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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Title: Reconstruction of the Nevsky branch Hydro Power Plants
The sectoral scope: 1. Energy industries (renewable/non-renewable sources)[1]
Version: 14
Date: 06/07/10

A.2. Description of the project:

The Svetogorskaya HPP and the Lesogorskaya HPP started operations in 1937 and 1947 respectively. These HPPs are part of the cascade of the Vuoksinskiye HPP, involving four HPPs constructed by Finland in 1920-1950 (Imatra and Tainionkoski HPPs are located further up on the Vuoksa river).

Project scenario

The project activity involves the reconstruction of two hydropower plants (HPPs) of the Nevsky Branch HPPs that are part of the Consolidated Energy Systems (CES) of North-West in Russia. The two HPPs are the Svetogorskaya HPP and the Lesogorskaya HPP. The owner is an open joint stock company (JSC) Territorial Generating Company #1 (TGC-1).

Reconstruction of HPPs provides the following benefits:

- Improvement of power supply and decreasing the power flow among CES North-West and other CES of Russia;
- Decreasing the pollutant emissions due to prevention of fossil fuel use for power generation (Reduction of NO_X, SO_2 and VOC);
- Creating additional employment;
- Promoting regional economical development.

Baseline scenario

The baseline scenario is based on the assumption that if the project is not implemented (i.e. additional electricity will not be supplied to the grid) third parties will cover the energy demand. The energy companies within the same regional energy system (URES “North-West”) can increase electricity generation at the existing capacities by delaying decommissioning of outdated capacity and/or installing new energy units.

Brief history of the Project

"UES of Russia" (Unified Energy System of the Russian Federation) RJSC has started to get prepared for implementing the mechanisms of Kyoto Protocol long before its ratification in Russia. "UES of Russia" RJSC has made every effort to cooperate with the UNFCCC (United Nations Framework Convention on Climate Change). For those purposes, the Energy Carbon Fund was established in 2001.

The Fund’s main achievements:

[1] http://ji.unfccc.int/Ref/Documents/List_Sectoral_Scopes_version_02.pdf

- The Fund took a complete physical inventory of the greenhouse gas emissions from 1990 to the present day at the power plants belonging to "UES of Russia" RJSC. Taking such an inventory met the world's standards. A greenhouse gas emissions inventory has been created.

- A greenhouse gas emissions monitoring system that includes an accounting system is well adjusted and in operation. The greenhouse gas emissions inventory is being put together.

- Joint implementation projects were prepared for approval by state authorities. Of them, a number of projects successfully went through the international determination. Foreign investors were attracted to take part in the joint implementation projects that passes such determination. Together with regional energy companies, the Fund took part in international tenders for buying greenhouse gas emissions quotas.

- The information analysis system Greenhouse Gases was developed and then implemented at most of the energy companies.

- Prospective volumes of the greenhouse gas emissions generated by the Unified Energy Network of Russia were determined.

- Several regulatory-and-procedural documents, including a procedure for calculating greenhouse gas emissions generated by thermal power plants have been issued and is in effect.

In 2006, the Energy Carbon Fund estimated whether it is possible to implement the project "Reconstruction of the Nevsky branch Hydro Power Plants" as a joint implementation project[2].

On June 20, 2006 the business plan "Reconstruction of the Nevsky branch Hydro Power Plants" was approved at a meeting of the Board of Directors.

On December 12, 2007 the decision of execution of JI Agreement by and between TGK-1 and Fortum was approved by Board of Director of TGK-1 (minutes No. 20)

On February 20, 2008 Fortum, the Russian Territorial Generating Company No. 1 (TGC-1) and ECF Project Ltd. (subsidiary of Energy Carbon Fund) had signed an agreement according to which Fortum would purchase approximately 5 million tones of emission reduction units (ERU) from TGC-1.

The purchase agreement is based on the Memorandum of Understanding between Fortum and United Energy Systems of Russia (RAO UES) in 2006, and it is the biggest of its kind ever made in Russia. The ERUs purchased cover approximately half of Fortum's annual CO2 emissions and their value is approximately EUR 70 million based on the current market value of Certified Emission Units in developing countries.

The ERUs will come from Joint Implementation projects conducted at TGC-1's production facilities during the Kyoto Period (2008-2012). The JI projects of TGC-1 will include reconstruction of hydro power plants in Leningrad Region, expansion and reconstruction of combined heat and power generation facilities as well as energy efficiency improvements with district heating network in St.Petersburg. Fortum can use the received ERUs to cover part of its own emissions once these projects are completed and their emission reduction has been verified.

In 2006, "UES of Russia" RJSC developed "The Master Plan for placing power plants up to 2020". This Master Plan is virtually a consolidated investment that was prepared based on the plans developed by those plants themselves and was later approved by the Government of the Russian Federation (the

[2] Letter from the Director of Investment Policy and Market Development of Energy Carbon Fund Kolesnikov D.A. No. DK-557 dated 18.12.2006

Government of the Russian Federation Executive Order No. 215-r of February 22, 2008). JSC "TGC-1" (TGK stands for Territorial Generating Company) was founded in March 2005 as part of Russia's power industry reform. JSCs "Lenenergo", "Kolenergo" and "Karelenergogeneratsiya" acted as founders of TGC-1. On October 1, 2005 the company started its operating activity. On November 1, 2006 TGC-1 completed the merging of its assets and establishment of an integrated operating company, which is a legal successor in rights and obligations of the merged legal entities. In connection with closing down "UES of Russia" RJSC, the company inherited the investment plans of "UES of Russia" RJSC. However, it is not obliged to implement them.

Even though the project is part of "The Master Plan for placing power plants up to 2020", JSC "TGK-1" has no obligations to the state to implement it. The Master Plan does not provide a list of companies, the facilities of which are its part. Therefore, in case the schedule to put new power facilities in operation is not followed to, the state cannot impose penalties on any of such companies. It is also confirmed by the fact that actual deadlines and volumes for putting new power plants in operation considerably differs from those in the Master Plan.

Executed on May 10, 2007 was the EPC/EPCM agreement for managing the engineering, procurement for and construction of a HPPs.

Reconstruction of the cascade of the Nevsky branch Hydro Power Plants offers the possibility of decreasing greenhouse gas emissions due to displacement of electricity in the grid produced by fossil fuel fired power plants.
In order to increase the generation from the HPPs and to reduce the quantities of emissions from pollutants and greenhouse gases from the thermal power plants, TGK-1K implements project for adding new hydropower capacities and the rehabilitation of the existing HPPs.
The additional electricity generated by HPPs will be supplied into the energy system of North-West region (which includes the City of St Petersburg, Republic of Karelia, Leningrad Region and Murmansk Region) and substitute power generation by the company's low efficiency coal-fired thermal power plants; some of the additional power may be supplied to the federal wholesale electricity market.
The thermal power plants where the power generation will be substituted by HPPs include Central CHPP, Pravoberezhnaya CHPP-5, Vasileostrovskaya CHPP-7, Pervomayskaya CHPP-14, Severnaya CHPP-21, Yuzhnaya CHPP-22, Avtovskaya CHPP-15, Vyborgskaya CHPP-17, Dubrovskaya CHPP-8.
The total CO_2 emission reduction under the Project is estimated as 659'914 tons of CO_2 for the period of 2009-2012.

A.3. Project participants:

Party Involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Russian Federation (Host Party)	• JSC "TGC-1" • ECF Project Ltd	No No
Finland	Fortum Power and Heat Oy	No

JSC «TGC-1» is the leading producer and supplier of electricity and heat power in the North-West region of Russia and the third largest territorial power generating company in Russia in terms of installed capacity. It operates 55 power plants in four regions of Russia – the city of St Petersburg, Republic of Karelia, Leningrad Region and Murmansk Region. The company's power assets include thermal, hydro, diesel and co-generation power plants and it has a heating network of 940 km.

The state registration of the company took place on March 25th, 2005. TGC-1 began operating on October 1st, 2005.

A.4. Technical description of the project:

A.4.1. Location of the project:

The location of the project is shown on the figure 1 below.

A.4.1.1. Host Party(ies):

Russian Federation

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

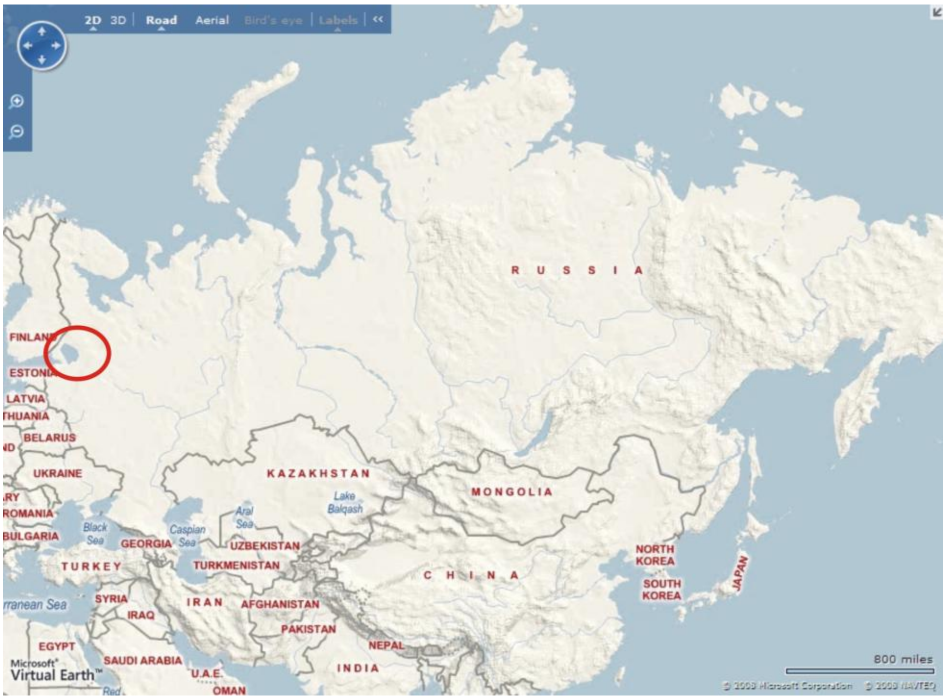
Leningrad region

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

Svetogorsk town

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

The location Svetogorskaya HPP has geographical coordinates of 61°03′30″ north latitude and 28°52′24″ east longitude and Lesogorskaia HPP has coordinates of 61°06′16″ north latitude and 28°50′23″ east longitude.



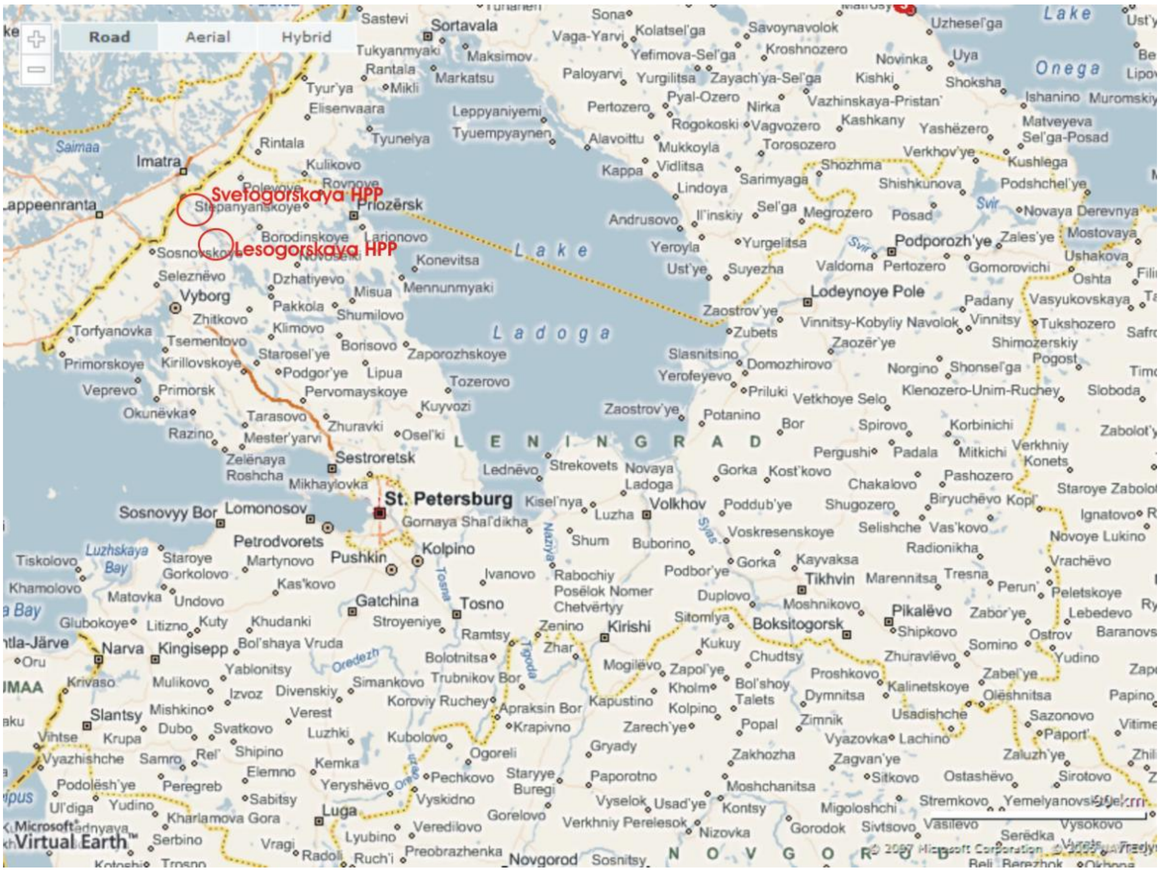


Figure 1: Project location.

