Fourth Generation Company
of the Wholesale Electricity Market

OGK-4

JI MONITORING REPORT

Installation of CCGT-400 at Shaturskaya TPP, OGK-4, Moscow area, Russia

Version 1.1
04 February 2010

OJSC "OGK-4" approval:

Popov Igor
Deputy General Director
on production

Vasilkonov Egor
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Installation of CCGT-400 at Shaturskaya TPP, OGK-4, Moscow area, Russia

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SECTION A. General description of project activities

A.1 Title of the project

Project name: Installation of CCGT-400 at Shaturskaya TPP, OGK-4, Moscow area, Russia

A.2. JI registration number of the project:

JI 0195

A.3. Project approval:

The Letters of Approvals (LoA) have been issued by the designated focal points:

- Ministry of Economic Development of the Russian Federation (dated 30 July 2010);
- German Emissions Trading Authority (DEHSt) of Federal Environment Agency of Federal Republic of Germany (dated 23 March 2010).

A.3. Short description of the project activity:

The project was implemented at Shaturskaya Thermal Power Plant (TPP) of OJSC "Fourth Generation Company of the Wholesale Electricity Market" (OGK-4). An additional electricity generating unit was constructed at Shaturskaya TPP. New energy unit is using the Combined Cycle Gas Turbine (CCGT) technology which is the most energy efficient and environmentally sound way of energy generation as of today. Electrical capacity of CCGT unit is 400 MW. The purpose of this project is to demonstrate the utilization of a Best Available Technology (BAT) and to decrease the specific CO_2 emissions per MWh generated and other negative anthropogenic impact.

A.4. Monitoring period:

- Monitoring period starting date: 24.09.2010 at 08:00;
- Monitoring period closing date: 31.12.2010 at 24:00.

A.5. Methodology applied to the project activity (incl. Version number):

A.5.1. Baseline methodology:

For the baseline identification, JI specific approach was used in accordance with the JI Guidance on Criteria for Baseline Setting and Monitoring, Version 02. This specific approach uses elements of CDM methodologies (AM0029 "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas", Version 3 and ACM0013 "Consolidated baseline and monitoring methodology for new grid connected fossil fuel fired power plants using a less GHG intensive technology", Version 2.1) and the CDM Tool "Tool to calculate the emission factor for an electricity system", Version 01.1.

The baseline scenario is based on the assumption that if the project is not implemented (i.e. additional electricity would not be supplied to the grid) third parties would cover the energy demand. The energy companies within the united regional energy system "Centre" (URES "Centre") can increase electricity generation at the existing capacities by delaying decommissioning of outdated capacity and/or installing new energy units. Grid emission factor for URES "Centre" was defined in accordance with approved CDM "Tool to calculate the emission factor for an electricity system" (version 01.1) with some deviations[1].

A.5.2. Monitoring methodology:

JI specific approach regarding monitoring is used. The project emissions are related to the natural gas combustion at the CCGT unit and the baseline emissions are emissions which would be generated within

[1] All deviations are based on conservative assumptions

URES "Centre" in the absence of the project activity for the equal quantity of the project net electricity generation.

The following main assumptions were used for the calculation of both baseline and project emissions:
- Used start-up fuel at the new CCGT unit is excluded[2];
- Electricity demand in the market is not influenced by the project (i.e. baseline net electricity generation = project net electricity generation);
- The baseline emissions of the grid are established using the combined margin (grid) emission factor;
- Grid emission factor is set ex-ante for the length of the crediting period.

A.6. Status of implementation including time table for major project parts:

Activity	Date in accordance with PDD	Actual date	Notes
Starting date of the project	06 June 2007	06 June 2007	The decision of OGK-4 Management Board
Commissioning	15 September 2010	24 September 2010	CCGT unit complex test (for 72 hours) dated 24 September 2010
Start date of monitoring period	15 September 2010	24 September 2010	

A.7. Intended deviations or revisions to the determined PDD:
There are no deviations or revisions to the determined PDD.

A.8. Intended deviations or revisions to the determined monitoring plan:
There is one deviation from the determined monitoring plan. Please see Section B.1.

A.9. Changes since last verification:
Not applicable.

