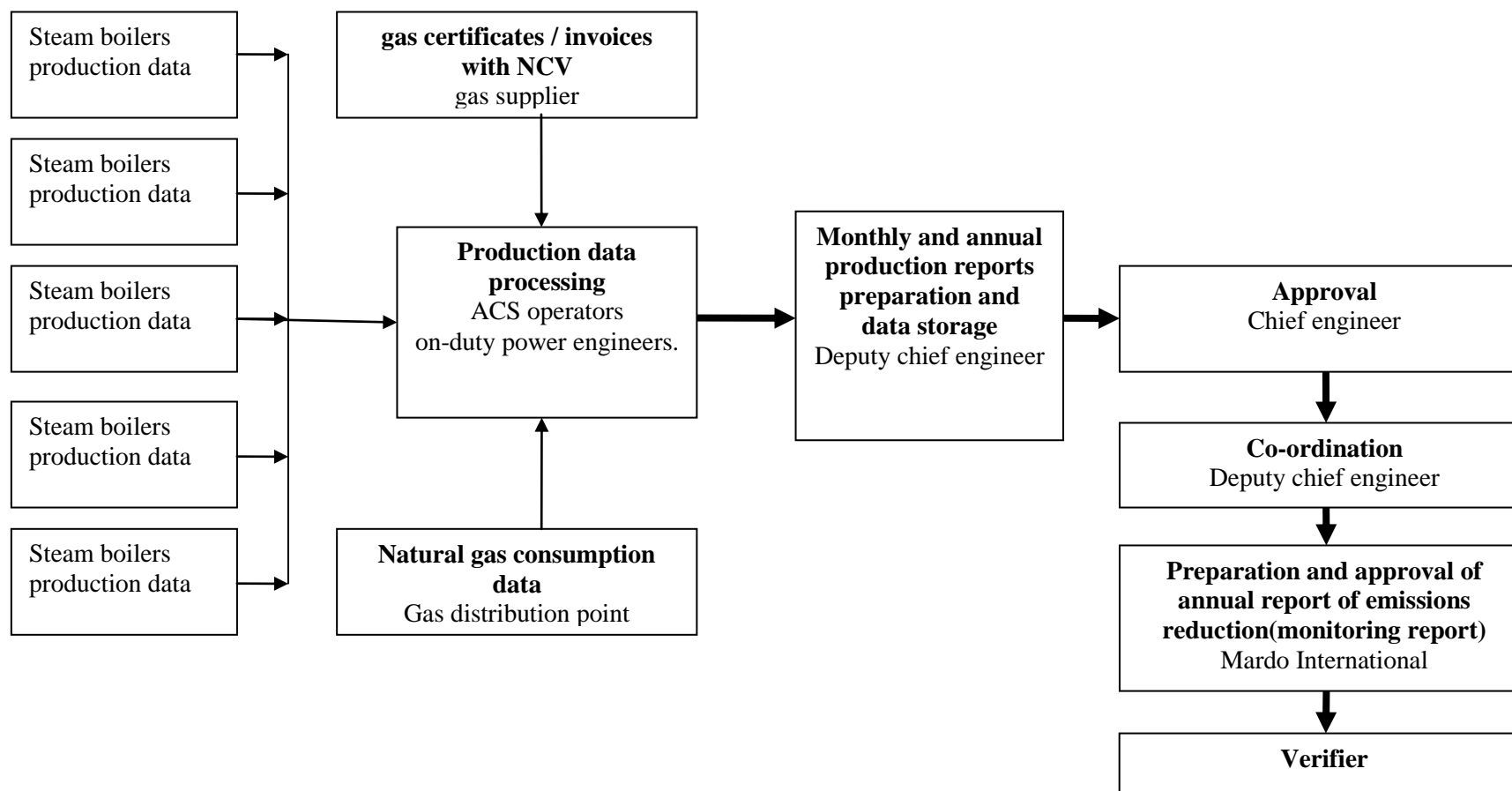
Measuring of all parameters except NCV is carried out by automatic electronic measurement systems installed under the project.

OJSC «Far Eastern Generating Company» provides all data according to the monitoring plan to Mardo International which is responsible for monitoring report preparation and verification tasks.