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

Svetogorskaya HPP

All turbines with regulating and auxiliary equipment were manufactured in the end of the 1930s (Table 1).Unit # 3 is non-operational (has been taken out of service and has also been partially taken apart).

Table 1: Hydro turbines of the Svetogorskaya HPP.

No.	Equipment Type	Installed Capacity, MW	Start of Operations, Year
1	PL	23.25	1945
2	PL	23.25	1946
3	PL	23.25	1947
4	PL	23.25	1947
5	RO	0.5	1947

Power generating units have been under continuous operation throughout the past 60 years with periodical repairs.

Lesogorskaya HPP

All turbines with regulating and auxiliary equipment were manufactured in the late 1930s (Table 2). All drawbacks and flows, as well as operational conditions of the turbines are the same as those at the Svetogorskaya HPP.

Table 2: Hydro turbines of the Lesogorskaya HPP.

No.	Equipment Type	Installed Capacity, MW	Start of Operations, Year
1	PL	23.5	1937
2	PL	23.5	1937
3	PL	23.5	1937
4	PL	23.5	1937

Power units have been continuously in operation throughout the past 67 years with periodical repairs.

Investment in the project activity would involve complex reconstruction of the cascade of Vuoksinskiye HPP (turn-key approach) including the replacement of four HPP units at the Lesogorskaya HPP (block unit capacity increases from 23.5 to 29.5MW) and four HPP units of the Svetogorskaya HPP (block unit capacity increases from 23.5 to 30.5 MW). Preliminary turbine parameters with new working wheel are described in Table 3.

Table 3: Preliminary main turbine parameters with new working wheel of Caplan type PL-20-B-562.

	Svetogorskaya HPP	Lesogorskaya HPP
Rated speed	100 rotation/min	100 rotation/min
Rated head	15.15 m	15.4 m
Estimated flow	210.9 m^3/sec	200 m^3/sec
Capacity	30.5 MW	29.5 MW
Accelerated rate speed	210 rotation/min	215 rotation/min

Due to the new operational wheel the turbine efficiency will increase. In the figure below the current and post-reconstruction turbine efficiencies are shown as function of water discharge. Turbine parameters presented below are based on the preliminary parameters obtained originally from the manufacturer of the turbine units (Tampella, GE Energy).

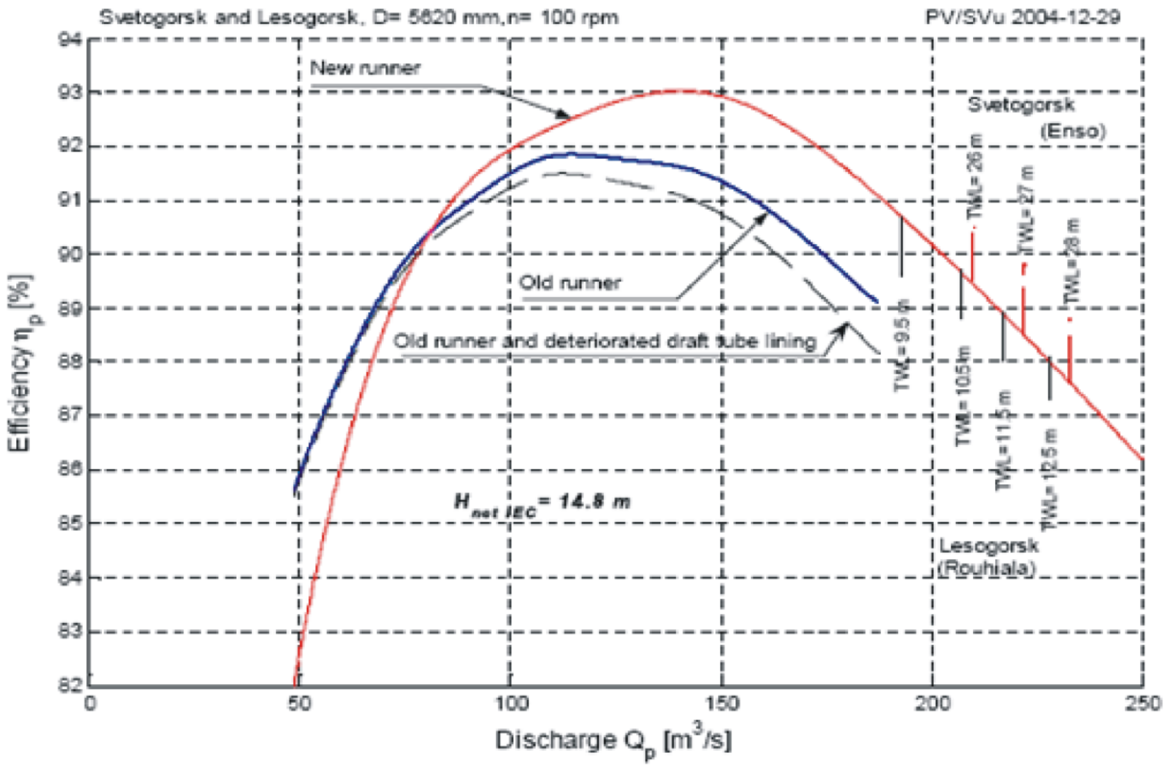


Figure 2: Turbine efficiency before and after reconstruction.

For reconstruction of the cascade of the Vuoksinskiye HPP the following equipments are to be replaced or upgraded:

- Kaplan turbine;
- regulators of turbine speed;
- oil pressure installations;
- generators;
- generator excitation system (switch from rotating to thyristor system);
- generator relay protection (automated start-up and shut-down of HPP unit);
- compressors;
- indoor switchgear -110 kV (pressure switch, disconnect switch and wires);
- power transformers 10/110 kV;
- flow passages (intake screen, fast-falling gates, gate lifting mechanisms).

The repairing of the bridge on Svetogorskaya HPP dam, which is in poor state, and the repairing of the rural unpaved road to Lesogorskaya settlement (around 10 km) are required in order to deliver main equipment, as well as the construction of dock with overhead-track hoisting facility is also required to unload and accommodate equipment.

Equipments comply with the latest level of technical and technological development, as well as with the requirements of the Conception of the Technical Policy of RAO “UES of Russia” approved by the Executive Board of the OJSC RAO “UES of Russia” on 11.04.05 (№ 1190pr/2).

Implementation schedule

On June 20, 2006 the business plan “Reconstruction of the Nevsky branch Hydro Power Plants” was approved at a meeting of the Board of Directors.

Executed on May 10, 2007 was an agreement for managing the engineering, procurement for and construction of Nevsky branch Hydro Power Plants.

In 2008, a feasibility study for the project was prepared by the Institute Teploelektroproject (a branch of UES Engineering Center OJSC).

In accordance with the implementation schedule, a phased launch of the project is planned from 2009 till 2012. The project implementation schedule is given in Table 4.2.1.

Table 4 .Project implementation schedule

№	Title	2006		2007		2008		2009		2010		2011		2012	
		I h/y	II h/y	I h/y	II h/y	I h/y	II h/y	I h/y	II h/y	I h/y	II h/y	I h/y	II h/y	I h/y	II h/y
1	Developing of Business plan	■													
2	Approving the feasibility study by Board of Directors		■												
3	Tender for reconstruction of the Cascade		■												
4	Signing the contract with general contractor			■											
5	Primary equipment supply			■	■	■	■	■	■						
6	Auxiliary equipment supply					■	■	■	■	■	■	■			
7	Disassembling of old equipment				■	■	■	■	■	■	■				
8	Construction and assembly work				■	■	■	■	■	■	■	■			
10	Precommissioning								■	■	■	■	■	■	
11	Commissioning date Svetogorskaya HPP-11, including								■	■	■	■	■	■	■
12	HT Generator GG-1										■				
13	HT Generator GG-2												■		
14	HT Generator GG-3								■						
15	HT Generator GG-4														■
16	Commissioning date Lesogorskaya HPP-10, Including								■	■	■	■	■	■	
17	HT Generator GG-1								■						
18	HT Generator GG-2											■			
19	HT Generator GG-3													■	

Source: Data provided by Open Joint-Stock Company Enel OGK-5

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

The electricity produced by the additional power capacity of reconstructed hydro power plants will replace electricity generated by fossil fuel fired power plants in the grid of the CES "The North-West". Displacement of electricity generated by fossil fuel power plants offers the possibility to reduce 659 914 tCO_2 over the crediting period.

Project additionality is based on the barrier analysis and explained in Section B.1.

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

	Years
Length of the crediting period	4 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2009	106 036
2010	138 437
2011	189 570
2012	225 871
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	659 914
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	164 979

A.5. Project approval by the Parties involved:

The project will be approved by the Russian Federation after the approval of the Russian procedure for the registration of JI projects.

The Parties' Letter of Approval will be received later.

SECTION B. Baseline

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

Indication and description of the approach chosen regarding baseline setting.

Baseline methodology:

Approved consolidated baseline and monitoring methodology ACM0002 (Version 10): Consolidated baseline methodology for grid-connected electricity generation from renewable sources (approved during th th 47 CDM EB conference on 28 of May, 2009)

This methodology draws upon the following tools :

- Tool for the demonstration and assessment of additionality;
- Tool to calculate the emission factor for an electricity system;

For more information on the baseline and monitoring methodology we refer to the UNFCCC website: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

Step1: Identification of alternative scenarios

Sub-step 1a: Define alternative scenarios to the proposed project activity:

Alternative 1: The reconstruction of the Nevsky branch HPPs not being undertaken as a JI project;
Alternative 2: Construction of new thermal power plant (TPP) with installation of CCGT to make up for the capacity of HPPs;
Alternative 3: Continuation of the current situation.

Outcome of Step 1a: Three possible scenarios were identified as realistic and credible.

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

All the alternatives identified above are in compliance with the existing legislative and regulatory requirements of the Russian Federation.

Outcome of Step 1b: The alternatives remain the same.

Proceed to Step 2 (Barrier analysis)

Step 2: Barrier analysis

Sub-step 2a.Identify barriers that would prevent the implementation of alternative scenarios

Alternative 1: Barrier does not exist. The reconstruction of the Nevsky branch HPPs not being undertaken as a JI project.
The project is approved by the TGC-1 Board of Directors on 20/06/2006 as a part of the Investment Programme of Strategy-of-Development for 2006-2015 and financed at account of additional emission of TGC-1 shares and equity of main shareholders (Gazprom and Fortum). However, the complete implementation of the Investment Program will require an amount of 35 bln. Roubles. Resulting from the additional issue, placed 5-25 October 2007, the amount of 34.2 bln. Roubles was raised. These funds are sufficient only for implementation of the Investment Program up to 2008 inclusively. To further realize the Investment Program, raising of borrowed funds will be necessary.
TGC-1 at present is able to leverage capital for this project activity by taking a loan. In order to provide needed guarantees loan, TGC-1 will use their fixed assets as collateral, as well as selling the ERU

(Emission Reduction Units) can be a security at borrowing a loan and will facilitate decreasing the loan support costs during the entire crediting period.

Alternative 2: Barrier exists.
The following barriers are considered:

The organizational barrier related to allotment of limits for the natural gas use and to connection to the gas transport system.

The Investment barrier related to the lack of funds in TGK-1 to implement the project in short terms.

General practice barrier related to the fact that as of the moment of approval of the Project in 2006, combined-cycle power plants were not prevalent in Russia.

These barriers are considered below in greater detail.

Organization barrier

The fuel, on which the Combined-Cycle Plant will work, is natural gas. The process of obtaining permits for connection and receiving the gas limits is of red-tape delayed nature. To obtain a permit for connection to the gas supply line, the following shall be required:

1. Drawing up of an application to the district branch of the gas service with a request to issue technical specifications for connection to the gas supply source. At the same time, the documents, which any organization has available shall be submitted: the charter, land certificate, documentation for the already available objects, registration data card, etc.
2. Provision of additional references: on gas limits from the supply organizations, approved from the side of the district branch of the gas service, dealing with gas transportation. At approval of the technical specifications, the following question will be settled: to what gas supply line it will be more expedient to connect the generation capacities. Besides, the remoteness of the gas supply source and possibilities of gas supply through it to the Combined-Cycle Power Plant will be of great importance. If the distance to it is too large or if the designed capacities thereof are exhausted, construction of an additional main gas supply line close to the generation capacities will require additional financing, and the term for making a positive decision on issue of the technical specifications may extend for a long time.