A.10. Person(s) responsible for the preparation and submission of the monitoring report:
OGK-4:
- Alexander Evstigneev, Head of Production and Technical Department of Shaturskaya TPP (preparation of the monitoring report);
- Sergey Bakurin, Chief Engineer of Shaturskaya TPP (submission of the monitoring report).

Global Carbon B.V.:
- Varfolomeev Alexey, Senior JI Consultant.

A.11. Person(s) responsible for the checking and approval of the monitoring report:
OGK-4:
- Popov Igor, Deputy General Director on production (approval of the monitoring report);
- Vasilkonov Egor, Expert of Production Department of OGK-4 (checking of the monitoring report).

Global Carbon B.V.:
- Olga Khlebinskaya, Team Leader JI Consultant

[2] Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas, AM0029/version 03, Approved Methodology, CDM Executive board

SECTION B. Key monitoring activities according to the monitoring plan for the monitoring period stated in A.4.
For the monitoring period stated in A.4 the natural gas consumption, the net calorific value of natural gas and the net electricity generation of CCGT unit have to be collected and registered.

Natural gas consumption
This parameter is metered by the gas flow meter at the CCGT unit directly. This data is automatically transferred into the electronic data base.

Net calorific value of natural gas
The natural gas supplier ("Gasprom transgas Moscow") provides a natural gas certificate (containing net calorific value of natural gas) monthly.

Net electricity generation
This parameter is calculated as difference between electricity generation and electricity consumption for internal needs of the CCGT unit. For measurement of these parameters the automatic accounting system is used. This data is automatically transferred into the electronic data base.

B.1. Monitoring equipment types

1. Gas flow meter.
   The gas flow meter is produced by General Electric and installed at CCGT unit. This type of gas flow meter measures natural gas flow in kg per second[3].

2. Automatic accounting system of electricity.
   The automatic accounting system consists of the measuring unit #54 for electricity generation measurement and the measuring units #55 and #57 (and back-up units #56 and #58) for measurement of the electricity consumption for internal needs. Each of the measuring units consists of an electrical counter, three voltage measuring transformers and three current measuring transformers.

Scheme of measuring units is presented on Figure B.1 below.

[3] This is a deviation from determined monitoring plan. Units of measurement for the gas flow meter in the determined monitoring plan were expected to be Nm^3. However this meter is not functional at the moment. Different type of gas flow meter (back-up meter) was used instead to carry out gas flow measurement. Units of measurement for the meter being used are kg/s.

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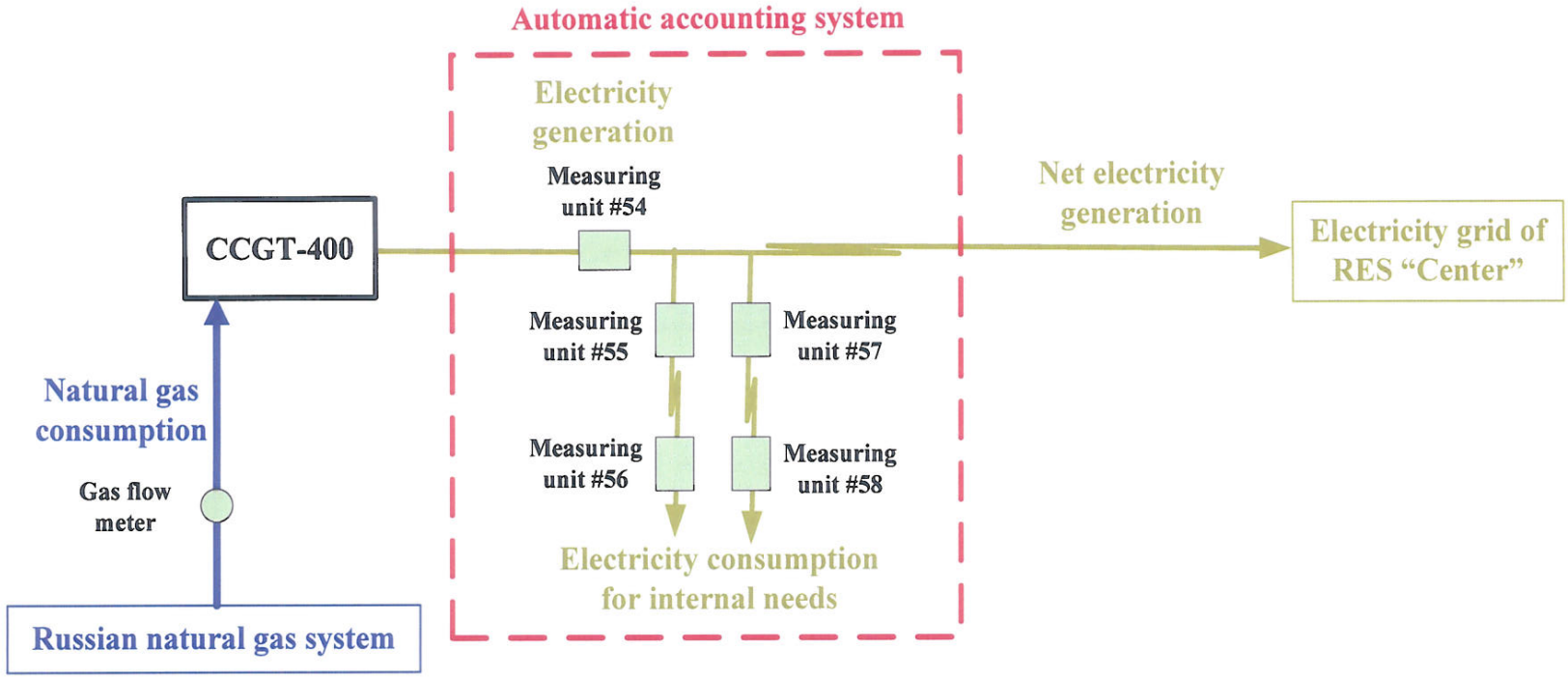