The basic management structure is shown below in the fig. D.3-1.



Figure D.3-1 The operational and management structure

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

Date of the monitoring plan setting: 13/12/2010



Monitoring plan was developed by “Mardo International”

E-mail: mardoint@gmail.com

“Mardo International” is not a project participant listed in Annex 1.

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

The project GHG emissions due to the natural gas combustion are presented in the tables below.

Table E.1-1. Project GHG emissions over the crediting period, t CO₂e

Year	GHG emissions under the project
2008	759,942
2009	744,660
2010	752,312
2011	752,312
2012	752,312
2008-2012	3,761,539

E.2. Estimated leakage:

Leakages associated with the project are presented in the tables below. This parameter is calculated as leakages in the project scenario minus leakages in the baseline scenario. This values are negative as leakages in the baseline are higher than in the project scenario

Table E.2-1. Leakages over the crediting period, t CO₂e

Year	GHG emissions under the project
2008	-54,269
2009	-53,263
2010	-53,767
2011	-53,767
2012	-53,767
2008-2012	-268,832

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

The sum of E.1 + E.2 = E.1 is presented in the tables below.

Table E.3-1. The sum of E.1 + E.2 over the crediting period, t CO₂e

Year	The sum of E.1 + E.2
2008	705,673
2009	691,397
2010	698,545
2011	698,545
2012	698,545
2008-2012	3,492,707

E.4. Estimated baseline emissions:

The baseline GHG emissions due to the coal combustion are presented in the tables below.

Table E.4-1. Baseline GHG emissions over the crediting period, t CO₂e

Year	GHG emissions under the baseline
2008	1,372,218
2009	1,344,623
2010	1,358,441
2011	1,358,441
2012	1,358,441



2008-2012	6,792,165
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E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

Emission reductions generated by the project are presented in the tables below.

Table E.5-1. Estimated GHG emission reductions over the crediting period, t CO₂e

Year	Estimate of annual emission reductions in tons of CO ₂ e
2008	666,545
2009	653,226
2010	659,896
2011	659,896
2012	659,896
Total estimated emission reductions over the crediting period (tonnes of CO ₂ e)	3,299,458

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

>>

Year	Estimated project emissions (tonnes of CO ₂ equivalent)	Estimated leakage (tonnes of CO ₂ equivalent)	Estimated baseline emissions (tonnes of CO ₂ equivalent)	Estimated emission reductions (tonnes of CO ₂ equivalent)
2008	759,942	-54,269	1,372,218	666,545
2009	744,660	-53,263	1,344,623	653,226
2010	752,312	-53,767	1,358,441	659,896
2011	752,312	-53,767	1,358,441	659,896
2012	752,312	-53,767	1,358,441	659,896
Total (tonnes of CO ₂ equivalent)	3,761,539	-268,832	6,792,165	3,299,458

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:**

The ecological effect gained from the project implementation (reduction of SO₂, NO_x and coal ash gross emissions) is reached due the following factors:

- Usage of pollution-free fuel (natural gas instead of coal),
- Increase of fuel combustion efficiency due to boilers efficiency coefficient increase and application of modern, more effective burners.

For estimation of the ecological effect the following data was used:

- From the baseline - retrospective data for emissions from coal combustion at Khabarovsk CHPP-1 during the period of 1999-2003,
- Under the project - data for NO_x emissions from natural gas combustion in steam boilers.

**Table F.1.1 shows the returns on emissions at Khabarovsk CHP-1 from 1999 till 2003**

Reported year	Total*	Coal ash	SO ₂	NO _x	Fuel coal fired
	t/y	t/y	t/y	t/y	thous. tce
1999	36 892,6	14 723,0	16 427,3	4 632,6	1 109,5
2000	25 868,9	13 102,4	6 268,9	5 362,2	1 135,2
2001	24 713,7	11 979,6	6 022,6	5 628,5	1 082,8
2002	26 643,1	15 421,7	4 789,9	5 370,9	1 060,4
2003	27 676,5	15 617,2	5 377,1	5 583,6	1 098,4

* - besides the emissions given in Table F.1.1 at Khabarovsk CHPP-1 under fuel oil combustion oil ash is also emitted. However, the percentage of fuel oil in the fuel balance is less than 0.25%, and the amount of fuel oil ash in the gross emissions is less than 0.001 % (0.22-0.25 t/y), thus, such emissions are not accounted when assessing environmental impact.