The procedure of obtaining the gas limits and permits for connection to the gas supply line frequently becomes an insurmountable obstacle even in cases when the gas main line is situated in direct accessibility zone. Allotment of the limits and issue of the permits for connection to the gas transport system for OJSC «TGK-1» is characterized with a long-term process of obtaining the approvals.

Therefore, this barrier actually exists.

Investment barrier

Although the technical level of TGC-1 is sufficient for the implementation of this alternative, but the lack of funds does not allow realizing these alternatives in the short term. Total cost for project implementation is 360 millions USD/270 millions EUR (the estimates are based using average indicative price of ~1,500 USD per 1 kW of installed capacity). Alternative 2 cost more than Alternative 1. Taking into account that TGC-1 does not have the ability to raise capital for Alternative 2, therefore Alternatives 2 are not feasible in economic terms.

Alternative 3: Barrier does not exist. Continuation of the current situation. At the moment, TGC-1 operates existing HPPs by maintaining these by periodical repairs of the installed equipment when financially feasible.

General practice barrier

There was put in operation GTU CHPP Luch (LM2500 + HSPT (GE)) in Belgorod in 2005. GTU CHPP Luch produced 26 849 MWh of power and 121 974 GJ of heat having natural gas consumption 8 238 thous. m3 in 2005.

GTU CHPP Luch is the first power plant of RAO "UES of Russia" being financed with funds borrowed from OAO "Bank for Foreign Trade" (Vneshtorgbank) and OAO "Savings Bank of Russia" (Sberbank of Russia), instead of the funds of RAO "UES of Russia" earmarked for investment purposes. The estimated cost of the project is RUB 1,136 million. Borrower banks have been selected from several banks interested to provide for the loan.

In spite of significant accumulated experiences in installation and operation of combined-cycle units the dominant technology in the Russian power sector as usual is the traditional steam-power cycle with using of steam turbines. In Russia the share of gas turbines amounts only 1.4 % (2006) of total capacities of the power plants (data from the corporative analysis information system AIS “Elektra”). Consequently, the construction of CHPP is not widely diffused practice in the Russian power sector.

Outcome of Sub-step 2a: There are following barriers: Organization barrier, Investment barrier and General practice barrier to implement Alternative 2.

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers
Based on the above, we have to eliminate alternatives 2 from further consideration

Outcome of Sub-step 2b: Alternatives 1 and 3 do not have obstacles for development; therefore these alternative scenarios could be considerate as the *baseline scenarios.*

According to the “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 02.2) if there are still several alternative scenarios remaining, including the proposed project activity undertaken without being registered as a JI project activity, proceed to Step 3 (investment analysis).

Application of the approach chosen.

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

Data/Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Total electricity delivered as a result of project activities to the grid, in year *y*
Time of determination/monitoring	Determined ex-ante
Source of data (to be) use	Federal Service of State Statistics (RosStat)
Value of data applied (for ex ante calculations/determinations)	Please see Table 3 in Annex 2

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurements are carried out continuously. Data are recorded monthly.
OA/QC procedures (to be) Applied	Equipment is verified and calibrated according to the necessary procedures. Maintenance is carried out according to the technical
Any comment	

Data/Parameter	$\sigma_{historical}$
Data unit	MWh/yr
Description	Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Time of determination/monitoring	Determined ex-ante
Source of data (to be) used	Federal Service of State Statistics (RosStat)
Value of data applied (for ex ante calculations/determinations)	Please see Table Anx.2.11 in Annex 2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	

Data/Parameter	$EG_{historical}$
Data unit	MWh/yr
Description	Annual average historical net electricity generation delivered to the grid by existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Time of determination/monitoring	Determined ex-ante
Source of data (to be) used	Federal Service of State Statistics (RosStat)
Value of data applied (for ex ante calculations/determinations)	Calculation is carried out in accordance with approach (a) of the “Consolidated baseline and monitoring methodology ACM0002”. Please see Table Anx.2.11 in Annex 2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	

Data/Parameter	$EF_{grid,OMsimple,y}$
Data unit	tCO_2/MWh

Description	Simple operating margin CO_2 emission
Time of determination/monitoring	Determined ex-ante
Source of data (to be) used	Parameter is calculated according to the formula 1 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.5707
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The coefficient was designed for the period from 2010 to 2012.
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	BM emission factor
Time of determination/monitoring	Determined ex-ante
Source of data (to be) used	Parameter is calculated according to the formula 2 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.4431
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin emission factor
Time of determination/monitoring	Determined ex-ante
Source of data (to be) use	Parameter is calculated according to the formula 4 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.5388
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The coefficient was designed for the period from 2010 to 2012.
OA/QC procedures (to be) applied	-
Any comment	-

Step 3. Investment analysis

The main goal of the investment analysis is to determine whether the proposed project is not:
(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of ERUs associated with the JI project.

Alternative 1. The proposed project, Reconstruction of the Nevsky branch Hydro Power Plants, shall be implemented by the project participant TGK-1. The approach recommended in p. 6 (a) of Additionality Tool is applied — using "government bonds rates increased by a suitable risk premium". As Russia does not have long term governmental bonds, a conservative approach of using Central Bank RF interest rate of 11.0% only is proposed in the analysis not including a county risk premium and inflation. Thus the overall IRR benchmark amounts to 11.0%. If the proposed project (not being implemented as JI project) has a less favorable indicator, i.e. a lower IRR, than the benchmark, then the project cannot be considered as financially attractive.

Calculation and comparison of financial indicators
The financial analysis refers to the time of investment decision-making.
The following assumptions have been used based on the information provided by the TGK-1:
1. Investment decision: June 2006, commissioning date: successively from 2009 till 2012;
2. The project requires investments of approximately EUR 135.6 million during six years;
3. The forecast for electricity "Concept of social-economical development of RF for the period up to 2020" approved by the Russian Federation Government Decree #1662-p dated 17/11/2008;
4. The exchange rate (EUR/RUR) is rounded up to 1/34.14 in accordance with the enterprise's conversion practice;
5. The project lifetime is 25 years (lifetime of CCGT in line with contract);
6. Electricity generation is taken into account in line with the technical specifications of the project design;
7. The scrap value is calculated as turbine weight (documented) multiplied by scrap price.

The project cash flow focuses, in addition to investment-related outflows, on revenue flows generated by additional sales of electricity produced by the new hydro turbine unit.

The project's financial indicators are presented in the Table 5 below.

Table 5. Financial indicators of the project

Scenario	IRR (%)	Discounted PBP	Simple payback period (years)[3]
Base case	9.4	Out of project lifetime	16

The cash flow analysis shows an IRR of 9.4%, which is well below the IRR benchmark identified as 11.0%. As a result a negative NPV is obtained. Hence, the project cannot be considered as financially attractive.

Sensitivity analysis

A sensitivity analysis shall be conducted to show whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions.

The following two key factors were considered in the sensitivity analysis: electricity tariffs and investment cost. The other cost components account for much less than 20% of total cost and therefore are not

[3] The discounted payback period would be outside of the project lifetime.

considered in the sensitivity analysis. In line with the guidance to the Additionality Tool (par. 17) the sensitivity analysis should be undertaken within the corridor of ±10% for the key indicators.

Scenario 1 considers a 10% investment cost growth. Scenario 1 shows that this assumption worsened the cash flow performance due to significant cost increase.

Scenario 2 is based on the assumption of a 10% investment cost decrease that improves cash flow and performance indicators a little with IRR remaining below the benchmark.

Scenario 3 implies electricity tariff raise 10%. The results of calculation shows that with an increase in electricity tariff by 10% IRR higher than the discount rate. However, taking into account that electricity tariffs are regulated by the Federal Tariff Service, this scenario is unlikely.

Scenario 4 implies electricity tariff decrease 10%. That means that sales revenues drop worsening the cash flow performance.

In all these scenarios, except Scenario 3 NPV is negative. The simple payback period is more than 15 years and discounted payback period exceeds project life time.

A summary of the results is presented in the Table 6 below.

Table 6. Sensitivity analysis

Parameter	**Fluctuation**				
	-10%	**-5%**	**0%**	**5%**	**10%**
Investment costs	10.20%	9.80%	9.40%	9.10%	8.70%
Electricity price	5.30%	7.60%	9.40%	11.00%	12.50%

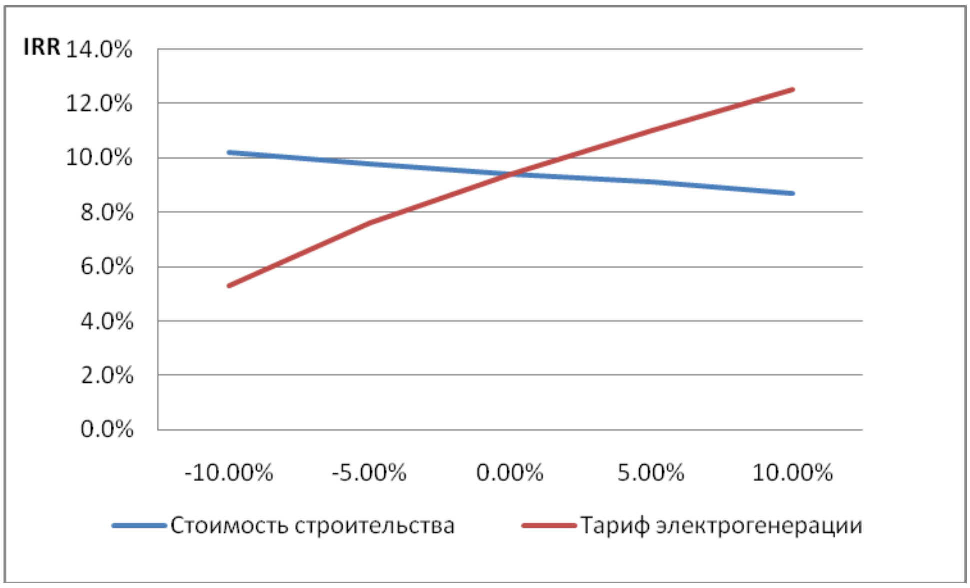


Figure 3. Sensitivity analysis

Hence, the sensitivity analysis consistently supports (for a realistic range of assumptions) the conclusion that the project is unlikely to be financially/economically attractive.

Alternative 3. Continuation of the current situation

For the Alternative 3 there is no need to conduct the Investment analyses due to the fact that the Alternative 3 does not have Investments.

In accordance with the above mentioned Alternative 3 is the most appealing scenario to the financial side as compared to Alternative 1.

Outcome of Step 3: Based on the Investment analysis Alternative scenario 3 - Continuation of the current situation (without the project activity) is most plausible, thus it is identified as the *baseline scenario*.

Step 4. Common practice analysis

The Tool recommends to provide an analysis of any other activities if they are in the same country/region and rely on similar technology, are of a similar scale, and take place in the comparable environment.

Saratov HPP (Hydro Power Plant).

HPP capacity — 1270 MW, annual generation — 5,352 bln. KW·h. The HPP building houses 24 installed hydro-electric units, operating at the design head of 9.7 m: 21 rotary-blade hydro-electric units PL-20/661-VB-1030 with the capacity of 60 MW each, 2 horizontal submerged hydro-electric units PL-20/548-GK-750 with the capacity of 45 MW each (are currently disassembled), 1 fish-path hydro-electric unit PL-661-VB-500 with the capacity of 10 MW. The HPP equipment is obsolete, is being replaced and modernized.
At present, modernization works are under way at the HPP, for example, in 2006 OJSC «GidroOGK» allocated for these purposes an amount exceeding 765 mln. Roubles, in 2008 an amount exceeding 1 bln. Rbl. was allocated. The works provide designing, manufacture and supply of two hydraulic turbines and two water-powered generators with the capacity of 54 MW each for the horizontal submerged hydro-electric units. The equipment supplies are scheduled for quarter II of 2010 and quarter I of 2011.

Rybinsk HPP

HPP capacity — 346.4 MW, annual generation — 644 bln. KW·h. The HPP building houses 6 installed rotary-blade hydro-electric units, operating at the design head of 13.4 m: 4 hydro-electric units with the capacity of 55 MW each, 2 hydro-electric units with the capacity of 63.2 MW each. The HPP equipment is obsolete and is being modernized.
The HPP worn-out equipment is gradually replaced, from 1998 to 2002, at Rybinsk HPP two hydro-electric units out of six were modernized, meanwhile, the HPP capacity was increased by 16 MW. The modernization completion is scheduled for 2015.

Kama HHP

HPP capacity — 522 MW (initially - 483 MW). Annual generation — 1710 mln. KW·h. The HPP building houses 23 installed rotary-blade hydro-electric units, operating at the design head of 15 m — 10 with the capacity of 21 MW each and 13 with the capacity of 24 MW each. The HPP equipment is obsolete and is gradually replaced, at the same time, the capacity of the hydro-electric units has been increased.
Since 1997 the HPP equipment has been reconstructed, since 2003 — the hydraulic turbines have been replaced. According to the HPP plans, the enterprise shall replace approximately 80-90 % of the equipment till 2015. Pursuant to the General Scheme of Disposition of Power-Engineering Objects till

2020, by 2015 all HPP turbines shall be replaced with new ones, besides, yet another, the 24th, hydro-electric unit shall be installed. The HPP capacity after the reconstruction shall amount to 555 MW.