Figure B.1. Scheme of measuring units

B.1.2. Table providing information on the equipment used (incl. type, serial number, information to specific uncertainty, date of last calibration, calibration authority, need for changes and replacements):

Meter ID number	Equipment type	Units	Meter name	Serial number	Accuracy index	Calibration authority	The last check date	The next check date
Natural gas consumption								
1	Gas flow meter	kg/s	-	7311	± 0.25	Braden Manufacturing LCC	April 2008	April 2012

Meter ID number	Equipment type	Units	Meter name	Serial number	Accuracy index	Calibration authority	The last check date	The next check date
Automatic accounting system								
Electricity measuring unit #54								
2	Electrical counter	kWh	Alfa A1800	01208211	0.2S	Elster Metronika Co Ltd	June 2010	June 2022
	Voltage measuring transformers	V	EPR20Z	1782400001	0.2	State company "Mendeleevsky Center of standardization, metrology and certification"	September 2010	September 2014
		V	EPR20Z	1782400002	0.2			
		V	EPR20Z	1782400003	0.2			
	Current measuring transformers	A	BCT	52596971	0.2S	State company "Rostest-Moscow"	September 2010	September 2014
		A	BCT	52596965	0.2S			
		A	BCT	52596958	0.2S			
Electricity measuring unit #55								
3	Electrical counter	kWh	Alfa A1800	01208212	0.2S	Elster Metronika Co Ltd	June 2010	June 2022
	Voltage measuring transformers	V	VB12	8549780013	0.5	State company "Mendeleevsky Center of standardization, metrology and certification"	September 2010	September 2014
		V	VB12	8549780015	0.5			
		V	VB12	8549780018	0.5			
	Current measuring transformer	A	AB24-2	8562660010	0.5			
		A	AB24-2	8562660003	0.5			
		A	AB24-2	8562660008	0.5			
Electricity measuring unit #56								
4	Electrical counter	kWh	Alfa A1800	01208214	0.2S	Elster Metronika Co Ltd	June 2010	June 2022
	Voltage measuring transformers	V	VB12	8549780014	0.5	State company "Mendeleevsky Center of standardization, metrology and certification"	September 2010	September 2014
		V	VB12	8549780017	0.5			
		V	VB12	8549780016	0.5			
	Current measuring transformer	A	AB24-2	8562660011	0.5			
		A	AB24-2	8562660007	0.5			
		A	AB24-2	8562660009	0.5			
Electricity measuring unit #57								
5	Electrical counter	kWh	Alfa A1800	01208215	0.2S	Elster Metronika Co Ltd	June 2010	June 2022