Based on the returns, an average specific value of emissions per the combusted fuel amount is the following:

- NO_x - 4.84 t of NO_x/thous. tce of coal;
- SO₂ - 7.09 t of SO₂/thous. tce of coal;
- Fuel coal ash - 12.91 t/thous. tce of coal.

NO_x emissions data when combusting natural gas in steam boilers

The volume of NO_x emissions when combusting natural gas in steam boilers depends on many factors, such as the type of boilers, actual load, application of DeNO_x technologies, etc.

According to the information received from the Environmental Protection Department of Russian Thermal Engineering Institute, the concentration of nitrogen oxides in flue gases when combusting natural gas in pulverized coal-fired boilers can reach 500 mg/m³.

During project implementation at Khabarovsk CHPP-1 project owner plans to apply the cyclone-swirl technology for gaseous fuel combustion (designers - «Nonprofit scientific and educational organization of the Far East State Technical University» and Technological Center «Modernization of boiler equipment» in Vladivostok). This technology allows reduction of NO_x emissions by 70% in comparison with common conventional gas/oil devices (gas-heavy oil device burners). This technology is successfully operated for boiler units at the Okhinskaya and Yakutskaya CHPP.

For the estimation of ecological effect, the NO_x concentration in the flue gases was assumed at the level of 250 mg/m³, which corresponds to NO_x specific emissions at the level of 2.4 t of NO_x/thous. tce.

Environmental Impact Assessment

When implementing the project of converting the boilers at Khabarovsk CHPP-1 from coal to natural gas combustion the gross emissions of sulphurous anhydride and of coal fly ash to the atmosphere will be eliminated, that will provide considerable improvement of the ecological situation not only in the Khabarovsk city, but also in Khabarovsk Region.

The results of pollutant emissions accounting in the base line and in the project for the period till 2012 are given in Tables F.1.2-F.1.4.

Table F.1.2 The forecast of pollutant emissions in the project baseline

Year	Fuel consumption	Coal ash	SO ₂	NO _x	Total
	tce/y	t/y	t/y	t/y	t/y



2007	1 068	13 791,3	7 570,0	5 173,9	26 535,2
2008	1 068	13 791,3	7 570,0	5 173,9	26 535,2
2009	1 068	13 791,3	7 570,0	5 173,9	26 535,2
2010	1 068	13 791,3	7 570,0	5 173,9	26 535,2
2011	1 068	13 791,3	7 570,0	5 173,9	26 535,2
2012	1 068	13 791,3	7 570,0	5 173,9	26 535,2

Table F.1.3 The forecast of pollutant emissions under the project implementation

Year	Gas consumption	Coal consumption	Coal ash	SO ₂	NOx	Total
	tce/y	tce/y	t/y	t/y	t/y	t/y
2007	320	748	9 653,9	5 299,0	4 390,7	19 343,6
2008	534	534	6 895,6	7,1	3 868,6	10 771,3
2009	1 068		0,0	0,0	2 563,3	2 563,3
2010	1 068		0,0	0,0	2 563,3	2 563,3
2011	1 068		0,0	0,0	2 563,3	2 563,3
2012	1 068		0,0	0,0	2 563,3	2 563,3

Table F.1.4 Results of pollutant emissions assessment in the period from 2007 to 2012 under the project implementation

Year	Coal ash	SO ₂	NOx	Total
	t/y	t/y	t/y	t/y
2007	4 137,4	2 271,0	783,2	7 191,6
2008	6 895,6	7 562,9	1 305,3	15 763,8
2009	13 791,3	7 570,0	2 610,7	23 971,9
2010	13 791,3	7 570,0	2 610,7	23 971,9
2011	13 791,3	7 570,0	2 610,7	23 971,9
2012	13 791,3	7 570,0	2 610,7	23 971,9