Niva HPP-1.

HPP capacity — 26 MW, annual generation — 129 mln. KW·h. The HPP building houses 2 installed rotary-blade hydro-electric units with the capacity of 13 MW each, operating at the design head of 11.5 m. The hydraulic turbines are imported (KMB Company). The HPP equipment is obsolete, it shall be modernized and replaced (in particular, the water-powered generators shall be replaced).
For this HPP, there is a turbine replacement project, however, realization of this project has been put off after 2020.
As we can see there are no other projects similar to this one in the electricity sector of North-West region and in Russia. Measures on modernization and energy efficiency improvement of the existing capacities are occasional in Russia and, due to high costs and technological problems. The complete upgrade of existing HPPs is not typical because generally partial reconstruction is done. Only one large-scale reconstruction project is known till today and the project is “Improvement of efficiency in power generation at the Bratsk Hydropower Plant, Irkutsk Oblast (Russia)”. This project also required income from ERUs for its successful implementation.

Project activity similar to the reconstruction of the Nevsky branch HPPs is not widespread in the Russian Federation. Hence, the proposed JI project is *not common practice* and proposed project activity is *additional*.

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:

Reconstruction of the cascade of the Nevsky branch Hydro Power Plants offers the possibility of decreasing greenhouse gas emissions due to displacement of electricity in the grid produced by fossil fuel fired power plants.
In order to increase the generation from the HPPs and to reduce the quantities of emissions from pollutants and greenhouse gases from the thermal power plants, TGK-1 implements project for adding new hydropower capacities and the rehabilitation of the existing HPPs.
The additional electricity generated by HPPs will be supplied into the energy system of North-West region (which includes the City of St Petersburg, Republic of Karelia, Leningrad Region and Murmansk Region) and substitute power generation by the company's low efficiency coal-fired thermal power plants; some of the additional power may be supplied to the federal wholesale electricity market.
The thermal power plants where the power generation will be substituted by HPPs include Central CHPP, Pravoberezhnaya CHPP-5, Vasileostrovskaya CHPP-7, Pervomayskaya CHPP-14, Severnaya CHPP-21, Yuzhnaya CHPP-22, Avtovskaya CHPP-15, Vyborgskaya CHPP-17, Dubrovskaya CHPP-8.

To describe and justify the chosen baseline the Methodology ACM0002/Version 10 is applied. Based on the Investment analysis – Continuation of the current situation (without the project activity) is identified as the *baseline scenario*. Please see Section B.1.

It was used the methodological "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 02.2) to assess the additionality of the project. As all steps are successfully completed, therefore the proposed project activity – Reconstruction of the Nevsky branch HPPs is *additional*. Please see Section B.1.

The monitoring plan is chosen in accordance with ACM0002/Version 10 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" and the methodological "Tool to calculate the emission factor for an electricity system" (Version 02).

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

The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the JI project power plant is connected to. The project boundary includes all sources where changes of GHG emission as a result of direct impact of project implementation take place. The direct impact of the project envisages increase of power output from the HPP without GHG emissions and reduction of power output from sources of GHGs like thermal power plants and combined heat and power plants (CHPPs). The project boundaries for generated electricity are situated within the existing power system.

The electrical power system is a complex system of jointly working power plants and networks with common mode of operation and centralized dispatching control. Several jointly working power systems connected together form the power pool system. The term "United regional electricity systems" (URES) is accepted in Russia. It means several energy systems with common mode of operation and centralized dispatching control. The major part of the energy systems of Russia are integrated into the United regional electricity system of Russia. The United regional electricity system of Russia includes 6 banked consolidated energy systems: the Centre, Mid-Volga, Ural, North-West, South and Siberia. The Far East Consolidated Energy System operates segregated from the United regional electricity systems of Russia. The geographical boundaries of the URESs mentioned are presented below (Figure 4).

Figure 4: The United Regional Electricity System of Russia

Since the project is implemented in the URES of North-West, the project boundary shown schematically on Figure 4 includes the URES of North-West.

Cascade Nevsky HPP is located in URES "The North-West". Installed capacity of this URES is 21 038 MW (status 2010). Project capacity (164.5 MW) is only 0.7% of the URES "The North-West" total electric capacity, therefore project capacity "...can be dispatched without significant transmission constraints"[4].

As a result URES "The North-West" is selected as a *project electricity system*.

[4] Tool to calculate the emission factor for an electricity system, version 02, Methodological Tool, CDM Executive board

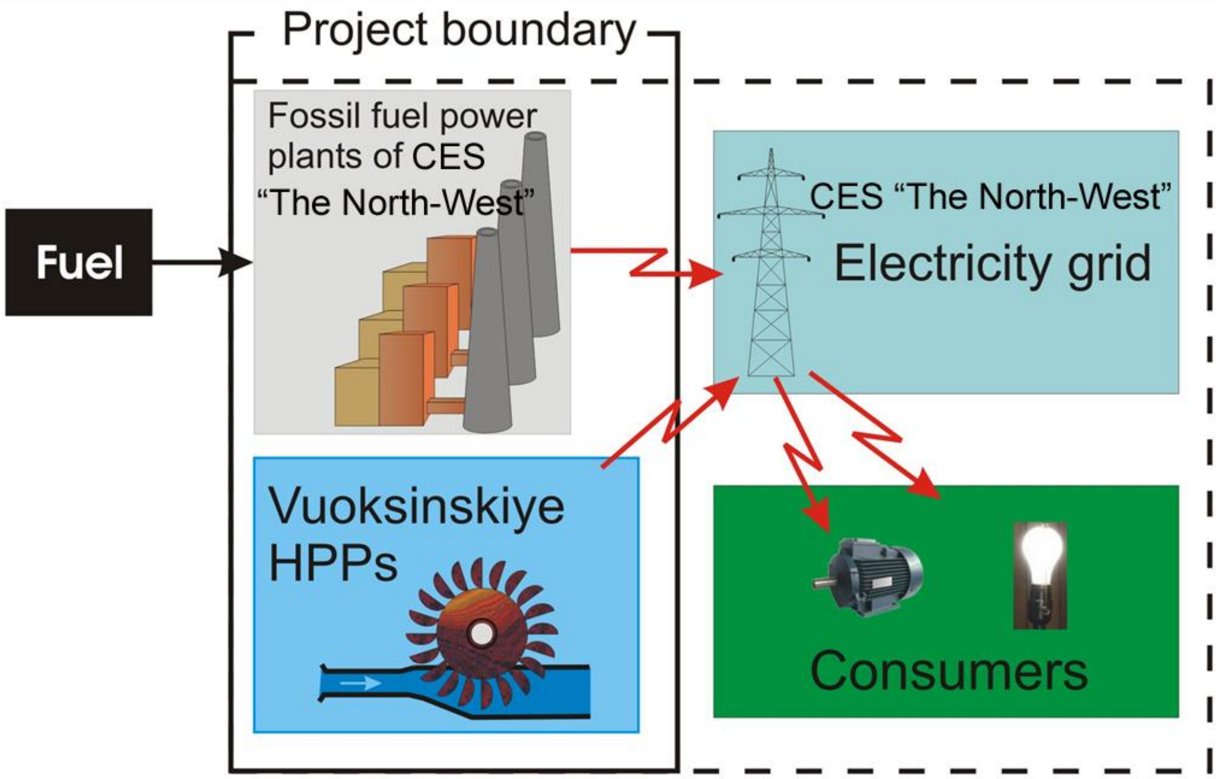


Figure 5: Project boundary

For the baseline determination, only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity needs to be accounted.

The greenhouse gases included in or excluded from the project boundary are presented in Table 7.

Table 7: Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Electricity generation in fossil fuel fired power plants that is displaced due to the project activity.	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Reservoir of hydro power plants.	CO_2	No	Excluded for simplification.
		CH_4	No	Project is realized on existing reservoirs
		N_2O	No	Excluded for simplification.

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 baseline setting: 11/08/2008

The following entities set the baseline:

ECF Project Ltd. is a project participant. See Annex 1 for detailed contact information.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

11/04/07 (signed supply contract of main equipment for Svetogorskaya HPP)

C.2. Expected operational lifetime of the project:

30 years (360 months)

C.3. Length of the crediting period:

4 years (48 months)

The starting date of the crediting period is 07/01/2009 and the end of the crediting period is 31/12/2012.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The monitoring plan is chosen in accordance with ACM0002/Version 10 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” and the methodological “Tool to calculate the emission factor for an electricity system” (Version 02).

The monitoring plan will be led by the project management and followed by the management team to ensure its complete implementation.

The monitoring plan includes the measurement, maintenance, recording and calibration tasks that should be performed to fulfil the requirements of the selected monitoring methodology and guarantee traceability in emission reduction calculations. The main steps of the monitoring plan are described below.

Monitoring of the electricity delivered to the CES of North-West
Electricity will be monitored using electricity meters, which will be maintained and calibrated according to QA/QC procedures. A cross check with electricity sale bills will be available after completion of reconstruction in each power plant.

Monitoring of parameters used in the calculation of grid-connected emission factor
The combined margin emission factor ($EF_{grid,CM,y}$) is fixed for the crediting period using the ex-ante option for the operating margin emission factor and option 1 for the build margin emission factor. For calculating emission reductions only the electricity supplied by each reconstructed unit to the grid should be monitored.

Data management system
A person will be appointed by the project owner to take responsibility for data handling, preparing monitoring reports of greenhouse gas emission reductions and collecting the data for emission reduction verification. (See Section D.3.)

Calibration of meters and quality assurance and quality control
The electricity meters installed should conform to national standards and rules that will guarantee quality assurance. Quality control should be provided by the responsible departments.

Verification

The verification of project emission reductions will be done annually. The project owner will be responsible for preparing documentation for verification by the Accredited Independent Entity (AIE).

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

According to ACM0002, being a hydro power project, no emissions from the Project scenario are identified. Therefore there are no entries in the following table.

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

Not applicable.

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

The project activity is electricity generation from hydro power plants. Project is implemented on existing reservoirs without increasing volume of reservoirs. So emission from the project activity is $PE_y = 0$.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B1. BE_y	Baseline emissions	Calculated under project activity	tCO_2	c	Annually	100%	Electronic	Defined according to formula 1
B2. $EG_{PJ,y}$	Total electricity delivered as a result of project activity to the grid	Electricity meter reading	MWh	c	Annually	100%	Electronic	Defined according to formula 2,3
B3. $EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid-connected power generation	Annex 2 of PDD	tCO_2/ MWh	c	Fixed ex ante	100%	Electronic	See Annex 2 of PDD
B4. $EG_{historical}$	Annual average historical net electricity generation delivered to the grid by existing renewable energy plant.	Electricity meters	MWh	m	Continuously	100%	Electronic/paper	Obtained from electricity meters of the Svetogorskaya HPP and the Lesogorskaya HPP

B5. $\sigma_{historical}$	Standard deviation	Electricity meters	MWh	m	Continuously	100%	Electronic/paper	Obtained from electricity meters of the Svetogorskaya HPP and the Lesogorskaya HPP

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

Baseline emissions

From ACM0002 v. 10, baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity, calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (1)$$

Where:
BE$_y$ = Baseline emissions in year *y* (tCO_2/yr).
EG$_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the JI project activity in year *y* (MWh/yr).
EF$_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid-connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (tCO_2/MWh).

The methodology assumes that all project electricity generation above baseline levels ($EG_{PJ,y}$) would have been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in $EF_{grid,CM,y}$.

Calculation of $EG_{PJ,y}$

As the project activity is the power increasing at the existing grid-connected HPPs:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical})\text{; until } DATE_{BaselineRetrofit} \quad (2)$$

$$EG_{PJ,y} = 0 \text{ ; on/after } DATE_{BaselineRetrofit} \quad (3)$$

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the JI project activity in year *y* (MWh/yr)..

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr).

$EG_{historical}$= Annual average historical net electricity generation delivered to the grid by existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr).

$\sigma_{historical}$ = Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr).

$DATE_{BaselineRetrofit}$ = Point in time when the existing equipment would need to be replaced in the absence of the project activity (date).

Calculation of $EG_{historical}$

$EG_{historical}$ is the annual average of historical net electricity generation, delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity. To determine EGhistorical, project participants may choose between two historical periods. This allows some flexibility: the use of the longer time period may result in a lower standard deviation and the use of the shorter period may allow a better reflection of the (technical) circumstances observed during the more recent years.

Project participants may choose among the following two time spans of historical data to determine $EG_{historical}$:

(a) The five last calendar years prior to the implementation of the project activity; or

(b) The time period from the calendar year following DATEhist, up to the last calendar year prior to the implementation of the project, as long as this time span includes at least five calendar years,

where DATEhist is latest point in time between:

(i) The commercial commissioning of the plant/unit;

(ii) If applicable: the last capacity addition to the plant/unit; or

(iii) If applicable: the last retrofit of the plant/unit.