Meter ID number	Equipment type	Units	Meter name	Serial number	Accuracy index	Calibration authority	The last check date	The next check date
	Voltage measuring transformers	V	VB12	8549780002	0.5	State company "Mendeleevsky Center of standardization, metrology and certification"	September 2010	September 2014
		V	VB12	8549780010	0.5			
		V	VB12	8549780012	0.5			
	Current measuring transformer	A	AB24-2	8562660001	0.5			
		A	AB24-2	8562660012	0.5			
		A	AB24-2	8562660013	0.5			
Electricity measuring unit #58								
6	Electrical counter	kWh	Alfa A1800	01208213	0.2S	Elster Metronika Co Ltd	June 2010	June 2022
	Voltage measuring transformers	V	VB12	8549780009	0.5	State company "Mendeleevsky Center of standardization, metrology and certification"	September 2010	September 2014
		V	VB12	8549780003	0.5			
		V	VB12	8549780011	0.5			
	Current measuring transformer	A	AB24-2	8562660004	0.5			
		A	AB24-2	8562660005	0.5			
		A	AB24-2	8562660002	0.5			

B.1.3. Calibration procedures

Chief Metrologist of TPP is responsible for all works concerning calibration. All measuring units have next check dates after 2012.

B.1.4. Involvement of Third Parties:

Checking and calibration of meters is usually done by state company "Mendeleevsky Center of standardization, metrology and certification" or other company which has necessary qualification, knowledge and equipment.

B.2. Data collection (accumulated data for the whole monitoring period):

Production and Technical Department of TPP collects and archives all data for the whole monitoring period:

- Natural gas consumption is collected yearly from the electronic data base;
- Net calorific value of natural gas is collected monthly. The natural gas certificates (containing net calorific value of natural gas) come from the natural gas supplier to the Production and Technical department directly;

- Electricity generation and electricity consumption for internal needs of the CCGT unit is collected yearly from the electronic database.

B.2.1. List of fixed default values and ex-ante baseline factors:

Variable	Source	Units	Value
Emission factor for natural gas $EF_{CO2,NG,y}$	Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006	tCO_2/GJ	0.0561
Baseline emission factor $EF_{BL,CO2,y}$	Annex 2 of the PDD	tCO_2/MWh	0.540

B.2.2. List of variables:

Variable	Source	Units	Calculation method	ID number of meters used (in accordance with Table B.1.2)
Volume of natural gas combusted at the new CCGT $FC_{NG,y}$	Meters readings	tonnes	This value is obtained by direct measurement of natural gas combusted at the new CCGT from the electronic database	1
Net calorific value per volume unit of natural gas $NCV_{NG,y}$	Certificate from supplier	GJ/tonne of gas	This value is obtained as average value based on values from monthly certificates	-
Quantity of electricity generated at the CCGT-400 $EG_{PJ,GEN,y}$	Meters readings	MWh	This value is obtained by direct measurement of electricity generated at the CCGT-400 from the electronic database	2
Quantity of electricity consumption for the new CCGT unit internal needs $EG_{PJ,AUX,y}$	Meters readings	MWh	This value is obtained by direct measurement of electricity consumption for the new CCGT unit internal needs from the electronic database	3-6

B.2.3. Data concerning GHG emissions by sources of the project activity:

Variable	Description	Units	Values
			2010
$FC_{NG,y}$	Volume of natural gas combusted at the new CCGT	Tonnes of gas	59,211
$NCV_{NG,y}$	Net calorific value per volume unit of natural gas	GJ/tonne of gas	49.147

B.2.4.Data concerning GHG emissions by sources of the baseline:

Variable	Description	Units	Values
			2010
$EG_{PJ,GEN,y}$	Electricity generated at the CCGT-400	MWh	426,089
$EG_{PJ,AUX,y}$	Electricity consumption for the new CCGT unit internal needs	MWh	18,391

B.2.5.Data concerning leakage:
Not applicable

B.2.6.Data concerning environmental impacts:
Currently CCGT is the most environmentally sound electricity generation technology. Proposed project was prepared according to Russian legislation and all necessary environmental activities were provided. Total pollutants during construction works were insignificant. The main pollutants of new CCGT unit are nitrogen oxides and carbon oxide. After commissioning these pollutants are monitored continuously. Shaturskaya TPP submits quarterly report to local environmental government bodies. All emissions are within the maximum allowable concentrations and lower significantly than ones from other energy units of Shaturskaya TPP.