Documents concerning impacts on environment are listed below:

1. Project design (explanatory note)²⁹;
2. Environmental impact assessment (part of the project design)³⁰;
3. Positive conclusion of Glavgoexpertiza #94-2003(F) dated 02.06.2004;
4. Positive conclusion of Gosgortekhnadzor, Priamorsk branch #12-41/681 dated 11.03.04;
5. Positive conclusion on EIA #419/P issued 31.05.2004 by Central Directorate of Natural Resources and Environmental Protection of the Ministry of Natural Resources of the Russian Federation on Khabarovsk Region;
6. Permission on emissions into the atmosphere #13-2/161 issued 30.03.2006 by Federal Service for Ecological and Technological Supervision.

²⁹ Project design (explanatory note) has been provided to verifiers for review.

³⁰ Project design (book 4 "EIA") has been provided to verifiers for review.



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:

As it is shown in Section F.1 above, the project leads to a significant decrease of pollutants emissions into the atmosphere in the amount. For references to relevant supporting documentation please refer to Section F.1 above.

SECTION G. Stakeholders' comments

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

Proposed JI project is not required to go through a formal local stakeholder consultation process. Despite this fact, the public was also involved in the whole process by published article at daily newspaper "The Power Engineer" dd. 20 January 2005. The title of the article was "The Pipeline on the Way to Khabarovsk". No negative stakeholder responses were received.

Annex 1**CONTACT INFORMATION ON PROJECT PARTICIPANTS**

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Fax:	+7 4212 21 30 87
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Represented by:	
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Annex 2

BASELINE INFORMATION

Summary of key elements of the baseline is presented in table below³¹:

Parameter	Monitored/not monitored parameter	Value	Data unit	Description
$FC_{NG,y}$	Monitored	-	Ths. m ³	Quantity of natural gas consumed by reconstructed gas-fired boilers at Khabarovsk CHPP-1 in year y.
$NCV_{NG,y}$	Monitored	-	GJ/ths. m ³	Weighted average net calorific value of natural gas in year y. This value is determined at the end of the year as a weighted average of 12 monthly values.
EF_{NG,CO_2}	Not monitored	56.1	kg CO ₂ /GJ	Emission factor for natural gas combustion. This is default IPCC value.
$\eta_{boilers,gas}$	Not monitored	93.93	%	The efficiency of BKZ-210-140-F (st. No 9-16) boilers after switch on natural gas. After switch of four boilers on natural gas efficiency of updated boilers was measured and flow charts were prepared. The lowest efficiency among four boilers was taken to provide conservatism.
$\eta_{boilers,coal}$	Not monitored	90.5	%	The efficiency of BKZ-210-140-F (st. No 9-16) boilers before switch on natural gas. This parameter is an average value taken from parameter charts of four boilers before their switch on natural gas.
EF_{BL,CO_2}	Not monitored	97.6	kg CO ₂ /GJ	The baseline CO ₂ emission factor is calculated as a weighted average value based on quantities of coal of different types and crude oil consumed by Khabarovsk CHPP-1 during 2003-2005. For more details please refer to the Section B.1 above.
$LF_{baseline}$	Not monitored	7.84	m ³ per tonne	Baseline CH ₄ leakage factor for coal. This parameter is calculated based on default IPCC values for different types of coals. To provide conservatism leakage factor for fuel oil is taken equal to 0.
$LF_{NG,y}$	Not monitored	0.0042	Gg/10 ⁶ m ³	Leakage factor for natural gas. For more details please refer to the Section B.1 above.
$density_{CH_4}$	Not monitored	0.67	kg/m ³	Density of natural gas. This parameter is taken according to the IPCC data.
NCV_{coal}	Not monitored	17.8	GJ/tonne	The net calorific value of coal used at Khabarovsk CHPP-1, (GJ/t). The highest NCV among all coal types used during 2003-2005 was taken for calculations to provide conservatism.
GWP_{CH_4}	Not monitored	21	tCO ₂ e/tCH ₄	Global warming potential for CH ₄ .

³¹ Sources and additional details are provided in Sections B and D above.



Annex 3

MONITORING PLAN

Please refer to the Section D.