Calculation is carried out in accordance with approach (a) of the “Consolidated baseline and monitoring methodology ACM0002”. See Table Anx.2.11 of Annex 2.

Calculation of $DATE_{BaselineRetrofit}$

In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity ($DATE_{BaselineRetrofit}$), project participants may take the following approaches into account:

(a) The typical average technical lifetime of the type equipment may be determined and documented, taking into account common practices in the sector and country, e.g. based on industry surveys, statistics, technical literature, etc.
(b) The common practices of the responsible company regarding replacement schedules may be evaluated and documented, e.g. based on historical replacement records for similar equipment.
The point in time when the existing equipment would need to be replaced in the absence of the project activity should be chosen in a conservative manner, i.e. if a range is identified, the earliest date should be chosen.

Calculation of Combined Margin Emission Factor

For determination of the combined margin (CM) the methodological tool used was version 2 “Tool to calculate the emission factor for an electricity system”. The CM emission factor is calculated as the sum of operating margin (OM) and build margin (BM) emission factors multiplied by corresponding weighting coefficients. The data for CM calculation are obtained from statistical forms 6-TP.

STEP 1. Identify the relevant electric power system.

The relevant electric power plant is CES “North-West” (see Section B.3).

STEP 2. Select an operating margin (OM) method.

Simple operating margin method can be used since for CES “North-West” low-cost/must-run resources constitute less than 50% of total grid generation. For CES “North-West” the installed capacity of low-cost/must-run resources (nuclear and hydro) is 87.14 GW (38.44%) and of fossil fuelled plants with industrial power plants 139.57 GW (61.56%)[5].

Ex-ante option is chosen to calculate the OM.

STEP 3. Calculate the operating margin emission factor according to the selected method.

The simple OM emission factor is calculated as follows:

---

[5] Data corresponding to year 2007. Source: Rosstat RF.

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (4)$$

Where:
$\boldsymbol{EF_{grid,OMsimple,y}}$ = Simple OM CO_2 emission factor in year *y* (tCO_2/MWh).
$\boldsymbol{EG_{m,y}}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).
$\boldsymbol{EF_{EL,m,y}}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
m = All power units serving the grid in year *y* except low-cost / must-run power units.
y = Three most recent years for which data is available.

STEP 4. Identify the cohort of power units to be included in the build margin (BM).

The cohort of five plants and units that have been built most recently are presented in Annex 2, Table 6.

Option 1 is chosen to calculate the BM.

STEP 5. Calculate the build margin emission factor.

The BM emission factor is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (5)$$

Where
$\boldsymbol{EF_{grid,BM,y}}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh).
$\boldsymbol{EG_{m,y}}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).
$\boldsymbol{EF_{EL,m,y}}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
m = Power units included in the build margin.

y = Most recent historical year for which power generation data is available.

STEP 6. Calculate the combined margin (CM) emission factor.

The baseline emission factor is represented by the combined margin emission factor and calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \qquad (6)$$

Where:

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year *y* (tCO_2/MWh).
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh).
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/MWh).
w_{OM} = Weighting of the operating margin emission factor (%).
w_{BM} = Weighting of the build margin emission factor (%).

In most cases the Tool recommends to apply $w_{0M} = w_{BM} = 0.5$. But developers may propose other weights. as long as $w_{0M} + w_{BM} = 1$.

As a starting point the weighting factor for w_{0M} is taken as 0.5.

When looking at the factor for w_{BM} the conditions of the Russian power system have to be taken into account. The Russian power system has a big quantity of old. worn-out low efficient power plants being in operation for decades. According to the JSC "UES of Russia" average turbines operational life time is around 30 years. Most of these capacities were put in operation in 1971-1980 that corresponds to 31.4% of the whole installed capacities.

In accordance with General Scheme[6]. dated 22 February 2008. it was planned to approximately 33 GW of old capacity has to be dismantled by 2015. To meet the growth in demand for new energy units with total capacity of 120 GW will be commissioned by 2015. This means that the JI project will not only initiate the construction of new power plants. but also accelerate the decommissioning of existing capacities. Given the impact of the financial crises on demand growth and the capability to finance new projects. the new estimation[7] (September 2008) expects that out of the planned 120 GW only about 80 GW will be operational by 2015. Out of the 33 GW of old capacity only 10 GW will be dismantled. This means that 1 GW of any project delay leads to a delay of 0.5 GW of old capacity dismantling. So the effect of the JI project on the acceleration of decommissioning of existing capacities will only be stronger as result of the financial crisis.

[6] http://www.e-apbe.ru/library/detail.php?ID=11106
[7] http://www.e-apbe.ru/library/detail.php?ID=11106

The estimation. that the effect of the JI project on the decommissioning of power plants and the delays of new power plants construction is approximately 50% / 50%. For the avoidance of new power plants the emission factor of the BM is representative whereas for the accelerated decommissioning effect the emission factor of the OM is representative. And it means that 0.25 of BM refers to the group of prospective power plants and another 0.25 of BM refers to the dismantling of existing capacities and can be related to OM.

Therefore effective w_{OM} = 0.50 + 0.25 = 0.75 and w_{BM} = 0.25.

CM emission factor is ex-ante for period 2008-2012 because OM and BM emission factors are ex-ante as well. This emission factor is the baseline emission factor ($EF_{grid,BM,y}$) which is used to establish the baseline emissions of the baseline scenario.
The result of the calculation of the combined margin emission factor is presented in Annex 2.

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

This Option 2 is not used in the project.

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 used in the project.

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 CO_2 equivalent):

This option is not used in the project.

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

This option is not used in the project.

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

According to the methodology ACM0002 the main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing, and transport), and land inundation. Project participants do not need to consider these emission sources as leakage in applying this methodology.

Hence, leakages are not included in the estimation of the project emission reductions.

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

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (7)$$

Where:
ER_y = Emission reductions in year y (tCO_2e).
BE_y = Baseline emissions in year y (tCO_2e).
PE_y = Project emissions in year y (tCO_2e). For the Vuoksinskiye HPPs $PE_y = 0$.

LE_y = Leakage emissions in year y (tCO_2e). Since there are no leakages with the project LE_y = 0.

Finally

$$ER_y = BE_y \quad (8)$$

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:

The main relevant Russian Federation environmental regulations:

- Federal law of Russian Federation "On Environmental Protection" (January 10, 2002, No. 7-FZ);
- Federal law of Russian Federation "On Air Protection " (May 04, 1999, No. 96-FZ);
- Federal law of Russian Federation "On Waste Production and Consumption" (June 24, 1998, No. 89-FZ);
- Water Code of Russian Federation.

In April 2008 JSC "TGC-1" has undertaken the development and deployment of an environmental management system (EMS) under the ISO 14001 standard. With this system in place, the Company hopes to make a further step in implementing its social responsibility program. The deployment of the EMS is aimed to minimize the environmental risks accompanying TGC-1 activities as well as to improve the reliability and safety of heat and electricity supply. By now, an Environmental Policy, which identifies priorities and commitments in respect to rational utilization of natural resources and environmental protection, has been drafted and approved in JSC "TGC-1".

To start with, the environmental management system will be put into operation in the Administration body of JSC "TGC-1" and at 3 facilities of Nevsky Branch, the Heating Grid enterprise and Vuoksinskiye HEPPs Cascade (Cascade-1). A consultancy company Ecopromsystems, has been contracted through a competitive tendering process to work out and implement the EMS in JSC "TGC-1".

The work on the development and deployment of the EMS has already begun. Experts have embarked on a diagnostic audit of the existing environmental management system. After the audit is completed, the consultants will prepare a comprehensive program for developing and deploying a new environmental management system. In June 2008, Ecopromsystems is to conduct a training session for JSC "TGC-1" employees in accordance with the ISO 14001:2004 standard's requirements and EMS deployment methods.

Assessment of the environmental impact was conducted in accordance with the "Regulations on environmental justification of economic and other activities" approved by Order No. 539 of 29.12.1995 of the Ministry of Nature Protection. These regulations were elaborated for implementation of the law of the Russian Federation "On environment protection" and include the most recent requirements of the Urban Construction Code of the Russian Federation (RF Code No. 190-

FZ of 29.12.2004 with amendments of 29.12.2006), Resolutions No. 145 of 05.03.2007 and identify the requirements to the project documentation on construction of structures as concerns environmental justification of project solutions and environment protection.

The monitoring of environmental impact is carried out by the counting method based on the fuel saving at TPPs of URES of North-West due to the additional electric energy generated at HPPs. The reduction of environmental impact is expressed in the reduction of pollutants emission into atmosphere.

The numerical evaluation of pollutants emission reduction is carried out in Section E. It is based on the use of the data of fuel utilization from the annual reports of State statistical accountancy (a form of state statistical accountancy No. 6-tp "Data of power plant's XX operation in 20….") and emissions (a form of statistical accountancy No. 2 tp-air «Protection of atmospheric air»). The analysis of pollutants' emission reduction depending on the additional electricity generated at HPPs was generalized in Table 9 of Section E.

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.
B2. $EG_{PJ,y}$	Low	The data will be measured by a standardized electricity meter with corresponding metrology requirements. Calibration of the electricity meters is made in accordance with the calibration schedule which is approved by the Chief Engineer of TGK-1 for one year. Supervision of calibration is performed by the Electrotechnical laboratory of the electrical department. The metering devices are calibrated by an independent entity which has a state licence. As electricity will be supplied to the grid, a double check can be applied from receipts of sales.

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

The monitoring plan will be implemented by the OJSC "TGC-1" to ensure that the project emission reductions during the crediting period are verifiable. Monitoring plan for the project activity includes the details of the operation and management of the project activity during the crediting period and the measurement of the parameters in baseline and project scenarios that will be used to calculate actual emission reductions. The basic management structure is shown below in the fig. 6.

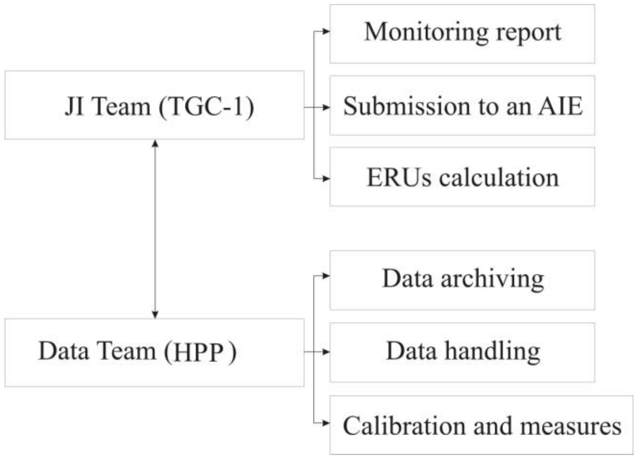


Figure 6: The management structure

The management and operational structure for monitoring of the project activity is as follows. The project owner will set up a JI Team to take charge of preparing and archiving monitoring reports, checking obtaining data, support validation process. Also TGC-1 establishes personnel (Data team) who will be responsible for data support of JI Team at the Svetogorskaya HPP and the Lesogorskaya HPP. The monitoring plan does not foresee any additional measures. All data collects from measurement equipment that will install with project implementation and standardized form of data handling are used. The personnel of the Svetogorskaya HPP and the Lesogorskaya HPP are responsible for calibration and maintenance of measurement equipment in accordance with national rules and standards and providing measurement of parameters. The project owner will organize the training of personnel for providing monitoring plan management and support of ERUs verification procedures.

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

The following entity established the monitoring plan:

- OJSC “TGC-1”,
  OJSC “TGC-1” is a project participant. The contact information is presented in Annex 1.

- ECF Project Ltd.,
  ECF Project Ltd. is a project participant. See Annex 1 for detailed contact information.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The project activity is electricity generation from hydro power plants. Project is implemented on existing reservoirs without increasing volume of reservoirs. Emission from the project activity is $PE_y = 0$.

E.2. Estimated leakage:

$LE_y = 0$

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

$PE_y + LE_y = 0 + 0 = 0$

E.4. Estimated baseline emissions:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (7)$$

Calculation of $EG_{PJ,y}$

As the project activity is the power increasing at the existing grid-connected HPPs:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical}); \text{ until } DATE_{BaselineRetrofit} \quad (8)$$

$$EG_{PJ,y} = 0; \text{ on/after } DATE_{BaselineRetrofit} \quad (9)$$

Calculation of $EG_{historical}$

The average of historical electricity delivered by the existing HPP units of the Nevsky Branch HPPs $EG_{historical}$ is presented in Table Anx.2.11 of Annex 2 for last 5 year of electricity generation. For the unit # 3 of Svetogorskaya HPP the design data of installed capacity multiplied by the number of hours in which the unit would be operating during a year (5688 hr/year) is used for estimation of annual electricity generation. Since this unit many years is in out-of-operation condition the $EG_{historical}$ equal 0.