B.3. Special event log:
No special events have taken place during the current monitoring period.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

Production and technical department collected and archived data for this monitoring report.
Name of the person responsible:
Alexander Evstigneev – Head of Production and Technical Department of TPP.

C.1.2. Trainings:

Training was provided during pre-monitoring process in September 2010.

C.2. Involvement of Third Parties:

Involvement of the third parties was not needed.

C.3. Internal audits and control measures:

Data (natural gas consumption, electricity generation and electricity consumption for internal needs) relevant to the emission reduction calculation are continuously registered in the log electronic books. Therefore, any measurement error can be easily identified, in case of getting values that significantly differ from the common (in case of equal conditions).

C.4. Troubleshooting procedures:

Some measuring systems are duplicated by back-up systems: gas flow meter and all measuring transformers for internal needs. In other cases all parameters of project can be calculated as difference between total natural gas consumption and total electricity output of Shaturskaya TPP and such parameters of the energy units #1-6 of TPP.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

The baseline emission is defined as:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO2,y} \quad (1)$$

Where:

BE_y Are the baseline emissions in the year y (tCO_2);

$EG_{PJ,y}$ Is the net quantity of electricity generated at the new CCGT unit in the year y (MWh);

$EF_{BL,CO\,2,y}$ Is the baseline emission factor in year y (tCO_2/MWh).

The net quantity of electricity generated at the new CCGT unit is defined as:

$$EG_{PJ,y} = EG_{PJ,GEN,y} - EG_{PJ,AUX,y} \quad (2)$$

Where:

$EG_{PJ,GEN,y}$ Is the quantity of electricity generated at the new CCGT unit in the year y (MWh);

$EG_{PJ,AUX,y}$ Is the quantity of electricity for the new CCGT unit internal needs (auxiliary equipment) in the year y (MWh).

Parameter	Unit	2010
Quantity of electricity generated	MWh	426,089
Quantity of electricity for the CCGT-400 unit internal needs	MWh	18,391
Net quantity of electricity generated	MWh	407,699
Baseline emission factor	tCO_2/MWh	0.540
Baseline emissions	**tCO_2**	**220,157**

E.2. Project emissions calculation

The project emission is defined as:

$$PE_y = FC_{NG,y} \times COEF_{NG,y} \quad (3)$$

Where:

PE_y Project emission in year y (tCO_2);

$FC_{NG,y}$ Is the total volume of natural gas combusted at the new CCGT unit in year y (tonne of gas);

$COEF_y$ Is the CO_2 emission coefficient in year y (tCO_2/tonne of gas).

$COEF_y$ is obtained as:

$$COEF_y = NCV_{NG,y} \times EF_{CO\,2,NG,y} \quad (4)$$

Where:

$NCV_{NG,y}$ Is the net calorific value per volume unit of natural gas in the year y (GJ/tonne of gas);

$EF_{CO2,NG,y}$ Is the CO_2 emission factor per unit of energy of natural gas in year y (tCO_2/GJ).

Parameter	Unit	2010
Total volume of natural gas combusted at the new CCGT unit	tonnes	59,211
Net calorific value per volume unit of natural gas	GJ/tonne of gas	49.147
CO_2 emission factor per unit of energy of natural gas	tCO_2/ GJ	0.0561
Project emissions	**tCO_2**	**163,253**

E.3. Leakage calculation

There are fugitive CH_4 emissions associated with fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant and fossil fuels in the grid in the absence of the project[4]. Technology of the proposed project is the most energy efficiency technology, therefore these emissions have not been taken into account for simplicity and conservatism.

E.4. Emission reductions calculation / table

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (5)$$

Where:

ER_y JI project emission reduction in year y (tCO_2);

BE_y Baseline emissions in year y (tCO_2);

PE_y Project emissions in year y (tCO_2).

Parameter	Unit	2010
Baseline emissions	tCO_2	220,157
Project emissions	tCO_2	163,253
Leakages	tCO_2	0
Emission reductions	**tCO_2**	**56,904**

[4] Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas, AM0029/version 03, Approved Methodology, CDM Executive board