Determination of $DATE_{BaselineRetrofit}$

TGC-1 also has the Volkhovskaya HPP, which was commissioned in 1926-1927. At present time, five units still work at the HPP and their expected reconstruction would be in 2013. Taking into account that the starting date of Lesogorskaya units is 1937 and the starting date of Svetogorskaya units is 1945-1947, it can be asserted that these units can work at least up to 2020 without reconstruction. So $DATE_{BaselineRetrofit}$ will be reached in 2020.

Detailed data about electricity supplied by the additional power capacity to the grid EG_y – $EG_{PJ,y}$ is presented in Table Anx. 2.12 of Annex 2.

Calculation of Combined Margin Emission Factor

For determination of the combined margin (CM) the methodological tool used was version 1 “Tool to calculate the emission factor for an electricity system”. The CM emission factor is calculated as the sum of operating margin (OM) and build margin (BM) emission factors multiplied by corresponding weighted coefficients. The data for CM calculation is obtained from the statistical forms 6-TP. The baseline emission factor for the project is 0.5388 tCO_2e/MWh. Calculation of $EF_{grid, CM, y}$ is presented in Annex 2.

Table 8: Baseline GHG emissions

Year	**2009**	**2010**	**2011**	**2012**
BE_y **(tCO_2e/year)**	106 036	138 437	189 570	225 871

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

$$ER_y = BE_y - 0 \quad (8)$$

E.5 is the same as E.4, i.e., emission reductions of the project (Table 9) are as shown for baseline GHG emissions in Table 8.

Table 9: Emission reductions

Year	**2009**	**2010**	**2011**	**2012**
ER_y **(tCO_2e/year)**	106 036	138 437	189 570	225 871

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)
2009	0	0	106 036	106 036
2010	0	0	138 437	138 437
2011	0	0	189 570	189 570
2012	0	0	225 871	225 871
Total (tonnes of CO_2 equivalent)	0	0	659 914	659 914

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 necessity of an Environmental Impact Assessment (EIA) in Russia is regulated by the Federal Law "On the Environmental Expertise" and consists of two stages: EIA (OVOS —in Russian abbreviation) and state environmental expertise (SEE). Significant changes into this procedure were made by the Law in Amendments to the Construction Code which came into force on the 1st of January 2007. This Law reduced the scope of activities subject to SEE transferred them to the so called State Expertise (SE) done in line with the Article 49 of the Construction Code of the Russian Federation. In line with the Construction code the Design Document should contain the Section "Environment Protection" (Environmental Protection). However, according to the Federal Agency for Construction and Housing and Utilities the Project of Reconstruction of Cascade Nevsky HPP is not subject to state examination[8].

The negative environmental impacts due to HPP include discharge of polluting agents into the surface-water bodies, generation and disposal of production waste. The volume of polluting agents does not exceed acceptable concentration at the discharge points of sewage and drainage waters approved by corresponding discharge limits. Drainage and sewage waters disposed from the territory of the HPP are classified as regulatory clean waters.

Due to the reconstruction of the Svetlogorskaya and the Lesogorskaya HPPs the leakage of oils and lubricant substances into the streams and environment will be prevented because of:

- the amount of turbine oil used for operations will amount to one third of the currently used quantity, since there will be a system of high pressure oil control; as well as, if possible, installation of turbine bearing with water lubricant;
- Bearings with oil lubricant will be substituted with self-lubricating.

After reconstruction, the Svetlogorskaya and Lesogorskaya HPPs will be able to operate in synchronized mode with Imatra and Tainionkoski HPPs. This will ensure levelling of the fluctuations along with the Vuoksa river level between towns of Imatra and Lesogorsk. Reconstruction will also reduce bench erosion. Short-term fluctuations of water level will increase slightly at the river segment down Lesogorsk when compared to current conditions. Fluctuations though will increase only along the small segment of river down the flow after the Lesogorskaya HPP.

The project does not have trans-boundary impact.

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:

There are no significant negative environmental impacts due to the project activity.

SECTION G. Stakeholders' comments

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

[8] Letter from the Federal Agency for Construction and Housing and Utilities No. 662/01-05 dated 04.05.2008

Since October 29 until December 4, 2007 public hearings had been held under the Project[9]. Representatives of environmental organizations, state and local authorities, mass media attended the public hearings (http://www.tgc-1.ru/responsibility/socOtchet/). No negative comments were received on the project during the public hearings.

Project information was published on the JSC "TGC-1" website: http://www.tgc-1.ru/about/invProgramma/all/.

JSC "TGC-1" has publications about the project in mass media. The short list of publications is presented below.

Table G.1.1 Identity of stakeholders

Stakeholder 1	
Name	**Boris Vainzikher (General Director of JSC "TGK-1")**
Description of the effects of the project on the stakeholder	21/05/2009 Newspaper "RBC" (www.rbc.ru) **" TGK-1 " introduced the hydroelectric of Svetogorsk HPP(Leningrad region) after its reconstruction."** According to CEO of TGK-1 Boris Vainzikher, by 2012 planned to complete the technical re-equipment of Vuoksinsk cascade, which includes Svetogorsk HPP. Estimated cost of works for re-cascade - 6 billion rubles. Until the end of 2009 TGK-1 intends to commission another reconstructed unit Vuoksinsk cascade.
Address	St. Petersburg, Marsovo Pole, 1
Phone	Phone: +7 (812) 901 36 06;
E-mail	office@tgc1.ru
Internet reception	http://www.tgk1.ru/
Contact person	**Boris Vainzikher (General Director of JSC "TGK-1")**

Stakeholder 2	
Name	**ABN News Agency**
Description of the effects of the project on the stakeholder	21/05/2009, 15:43 ABN News Agency (www.abnews.ru/) **"Reconstruction Vuoksinskogo hydropower cascade (Leningrad region) is to be completed by 2012"** Reconstruction and technical re-equipment of Nevsky cascade of hydropower plants in Leningrad is to be fully completed by 2012. As a result, electric power of cascade will increase from 164.2 to 240 MW. Starting this year, it will annually put into operation one modernized hydraulic unit at each station, the company noted.
Address	St. Petersburg, Zagorodny pr., 24 PO Box 191002
Phone/fax	Phone: +7 (812) 314-03-73; Fax: +7 (812) 314-58-14.
E-mail	commerce@abnews.ru
Internet reception	http://www.abnews.ru
Contact person	**Lubov Osadchaya (Editor in Chief)**

[9] The conclusion about results of public hearings under the documentation, the report of discussion of the documentation.

Stakeholder 3	
Name	**Vladimir Afanasiev**
Description of the effects of the project on the stakeholder	22/05/2009 Nevscoe Vremya (St. Petersburg) **" Hydroturbine was introduced at Vuoksinsk HPP"** Nowadays more efficient use of water resources in the region - one of our priorities, and start a new hydro unit of Svetogorsk HPP is one more step that we have done in this direction. Due to unique technical solutions that were found in the design of the turbine, the power of the HPP has grown by almost a quarter. Now we will be able to use the energy of Vuoksa to maximum benefit.
Address	St. Petersburg, Bolshaya Morskaya st., 47 PO Box 190000
Phone/fax	Phone/Fax: +7 (812) 312-40-40;
E-mail	assist@nv.net.ru
Internet reception	http://www.nvspb.ru/
Contact person	**Vladimir Afanasiev (Journalist of newspaper "Nevscoe Vrmya)"**

Stakeholder 4	
Name	**100 TV (TV Chanel)**
Description of the effects of the project on the stakeholder	25/08/2009 100 TV (TV Chanel) **" The future - for the small hydro"** According to Alexey Krylov (deputy general director of company-investor) small hydro power plants are very convenient for the fact that they are close to the consumer. The stations do not just located on the rivers of North-West, but form a whole cascade.
Address	St. Petersburg, Petrogradskaya nab., 18A PO Box 197046
Phone/fax	Phone/Fax: +7 (812) 332-21-40
E-mail	news@tv100.ru
Internet reception	www.tv100.ru
Contact person	**Igor Rabeco (Specialist)**

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	OJSC "TGC-1"
Street/P.O.Box:	Marsovo Pole
Building:	1
City:	St. Petersburg
State/Region:	
Postal code:	191186
Country:	Russian Federation
Phone:	+7 (812) 901 36 06
Fax:	+7 (812) 494 3477
E-mail:	office@tgc1.ru
URL:	http://www.tgc1.ru
Represented by:	Boris Vainzikher
Title:	Mr.
Salutation:	
Last name:	Vainzikher
Middle name:	Feliksovich
First name:	Boris
Department:	
Phone (direct):	+7 (812) 901-31-22; +7 (812) 901-32-14
Fax (direct):	+7 (812) 4943477
Mobile:	
Personal e-mail:	office@tgc1.ru

Organisation:	ECF Project Ltd.
Street/P.O.Box:	Alexandra Solzhenitsyna street
Building:	18
City:	Moscow
State/Region:	
Postal code:	109004
Country:	Russia
Phone:	+7 495 748 79 60
Fax:	
E-mail:	ecf@energyfund.ru
URL:	http://www.carbonfund.ru/home/
Represented by:	Gleb Anikin
Title:	Mr.
Salutation:	
Last name:	Anikin
Middle name:	Vladislavovich
First name:	Gleb
Department:	
Phone (direct):	+7 495 748 79 60
Fax (direct):	+7 495 748 79 60
Mobile:	
Personal e-mail:	anikingv@energyfund.ru

Organisation:	Fortum Power and Heat Oy
Street/P.O.Box:	Keilaniementie / P.O. Box 100,
Building:	1

City:	Espoo
State/Region:	
Postal code:	00048
Country:	Finland
Phone:	+358104528900
Fax:	+358104528900
E-mail:	communications@fortum.com
URL:	http://www.fortum.com/
Represented by:	Evgenia Tkachenko
Title:	Environmental manager
Salutation:	Mrs.
Last name:	Tkachenko
Middle name:	
First name:	Evgenia
Department:	Fortum Service
Phone (direct):	+7 922 639 41 73
Fax (direct):	
Mobile:	+7 922 639 41 73
Personal e-mail:	Evgenia.tkachenko@fortum.com

Annex 2

BASELINE INFORMATION

CO_2 baseline emission factor

This baseline emission factor was defined in accordance with approved CDM "Tool to calculate the emission factor for an electricity system" (version 02) with some deviations, further referred as "The Tool". The full version of the Tool is published on the UFCCC website at the following address: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

Scope and applicability

This Tool "...may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid…".

The project activity involves the reconstruction of two hydropower plants (HPPs) of the Nevsky Branch HPPs that are part of the Consolidated Energy Systems (CES) of North-West in Russia. The two HPPs are the Svetogorskaya HPP and the Lesogorskaya HPP. After project implementation the new electricity energy unit will supply electricity to grid of United Regional Energy System (URES) "North-West". It will substitute electricity that would have been otherwise generated by the other power plants of URES "North-West". Therefore, this Tool can be used for determination of CO_2 baseline emission factor.

Parameters

The Tool provides procedures to determine the following parameters:

Parameter	SI Unit	Description
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for grid connected power generation in year y
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor for grid connected power generation in year y
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for grid connected power generation in year y

Data source

The following sources of information were used for the OM development:

- Federal Service of State Statistics (RosStat RF). This is aggregated data provided by energy companies using the official statistical form 6-TP;
- JSC "Unified Energy System of Russia" (UES);
- OJSC <System Operator of Unified Energy System> (JSC "SO of UES");
- CJSC "Agency of Energy Balances in the power industry".

The combined heat and power plants (CUP) can operate as cogeneration and as simple (only electricity generation) cycles and some TPPs have cogeneration energy units. Each power plant submits the electricity and heat generation and fuel consumption data in RosStat RF according to the annually statistic report (6-TP).

CUPs produce electricity predominantly in the prescribed heat supply mode. Therefore they can be excluded from OM and BM calculation. However the reports (according to form 6-TP) do not contain any information about fired fuel amount for cogeneration or simple cycles and it is impossible to exclude from calculation the fired fuel amount and electricity generation with cogeneration cycle. Therefore, the parameters of cogeneration energy units were taken into account in the OM and BM calculation. It is a deviation from the Tool but it is conservative because cogeneration cycles are more efficient than simple (or combined) cycles.

The reports contain information about the total fired fuel amount (for each fuel type), fired amount fuel for electricity and heat generation (separately). The part of the fired amount fuel for electricity generation was used in the OM and BM emission factors calculation.

BM calculation is based on the data from:

- Official annual reports of JSC UES;
- Official annual reports of energy companies;
- Energy companies investment programs;
- Technical manual "Territorial Generating Companies", CJSC "IT energy analyst", 2007;
- Reports containing information on new power capacities put in operation in recent years, "General Scheme of Allocation of Energy Objects up to 2020" approved by the Government of the Russian Federation (Order of February 22 2008 # 2l5p).

The "General Scheme" is not a legislative act but a research work which was implemented by a commission of the Government of the Russian Federation. OJSC "RAO UES of Russia" (and some research institutes) prepared the draft of "General Scheme" in 2007. It was based on the electricity consumption forecast and the inquiry of energy companies about their investment plans. The "General Scheme" is compilation of such information and doesn't contain any recommendations and is not responsible for where, when, what and who will construct energy units etc. The main aim of "General Scheme" is definition of the sufficiency of consumers power supply. In case of insufficiency of consumers power supply the Government of RF will prepare the arrangements on stimulation of new energy project implementation. The Government of RF approved this document in 2008 (Order of February 22 2008 # 2l5p). It means that this work was done according to the commission of the Government of the Russian Federation.

Also according to the Order the Ministry of Energy organizes the monitoring of the GS implementation. Currently CJSC "Agency of Energy Balances in the power industry" is preparing a revised version of the "General Scheme"[10]. The new power consumption forecast and the revised investment plans of energy companies are taken into account. In comparison with the previous version of the "General Scheme" some supposed power projects are delayed and some supposed power projects are stopped.

As stated above the "General Scheme" is not an obligatory document especially for private energy companies but data from the "General Scheme" can be used for emission factors calculation in accordance with the Tool.

Methodology procedure

The Tool determines the CO_2 emission factor for an electricity, generated by power plants, displacement in an electricity system, by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM). Operating margin is the emission factor that refers to the group of existing power plants whose electricity generation would be affected by the proposed project activity. Build margin is the emission factor that refers to the group of prospective power units whose construction would be affected by the proposed project activity.

In line with the Tool the following steps presented in detail below should be followed. Possible deviations should be identified and justified.

STEP 1: Identify the relevant electric power systems

---

[10] http://www.e-apbe.ru/scheme

A *project electricity system* is the system defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

Similarly, a *connected electricity system* is defined as a system that is connected by transmission lines to the project electricity system. Power plants within connected system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

If the Designated National Authority of the host country (in Russia it is the Ministry of Economic Development RF) has published a delineation of the project electricity system and connected power systems, these delineations should be used. The Designated Focal Point (DFP) of the Russian Federation didn't publish a delineation of the project electricity system and connected electricity systems. In this case the Tool recommends: ". to use a regional grid definition in case of large countries with layered dispatch systems (e.g. provincial I regional I national)".

Electric power industry in Russian Federation comprises nearly 400 power plants: thermal power plants (about 70% of total installed capacity), hydro power stations (20% of total installed capacity) and nuclear power stations (10% of total installed capacity). Power stations and consumers are connected by transmission lines. Power stations, consumers and regulatory organizations (JSC "SO of UES" for instance) constitute the national energy system (hereinafter referred to as UES of Russia). The UES of Russia is functioning centralized. JSC "SO of UES" contributes a great value to the operative-dispatching management. Power stations are unified by transmission lines in 60 area electricity systems (AESs), while these systems have in its turn the electric connections with the neighbouring ones (excluding some isolated area systems). AESs are unified in seven united regional electricity systems (URESs), that are connected between each other through backbone and interconnection networks: "North-West", "Ural", "The South", "Volga", "Ural", "Siberia" and "The East".

The scheme of UES of Russia is presented in Figure Anx.2.1.

Figure Anx.2.1: Scheme of UES of Russia

Source: JSC "SO of UES"(http://www.so-ups.ru/)

The status of these URESs is defined in State Standard (GOST) 21027-75 "Power systems. Terms and definitions" as: "the group of some area energy systems with common operating conditions and dispatching management".

The Nevsky Branch HPPs is located in URES “North-West”. Installed capacity of this URES is 21 038 MW (status 2009). Project capacity (360 MW) is only 1.7% of the URES “North-West” total electric capacity, therefore project capacity ‘”.can be dispatched without significant transmission constraints”[11].

As a result URES “North-West” is selected as a *project electricity system*.

URES “North-West” is located in 10 regions of the Russian Federation North-West Federal District: Saint-Petersburg, Murmansk, Kaliningrad, Leningrad, Novgorod, Pskov and Arkhangelsk regions, the republics of Karelia and Komi, Nenets autonomous district.

The structure of installed capacity of URES “North-West” (status 2009) is as follows:

- 48.4.4% — TPPs (including combined heat and power plants and units);
- 14.3% — Hydro power stations (HPSs);
- 37.3% — Nuclear power stations (NPSs);

NPSs operate as “must-run” resources and HPSs and WPSs — as “low-cost”.

URES “North-West” is bordered by the URES “Centre” and URES “Ural”, which have no effect on her. The most recently available date of annual URES “North-West” electricity import is presented in Table Anx.2.1.

Table Anx.2.1: The recently date of annual URES “North-West” electricity generation, consumption and import

Indicator	Unit	2007[12]	2008[13]	2009[14]	Average
Generation	mln. MWh	94.7	100.7	97.6	97.7
Consumption	mln. MWh	89.3	91.3	88.3	89.6
Electricity import	mln. MWh	-5.4	-9.4	-9.3	-8.0
	%	-5.7%	-9.3%	-9.5%	-8.2%

STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Some power plants can be considered as off-grid power plants. For North-West region they can be power plants of oil and gas companies (located on the remote oil and gas deposits) and power plants of villages located within sparsely populated area. Usually these power plants are based on the gas turbine and diesel-engine technologies with a small electric and heat capacity.

As shown above in the Russian Federation the individual plant data is considered strictly confidential and only aggregate data on the regional basis are available. The off-grid power plants report according to statistic form also. Therefore Rosstat RF data includes off-grid power plants data.

Part of off-grid power plants electricity generation can be estimated using the “ODU “North-West” (branch of “SO UES” is superior body of operating-dispatching management in URES “North-West”) operative data. The comparison of Rosstat RF and “ODU“North-West” data by 2007 are presented in Table Anx.2.2.

Table Anx.2.2: The comparison of Rosstat RF and “ODU “North-West” data by 2007

[11] Tool to calculate the emission factor for an electricity system, version 02, Methodological Tool, CDM Executive board

[12] http://www.so-ups.ru/fileadmin/files/company/reports/disclosure/2009/pokazateli_2008.pdf

[13] http://www.so-ups.ru/fileadmin/files/company/reports/disclosure/2009/pokazateli_2008.pdf

[14] http://www.so-ups.ru/fileadmin/files/company/reports/disclosure/2010/ues_rep_2009.pdf

Area (Republic)	Installed capacity. kW		Diff[15]	Electricity generation. thous.kWh		Diff
	Rosstat RF	ODU "North-West"	%	Rosstat RF	ODU "North-West"	%
The Arkhangelsk area	1 946	1 908	1,9%	7 719	7 086	8,2%
The Kaliningrad area	647	639	1,2%	2 764	2 761	0,1%
The Republic of Karelia	1 101	1 094	0,7%	4 952	4 926	0,5%
The Murmansk area	3 743	3 737	0,2%	17 551	17 540	0,1%
The Komi Republic	2 322	2 215	4,6%	9 063	8 897	1,8%
Novgorod Region	216	216	-0,4%	926	921	0,6%
Pskov Region	434	432	0,4%	1 751	1 736	0,8%
St. Petersburg and Leningrad Region	10 841	10 931	-0,8%	51 019	50 743	0,5%
Total	***21 250***	***21 173***	***0,4%***	***95 745***	***94 610***	***1,19%***

The off-grid power electricity generation of URES "North-West" is only two and half percent of total electricity generation.

According to the Tool project participants may choose between the following two options:

- Option I: Only grid power plants are included in the calculation.
- Option II: Both grid power plants and off-grid power plants are included in the calculation.

In accordance with the Tool. "option II aims to reflect that in some countries off-grid power generation is significant and can partially be displaced by CDM project activities. e.g. if off-grid power plants are operated due to an unreliable and unstable electricity grid.". As the off-grid power generation is not significant. option I was chosen.

STEP 3: Select an operating margin (OM) method

The Tool recommends calculating the $EF_{grid.\ OM.\ y}$ based on one of the following methods:

(a) Simple OM. or

(b) Simple adjusted OM. or

(c) Dispatch data analysis. or

(d) Average OM.

Any of these listed methods can be used; however. the simple OM method (a) can only be used if low-cost/must run resources constitute less than 50% of total grid generation calculated:

1) As average of the five most recent years or.

2) Based on long-term averages for hydroelectricity production.

Low-cost/must run resources are defined as power plants with low marginal generation costs or that are dispatched independently of the daily or seasonal load of the grid. Typically they include hydro. geothermal. wind. low-cost biomass. nuclear and solar generation. In URES "North-West" geothermal. low-cost biomass. and solar generation are negligible for the power balance. Therefore nuclear stations (as "must-run") and wind (1 MW) and hydro plants (as "low-cost") are defined as low-cost/must run

[15] Difference

resources. Table Anx.2.3 represents” total electricity generation during the five last years and the five year average share of low-cost/must run resources in URES “North-West” (2003-2007).

Table Anx.2.3: Total eiectricity generation during the iast five years and share of RES‘s low-cost/must run net electricity generation (MWh)

URES “North-West”	2005	2006	2007	2008[16]	2009	Five year average % of low-cost
All power plants	94 911 879	99 168 490	103 352 040	100 664 000	97 597 600	49.11
Uydro (with wind)	12 953 642	11 980 721	13 340 302	13 553 100	13 979 500	
Nuclear	34 194 021	33 770 747	34 923 872	38 385 800	36 376 700	

Source: JSC “SO of UES” and Rosstat RF

As this indicator is lower than 50% the nuclear and hydro energy generation may not be taken into account. Therefore simple OM (method “a”) can be used and is selected for calculation of emission factor of URES “North-West”.

STEP 4: Calculate the operating margin emission factor according to the selected method

The Tool specifies how simple OM is calculated - as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system. not including low-cost/must run plants/units (e.g. hydro and nuclear).

The Tool suggests making calculations based on:

- the net electricity generation and CO_2 emission factor of each power unit (Option A);
- total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option B).

The Option B was chosen because:

(a) The necessary data for Option A is not available;

(b) Only nuclear and renewable power generation are considered as low-cost/must run power sources and the quantity of electricity supplied to the grid by these sources is known;

(c) Off-grid power plants are not included in the calculation.

Under this option the simple OM emission factor is defined by the following formula:

$$EF_{grig,\,OMsimple,\,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \quad (1)$$

Where:

$EF_{grid.OMsimple.y}$ = simple operating margin CO_2 emission factor in year y (tCO_2/MWh);
$FC_{i.m.y}$ = amount of fossil fuel *i* consumed in the project electricity system in year *y* (mass or volume unit);
$NCV_{i.y}$ = net calorific value (energy content) of fossil fuel type *i* in year y (GJ / mass or volume unit);
$EF_{CO2.i.y}$ = CO_2 emission factor of fossil fuel type $_i$ in year y (tCO_2/GJ);

[16] http://www.so-ups.ru/fileadmin/files/company/reports/disclosure/2010/ues_rep_2009.pdf

$EG_{m.y}$ = net electricity generated and delivered to the grid by all power sources serving the system. not including low-cost/must-run power plants/units. in year y (MWh);

m = all power plants / units serving the grid in year y except low-cost / must-run power plants / units;

i = all fossil fuel types combusted in power plant / unit m in year *y*;

y = three most recent years for which data is available (2006-2008).

The net electricity generation and fossil fuels consumed in the project electricity system are received from Rosstat RF. The amount of fossil fuels are expressed in tonne of coal equivalent with net calorific value is equal to 7.000 kcal/kg c.e. or 29.33 GJ/t.c.e.

The net electricity generation and emission factors data at all TPPs of URES "North-West" in 2003-2007 are presented in the Annex 4..

Exclusion off-grid power plants data

The above mention data includes net electricity generation and fuel consumption of the off-grid power plants. And the individual data of off-grid power plants is not available by this source. To exclude the off- grid power plants the following conservative assumptions were taken:

- The net electricity generation of the off-grid power plants is 49.11 percent (as shown in the Table Anx.2.3) of total net electricity generation of URES "North-West" in year y;
- Efficiency factor of the off-grid power plants was defined according to the Annex 1 of the Tool.

The off-grid power plants fuel consumption is defined based on the analysis of OJSC "Zvezda Energetika" (the biggest company constructing such type of power plant in Russia). The results of the analysis are presented in Table Anx.2.4.

Table Anx.2.4: The analysis results of OJSC "Zvezda Energetika" activity and value of default efficiency factors of the energy unit types

Type of power unit (CAP is nominal capacity in MW)	Total capacity	Percentage	Default efficiency factor
	MW	%	%
Diesel-engine units (10<CAP<50)	105.4	49.3	33.0
Diesel-engine units (CAP<10)	34.0	15.9	28.0
Gas turbine units (10<CAP<50)	24.0	11.2	32.0
Gas turbine units (CAP<10)	50.3	23.5	28.0
Total	213.7	100.0	-

Source: http://www.energostar.com/activity/activity_map.php

The net electricity generation and fuel consumption data at TPPs of URES "Ural" excluding off-grid power plants in 2006-2008 are presented in the Table Anx.2.6.

Table Anx.2.5: The net eiectricity generation and fuei consumption data excluding off-grid power plants

Indicator	Unit	2005	2006	2007
Net electricity generation	MWh	218 010	247 731	249 064
Natural gas	GJ	2 871 847	3 195 328	3 766 764
Heavy fuel oil	GJ	482 244	512 395	577 625
Coal	GJ	0	0	47 515
Peat	GJ	0	0	0
Other	GJ	0	0	0

Definition of other fuel types

According to statistic form 6-TP the electricity and heat producers must indicate following fuel types: natural gas (including associated gas). heavy fuel oil. coal. peat. oil-shales (slate). firewood and other fuels are indicated as other fuel types.

In North-West region some power stations use such type of fuel as blast furnace and coke even gases (power plants at the metallurgical works) and wood waste. These types are reflected in statistic form 6-TP as other fuel types. The "other" fuel type (see table above) is third fuel of URES "North-West" power plants for last years. The most relevant areas are Murmansk, Leningrad and Arkhangelsk regions, the republics of Karelia and Komi.

The amount of other fuel type consumption on the regional basis during 2005-2007 is presented in the Table Anx.2.6.

Table Anx.2.6: The other fuel type consumption on the regional basis during 2005-2007

Area (Republic)	Unit	2005	2006	2007
The Arkhangelsk area	GJ	29 506 831	30 365 320	29 735 341
The Republic of Karelia	GJ	6 533 023	7 040 520	7 599 843
The Murmansk area	GJ	13 550	9 122	8 858
The Komi Republic	GJ	13 093 909	13 245 076	13 072 352
Novgorod Region	GJ	0	0	0
Pskov Region	GJ	0	0	0
St. Petersburg and Leningrad Region	GJ	1 837 671	1 530 586	1 309 086
Total	GJ	50 984 984	52 190 623	51 725 479

Source: Rosstat RF

For emission calculation the following assumptions were taken: The proportion of other fuel in the fuel balance of North-West region is 5.5% and the emission factor of other fuel types in North-West region was considered as zero.

Table Anx.2.7: The data of total fuei balance and net electricity generation of URES "North-West"

Indicator	Unit	2005	2006	2007
Net electricity generation	MWh	47 758 867	53 412 399	55 082 048
Natural gas	GJ	574 154 460	599 737 171	636 293 614
Heavy fuel oil	GJ	101 004 924	107 701 754	91 278 509
Coal	GJ	80 852 251	100 731 304	96 119 044
Peat	GJ	74 029	12 113	4 253
Firewood	GJ	8 861 356	4 563 807	4 490 159
Other	GJ	43 272 455	48 286 800	48 316 541

Calculation of emission at the TPPs of URES "North-West"

The default fuel emission factors are presented in the Table Anx.2.6.

Table Anx.2.6: The default fuel emission factors

Fuel type	Default emission factor[17]
	tCO_2/GJ

[17] Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006

Natural gas	0.0561
Heavy fuel oil	0.0774
Coal	0.0961
Peat	0.1060
Other fuel types[18]	0.0

Emission calculation of the net electricity consumption from a connected electricity system (see Annex 4).

And the results of $EF_{grid, OMsimple, y}$ and the average electricity weighted OM emission factor calculation are presented in the Table Anx.2.7.

Table Anx.2.7: Results of calculation $EF_{grid, OM, y}$ and the average electricity weighted OM emission factor

Indicator	Unit	2003	2004	2005	2006	2007
OM emission factor URES "North-West"	tCO_2/MWh	0.573	0.566	0.569	0.583	0.560
Average electricity weighted OM emission	tCO_2/MWh	0.5707[19]				

The OM emission factor is fixed ex-ante for the period 2008-2012.

STEP 5: Identify the cohort of power units to be included in the BM

The Tool provides the recommendations on how to form the sample groups of power units used to calculate the BM. They consist of either:

(a) The set of five power units that most recently have been built. or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

If the recommended approach does not reasonably reflect the power plants that would likely be built in the absence of the project activity. the participants are encouraged to submit alternative proposals.

Capacity additions from retrofits of power plants should not be included in the calculations of BM.

The main principle stated by the Tool is that "the build margin is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed" project which means that the BM capacity is counterfactual and the power plants are assembled just to determine the parameters of such capacity to calculate GHG emissions.

In the Table Anx.2.8 lists all the plants/units commissioned recently (since 1991) in URES "North-West".

Table Anx.2.8: URES "North-West". Power plants/units commissioned recently

N	Power plant/unit	Year of commissioning	Capacity, MW	Technology	Fuel
Commissioned in 1991-2009					
1	Severo-Zapadnaia CHPP	2000	450	CC GT	Gas
2	Vasileostrovskaya TPP-7, #3	2009	50	Steam cycle	Gas
3	Severo-Zapadnaia CHPP	2006	450	CC GT	Gas

[18] Emission factor for other types of fuel is taken as zero. It is conservative

[19] See Annex 4.

4	Avtovskaya TPP-15	2007	30	Steam cycle	Gas
5	Pravoberejnaya TPP-5	2006	180	Steam cycle	Gas

Source: Energy companies[20]

For the first commitment period of the Kyoto Protocol projects participants can choose between one of the two options:

(1) ex-ante based on the most recent information available on units already built;

(2) ex-post based on information updated during each relevant monitoring period.

The approach presented above is based upon ex-ante option.

STEP 6: Calculate the build margin emission factor

In line with the Tool the BM emission factor is the generated-weighted average emission factor of all power units m during the year y and is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (2)$$

Where:

$EF_{grid.BM.y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m.y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL.m.y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

Method of $EF_{EL.\ m.\ y}$ calculation here is the same as for $EF_{grid.\ OMsimple.\ y}$ described under Step 4. i.e. by using specific fuel consumption per 1 kWh of energy output $b_{m.\ y}$ (kg c.e./kWh).

$$EF_{EL.\ m.\ y} = b_{m.\ y} \times EF_{CO2.\ fuel} \quad (3)$$

Where:

$EF_{CO2.\ fuel}$ = fuel emission factor (fuel type weighted) in tCO_2/MJ or tCO_2/t.c.e; the IPCC factors for main types of fuel values;

$b_{m.\ y}$ = specific fuel consumption by the unit *m* (MJ/MWh or t.c.e./MWh)

In the Russian Federation individual plant based data is considered strictly confidential. Therefore the specific factors of the power units (or similar power units) from open sources were used.

The background data for $EF_{grid.\ BM.\ y}$ calculation is presented in the Table Anx.2.9.

Table Anx.2.9: Background data for $EF_{grid.\ BM.\ y}$ calculation

Indicator	Unit	Severo-Zapadnaia CHPP, #1	Severo-Zapadnaia CHPP, #2	Vasileostrovskaya TPP-7, #3	Avtovskaya TPP-15	Pravoberejnaya TPP
Electric capacity	MW	900	900		30	180

[20] http://www.so-ups.ru/index.php?id=tech_disc

Annual net generation of electricity	MWh	3 313 266	539 469	1 261 715	1 002 805
Specific fuel consumption	g c.e./kWh	233	312,7	349,4	260,6
	GJ/MWh	6,85	9,20	10,28	7,66
Fuel	-	Natural gas			
	GJ	22 705 617	4 961 528	12 965 977	7 686 205
Fuel emission factor	tCO2/GJ	0,0561			

Source: Rosstat RF

The results of $EF_{grid.\ BM.\ y}$ calculation are presented in the Table Anx.2.10.

Table Anx.2.10: Results of $EF_{grid.\ BM.\ y}$ calculation

Indicator	Unit	Severo-Zapadnaia CHPP, #1	Severo-Zapadnaia CHPP, #2	Vasileostrovskaya TPP-7, #3	Avtovskaya TPP-15	Pravoberejnaya TPP
Power unit CO2 emission factor	tCO2/MWh	0,384	0,384	0,516	0,577	0,430
Average weighted BM emission factor	tCO2/MWh	0,443				

BM emission factor is ex-ante for period 2008-2012.

STEP 7: Calculate combined margin emission factor

The combined margin emission factor (CM) is calculated as follows:

$$EF_{grid.\ CM.\ y} = w_{0M} \times EF_{grid.\ 0M.\ y} + w_{BM} \times EF_{grid.\ BM.\ y} \quad (4)$$

Where:

$EF_{grid.\ CM.\ y}$ = CM emission factor in year y (tCO_2/MWh);
$EF_{grid.\ OM.\ y}$ OM emission factor in year y (tCO_2/MWh);
$EF_{grid.\ BM.\ y}$ = BM emission factor in year y (tCO_2/MWh);
w_{0M} = weight of OM emission factor;
w_{BM} = weight of BM emission factor.

In most cases the Tool recommends to apply $w_{0M} = w_{BM} = 0.5$. But developers may propose other weights. as long as $w_{0M} + w_{BM} = 1$.

As a starting point the weighting factor for w_{0M} is taken as 0.5.

When looking at the factor for w_{BM} the conditions of the Russian power system have to be taken into account. The Russian power system has a big quantity of old. worn-out low efficient power plants being in operation for decades. According to the JSC “UES of Russia” average turbines operational life time is around 30 years. Most of these capacities were put in operation in 1971-1980 that corresponds to 31.4% of the whole installed capacities.

In accordance with General Scheme[21]. dated 22 February 2008. it was planned to approximately 33 GW of old capacity has to be dismantled by 2015. To meet the growth in demand for new energy units with

[21] http://www.e-apbe.ru/library/detail.php?ID=11106

total capacity of 120 GW will be commissioned by 2015. This means that the JI project will not only initiate the construction of new power plants. but also accelerate the decommissioning of existing capacities. Given the impact of the financial crises on demand growth and the capability to finance new projects. the new estimation[22] (September 2008) expects that out of the planned 120 GW only about 80 GW will be operational by 2015. Out of the 33 GW of old capacity only 10 GW will be dismantled. This means that 1 GW of any project delay leads to a delay of 0.5 GW of old capacity dismantling. So the effect of the JI project on the acceleration of decommissioning of existing capacities will only be stronger as result of the financial crisis.

The estimation. that the effect of the JI project on the decommissioning of power plants and the delays of new power plants construction is approximately 50% / 50%. For the avoidance of new power plants the emission factor of the BM is representative whereas for the accelerated decommissioning effect the emission factor of the OM is representative. And it means that 0.25 of BM refers to the group of prospective power plants and another 0.25 of BM refers to the dismantling of existing capacities and can be related to OM.

Therefore effective w_{OM} = 0.50 + 0.25 = 0.75 and w_{BM} = 0.25.

The resulting grid factor is $EF_{grid.\ CM.\ y}$ = 0.539 tCO_2/MWh.

CM emission factor is ex-ante for period 2008-2012. because OM and BM emission factors are ex-ante as well. This emission factor is the baseline emission factor ($EF_{BL.C02\ .y}$) which is used to establish the baseline emissions of the baseline scenario.

Table Anx.2.11: Historical electricity generation (MWh) by the Vuoksinskie HPPs

HPP	Unit	2003	2004	2005	2006	2007	Average $EG_{historical}$, MWh	σ, MWh	Installed capacity, MW	Capacity factor
Lesogorskaya HPP	1	45 700	177 500	144 400	117 830	146 779	126 442	49 871	23.5	0.8563
Lesogorskaya HPP	2	142 200	164 600	149 000	144 612	130 355	146 153	12 410	23.5	0.7702
Lesogorskaya HPP	3	106 400	179 000	198 300	97 248	187 201	153 630	47 895	23.5	0.9789
Lesogorskaya HPP	4	142 200	162 100	191 000	142 201	185 900	164 680	23 240	23.5	0.9129
Svetogorskaya HPP	1	162 900	138 800	180 300	151 279	155 075	157 671	15 355	23.25	0.8495
Svetogorskaya HPP	2	81 000	167 400	171 100	134 593	123 154	135 449	36 771	23.25	0.8456
Svetogorskaya HPP	3	-	-	-	-	-	-	-	-	-
Svetogorskaya HPP	4	103 600	143 600	126 400	140 453	186 702	140 151	30 430	23.25	0.8375

Weighted average capacity factor of Vuoksinskie HPPs is 0.7147

Table Anx.2.12: Electricity supplied by the additional capacity after reconstruction of Vuoksinskie HPPs (January 7th, 2009 – December 31st, 2012)

HPP	Unit	Start of Electricity Generation	2009	2010	2011	2012
Lesogorskaya HPP	1	29.04.2009	26 635	45 008	45 008	45 008
Lesogorskaya HPP	2	08.10.2010			40 484	40 484
Lesogorskaya HPP	3	18.08.2011			19 031	51 453

[22] http://www.e-apbe.ru/library/detail.php?ID=11106

HPP	Unit	Start of Electricity Generation	2009	2010	2011	2012
Lesogorskaya HPP	4	27.12.2012				526
Svetogorskaya HPP	1	15.04.2010		38 433	53 954	53 954
Svetogorskaya HPP	2	18.08.2011			19 863	53 703
Svetogorskaya HPP	3	07.01.2009	170 157	173 484	173 484	173 484
Svetogorskaya HPP	4	27.12.2012				583

Annex 3

MONITORING PLAN

See Section D.

Annex 4

THE CALCULATION OF THE OPERATING MARGIN AND BUILD MARGIN EMISSION FACTORS

See file: Emission Reduction Calc (Nevsky HPPs).xls